FINDING OF NO SIGNIFICANT IMPACT (FONSI)
AND
CLEAN WATER ACT SECTION 404 STATEMENT OF FINDINGS
LYNDEN LEVEE AND CULVERT REPAIR
WHATCOM COUNTY, WASHINGTON

The U.S. Army Corps of Engineers, Seattle District (Corps) has conducted an environmental analysis in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended. The final Environmental Assessment (EA) completed in June 2021, for the Lynden Levee and Culvert Repair addresses flood damage to the Lynden Levee in Whatcom County, Washington.

The Final EA, incorporated herein by reference, evaluated various alternatives to restore flood protection to the damaged levee. There is one major Federal action, presenting two events requiring NEPA compliance and analyzed in the EA summarized below.

a. Signing of the Cooperation Agreement (CA): The CA reflects a commitment of Federal funds in agreement with the non-federal sponsor, Whatcom County. The CA was signed on April 15, 2021 so the Corps can complete the necessary solicitation, contracting, and construction scheduling before the deadline for completing the repair within the in-water work window and before commencement of the ensuing flood season.

b. Proposed Action: The proposed action is to repair the levee in-kind at two damaged sites, Site 1 and Site 2. Levee embankment materials and riverward armor will be restored at both sites. In addition, repairs to Site 1 will replace two segmented concrete culverts with a flap gate culvert and will repair the levee crown and landward slope to pre-flood conditions. Minor deviations in the structure's configuration will be integrated due to changes in materials, construction techniques, and safety standards that are necessary to make the repair. Minor deviations include an increase in riprap size at both repair sites, and changes in the levee alignment and armored area at Site 1 to accommodate the new culvert and to reduce scour and erosion potential within the project reach. The deviations will not shift the levee into the river. The levee's riverward toe will remain within the pre-damaged footprint, while the landward toe will be shifted approximately 25 feet inland from the current location at the downstream end at Site 1 to accommodate the flap gate culvert. Additionally, there will be a slight increase in rock size (approximately 7 inches wider in diameter) above what is currently present. These changes are necessary to meet sound engineering principles consisting of the application of updated technology and construction techniques and reflect Corps design requirements in the interest of levee safety when conducting repairs under PL 84-99. Total repair length at Site 1 is 457 linear feet (LF) and total repair length at Site 2 is 275 LF, totaling 732 LF of repairs. All repairs will occur within or landward of the pre-damage footprint of the levee.

Alternatives: In addition to a "no action" plan, three alternatives were evaluated. The alternatives included the Nonstructural, Levee Setback, and Repair In-Kind Alternatives. Of these, potential effects were evaluated for the No Action and Repair In-Kind Alternatives. See Section 2 of the EA for alternative formulation and selection. A summary assessment of the potential effects of the recommended plan are listed in Table 1:

Table 1: Summary of Potential Effects of the Proposed Action

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action
Land use	☒	☐	☐
Geology and Soils	☒	☐	☐
Water Resources and Water Quality	☐	☒	☐
Vegetation and Wetlands	☐	☒	☐
Fish and Wildlife	☐	☒	☐
Threatened and Endangered Species	☐	☒	☐
Air Quality and Noise	☒	☐	☐
Historic Properties and Cultural Resources	☒	☐	☐
Utilities and Infrastructure	☒	☐	☐

Impact Minimization: All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the recommended plan. Conservation Measures and best management practices (BMPs), as detailed Section 2.5 in the EA, will be implemented to minimize impacts. Measures include silt curtains to minimize turbidity impacts, restricting in-water work to June 15 through August 31 to minimize construction related impacts to protected salmon, removing fish from in-water work areas, and mitigating impacts to water quality and vegetation.

Mitigation: The recommended plan will result in unavoidable adverse impacts to water quality and vegetation due to construction activities and fill in Waters of the U.S. To mitigate for these unavoidable adverse impacts, the Corps and Whatcom County will incorporate approximately 72 willow bundles into the levee repair, plant 136 coniferous trees, 75 shrubs, and place woody debris along the levee toe. The willow bundles, trees, and shrubs will provide shade and other beneficial habitat functions to aquatic and terrestrial species. Woody debris will also provide riverine and shoreline complexity as well as velocity breaks during high flow events until it is washed away. When woody debris is washed away, it will continue to provide benefits as it moves down the watershed. The Corps will coordinate with Whatcom

County to ensure that the agreed-on planting survival standards are met. The Corps will maintain and monitor the willow bundles for one-year after construction to ensure 80 percent survival. If less than 80 percent survival is recorded after one year, the Corps will replace all the dead plants (via mechanical installation or hand installation) and the willows will be monitored for two additional growing seasons. Whatcom County has committed to maintaining and monitoring the tree and shrub plantings for 5 years as outlined in the mitigation plan. See Appendix D in the EA for the mitigation plan, which was reviewed and approved by the Washington State Department of Ecology (Ecology) on May 10, 2021.

Public Review: Public review of the Notice of Preparation was completed on May 1, 2021. All comments submitted during the public review period were responded to in the Final EA and FONSI.

Treaty Tribes: The Lummi Nation, Nooksack Tribe, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and the Tulalip Tribes were contacted regarding the levee repairs and the Corps will continue to coordinate throughout the project to meet Tribal Treaty obligations. To date, the Corps has received one response from the Lummi Nation on January 20, 2021, requesting the Corps notify them in the event of an inadvertent discovery.

Compliance:

a. Endangered Species Act:

The National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS) are responsible for the Endangered Species Act of 1973 (ESA). The Corps evaluated potential effects to endangered species in a Biological Assessment (BA). ESA consultation was initiated through the submission of the BA to the USFWS and NMFS on December 23, 2021 and March 8, 2021, respectively. For Puget Sound Chinook, Puget Sound steelhead, and Coastal/Puget Sound bull trout, the Corps reached an agency determination that the project may affect and is likely to adversely affect these species and their critical habitat. For southern resident killer whale, the project may affect, but is not likely to adversely affect this species and its critical habitat. The project may affect, but is not likely to adversely affect, marbled murrelet and will have no effect to marbled murrelet critical habitat. The Corps informed the USFWS and NMFS that due to the urgent nature of completing the emergency actions prior to the oncoming flood season and due to time constraints, the Corps intends to proceed with construction prior to completion of consultation with USFWS and NMFS pursuant to 50 CFR 402.05 alternative emergency procedures. Due to the urgent nature of completing the emergency action to protect human life and property and the effort to limit impacts to listed species by working within the work window, and because the repair is time-critical in light of the ensuing flood season, the Corps may proceed with construction prior to completion of the consultation with the Services pursuant to the "emergency circumstances" provisions of the ESA consultation regulations. The Corps will commit to fully funding and performing all Reasonable and Prudent Alternatives necessary to avoid the likelihood of jeopardy

to listed species or destruction or adverse modification of designated critical habitat, as well as Reasonable and Prudent Measures necessary and appropriate to minimize the impact of Incidental Take, that are described if a Biological Opinion is received from USFWS and NMFS. The EA will be reevaluated at the time that consultation is complete. If necessary, the EA will be supplemented with necessary and applicable corresponding modifications to the scope and/or nature of the project, the procedures and practices used to implement the project, and/or the type and extent of compensatory mitigation associated with the project, and this Finding of No Significant Impact will be reassessed.

b. Manguson-Stevens Fishery Conservation and Management Act:

The BA also contained the Corps' determination that the proposed action may adversely affect Essential Fish Habitat (EFH) for Federally managed fish species in Washington waters. The Corps will review any and all EFH Conservation Recommendations when they are received from NMFS. The Corps intends to proceed with construction prior to completion of consultation with NMFS pursuant to the "emergency Federal actions" provision of the EFH regulations, and to complete EFH consultation after the fact pursuant to 50 CFR Section 600.920(a). The Corps will reevaluate the EA at the time that EFH consultation is complete. If necessary, the Corps will supplement the EA with necessary and applicable corresponding modifications to the scope and/or nature of the project, the procedures and practices used to implement the project, and/or the type and extent of compensatory mitigation associated with the project, and this FONSI will be reassessed.

c. Coastal Zone Management Act:

The Corps has determined that the proposed project is consistent to the maximum extent practicable with the enforceable policies of the State of Washington Coastal Zone Management Program. The Corps provided a Coastal Zone Management Act (CZMA) Consistency Determination outlining this determination to Ecology, with the public notice date of April 1, 2021. State concurrence may be presumed if no response is received after 60 days, May 31,2021. To date the Corps has not received comment or concurrence from Ecology. Since more than 60 days has elapsed, state concurrence has been presumed.

d. Clean Water Act:

The Corps has determined that the proposed project substantively conforms to the provisions of Nationwide Permit (NWP) 3, Maintenance. The Corps prepared a functional analogy evaluation outlining the proposed project's conformity with this NWP and provided it to Ecology on April 1, 2021. Ecology approved the mitigation and water quality monitoring plans on May 10, 2021 and May 11, 2021, respectively. A Water Quality Certificate (#19995) was issued by Ecology on May 28, 2021.

e. National Historic Preservation Act:

On December 21, 2020 the Corps initiated consultation with the Department of Archaeology and Historic Preservation (DAHP; Washington's State Historic Preservation Office) and affected tribes with an area of potential effect (APE) letter.

DAHP concurred with the APE determination on January 26, 2021. The Corps notified the Lummi Nation, Nooksack Tribe, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and the Tulalip Tribes about the project to identify properties to which they may attach religious or cultural significance or other concerns with historic properties that may be affected in mid-January 2021. To date, the Corps has received one response from the Lummi Nation on January 20, 2021, requesting the Corps notify them in the event of an inadvertent discovery. After receiving concurrence from DAHP on the APE determination and sending letters to the six affected tribes, the Corps submitted its determination and findings letter on March 15, 2021 to DAHP that the proposed undertaking would have no adverse effect. DAHP concurred with the Corps determination that the undertaking will have no adverse effect in a letter dated April 7, 2021.

Determination:

a. Results of the Environmental Analysis:

On April 15, 2021, the District Commander signed a CA with the non-federal sponsor, an action constituting a major Federal action and requiring NEPA compliance. As further described in detail in the EA, the CA could not have been executed any later in light of the critical-path processes needing to be completed following the CA execution in order for permanent repair construction to be completed during the available in-water work window prior to the deadline of the commencement of the ensuing flood season. Furthermore, due to considerations including timing of project authorization and funding and timing of finalization of project design parameters, it was not possible to conclude NEPA processes prior to the last date on which the CA could be executed. The agency complied with NEPA to the fullest extent possible under the circumstances, and the District Commander issued a Determination of Alternative Environmental Procedural Compliance on April 15, 2021 documenting that determination for the record.

b. Summary of Impacts and Compliance:

Impacts of the proposed work will be minor, short-term, and temporary. This project is undergoing ESA consultation; a BA has been prepared and transmitted to NMFS and USFWS. Impacts to ESA listed fish and their prey will be minimized by construction during the in-water work window of June 15 to August 31. Consultations under Section 7 and EFH regulations are not complete, but the Corps will proceed with urgently needed repairs under the emergency circumstances provisions of those regulatory regimes, as described above. The Corps received a Water Quality Certification (#19995) from Ecology on May 28, 2021. The project complies with the National Historic Preservation Act and the Corps has coordinated the work with the Department of Archaeology and Historic Preservation (Washington State Historic Preservation Office) and affected Indian Tribes.

District Engineer's Findings and Conclusion: I have evaluated the repair in light of the public interest factors prescribed in 33 CFR 336.1(c). The following factors were evaluated as considerations potentially impacting the quality of the human environment in the accompanying EA and coastal zone consistency evaluation: navigation and the federal standard for dredged material disposal; water quality; coastal zone consistency; wetlands; endangered species; historic resources; scenic and recreation values; fish and wildlife; marine sanctuaries; and applicable state/regional/local land use classifications, determinations, and/or policies. In accordance with 33 CFR 337.1(a)(14) and 325.3(c)(1), the following additional relevant factors were also considered: land use, geology and soils, air quality and noise, utilities and infrastructure, and safety.

The preferred alternative represents the least costly alternative, constituting the discharge of dredged or fill material into waters of the U.S. in the least costly manner and at the least costly and most practicable location, is consistent with sound engineering practices, and meets the environmental standards established by the CWA Section 404(b)(1) evaluation process. Execution of the preferred alternative, following consideration of all applicable evaluation factors, is in the public interest.

All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives. Based on the analysis presented in the EA, which has incorporated or referenced the best information available; the reviews by other Federal, State and local agencies, Tribes; input of the public; and the review by my staff, it is my determination that the recommended plan would not cause significant adverse effects on the quality of the human environment. I have determined that the selected action will not have significant effects on the quality of the human environment and does not require preparation of an environmental impact statement.

7 Jan 21
Date

Alexander "Xander" L. Bullock
Colonel, Corps of Engineers
District Commander

ENVIRONMENTAL ASSESSMENT AND CLEAN WATER ACT, SECTION 404 PUBLIC INTEREST REVIEW

LYNDEN LEVEE AND CULVERT REPAIR

WHATCOM COUNTY, WASHINGTON

View looking upstream the Nooksack River from the Lynden Levee at Site 1.

US Army Corps of Engineers®
Seattle District

June 2021

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ACRONYMS AND ABBREVIATIONS

ACE	Annual Chance of Exceedance
AE	Architect-Engineering
APE	Area of potential effect
BA	Biological Assessment
BMP	Best Management Practices
CSBC	crushed surfacing base course
CFR	Code of Federal Regulation
cfs	Cubic feet per second
Corps	United States Army Corps of Engineers, Seattle District
CWA	Clean Water Act
cy	cubic yards
CZMA	Coastal Zone Management Act
DAHP	Department of Archaeology and Historic Preservation
dB	decibels

DPS	Distinct Population Segment
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FONSI	Finding of No Significant Impacts
gpm	gallons per minute
H:V	Horizontal and Vertical ratio, measured in feet
HPIF	Historic Property Inventory Form
LF	linear feet
LOP	Level of Protection
LWD	Large Woody Debris
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service / NOAA Fisheries
NOP	Notice of Preparation
NRHP	National Register of Historic Places
NWP	Nationwide Permit
OHWM	Ordinary High-Water Mark
PHS	Priority Habitats and Species

PIR	Project Information Report
PL	Public Law
PN	Public Notice
Sp., Spp	species (singular and plural)
SR	State Route
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WISAARD	Washington Information System Architectural and Archaeological Records Database
WQC	Water Quality Certificate
WWTP	Wastewater treatment plant

1 INTRODUCTION

Under the Council on Environmental Quality regulations, 40 CFR § 1501.5, implementing the National Environmental Policy Act (NEPA) of 1969 (as amended), the purpose of an Environmental Assessment (EA) is to "provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a finding of no significant impact (FONSI)" on actions authorized, funded, or carried out by the federal government, and to assist agency officials to make decisions that are based on understanding of "environmental consequences, and take actions that protect, restore, and enhance the environment." This EA evaluates environmental effects of proposed repairs by the U.S. Army Corps of Engineers, Seattle District (Corps), in the summer of 2021 to the Lynden Levee. In accordance with Section 404 of the Clean Water Act (CWA), this integrated document also evaluates whether it is in the public interest to undertake the federal action.

This document also integrates a review of factors underlying a determination of whether executing the project would be in the public interest, pursuant to CWA Section 404 and rules and regulations published as 33 CFR Part 335, "Operation and Maintenance of Army Corps of Engineers Civil Works Projects Involving the Discharge of Dredged or Fill Material into Waters of the U.S. or Ocean Waters"; 33 CFR Part 336, "Factors to be Considered in Evaluation of Army Corps of Engineers Dredging Projects Involving the Discharge of Dredged Material into Waters of the U.S. and Ocean Waters"; 33 CFR Part 337, "Practice and Procedure"; and 33 CFR Part 338, "Other Corps Activities Involving the Discharge of Dredged Material or Fill into Waters of the U.S.

1.1 BACKGROUND

1.1.1 Project Design

The Lynden Levee is located on the right bank of the Nooksack River near the City of Lynden, Whatcom County, Washington. It is a non-federal levee system constructed by local interests and protects public infrastructure, residential, commercial, and agricultural properties from recurring flooding from the Nooksack River. It is owned and operated by Whatcom County. The levee forms one segment of a three-segment system, which also includes Bertrand Creek Left Bank and River Road Levees. The Lynden Levee ties into Hannegan Road at its upstream end and River Road Levee near Guide Meridian Road at its downstream end. The levee is approximately 13,800 linear feet (LF) long and is 3 to 6 feet high on the landward side. The levee crown is approximately 10 to 12 feet wide. The riverward slope and toe is armored with Class IV riprap. Based on onsite conditions, best professional judgment by engineers, and available historical and technical data, the Lynden Levee at the repair site had adequate scour protection as originally designed and constructed by the local entity that resembles an armored launchable toe. In its undamaged state, the levee provides flood risk reduction up to the 10 percent (10-year return period) annual chance of exceedance (ACE) event.

1.1.2 Disaster Incidents

In November 2017, high flows occurred along the Nooksack River with a peak flow of 39,900 cubic feet per second (cfs) at the Everson U.S. Geological Survey gage 12211200, corresponding to an ACE of 40 percent (2.5-year return period). For more information regarding the flood event and the hydraulic considerations for the project, see Appendix A.

Flooding scoured the levee's riverward slope and toe at two locations, Site 1 and Site 2 (Figure 1), resulting in loss of riprap and embankment material from within the levee prism. In some areas the damage extended up the riverward slope to the levee crest. Shortly after the damage occurred, Corps inspections found material missing up to 30 feet deep into the levee prism. The Corps estimates that the levee at Site 1 lost approximately 8,333 cubic yards (CY) and 6,111 CY at Site 2. Vegetation such as trees, shrubs, and sod were also washed away from the riverward slope took with them levee material. At Site 1, flooding also damaged two segmented concrete culverts, overtopped the levee, and scoured the levee crest and landward slope. The two culverts (24- and 48-inch-diameter), which transport runoff from the City of Lynden through the Lynden Levee, exhibit evidence of sedimentation, joint separation, and/or settlement.

In the damaged condition, the level of protection (LOP) provided by the Lynden Levee is diminished from 10 percent (10-year return period) to 100 percent (1-year return period) ACE event to residential and agricultural properties, and associated utilities and infrastructure.

1.2 AUTHORITY

Repairs to the Lynden Levee are authorized by Public Law (PL) 84-99 (33 U.S.C. Section 701n). The Corps' rehabilitation and restoration work under this authority is limited to flood control works damaged or destroyed by floods. The statute authorizes rehabilitation to the condition and LOP exhibited by the flood control work prior to the damaging event.

Whatcom County is the local non-federal sponsor for the proposed levee repair project.

1.3 PROJECT LOCATION AND DESCRIPTION

The Lynden Levee is located on the right bank of the Nooksack River near the City of Lynden, Whatcom County, Washington. Repairs would occur at two sites between the Lynden wastewater treatment plant (WWTP) and Guide Meridian Road (State Route 539; Figure 1). Two culverts are located at Site 1. The culverts are not gated and allow flood water to pass to the protected side of the levee, contributing to flooding roads and blocking access to the Lynden WWTP. Total repair length at Site 1 is 457 LF and total repair length at Site 2 is 275 LF, totaling 732 LF of repairs. The total project footprint, including staging areas, is approximately 1.5 acres. Photos of the damaged levee are in Appendix B.

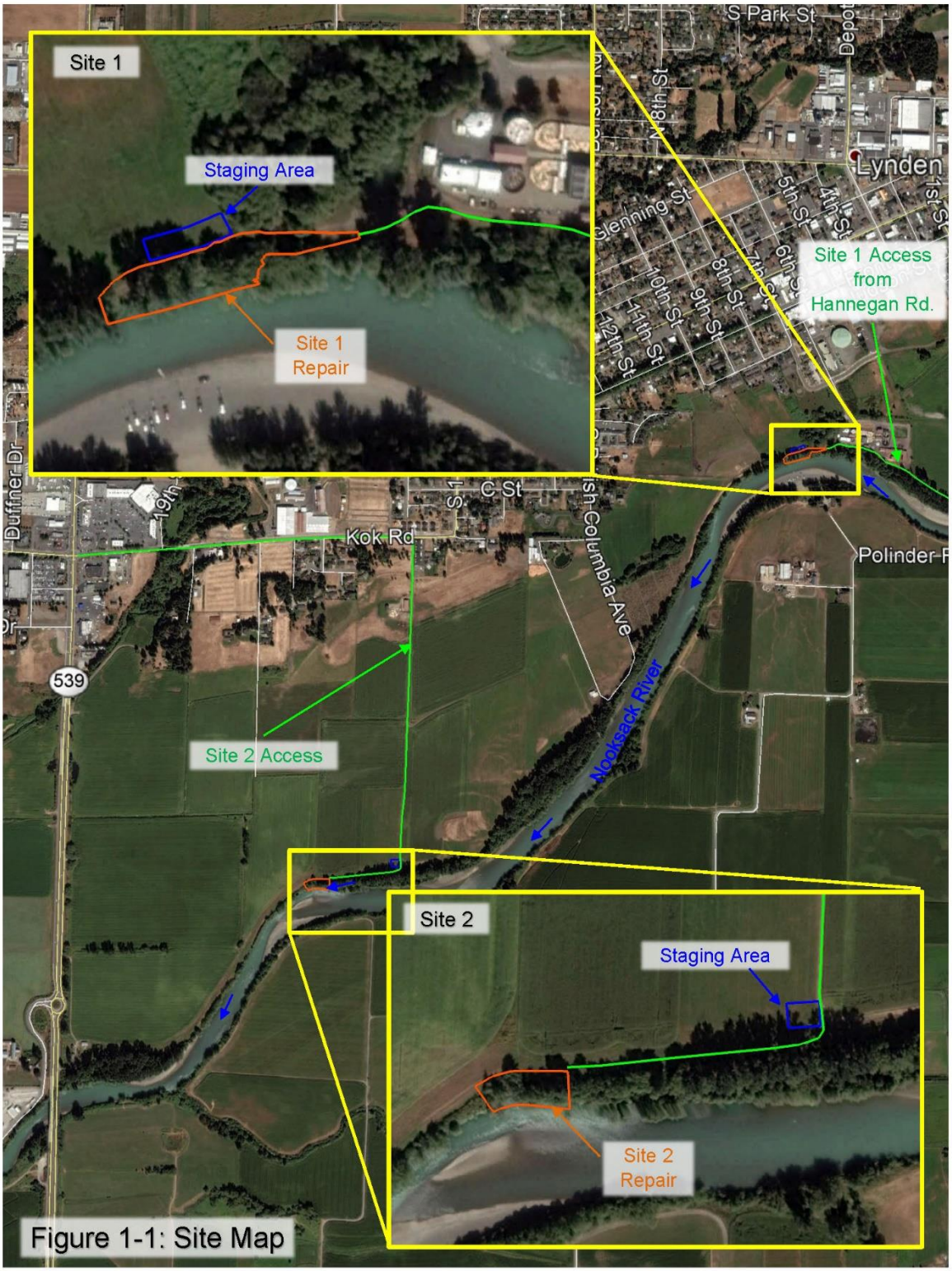

Figure 1. Project Location.

1.4 PURPOSE AND NEED

The purpose of the project is to restore the LOP exhibited by the Lynden Levee in its pre-damaged condition to reduce risk to lives and property damage that may arise due to future flooding. The repair is needed because the Lynden Levee was damaged by flooding related to the disaster incidents as described in Section 1.1.2 and no longer provides the designed LOP against flooding. If the Lynden Levee were to fail, there would be an increased risk to life safety, improved property, and public infrastructure. The repairs would be constructed in the summer of 2021 by the Corps, in partnership with Whatcom County.

2 PROPOSED PERMANENT REPAIR ACTION AND ALTERNATIVES

A preliminary evaluation has been conducted on the alternatives for fulfilling the purpose of restoring the LOP. Viable alternatives must restore reliable flood protection to the LOP prior to the damaging event, must be environmentally acceptable, and should address the identified flood risk by being capable of being constructed prior to the next flood season. The preferred alternative must be the least cost alternative that restores the LOP while fulfilling all legal, technical, and environmental requirements.

2.1 ALTERNATIVE 1: NO ACTION ALTERNATIVE

Under the No Action Alternative, the levee would remain in the current damaged state. This alternative would not meet the project purpose because the levee would likely be further damaged in future flood events and could fail, which would endanger lives and property. During any flood event threatening the integrity of the levee system, the Corps or other Federal and non-Federal agencies may act under emergency authorities to preserve the levee system and, to the extent possible, maintain protection of life and property landward of the levee. However, responding to damages during a flood event, would be temporary, less certain of success, potentially more expensive, and could be less protective of environmental and cultural resources. If flood fighting efforts don’t take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, floodwaters would enter into the protected area. Flooding could have detrimental effects including transporting debris, sediment, and/or pollutants into the community and surrounding areas, as well as transporting the polluted mix back into the river. Depending on the scope of the flood, this could cause substantial impacts.

The No Action Alternative is not recommended because it does not meet the project purpose and need. While the No Action Alternative is not recommended, it is carried forward for further evaluation to serve as a base condition for evaluation of other alternatives.

2.2 ALTERNATIVE 2: NONSTRUCTURAL ALTERNATIVE

This alternative consists of floodplain management strategies that involve changes in land use offered by other federal and state programs. Such strategies would include zoning, easements, flood warning, floodplain evacuation, and flood insurance. Nonstructural strategies involve acquisition, relocation, elevation, and flood proofing existing structures. The costs and timeframe for implementing this alternative are high when compared to structural alternatives, and the additional time it would take to implement this alternative would increase the amount of time that the purpose and need was not fulfilled, increasing flood risk to the area protected by the levee for some increment of time. Furthermore, the participation of the non-federal sponsor would be required to implement a nonstructural alternative, and Whatcom County has not agreed to meet its various obligations in executing a nonstructural alternative. Therefore, this alternative will be eliminated from detailed consideration.

2.3 ALTERNATIVE 3: LEVEE SETBACK ALTERNATIVE

The Levee Setback Alternative would shift the alignment of the levee landward of the riverbank. Typically, the setback levee would be a newly constructed earth embankment structure and the existing levee located on the riverbank would be abandoned. In this instance, a setback levee may be more costly than other alternatives due to more extensive embankment material and real estate requirements. Such an approach could also encroach on existing structures, privately-owned land, and public infrastructure. The costs and timeframe for implementing this alternative are high when compared to structural alternatives since this alternative would need to maintain flood protection for important infrastructure like the Lynden WWTP. In addition, the time it would take to implement this alternative would increase the amount of time that the purpose and need was not fulfilled, increasing flood risk to the area protected by the levee for some increment of time. This alternative would require participation of the non-federal sponsor to implement, and Whatcom County has not agreed to meet its various obligations in executing a setback alternative. Therefore, this alternative will be eliminated from detailed consideration.

2.4 ALTERNATIVE 4: REPAIR IN-KIND ALTERNATIVE (PREFERRED ALTERNATIVE)

This alternative would repair the levee at each damaged site. Levee embankment materials and riverward armor would be restored at Site 1 and Site 2. In addition, repairs to Site 1 would replace two segmented concrete culverts with a flap gate culvert and would repair the levee crown and landward slope to pre-flood conditions. Minor deviations in the structure's configuration would be integrated due to changes in materials, construction techniques, and safety standards that are necessary to make the repair. Minor deviations include an increase in riprap size at both repair sites, and changes in the levee alignment and armored area at Site 1 to accommodate the new culvert and to reduce scour and erosion potential within the project reach. The deviations would not shift the levee into the river. The levee’s riverward toe would remain within the pre-damaged footprint, while the landward toe would be shifted approximately 25 feet inland from the current location at the downstream end at Site 1

to accommodate the culvert. Additionally, there would be a slight increase in rock size (approximately 7 inches wider in diameter) above what is currently present. The proposed rock size and launchable toe design is based on hydraulic analysis using the HEC-RAS model and Corps design guidance (Engineer Manual EM 1110-2-1601). The hydraulic analysis that was completed provided an estimated river velocity. This expected velocity was used to select the appropriate riprap size for scour protection. Based on scour calculations, the volume and class size needed was determined to be Class IV riprap. These changes are necessary to meet sound engineering principles consisting of the application of updated technology and construction techniques and reflect Corps design requirements in the interest of levee safety when conducting repairs under PL 84-99.

Total construction length would be approximately 732 LF, including any necessary transitions, at the two sites (Figure 1). All repairs would occur within or landward of the pre-damage footprint of the levee.

The current recommended repair is described further below. Design plans for repairs to Site 1 and 2 under this alternative are in Appendix C.

2.4.1 Project Sequencing

The proposed levee repairs would occur in the summer of 2021, and plantings in late winter 2022. The Corps would start construction in June and complete the repair in early September 2021 at the latest. All in-water work would occur in the fish window (June 15 to August 31). Mitigation shrub and tree plantings would be completed in late February and early March by Whatcom County. See Appendix D for the mitigation plan.

Project construction would begin by gaining access to the sites, marking site limits using stakes and flagging, and preparing the existing levee prism for work. At both sites, storage and staging would occur at the project location and landward of the levee in an adjacent field. Staging activities consist of temporarily stockpiling excavated embankment fill, excess rock, supplies, equipment, and vehicles. A dump truck would move and deliver materials to the repair sites. A bulldozer and excavator, or similar equipment, would place and compact the construction materials.

At Site 1, Whatcom County has proposed a concurrent project to re-grade the area landward of the Lynden Levee to combine the drainage areas currently served by the two culverts away from a small WWTP lagoon. This is not a component of the Corps' project or major Federal action under NEPA, but is described for contextual purposes, only. The new culvert would align with the grading proposed by the local sponsor. The Corps developed the following preliminary project sequencing approach to complete repairs to the Lynden Levee while accommodating Whatcom County's distinct but concurrent project.

1. The Corps would remove the two culverts at Site 1 and install a 48-inch culvert with a side-hinged flap gate. The embankment would be reconstructed, and the drainage channel backfilled with excavation spoils above the culvert outlet. All grading around the new culvert would be completed, but riprap armor would not

be placed at this stage. To maintain drainage during this stage, the Corps would direct incoming water to a sump and would pump water around the work area to the river.

2. The Corps would construct the Site 2 repairs. While Site 2 work is ongoing, Whatcom County would re-grade the drainage area upland of Site 1 to direct drainage to the new culvert.

3. The Corps would return to Site 1 to complete repairs along the riverbank downstream of the culvert and to place riprap armor along the culvert and side channel. Priority would be given to complete the launchable toe and any other in-water work during the in-water work window (June 15 to August 31).

2.4.2 Site 1 Culvert Replacement and Work Site Isolation

At Site 1, the two obsolete concrete culverts would be removed. These culverts under normal conditions receive runoff from the city of Lynden and drain into the Nooksack River (see Section 3.3). During flood events over 16,000 cfs, the Nooksack River flows through the culverts landward of the levee. The Corps would replace these culverts with a single 48-inch culvert. Work to replace the culverts would occur during the in-water work window when average precipitation is at its lowest and when the channel is transporting less than 10 gallons per minute (gpm, equals to 0.022 cfs). This flow would enter the 48-inch diameter culvert (easternmost) as the 24-inch diameter culvert (westernmost) is expected to be dry. No water from the Nooksack River would be entering the work area because the outlet is perched above the Nooksack River.

A temporary bypass pipe would carry incoming flows around the culvert work site so it is isolated, and work can occur in the dry. A temporary sump would be excavated upstream of the work area to collect incoming water. A net would be installed upstream of the sump to prevent fish from entering the worksite and a fish rescue would occur before the pump starts operating to remove any fish from the worksite. The bypass pipe would lead to the riverward side of the repair site and drain into the river. A temporary cofferdam may be needed to help block water from entering the work site and direct it into the bypass. A cofferdam would not be needed at the downstream end of the work area since the drainage channel is perched above the Nooksack River. Corps biologists would inspect the fish exclusion net daily and determine if additional fish rescues are necessary. Following the work (within 3 to 4 weeks), Whatcom County would regrade the drainage area upland of the culvert at Site 1 to direct drainage to the new culvert inlet. Once the new culvert is installed, the sump would be backfilled, and the bypass pipe system and fish exclusion net removed.

The new culvert outlet would have a flap gate to prevent the Nooksack River from flowing into the landward side of the levee during floods. This would alleviate flooding at the Lynden WWTP Road. Section 2.4.4 provides additional information on the operation of the culvert and flap gate.

2.4.3 Levee Repair

Typical levee repairs begin with preparing the site, access routes, and levee prism for construction. The site limits would be clearly marked using stakes and flagging. Access routes would be prepared using crushed surfacing base course (CSBC) along the levee crest. The Corps may also place CSBC to improve existing access routes, particularly at Site 2, and at the staging areas. Staging would occur near the project location on the landward side of the levee in a grassy field (Site 1) and an agricultural field (Site 2), as depicted in the plan set (Appendix C). These sites would be restored in-kind at the end of construction.

Rock used in the repair at each site consists of riprap and quarry spalls. Rock would consist of hard, sound, and durable material free from seams, cracks, and other defects tending to lead to premature weathering. For this project, the Corps would use a 12-inch-thick layer of 4- to 8-inch quarry spalls as bedding between the granular embankment fill and riprap. A 3-foot-thick blanket and a launchable toe of Class IV riprap would be placed over the quarry spall layer. Class I and Class IV riprap would be used in the repair at Site 1. Existing riprap would be salvaged and incorporated into the repairs at both sites. The repair would smoothly transition into the adjacent upstream and downstream slopes at each site.

A dump truck would deliver and move materials at each repair site. A bulldozer and excavator, or similar equipment, would place and compact the construction materials. Armor and toe rock would be placed individually, and spall material would be placed by individual bucket load; no material would be end-dumped or placed in an uncontrolled manner on the riverward slope. Areas on the levee crown and along access routes that are disturbed by construction activities would be topped with up to 6 inches of gravel to repair any rutting or damage, or restored with sod, per the designs. All exposed or disturbed soils would be hydroseeded.

Site 1 Levee Repair

Site 1 work includes repairs to the culvert and the levee. The culverts would be replaced as described above, and the levee deconstructed and repaired. The levee’s riverward toe would remain within the pre-damage footprint, while the landward toe would shift approximately 25 feet inland from the current location at the downstream end.

The levee embankment would be reconstructed with a 1-foot overbuild to compensate for future settlement. A 12-inch layer of quarry spalls would be placed over the embankment and covered with a 3-foot-thick layer of Class IV riprap at 2 Horizontal and 1 Vertical (1H:1V). A launchable toe would be constructed at 1.5H:1V slope using Class IV riprap. Class IV riprap would be placed at the outlet of the new culvert and along the outlet channel to prevent erosion. On the landward side of the levee, Class I riprap

would be placed around the inlet of the culvert and along the levee backslope where it is steeper (2.4H:1V) to prevent erosion, such as rill[1] development, from overtopping flows.

Site 2 Levee Repair

Repairs at Site 2 would be similar to those at Site 1. A launchable toe would be constructed at 1.5H:1V using Class IV riprap. The damaged slope would be re-armored at 2H:1V with a 3-foot-thick blanket of Class IV riprap backed by a 12-inch layer of quarry spalls.

2.4.4 Culvert Operation

The new culvert at Site 1 would have a flap gate that would operate to reduce flooding to the Lynden WWTP and roadway. It is designed to withstand maximum expected flows. The gate would be installed on the riverward side of the culvert and is vertically hinged, slightly over-center axis. The flap gate is intended to limit the risk of interior flooding from high water events so long as the levee is not overtopped either at the project site or upstream reaches. The Corps would install a staff gage at the culvert and complete an initial calibration of the gage to match the gage height at the low point of the WWTP access road (i.e., water surface elevation 54 feet).

A closure trigger mechanism would allow the flap gate to close under its own weight as flood waters rise in the Nooksack River channel. The trigger mechanism and the vertical setting of the hinge alignment would be automatic but manually adjustable for Whatcom County to change the setting if needed. The ability to manually override operation of the gate is desired, but typical gate closing and opening operations are automatically triggered by the river levels.

The U.S. Geological Survey Everson gage would be the primary source of information for flap gate operation adjustment and operator calibration, although the gate's triggering mechanism would be directly responsive to the Nooksack River channel water surface elevation at the gate itself. When flow at the Everson gage reaches 20,000 cfs, staff would be alerted that the flap gate may automatically activate as the river rises. If flow is forecasted to rise above 23,000 cfs, the adjustment on the flap gate closure triggering mechanism should ensure closure of the gate until flows recede. At lower flows when the flap gate is not in operation, the culvert would remain open, maximizing the amount of time off-channel refuge is available for fish. When flows in the Nooksack River drop below 5,000 cfs, there is no direct connection to the culvert from the river due to the outlet's perched location.

See Appendix A for a more detailed description of the hydraulic analysis and function of the new culvert. The culvert would be operated and maintained by Whatcom County after the repair is completed. Whatcom County plans to use hydrologic analysis to calibrate the gate in the future. This analysis would tie local data to river gage data as a

[1] Defined as "a shallow channel cut by water flowing over rock or soil."

tool to inform operators of river forecasts and when the gate is anticipated to close or open. Whatcom County would work with resource agencies such as the Washington Department of Fish and Wildlife (WDFW), National Marine Fisheries Service (NMFS), Nooksack Tribe, and the city of Lynden on flap gate operation when it revises the O&M manual, after repairs are completed.

2.4.5 Mitigation

Mitigation is proposed to compensate for project impacts to riparian vegetation and water quality at the two repair sites (Appendix D). Repairs to the Lynden Levee would require removal of vegetation within the construction footprint. At Site 1, the Corps estimates eight Pacific willows (*Salix lasiandra*) and 12 red alder (*Alnus rubra*) trees between 30 to 50 feet tall, with an understory of red elderberry (*Sambucus racemose)*, snowberry (*Symphoricarpos albus)*, and salmonberry (*Rubus spectabilis)* would be removed. Site 2 is similarly vegetated, although it has fewer understory shrubs. Site 2 has 11 red alders and three willow trees approximately 20 to 30 feet tall on the riverward slope that would be removed. Mitigation includes vegetation plantings (willow bundles, shrubs, and trees) and woody debris to offset habitat and water quality impacts from the repair.

The Corps would incorporate willow bundles into the riverward side of the levee. Willow bundles consist of 10 live willow stakes of Sitka willow (*Salix sitchensis*) in a lens of topsoil two feet high by about three feet long. The planting bundles would be spaced 10 feet apart for continued levee inspection and would be placed just above the launchable toe and close to the ordinary high-water mark (OHWM). The Corps would also place woody debris along the riverward toe of the repaired levee. Woody debris would come from materials generated at each repair site and from pieces Whatcom County has accumulated (Appendix D). This woody debris would be placed to provide aquatic benefits (e.g., shoreline complexity, shade, and cover). Smaller woody material, such as slash, would be intertwined with the large logs and root wads. The riprap would be covered by the woody material as much as possible.

Following levee repairs, in late February and early March, Whatcom County would plant 136 native trees and 75 native shrubs at two locations (Appendix D). In the NOP, the Corps initially proposed replacing trees at a 3:1 ratio with three years of monitoring. After a meeting with the Washington State Department of Ecology (Ecology) and WDFW on April 30, 2021, Whatcom County committed to increasing the tree replacement ratio to 4:1 with 5 years of monitoring which is outlined in the mitigation plan (Appendix D). All dead tree and shrub plantings within the first year shall be replaced in kind. Plantings shall have a minimum 80 percent survival rate for years 1 through 5. Willow bundles will be monitored by the Corps for three years. All failed bundles will be replaced if less than 80 percent survive in the first year. The Corps will continue to monitor the willow bundles for an additional two years during levee inspections.

The overcompensation in numbers of planted trees versus lost trees is intended to compensate for the temporal lag until full maturity, as well as the loss of sod cover on

portions of the riverward armored slope. Tree plantings would consist of coniferous trees rather than deciduous trees because native conifers provide more effective long-term shade over the river, long-lasting floodplain refugia, and would eventually provide long lasting large wood in the channel when the mature trees are taken by the river. The proposed mitigation would offset impacts to riparian habitat (e.g., canopy structure, large woody debris, cover, high flow velocity breaks) and water quality (e.g., thermal buffers, shade).

2.5 CONSERVATION, BEST MANAGEMENT PRACTICES, AND MITIGATION

Mitigation for effects of proposed actions is evaluated as part of the NEPA process. Mitigation can take any of the following forms:

- Avoiding effects altogether by not taking a certain action or parts of an action.
- Minimizing effects by limiting the degree or magnitude of the action and its implementation.
- Rectifying effects by repairing, rehabilitating, or restoring the affected environment.
- Reducing or eliminating effects over time by preservation and maintenance actions during the life of the action.
- Compensating for effects by replacing or providing substitute resources or environments.

The project is planned and designed to avoid and minimize project impacts to the maximum extent feasible. All access would be over existing roads and trails, and all staging would be in previously developed or disturbed uplands. All in-water activity would be timed to use construction timing windows established to protect fish (June 15 through August 31). Conservation Measures and Best Management Practices (BMPs) listed below include measures to protect the Nooksack River from sediment and turbidity originating from the site. It also includes measures to reduce impacts to aquatic life.

2.5.1 Conservation Measures

The Corps has developed a list of conservation measures and incorporated these into the levee repair to reduce environmental impacts of the repair. For this project the measures the following:

- Hydroseed with a native seed mix and mulch would be placed on disturbed areas not armored with rock.
- Repairs would start at the upstream end and continue downstream. This would allow the repaired levee to act as a localized flow deflector and help manage flows in the work area, reducing turbidity.
- Willow bundles, and tree and shrub plantings are incorporated into the repair. Monitoring and adaptive management, including replacement and maintenance, would be conducted by the Corps and Whatcom County. The Corps and

Whatcom County will coordinate on adaptive management replacement strategies if plantings totally fail to meet performance standards (Appendix D). Replacement strategies may include planting different species, changing the planting location, or adding pest control or exclusion devices. The Corps would report the success of the mitigation plantings to the resource agencies coordinated with for the repair.

- Rock would be placed individually or in small bucket loads, with no uncontrolled dumping of rocks in-water or along the levee slope. Large rock would be placed and manipulated using the thumb attachment. Small rock that is impracticable to manipulate with the thumb attachment, such as quarry spalls, would be transferred from the bucket to the levee slope in a pouring motion.
- In-water work would be limited to the in-water work window (June 15 to August 31) to limit impacts to aquatic species, particularly salmon.

The Corps would inspect the repair sites after the repair is completed. If conservation measures and repairs are different from those described here, or what is depicted in the plans, they would be recorded and reported. The Corps would assess if changes are needed, such as change in type or location of plantings, and would coordinate with resource agencies such as the Ecology, U.S. Fish and Wildlife Service (USFWS), or NMFS.

2.5.2 Best Management Practices

BMPs would be employed to minimize project impacts. Some are integrated into the repair, while others are guides to operation and care of equipment. Note, some of these have been mentioned above.

- In-water work would be limited to the in-water work window (June 15 to August 31) and minimized to the extent possible.
- A silt curtain would be installed for work in the Nooksack River to control turbidity generated along the shoreline. If the curtain is damaged and cannot be repaired or replaced, the Corps would slow down in-water work to minimize turbidity generation.
- Water quality monitoring for turbidity would be performed as outlined in the Water Quality Monitoring Plan (Appendix E). If a potential exceedance is detected at the early warning sample locations, onsite personnel would evaluate construction activities and take measures to minimize turbidity generation. Examples include slowing down a specific in-water activity, changing the amount of material that is moved below the waterline, and inspecting the silt curtain.
- In-water excavation would be completed slowly to minimize turbidity generation. Care would be taken to reduce discharge from saturated material excavated below the waterline from entering back into the river. A bench with a concave surface would be created on the levee slope during deconstruction of the damaged levee. Wet material would be placed in the bench, so water drains downward through the levee and not directly back into the river. This material will be reused onsite (e.g., levee embankment and willow bundles). Material not used for reuse would be transported offsite for disposal at an approved, permitted location.

- Vegetation removal would be limited to the repair sites.
- Noxious weeds would be disposed of separately from other organic materials at an approved off-site location.
- Equipment used near and in water would be cleaned prior to construction.
- Drive trains would not work in the water. Only the excavator bucket with thumb attachment would extend into the water.
- Fueling would occur on the landward side of the levee, and biodegradable hydraulic fluids would be used as appropriately in any portion of the equipment that would work in the water.
- Construction equipment shall be regularly checked for drips or leaks, and fixed.
- At least one fuel spill kit with absorbent pads would be onsite at all times.
- Material placed into the water would be placed individually or in small bucket loads. No end dumping of rock into the water would occur.
- Rock placement would occur only within the project footprint.
- Rock placement and underwater excavation would occur from the upstream end of the project to the downstream end. Rock is placed shortly after excavation so it would act as a localized flow deflector and help manage flows in the installation areas.
- After construction is complete, the sites would be reseeded using a native grass seed mix including a mulch base.
- At least one biologist would be onsite during construction. Corps or Service biologists may visit construction site. All visits would be coordinated with the Project Manager and Construction Manager.
- Fish would be excluded from the work sites in the Nooksack River by a silt curtain and from Site 1 by a net upstream of the sump. The Corps would coordinate with NMFS, USFWS, WDFW, and Whatcom County to complete fish rescues in the excluded areas in accordance to the fish rescue plan (Appendix F).
- Woody debris generated during construction and/or provided by Whatcom County would be placed along the riverward toe of the repaired levee. The onsite biologist would direct the orientation of the woody debris to provide aquatic benefits (e.g., shoreline complexity, shade, cover). Smaller woody materials like slash would be intertwined with larger logs and rootwads. As much of the riprap would be covered by the woody material as possible.
- All trash and unauthorized fill (including concrete blocks or pieces, bricks, asphalt, metal, treated wood, glass, floating debris, and paper) generated during the repair would be removed from the project and staging areas after work is complete.
- A pre-construction meeting would be conducted to look at existing conditions and any possible fine-tuning that should be done for BMPs or environmental requirements. The pre-construction meetings would include outside resources agencies like USFWS or NMFS.

In addition, a Fueling and Spill Recovery Plan would be developed prior to construction that would include specific BMPs to prevent and react to any spills should an incident occur. A Stormwater Pollution and Prevention Plan would be developed to identify

potential sources and reduce pollutants in stormwater discharges from the construction site.

3 ENVIRONMENTAL RESOURCES OF CONCERN AND EFFECTS

3.1 LAND USE AND RECREATION

Most of the non-Federal land in unincorporated Whatcom County is dedicated to forestry and agricultural uses. The next largest category of land use is residential. Much smaller areas of the county are dedicated to industrial, commercial, and other uses (Whatcom County 2021). The Federal government manages approximately 875,100 acres of land in Whatcom County (Washington State Recreation and Conservation Office 2021).

Land use in the vicinity of the Lynden Levee is a mix of transportation, residential, commercial, and agricultural. Landward of Site 1 is the city of Lynden and the Lynden WWTP. The city of Lynden includes residential areas, businesses, and public infrastructure. Landward of Site 2 are agricultural fields.

The Lynden Levee is not designed to be a recreational structure although pedestrians use it as an unofficial walking path. While Whatcom County has a considerable amount of Federal and state recreational land, limited accessibility and distance to these lands is a challenge for many residents. The majority of recreational use by county residents occurs in local and county parks, and recreational facilities (Whatcom County 2016). Patterson Park is located landward of Site 1 and the WWTP. the park contains paths, grassy areas, and a disc golf course (City of Lynden 2020). Water resource-oriented activities, such as boating and fishing, are also major recreational activities in the area. A number of sites in the area are used to access the Nooksack River. A gravel bar opposite from Site 1 is a popular fishing location and approximately half a mile upstream from this site is boat access. Approximately 1 mile downstream of Site 2 off State Route (SR) 539 is a public access site, locally known as De Groot, which has parking area and concrete boat launch.

3.1.1 No Action Alternative

The No Action Alternative is not expected to cause any changes to land use and recreation. There would be a higher risk for flood damage to land use under this alternative. Emergency flood fight efforts would likely be needed to protect lives and property during a flood event threatening the levee. Flood fighting efforts are expected to be sufficient to maintain the existing land use and recreational uses within the floodplain landward of the levee. If flood fighting efforts don’t take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, floodwaters would enter into the protected area. Flooding could have detrimental effects that could alter land use and prevent recreational activities. The No Action Alternative is not expected to cause significant adverse impacts to land use and recreation.

3.1.2 Repair In-Kind Alternative

The Repair In-Kind Alternative may disrupt surrounding properties during repairs while equipment and personnel access the construction area via land easements. After completion of the project, land uses would be protected from the potential damages resulting from floods up to the LOP provided by the levee (10 percent ACE). There would be no change in land use after repairs are completed. During construction, the quality of recreational activities in the area may be reduced due to noise or from disruption of traffic from construction equipment. To ensure public safety during construction, access to the project site would be prohibited, temporarily interrupting pedestrian use. Use of Patterson Park and of river access points are not expected to be affected by the Corps' repair. The Repair In-Kind Alternative would not have significant adverse impacts to land use and recreation.

3.2 GEOLOGY AND SOILS

The Nooksack River drains westward from the Cascade Mountains in the northern Puget Sound region. The topography of the Nooksack River basin varies greatly due to its mountainous origins. Elevations range from sea level to over 10,000 feet at Mt. Baker. Elevation at the repair sites are approximately 50 feet above sea level and geologic conditions in the vicinity are generally quaternary alluvium, outwash sand and gravel (Figure 2; Easterbrook 1976). Riverine processes have deposited well-sorted layers of sand, gravel, silt, and clay on terraces adjacent to the Nooksack River. In addition to mineral deposits, peat and organic silt are present in bogs or former channels in the floodplain, including Site 1.

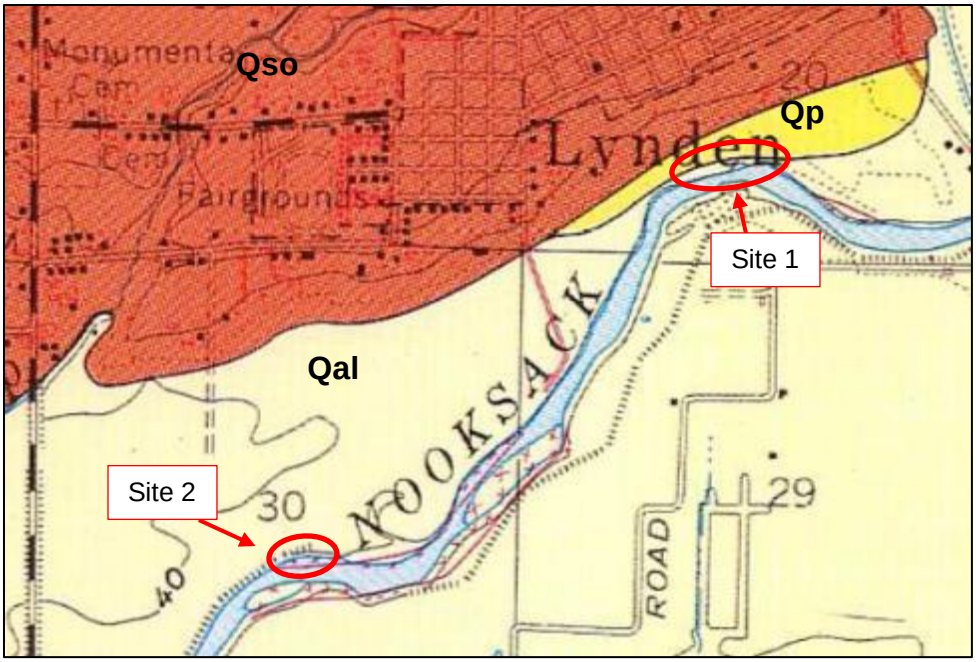

Figure 2. Portion of the Geological Map of Whatcom County, Washington (Easterbrook 1976). Quaternary alluvium (Qal), outwash sand and gravel (Qso), and peat (Qp).

Geotechnical investigations at Site 1 show that the levee embankment, consisting of silty sand with gravel, overlies silty sand and sandy silt to a depth of about 12 to 13 feet below the levee crest. At this depth, a 9- to 11-foot-thick layer of very soft peat was encountered. The peat is underlain by sand and lean clay to the bottom of the borings, which extended 30 to 32 feet below the levee crest. Site 2 soils are mapped as quaternary alluvium (Figure 2). Well logs from the vicinity of Site 2 were reviewed and indicated materials consisting of sand, silty sand, sandy silt, and clay, with some gravels intermixed. According to the Natural Resource Conservation Service, soils at both sites are primarily classified as Briscot silt loam, with areas of Pangborn muck located landward of the levee at Site 1 (NRCS 2019). Briscot silt loam is poorly drained, has a moderately high to high capacity to transmit water, and is formed in floodplains on alluvium.

3.2.1 No Action Alternative

The No Action Alternative would allow continued erosion of the damaged levee and a higher risk from flooding to persist. This alternative could lead to emergency flood fight measures during a flood event. A flood fight response during an event could require more rock placement and the use of larger rock as compared with the Repair In-Kind Alternative, depending on the specific events at the time of the emergency. In the event of a levee breach during a flood event, the river channel could migrate, changing the hydrology and underlying soils at the breach and throughout the affected reach of river. However, such an event is expected to be avoided through implementation of emergency flood fighting measures. If flood fighting efforts don't take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, such as a breach, a large volume of floodwater would enter the protected area landward of the levee and erode soils and alter change surface conditions. Sediment contamination could also occur, especially if flooding damages the Lynden WWTP releases untreated wastewater. The No Action Alternative is not expected to cause significant adverse impacts to geology and soils.

3.2.2 Repair In-Kind Alternative

The Repair In-Kind Alternative would minimize riverbank erosion at the damaged sites by restoring the levee embankment and armor that was lost by the flood event. There would be localized impacts to soils within the project footprint from the removal and replacement of materials, such as levee embankment and riprap. However, this impact is necessary to complete repairs. At Site 1, the levee is on compressible materials including peat and lean clay. Existing culverts show evidence of settlement (e.g., sags and separated joints). Excavation and reconstruction of the levee embankment and replacement of the existing culverts are expected to cause settlement. Peat tends to creep over time (secondary compression), resulting in ongoing settlement over the life of the levee. Design of the Repair In-Kind Alternative took settlement into consideration. To accommodate the estimated settlement, the new culvert would be installed above the design elevation and a camber would be built into the culvert to reduce the sag that is expected to develop over time. There is no evidence of compressible foundation soils

at Site 2. The Repair In-Kind Alternative is not expected to cause significant adverse impacts to geology and soils.

3.3 WATER RESOURCES AND WATER QUALITY

The Nooksack River has three main tributaries: the North Fork, the Middle Fork, and the South Fork. The North Fork receives glacial runoff and sediment from the north side of Mt. Baker and mountains along the northern United States border with Canada. The Middle Fork drains the western flank of Mt. Baker, and the South Fork drains the lower-elevation terrain between Mt. Baker and the Skagit River (Anderson et al. 2019).

The Nooksack River is heavily confined by levees, restricting the river's access to the floodplain except in extreme events. The Lynden Levee is on the right bank of the lower Nooksack River, in a downstream reach of an outside bend. River energy is parallel to the levee except during large floods when the river energies are directed into the levee, and during low-flow periods when gravel bars direct flow into the bank.

Two small culverts penetrate the levee at Site 1. These culverts collect runoff and stormwater from the city of Lynden. Most of the drainage basin flows into the 48-inch (easternmost) culvert, while the 24-inch (westernmost) culvert shows little evidence of running water. The drainage channel for these culverts is perched above the OHWM of the Nooksack River. The invert of the existing 24- and 48-inch diameter culverts are at an elevation of approximately 48.5 and 45 feet, respectively. Due to silt accumulation in the 48-inch culvert, water flow is blocked and its effective invert elevation is approximately 47 feet.

Different Nooksack flows result in a variety of drainage patterns at Site 1. Figure 3 shows the extent of the drainage basin at Site 1 and describes normal, non-flood conditions. Figure 4 shows drainage patterns during flood events. During floods, the following events occur:

- Below approximately 5,000 cfs: The Nooksack River is below the perched outlet of the culverts' drainage basin (Figure 3).
- At approximately 5,000 cfs: The Nooksack River WSE rises and fish in the river can access the perched channel but not the culverts.
- At approximately 7,000 to 8,000 cfs: The Nooksack River water surface elevation meets the culvert inverts. Fish can start accessing the landward side of the levee.
- 16,000 cfs: Floodwater from the Nooksack River starts flowing through the culverts and to the protected (landward) side of the levee. Based on calibrated model and observed data, the culvert invert is approximately 6 feet below the water surface elevation at this point.
- 16,000–17,000 cfs: The western basin boundary experiences overflow. Floodwaters start moving west towards Fish Trap Creek and the Duffner ditch (Figure 4).
- 20,000–22,000 cfs: WWTP road overtops. The smaller flow represents the most conservative estimate based on no upstream storage. The larger flow represents

a flow where the WWTP road would overtop regardless of the type of flooding event (flashy or long term).

- 20,000–25,000 cfs: Levee and Hannegan Road overtopped (Figure 4). The smaller flow represents the most conservative estimate based on no upstream storage. The larger flow represents a flow where Hannegan Road would overtop regardless of the type of flooding event (flashy or long term).

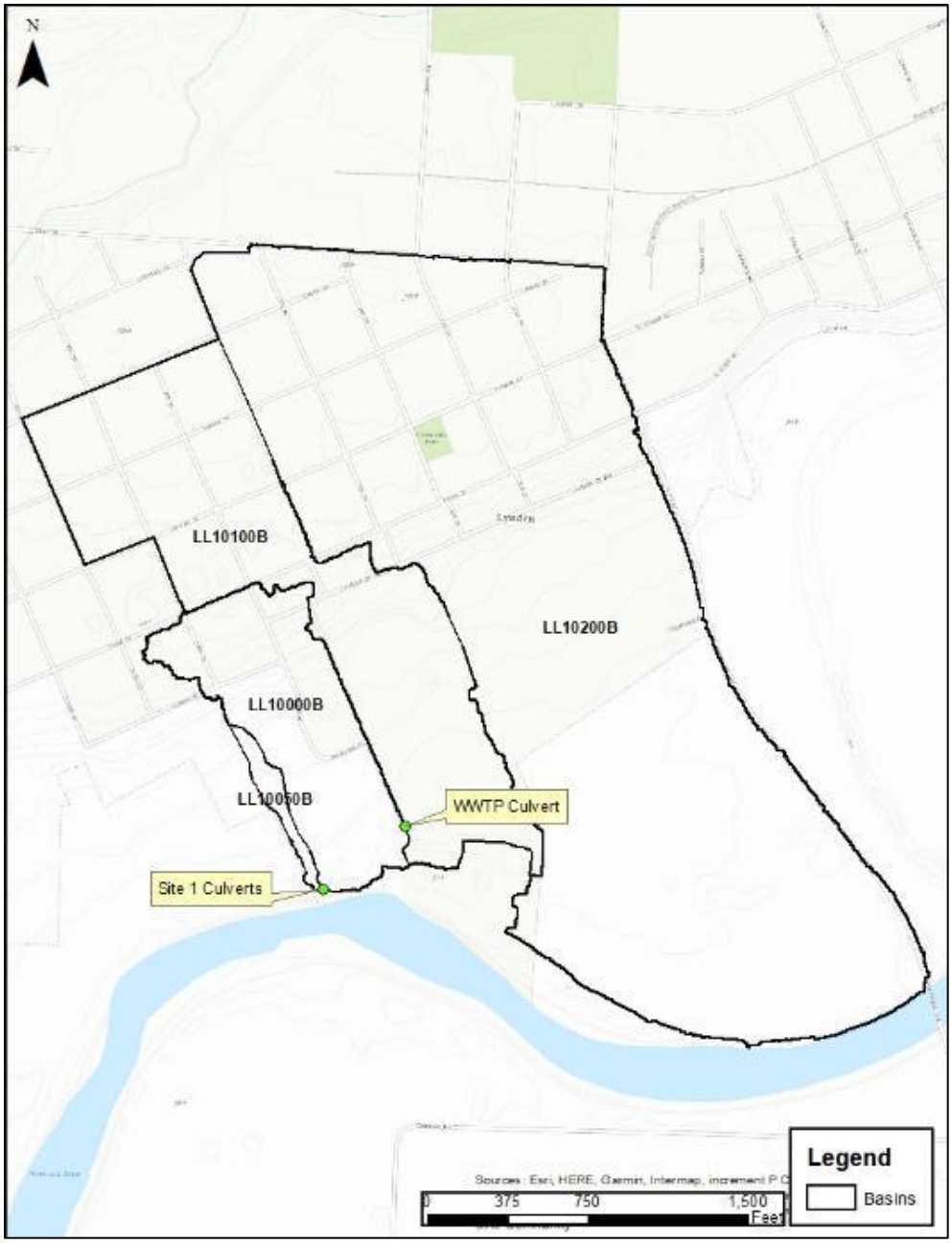

Figure 3. Culvert basin. Under normal conditions, runoff from the city of Lynden drains through the culverts at Site 1 into the Nooksack River. Access to the WWTP is via a road over the WWTP culvert, which overtops during some flood events, blocking access.

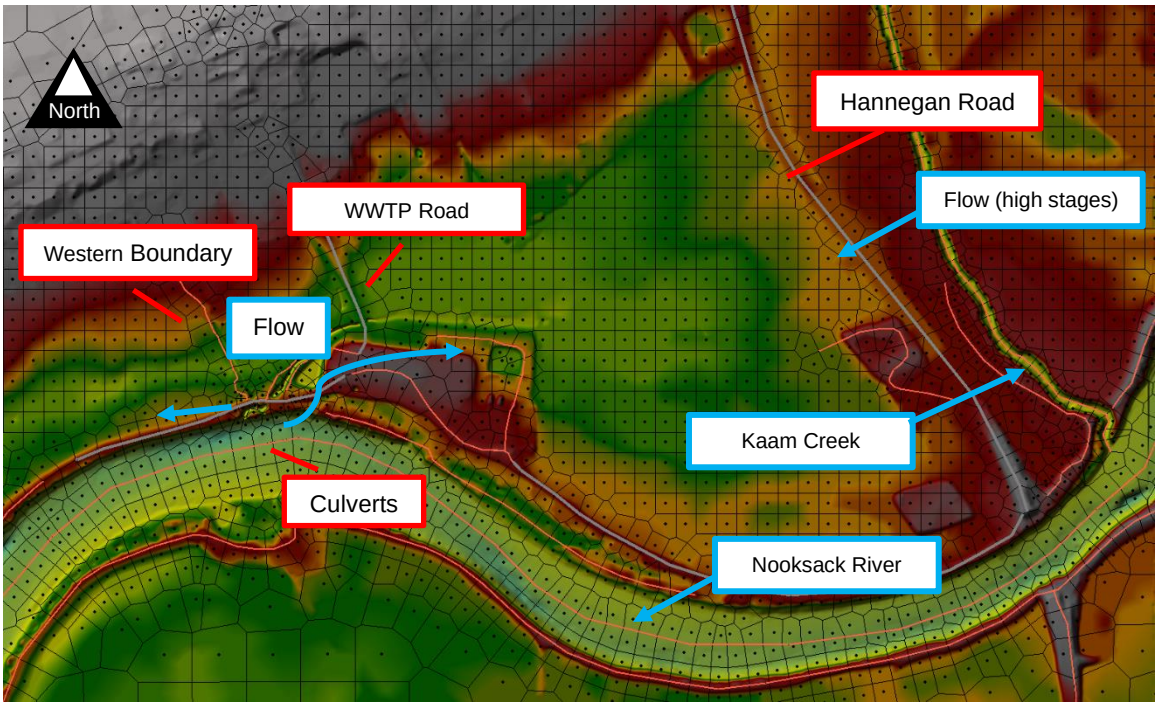

Figure 4. General flow conditions during a rising flood event at Site 1. Overtopping flows from Kaam Creek east of Hannegan Road flow west of the Site 1 repair site. Kaam Creek is also known as Stickney Slough.

The Nooksack River has high levels of ambient turbidity during the high temperatures of mid-summer when glacier melt releases suspended sediments. Ecology lists the Nooksack River adjacent to the damaged sites on the 303(d) list for dissolved oxygen (Ecology 2020a). Approximately eight miles downstream of the damaged sites, the Nooksack River is on the 303(d) list for temperature. Ecology also lists the North Fork Nooksack River as Category 2 for temperature excursions over the criteria (16°C; 60.8°F). Waters listed as Category 2 have some evidence of a water quality problem, but not enough to show persistent impairment. Ecology lists the Middle Fork as Category 5 for excursions over 7-day mean of daily maximum values (Ecology 2020b).

3.3.1 No Action Alternative

The No Action Alternative would allow continued erosion of the damaged levee and a higher risk from flooding to persist. The damaged levee could sustain more damage causing increased erosion, turbidity, and sedimentation. A flood fight response may be necessary depending on the severity of the flood event and require fill placement during high water. This may be a minor concern during a flood event. If flood fighting efforts are successful, no significant adverse impact to water resources and water quality is expected. If flood fighting efforts don't take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, floodwaters would transport debris, sediment, and/or pollutants into the community and surrounding areas. Floodwaters would transport the polluted mix back into the river with the potential for substantial

impacts to water quality and sediment contamination. For example, water quality could be negatively affected if flooding damages the Lynden WWTP and causes release of untreated wastewater.

3.3.2 Repair In-Kind Alternative

The Repair In-Kind Alternative would minimize riverbank erosion at the damaged sites by restoring levee embankment and armor that was lost by flooding. Replacing the existing two drainage culverts with a single flap gate culvert at Site 1 would not significantly change drainage through the levee. Closing of the flap gate would alleviate flooding at the Lynden WWTP Road, preserving access to the facility for a longer period of time during flood events. There would be no change to the overall river hydrology at the two locations. See Appendix A for a more detailed description of the hydraulic analysis and function of the new culvert.

The riverward invert elevation of the existing culverts is approximately 45 feet, has approximately two feet of silt accumulation, bringing the bottom invert to approximately 47 feet. In discussions with the County it was decided that an invert of 47 feet was the elevation that could sustain and maintain culvert capacity. Flow conditions through the new flap gate culvert would resemble the following:

- Below approximately 5,000 cfs in the Nooksack River, the culvert and off-channel area are perched above the main Nooksack (inaccessible by fish).
- At approximately 5,000 cfs, the Nooksack River rises and fish in the river can access the perched channel, but not the culvert.
- At approximately 7,000 cfs in the Nooksack River, water from the river meets the riverward invert of the proposed culvert.
- At approximately 8,000 cfs in the Nooksack River, the water levels in the river are high enough that fish can access the landward are through the proposed culvert.
- At approximately 16,000 cfs in the Nooksack River, water from the river starts flowing through the culvert to the landward side. Based on calibrated model and observed data, the culvert invert is approximately 6 feet below the water surface elevation at this point.
- At approximately 20,000 cfs in the Nooksack River, the flap gate on the proposed culvert may close on the rising limb of the flood. The WWTP road is overtopped.
- At approximately 23,000 cfs in the Nooksack River, the flap gate on the proposed culvert would close on the rising limb. At high flows such as these, the controlling water surface and source of overland flow is upstream of the levee at Hannegan Road from Kaam Creek (Figure 4).

Repair work would involve minimal, short-term water quality impacts from construction. Elevated turbidity levels may result from bank excavation and placement of rock in the water. However, BMPs would be utilized to minimize discharge of pollutants or excess sediments into the river. The repairs would be performed by equipment operating from the land, and it is expected that only a portion of equipment would enter the river, specificallythe end of the excavator bucket to complete repairs to the levee embankment, slope, and toe. The excavator would be similar to a 300 series, with a

minimum of reach of 30 feet and weighing at least 70,000 pounds. Construction would cause localized and temporary increases to turbidity resulting from the removal and replacement of materials, such as rip rap and embankment material. Only clean material would be used. Silt curtains would be used for work in the Nooksack River to control turbidity. At Site 1, turbidity would be further controlled from working in the dry using a cofferdam to install the new culvert. All in-water work would be limited to the in-water work window and minimized to the greatest extent possible. Water quality monitoring for turbidity would be performed (Appendix E). In the event that significant sediment enters the river and high levels of turbidity occur, work would be halted until the situation can be assessed and corrected. Therefore, it is anticipated that any project-related increases in turbidity would be highly localized and temporary.

Repairs would remove vegetation from the shoreline, which would increase water temperatures. The proposed mitigation would compensate for this impact (Appendix D). Plantings would provide shade and create a thermal buffer as they become established. Overhanging vegetation would provide shade and reduce local water temperatures. However, until vegetation grows large enough to provide shade, reflected light and heat off bare rock would increase local water temperatures. The amount the rock that warms the water is expected to be minor, and difficult to measure relative to the overall volume of water in the Nooksack River.

The Repair In-Kind Alternative is not expected to cause significant adverse impacts to water resources and water quality.

3.4 VEGETATION AND WETLANDS

The project area is in the Fraser Lowlands, a subcategory within the Puget Lowland ecoregion. The Fraser Lowland ecoregion is characterized by undulating terrain, a mild, wet climate, and productive pastureland (Pater et al. 1998). Historically, the Nooksack River covered a large floodplain with extensive riparian forest habitat. When settlers arrived, they harvested and cleared the riparian forest and drained large areas of swampy lowlands for farming. Today, the lower Nooksack River watershed is characterized by fragmented patches of mixed deciduous and conifer forest scattered among long agricultural reaches. The agricultural reaches are ditched and dominated by pasture grasses and blackberry vines, which provides minimal shading to stream or river waters. Human impacts to the floodplain include intensive agriculture and dairy operations, forestry, rural residential developments, recreation, WWTPs, and other human developments.

Land at and around each of the damaged sites is heavily developed and altered by human activity. Vegetation at Site 1 consists of a deciduous forested riparian area and frequently mowed fields. Vegetation within the damaged reach include pacific willow, red alder, elderberry, snowberry, salmonberry, tall fescue (*Schedonorus arundinaceus*), common dandelion (*Taraxacum officinale*), and red clover (*Trifolium pretense*). The drainage channel that passes through Site 1 is flat bottomed and unvegetated. Site 2 is similarly vegetated, but landward of the site are agricultural fields. While wetlands are located landward of Site 1, no wetlands are present at either damaged footprint (HDR

2019). In general, the vegetation, soils, and hydrology are consistent with those found in a riparian floodplain but are not representative of wetlands.

3.4.1 No Action Alternative

The No Action Alternative would not result in vegetation clearing or work in wetlands. However, the No Action Alternative would allow continued erosion of the damaged levee and a higher risk from flooding to persist. Continued erosion could compromise vegetation on the riverward side of the levee, although this would be a natural process. Scour holes may develop and remove additional levee material that could require future repairs or a flood response during a flood event. Under these circumstances, a flood fight would likely be conducted. Construction during a flood event is difficult and is completed as quickly as possible; therefore, vegetation would be removed or buried as needed to accomplish the levee repair under difficult construction conditions, regardless of the type of vegetation. Levees typically are not revegetated following flood fight actions. If flood fighting efforts don't take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, such as a breach, floodwater would enter the protected area landward of the levee could damage or wash away vegetation. Woody debris taken in by the river would provide habitat benefits to aquatic life. Otherwise, if no flood fight is necessary, the No Action Alternative is not expected to cause significant adverse impacts to fish and wildlife.

3.4.2 Repair In-Kind Alternative

The Repair In-Kind Alternative would clear vegetation, including trees, in the construction footprint. Clearing at Site 1 would remove eight Pacific willows and 12 red alder trees between 30 to 50 feet tall, as well as an understory of red elderberry, snowberry and salmonberry. Clearing at Site 2 would be similar with three willow trees and 11 red alders approximately 20 to 30 feet tall on the riverward slope.

Riparian vegetation is important for a variety of habitat and environmental conditions such as large woody debris (LWD), shade, cover, food, shoreline complexity, and nutrient input. Mitigation plantings are included in the proposed repair to compensate for vegetation loss from repairs. Plantings consist of native willows, conifer trees, and shrubs. Willow bundles would be incorporated into the levee repair at each site every 10 feet (approximately 72 bundles). After levee repairs are completed, Whatcom County will plant 10 coniferous trees and 75 shrubs in the designated planting area at Site 1 and 126 coniferous trees upstream of Site 2 (Appendix D). These plantings would compensate for impacts to riparian vegetation and provide habitat (e.g., canopy structure, large woody debris, cover, high flow velocity breaks) and water quality benefits (e.g., thermal buffers, shade). Coniferous plantings would allow for long-term succession and beneficial LWD recruitment. Native conifers provide more effective long-term shade over the river, long-lasting floodplain refugia, and would eventually provide long lasting large wood in the channel when the mature trees are taken by the river. In addition, conifers would replace a combination of canopy structure, vertical habitat, and perch habitat found in existing trees slated for removal.

As the levee revegetates, the affected habitat and environmental conditions would return. However, functions provided by the willow bundles, such as shade, could be limited by maintenance trimming and clearing to protect levee integrity and allow inspection through the County's maintenance regiment. The County's maintenance routine would not affect the conifer tree and shrub plantings. The Repair In-Kind Alternative is not expected to cause significant adverse impacts to vegetation and wetlands.

3.5 FISH AND WILDLIFE

Salmonid fish species known to occur in the Nooksack River and its tributaries include steelhead and rainbow trout (*Oncorhynchus mykiss*), Chinook (*O. tshawytscha*), sockeye (*O. nerka*), coastal cutthroat trout (*O. clarki*), pink salmon (*O. gorbuscha*), coho (*O. kisutch*), chum (*O. keta*), and bull trout (*Salvelinus malma;* WDFW 2020). Other species found in the region's rivers include, but are not limited to, the three-spined stickleback (*Gasterosteus aculeatus*), lampreys (*Petromyzontidae*), whitefish (*Prosopium sp.*), and dace (*Rhinichthys sp.*). The Nooksack River adjacent to the repair is also designated as essential fish habitat (EFH) for Chinook, coho, and pink salmon (NMFS 2019; PFMC 1999). The habitat impacts discussed below would also affect EFH for these species.

The areas surrounding the project site along the Nooksack River is frequented by a variety of wildlife species. These include but are not limited to raccoon (*Procyon lotor*), foxes (*Vulpes spp.*), coyote (*Canis latrans*), skunks *(Mephitis spp.*), Douglas squirrel (*Tamiasciurus douglasi*), mice (*Peromyscus* spp.), voles (*Microtus* spp.), little brown myotis (*Myotis lucifugus*), mink (*Carnivora mustelidae*), elk (*Cervus elaphus*), and Columbia black-tailed deer (*Odocoileus hemionus*). Due to the rural location of the project site, medium to small mammals are expected to utilize the levee and fringe riparian habitat. Larger species such as elk and bear (*Ursus americanus*) are unlikely to utilize the project area.

Washington Birder (2020) lists 369 bird species in Whatcom County. More locally, birders visiting the nearest eBird hotspots to the two damaged sites, Hannegan Road and Lynden-Flynn & River Road, recorded 135 and 119 species, respectively (eBird 2020). A variety of songbirds, raptors, and waterfowl including purple martin (*Progne subis*), chestnut-backed chickadee (*Parus rufescens*), bald eagles (*Haliaeetus leucocephalus*), northern goshawk (*Accipiter gentilis*), great blue heron (Ardea Herodias), and wood duck (*Aix sponsa*) are found in the area. Query of the WDFW Priority Habitat and Species (PHS) mapper indicates that no bald eagle nests are currently recorded as being near the levee rehabilitation site and none have been observed.

The drainage channel at Site 1 is perched above the Nooksack River's OHWM and is only accessible by fish in the Nooksack River at specific water levels. When water levels are high enough in the Nooksack River (above approximately 5,000 cfs), fish, primarily juvenile fish including coho salmon, can access the drainage channel and use it as refuge habitat from high flows (J. Ingram, WDFW, personal communication, November

15, 2019). Off-channel refuge habitat landward of the levee is only accessible through the culverts when flows approximately 8,000 cfs, and from overtopping flows during rising flood events. The culverts become a drain to the system during the receding flood. Fish stranding is possible when water floods the adjacent field to the west and continues flowing towards Fish Trap Creek and the Duffner ditch through the Bertrand Levee (J. Ingram, WDFW, personal communication, November 15, 2019). When flooding recedes, water drains back out through the culverts or continues west, leaving some low areas landward of the undrained. Any fish that remain in these areas are exposed to receding water and high summer temperatures, as well as predation from birds and wildlife. Fish may also remain in the landward drainage or follow flows out of the culverts or back to the Nooksack River through Fish Trap Creek and the Duffner ditch if there is enough flow and culvert conditions (e.g., debris or joint separation) allow.

3.5.1 No Action Alternative

The No Action Alternative would not directly disturb fish and wildlife in the area. However, the No Action Alternative would allow continued erosion of the damaged levee and a higher risk from flooding to persist. Erosion from flooding may remove additional levee material that may wash away riparian vegetation and could eventually compromise the levee. This could lead to emergency flood fight measures during a flood event to protect lives and property. Construction during a flood event is difficult and is completed as quickly as possible; therefore, habitat would be disturbed as needed to accomplish the levee repair under difficult construction conditions, regardless of its type or quality. This would have negative impacts to fish and wildlife. The exact effect to fish and wildlife associated with emergency flood actions is difficult to quantify or predict but does have the potential to be significant if the flood event warrants repairs at damaged sites. If flood fighting efforts don't take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, floodwaters would transport debris, sediment, vegetation, and/or pollutants into the community and surrounding areas. Floodwaters would transport the polluted mix back into the river with the potential for substantial impacts to fish and wildlife. For example, water quality could be negatively affected if flooding damages the Lynden WWTP and causes release of untreated wastewater. Additionally, while fish stranding already occurs, a breach could increase the amount of water that enters the protected area landward of the levee, increasing the area in which stranding could occur. Otherwise, if no flood fight is necessary, the No Action Alternative is not expected to cause significant adverse impacts to fish and wildlife.

3.5.2 Repair In-Kind Alternative

Use of the site by fish and wildlife would be temporarily affected under this alternative. There would be long- and short-term construction related impacts during the repairs. Long-term impacts result from vegetation removal and shoreline simplification. Short-term impacts result from construction activities that are temporary and localized, such as vibration, sound, and turbidity. These impacts could impact how fish and wildlife utilize the area, such as deterring wildlife from approaching and utilizing the area.

Vegetation

Mature riparian vegetation provides important functions for aquatic species. In particular, large conifers are key characteristics of a mature riparian forest because they provide functional LWD and shade (Capuana 2013). A deciduous dominated forest, which is the primary tree type found in the project area, does not provide LWD of the size that is needed to function in most Pacific Northwest streams and decays more rapidly than coniferous species (Naiman and Latterell 2005, Naiman et al. 2005). Repairs at each site would reduce riparian vegetation. At Site 1, repair activities would remove eight large willows and 12 red alder trees. At Site 2, three willow trees and 11 red alder would be removed. While this vegetation is not equal to a mature riparian habitat, it provides similar, but reduced, function. Removing this vegetation would negatively impact fish and wildlife habitat such as shoreline complexity, shade, cover, food, LWD, and nutrient input. Revegetation to match current site conditions is anticipated to take 5 to 15 years.

To mitigate for this impact and accelerate vegetation establishment, topsoil would be placed over unarmored areas and hydroseeded, willow bundles would be installed into the levee, shrub and tree plantings installed at two sites, and woody debris placed along the toe of the repaired levees (Appendix D). The mitigation would compensate for the lost canopy and understory structure, vertical habitat, and perch habitat found in existing vegetation slated for removal. Eventually, the coniferous trees would provide more effective long-term shade over the river, long-lasting floodplain refugia, and would eventually provide long lasting large wood in the channel when the mature trees are taken by into the river. The willow bundles and woody debris would provide shoreline shade and cover, including velocity breaks during high flow events.

Water Temperature

Rising river temperatures are an issue for salmonids in the Puget Sound. Therefore, preserving and increasing shade within the flood channel is important. The repairs would remove vegetation from the shoreline, which would increase water temperatures. Warmer water temperatures can increase physiological rearing costs and lower growth rates if warmer streams do not produce sufficient food resources to offset heightened metabolic demands. Additionally, summer temperatures may approach or exceed incipient lethal levels for salmon and trout (Crozier and Zabel 2006, Crozier et al. 2008), and higher temperatures would likely favor non-salmonid species that are better adapted to warmer water, including potential predators and competitors (Reeves et al. 1987). The proposed repair includes plantings to compensate for this impact (Appendix D). However, bare rock would receive sunlight and increase local water temperatures until vegetation regrows. The amount that rock warms the water is expected to be minor, and difficult to measure relative to the overall volume of water in the Nooksack River.

Vibration and Sound

Vibration and sound generated during repairs could impact fish and wildlife near the repair. Data are lacking for species of interest in the region, primarily aquatic species such as Chinook, but one study showed Atlantic salmon are sensitive to sounds transmitted through substrate in a river environment (Hawkins and Johnstone 1978). Studies directly measuring underwater sound from underwater rock placement and removal are lacking (Kongsberg Maritime Limited 2015). In one study, Nedwell and Edwards (2004) measured sound generation from a vessel placing rock through a steel/HDPE pipe in an open-water marine environment. The study measured sound levels up to 120 decibels (dB), but most of the sound is attributed to the vessel. Another study recorded sound between 124 and 148 dB from a backhoe dredge 60 meters away (Reine et al. 2012). This study estimated a maximum intensity of 179 dB from 1 meter away. This backhoe dredge is significantly larger and more powerful than excavators that would be used to conduct work under the proposed action, so the sound created by a backhoe is expected to be more intense than that created from the proposed action. Work above the waterline could create sound that propagates through the ground into the water, albeit at a lower level than the source (Reinhall and Dahl 2011; Hawkins and Johnstone 1978).

The limited data available suggests sound potentially created by the proposed action would not exceed these thresholds and therefore not cause fish injury. Popper et al. (2014) and Reine et al. (2012) both indicate there is no direct evidence for fish mortality or mortal injury from continuous sound such as that resulting from the proposed action. The NMFS threshold for fish harassment is 150 dB (Hastings 2002; NMFS et al. 2008). It is possible this harassment threshold could be exceeded by the proposed in-water excavation work based on Reine et al. (2012) discussed above. If this were to occur, it would result in fish moving away from the immediate project site. This behavior is likely to occur regardless, simply due to the ground and water disturbance associated with removing and placing rock along the levee. It is possible a temporary migration barrier could be formed during short periods when this work is occurring.

The main source of vibration and sound generated by the repairs would come from the removal and placement of riprap below the waterline. These activities would occur within the in-water work window (June 15 to August 31). Vibration and noise generated by the repair could trigger a behavioral response; however, the Corps does not anticipate noise levels sufficient to injure aquatic species, especially those of greater interest such as Chinook or coho salmon.

Fish moving past the in-water work locations could be temporarily delayed due to construction generated noise. If construction does interfere with fish movement beyond the repairs (i.e., upstream or downstream the source of disturbance), breaks in the work during the day or overnight would allow fish to continue past, minimizing any effect. The degree to which aquatic species use the specific project locations for spawning is unknown. The area affected would be limited to the portion of the channel adjacent to the levee and the proposed actions would likely have no long-term effect on the movement or spawning of fish species.

Levee Armor

The Repair In-Kind Alternative has a minor deviation in rock size. For engineering and safety standards this alternative would use Class IV riprap approximately 7 inches wider in diameter than what was previously used. However, rock size has not been shown to have significant effects on fish species. In fact, in some cases larger rock size has been shown to be better (Lister et al. 1995; Schmetterling et al. 2001; Zale and Rider 2003). This deviation in rock size is not expected to adversely impact aquatic species and their habitat. Furthermore, the larger rock size is expected to increase the durability of the levee, avoiding or reducing the need for future repairs.

Fish and wildlife may be injured or killed if they do not leave the immediate area of a construction activity, such as rock placement or removal. However, construction activities are expected to cause a startle response, causing fish and wildlife to leave the project area. For example, salmonids in the mainstem are larger and able to swim away from sources of disturbance or would not be present during the construction period. Even if no injury occurs, rock placement and removal could disturb and displace an individual in the action area. Furthermore, the project sites would be isolated from fish. Silt curtains for work in the Nooksack River would exclude fish form the work site. A net would be placed upstream of the sump to exclude fish from the work site in the drainage basin at Site 1. The Corps would complete fish rescue activities after the silt curtains and block net are installed to remove fish from the excluded areas before works start.

Turbidity

In-water work can cause elevated turbidity levels. Fish, including salmonids exhibit physiological and behavioral responses to suspended sediments (Newcombe and MacDonald 1991). Physiological effects of increased turbidity can include gill trauma (Servizi and Martens 1987; Noggle 1978; Redding and Schreck 1987), and affect osmoregulation, blood chemistry (Sigler, 1988), growth, and reproduction. Behavioral responses include feeding disruption from olfactory and visual impairment (Sigler 1988); gill flaring; and curtailment of territorial defense (LaSalle 1988). Conversely, some protection against predation may be afforded salmonids in areas of suspended sediment (Gregory 1988).

The Corps anticipates that turbidity generated by construction activities would be negligible. The Nooksack River is a glacially fed river system, so salmonids are exposed to naturally elevated suspended sediment levels (Gregory and Northcote 1993). Turbidity would be monitored (Appendix E) during in-water work to ensure it remains below standards thereby minimizing its effects on aquatic biota. Additionally, silt curtains would be installed for work in the Nooksack River at Site 1 and Site 2 to prevent turbidity from leaving the work site.

Culvert Operation

The drainage basin at Site 1 does not contain spawning habitat. The value of the drainage basin to fish and wildlife stems from it being accessible for off-channel refuge

during flood events. Existing and proposed flow characteristics and flap gate operations are described in Section 3.3. The flap gate will remain open when flows in the Nooksack River are below 20,000 cfs. At 20,000 cfs the flap gate should close, which would prevent fish from accessing the floodplain landward of the levee through the culvert. Hydraulic modelling and analysis found closing the gate at this point maximizes the amount of time fish have access to off-channel refuge through the culverts, while minimizing flooding landward of the leveeso access to the Lynden WWTP is maximized. Analysis by Whatcom County found that if the proposed flap gate was present during a flood in 2020 it would have been closed for 1.3 days. If there was a flap gate during a 100-yr flood, it would have been closed for 2.7 days.

While a closed flap gate would prevent fish from accessing the off-channel area landward of the levee, it does not prevent fish from accessing it at different locations. Flows begin overtopping Kaam Creek not long after they begin overtopping the Lynden WWTP road. At this point, the floodplain is inundated and flows begin overtopping the Lynden Levee not long after that. Therefore, fish can access the floodplain across multiple locations, and not just through a 48-inch culvert. Overall, the flap gate has a negligible effect on the system except at the WWTP road where it delays flows overtopping the WWTP road by an estimated 1 to 3 hours.

In the aggregate, the effects on fish and wildlife from the Repair In-Kind alternative would be less than significant.

3.6 THREATENED AND ENDANGERED SPECIES

There are nine listed species protected under the Endangered Species Act (ESA) of 1973, as amended; potentially occurring in the project vicinity (Table 1). In accordance with Section 7(a)(2) of the ESA, Federally funded, constructed, permitted, or licensed projects must take into consideration impacts to Federally listed and proposed threatened or endangered species. To satisfy the requirements of the ESA, the Corps prepared a Biological Assessment (BA) to determine the effects of the proposed project on species possibly affected by the proposed action. The relevant threatened and endangered species under the jurisdiction of USFWS are marbled murrelet (*Brachyramphus marmoratus*), streaked horned lark (*Eremophila alpestris strigata*), yellow-billed cuckoo (*Coccyzus americanus*), and bull trout. The gray wolf (*Canis* lupus) was included in the BA but has since been delisted by the USFWS and won't be discussed further in this document (USFWS 2020). The relevant threatened and endangered species under the jurisdiction of NMFS are Chinook salmon, steelhead, southern resident killer whale (SRKW; *Orcinus orca*).

Under the ESA, the action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for the Lynden Levee and Culvert Repair includes terrestrial areas 1,300 feet from each of the two construction sites to encompass all areas that would experience temporary elevated in-air noise levels generated by heavy equipment. This distance was derived using average maximum noise levels from common construction equipment including excavators and dump trucks, and the WSDOT (2015)

standard noise attenuation model. The action area also includes one half mile upstream and one mile downstream within the Nooksack River. This area includes sufficient river area to encompass all possible effects to ESA-listed species and extends to the point where any far field effects would be lost. The project area is defined as the area where work will be completed. This includes construction, staging, and access to/from the construction site.

Table 1. ESA-listed species potentially occurring in the project area.

Species (common name and scientific name)	**Distinct Population Segment (DPS) or Evolutionary Significant Unit (ESU)**	**Federal Listing**	**Critical Habitat in Project Area**	**Potential Occurrence (Likely, Unlikely, or Absent)**
Fish				
Chinook salmon (*O. tshawytscha*)	Puget Sound ESU	Threatened Critical Habitat Designated	Yes	Likely
Steelhead (*O. tshawytscha*)	Puget Sound ESU	Threatened Critical Habitat Designated	Yes	Likely
Bull trout *(S. confluentus)*	Coastal/Puget Sound DPS	Threatened Critical Habitat Designated	Yes	Likely
Mammals				
Southern Resident Killer Whale (*O. orca*)	Southern Resident DPS	Endangered Critical Habitat Designated	Includes all waters in Puget Sound deeper than 20 feet	Absent
Birds				
Marbled Murrelet *(B. marmoratus)*	N/A	Threatened Critical Habitat Designated	Designated, not in Action Area	Unlikely
Streaked Horned Lark *(E. alpestris strigata)*	N/A	Threatened Critical Habitat Designated	Designated, not in Action Area	Unlikely
Yellow-billed cuckoo *(C. aericanus)*	N/A	Threatened Critical Habitat Proposed	Proposed, not in Action Area	Unlikely

Streaked horned lark and yellow-billed cuckoo are unlikely to occur in the action area and thus would not be affected by the proposed action. Streaked horned lark preferred habitat is short-grass prairie. Their current range in Washington is limited to the south Puget Sound, coast, and lower Columbia River islands (Anderson and Pearson 2015). The WDFW PHS database does not record the presence of streaked horned lark in or near the action area, and no suitable habitat for this species occurs in the project action area or vicinity (WDFW 2020). There are no records of western yellow-billed cuckoo near the repair sites (USFWS 2014; BirdWeb 2020; WDFW 2020). The riparian forest habitat at the project site is limited to a narrow strip of deciduous trees along the riverward side of the levee. The surrounding area includes agricultural fields and roadways that do not support yellow-billed cuckoo. No critical habitat for these two species is designated in the action area. Thus, these species and their critical habitat would not be affected by the proposed action and are not discussed further in this document.

Chinook are most often found in large streams or rivers, and many stocks spawn far inland. Chinook salmon are considered main channel spawners, although they do use smaller channels and streams with sufficient flow. Due to their large size, Chinook salmon are able to spawn in larger substrate than most other salmon species (Anchor Environmental, L.L.C. 2003). There are two runs of Chinook salmon in the Nooksack River Basin, a spring run and a fall run. Chinook salmon juveniles are expected to be present during the in-water work window (June 15 to August 31). The proposed repair sites are downstream of the spring Chinook spawning area. Fall Chinook potentially spawn throughout the lower mainstem, and in the North and South Fork. During the in-water work window, adult Chinook migrants would be passing the damaged sites, and some would be holding. Mainstem spawners could be laying eggs late during the in-water work window. Rearing juvenile Chinook can be assumed to be present year-round in the river with fry, parr, and yearling fish. During the work window, parr are the only likely juvenile type present. Juveniles of all Nooksack Chinook spawning types could be present, but the Mainstem/North Fork Chinook populations are likely to be the dominant stock present. Chinook smolts could be migrating through the project site during the beginning of the work window.

Steelhead are likely present in the river during the in-water work window. There are two distinct migratory runs of steelhead in the Puget Sound DPS, a summer run and winter run migration. Summer steelhead would be migrating or holding in Nooksack River. Summer steelhead spawn in the South Fork, well upstream of the repair sites (WDFW and WWTIT 1994). Of the two migratory run lifestyles, only winter steelhead from the Mainstem/North Fork Nooksack population spawn in the river reach containing the damaged sites, so eggs and alevins may also be present. Juvenile steelhead from all stocks rear year-round in the Nooksack River. Multiple age classes including fry, yearling, and two-year fish may be present. The Mainstem/North Fork winter steelhead population is likely the most common.

Bull trout have more specific habitat requirements than most other salmonids, in that they require colder water (46 ºF or below) for spawning and egg incubation (Rieman and McIntyre 1993) compared to other salmonids. Bull trout express resident and

migratory life history strategies (Rieman and McIntyre 1993). Resident forms complete their entire life cycle in the tributary, or nearby streams, in which they spawn and rear. Migratory bull trout spawn in tributary streams, where juvenile fish rear before migrating to either a lake (adfluvial form; Downs et al. 2006), river (fluvial form; Fraley and Shepard 1989), or to saltwater in certain coastal areas (anadromous; Brenkman and Corbett 2005). Adult and subadult bull trout likely use the lower Nooksack River to forage, overwinter and migrate from November to July. Anadromous fish exit the lower Nooksack river into the Puget Sound in late winter and return to the river from late May to early July (Goetz et al. 2007 and Goetz 2016). These fish leave the lower river returning to their natal streams from May to July before water temperatures reach 64°F. Subadults and adults may use the Nooksack River near the damaged sites during the in-water work window as a migration corridor, although it is likely they spend little time in the action area since it lacks good quality pools and in-stream features. The Nooksack River in the action area does not provide appropriate habitat for bull trout spawning or rearing. During the in-water work window, river temperatures can exceed 64°F, which may limit bull trout presence (Ecology 2020c).

SRKWs are large mammals requiring abundant food sources throughout the year and travel significant distances to locate sufficient prey to support their numbers (NMFS 2006). SRKWs movement coincides with migratory salmon returning from the Pacific Ocean and therefore spend large amounts of time in the Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait (NMFS 2006). Little is known about the winter movements and range of the SRKW (NMFS 2005). SRKWs show a strong preference for Chinook salmon, primarily Fraser River Chinook salmon, with chum salmon as the second most preferred (NMFS 2008; Ford and Ellis 2005). The survival of these whales positively correlates with Chinook salmon abundance (Ford et al. 2010). SRKW may occasionally include Nooksack River Chinook salmon in their diet.

The marbled murrelet is a small seabird that spends most of its time on the ocean but flies inland to nest in old growth forests. Most marbled murrelets in Washington are found in the Puget Sound and Strait of Juan de Fuca region. Their nests are on large branches or deformities, typically 33 feet off the ground, in old growth trees (USFWS 2012). Most nests are in conifers over 150 years old with a diameter at breast height greater than 55 inches. Marbled murrelets are not documented to occur in the action area, nor is suitable habitat that supports consistent, long-term breeding, rearing, and foraging. Given the project location between Puget Sound and inland nesting areas to the east, marbled murrelets may fly over the levee while travelling between their marine foraging areas and inland nesting sites.

3.6.1 No Action Alternative

The No Action Alternative would have the same impacts as that described under Section 3.5.1. Implementation of this alternative is not expected to cause significant adverse impacts to ESA-listed species and their critical habitat.

3.6.2 Repair In-Kind Alternative

Impacts to ESA-listed species under the Repair In-Kind Alternative would largely resemble those outlined in Section 3.5.2. Potential negative physical and environmental effects are primarily construction related and expected to be minimal due to the short construction period, conservation measures and BMPs, and proposed timing of in-water work. The proposed mitigation would compensate for impacts to habitat and water quality affecting ESA-listed species.

There is a reasonable expectation that more steelhead are present in the project area than Chinook or bull trout since steelhead stay in freshwater longer. Most sub-adult and adult bull trout would have migrated past the repair sites to upstream habitat or spawning areas during the in-water work window. At Site 1, the drainage channel is perched above the river except during high flow events. Chinook, steelhead, and bull trout in the Nooksack River would not have access to the drainage channel during the in-water work period (June 15 to August 31). The area landward of Site 1 is not suitable habitat for these three species and is expected to be dry or very shallow (less than 10 gpm) during construction. There is no spawning habitat and the basin's suitability for rearing, foraging, and overwintering is questionable due to fluctuating water levels and low water quality from runoff. If these fish are present, they accessed the drainage basin landward of the levee during a flood event, either through the culverts or from overtopping flows.

SRKW would not be directly affected by repairs since they are not found in the Nooksack River. Project effects to SRKW prey base, such as Chinook and chum salmon (NMFS 2006), could have an indirect impact. Construction related impacts to these prey species would be temporary. Once the project is completed, the damaged culverts would be replaced with minor changes to off-channel refuge during flood events above 20,000 cfs. However, because the percentage of Nooksack River Chinook and chum that make up the SRKW diet is likely small, the Corps expects little to no discernable far-reaching effect to their food base.

Given the project location between the Puget Sound and inland nesting areas to the east, there is the potential that marbled murrelets could fly over the action area while transiting between inland and marine areas. The additional noise and disturbance generated by repairs is not expected to affect marbled murrelets flying over the area.

Table 2 lists the effect determinations for each ESA-listed species potentially occurring in the action area. These determinations were based upon the following reasons:

- Repairs would occur in summer during the in-water work window (June 15 to August 31) when flows are generally at their lowest and temperatures at their highest.
- Conservation measures and BMPs avoid and minimize project impacts to the maximum extent feasible.
- Riparian, riverine, and floodplain conditions have been heavily altered by human development.

- Mitigation would compensate for impacts to vegetation and water quality.
- Chinook, steelhead, and bull trout may be present in the Nooksack River during repairs. These species have the potential to be directly or indirectly impacted by in-water work. None of these species have been observed in the drainage basin landward of the levee, but these and other salmon seek off-channel refuge during flood events.
- The existing culverts are broken and a barrier to fish seeking off-channel refuge during high flow events.
- The flap gate design maximizes the amount of time fish have access to off-channel refuge through the culverts, while minimizing flooding landward of the levee.
- Off-channel habitat landward of the levee would improve with Whatcom County's channel realignment.
- SRKWs would not be directly affected but may be indirectly affected by impacts to prey species.
- Marbled murrelets would not be affected by the proposed project.

In the aggregate, the effects on listed species of the proposed would be less than significant.

Table 2. Effect determinations for the Lynden Levee and Culvert Repair.

Species	Species Effects Determination	Critical Habitat Effects Determination
Puget Sound Chinook	May Affect, Likely to Adversely Affect	May Affect, Likely to Adversely Affect
Puget Sound Steelhead	May Affect, Likely to Adversely Affect	May Affect, Likely to Adversely Affect
Coastal/Puget Sound Bull Trout	May Affect, Not Likely to Adversely Affect	May Affect, Likely to Adversely Affect
Southern Resident Killer Whale	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
Marbled Murrelet	May Affect, Not Likely to Adversely Affect	No Effect

3.7 AIR QUALITY AND NOISE

The Environmental Protection Agency's (EPA) Clean Air Act sets National Ambient Air Quality Standards (NAAQS) for several criteria pollutants including ozone, lead, carbon monoxide, nitrogen oxides, sulfur dioxide, and particle pollutants with diameters less than 10 microns. Areas that persistently exceed the standards are designated as nonattainment areas. Once a nonattainment area has attained and maintained NAAQS,

they may be redesignated as “maintenance areas”. According to Ecology (2021), all of Washington State meets national air quality standards. The EPA has not designated any nonattainment areas in Washington and there are currently no designated maintenance areas in Whatcom County. Typical noises in the area consist of those generated by agricultural machinery, trucks, automobiles, aircraft, and other internal combustion engines.

3.7.1 No Action Alternative

The No-Action Alternative would not directly increase emissions or ambient noise. Emergency actions may be required to protect lives and property in the event of a flood. Flood fighting activities are likely have similar air emissions and noise effects as the Repair In-Kind Alternative. Effects to air quality and noise would be temporary and within the range of intensity of noise produced by on-going activities in the area. The No Action Alternative is not expected to cause significant adverse impacts to air quality and noise.

3.7.2 Repair In-Kind Alternative

Vehicles and heavy equipment used in construction would temporarily and locally generate increased gasoline and diesel exhaust fumes. The small area of construction and the short duration of the activities would limit the impact to air quality. The activity would constitute routine repair of an existing facility, generating an increase in direct emissions of a criteria pollutant or its precursors that would be *de minimis*, and would therefore be exempt by 40 CFR Section 93.153(c)(2)(iv) from the conformity determination requirements. Emissions generated by the construction activity are expected to be minor, short-term, and well below the de minimis threshold. Repairs would not affect how Washington State carries out, maintains, and enforces NAAQS. Unquantifiable but insignificant exacerbation of effects of CO_2 emissions on global climate change would be anticipated. Equipment operation during construction activities would cause a localized increase in ambient noise levels. Equipment would only operate during daylight hours (7 AM to 7 PM) to limit noise impacts on surrounding properties. Wildlife in the area are likely habituated to human activity and noise. There would be no long-term increase in noise generation under this alternative. The Repair In-Kind Alternative is not expected to cause significant adverse impacts to air quality and noise.

3.8 HISTORIC PROPERTIES AND CULTURAL RESOURCES

Research suggests that the Lynden Levee was likely constructed by individual landowners and eventually the individual sections were conjoined by the mid-1930s.The Corps staff archaeologist has conducted a records search and literature review of the Washington Information System Architectural and Archaeological Records Database (WISAARD). There are no properties listed in the National Register of Historic Places (NRHP) or the Washington State Historic Site Register in the project vicinity. No cultural resources have been previously recorded within the area of potential effect (APE).

Lynden Levee is likely more than 50 years old making the structure eligible for review under the National Historic Preservation Act (NHPA). A pedestrian survey was conducted by two staff archaeologists at the Corps on March 8, 2021. They walked parallel transects across the APE and made the determination that the undertaking would have no adverse effect. The Corps did not evaluate the entire levee system as it was considered out of scope with the limited nature of the repair. As the levee is being repaired in-kind, the Corps has determined that this work would have no adverse effect on the levee system, assuming the system is eligible for the NRHP.

Based on Lynden Levee's eligibility potential, the Corps submitted a Historic Property Inventory Form (HPIF) via WISAARD. The following is a review of the criteria as it applies to Lynden Levee. The Lynden Levee system has the potential to be eligible under criterion A as it is associated with broad patterns of history that occurred in the state of Washington during the 1930s. Specifically the Lynden Levee system may have had an impact on the broad patterns of historic settlement in the region. Under Criterion B, the levee would not be considered eligible for inclusion on the NRHP, since it has no connection to any person of national or local significance. Under Criterion C, the levee would not be considered eligible for inclusion on the NRHP as the construction of the levee is typical for features of this type across the state, and it does not embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction. Under Criterion D, the levee does not have the potential to provide any new information on historic or prehistoric habitation in the area.

This evaluation focused on just two small sections of a much larger feature. Based on those sections, the Corps made the determination that the levee is potentially eligible for the NRHP.

3.8.1 No Action Alternative

Under the No-Action Alternative, the degree of adverse effects that could impact any historic properties and cultural resources would be the same as the existing condition. The Lynden Levee would remain in its current damaged state. Emergency actions may be required to protect lives and property in the event of a flood. Flood damages or emergency repairs to the Lynden levee could have an adverse effect to specific repair locations of the Lynden Levee system that is potentially eligible for inclusion on the NRHP. If flood fighting efforts don't take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, floodwaters would enter into the protected area and may impact additional historic properties and cultural resources. The Repair In-Kind Alternative is not expected to cause significant adverse impacts to historic properties and cultural resources.

3.8.2 Repair In-Kind Alternative

Lynden Levee is likely more than 50 years old making the structure eligible for review under the NHPA. This evaluation focused on just two small sections of a much larger

feature. Based on those sections, the Corps made the determination that the levee is potentially eligible for the NRHP.

The Corps coordinated with the Department of Archaeology and Historic Preservation (DAHP; Washington's State Historic Preservation Office), Lummi Nation, Nooksack Tribe, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and Tulalip Tribes. Consultation with DAHP, a pedestrian survey, and the completion of the HPIF determined that the proposed undertaking would not have an adverse effect on the Lynden Levee. See Section 7.9 for consultation details. The Repair In-Kind Alternative is not expected to have significant adverse impacts to historic properties and cultural resources.

3.9 UTILITIES AND INFRASTRUCTURE

The levee provides protection for over 20 residences, several farms, county and farm roads, and associated public infrastructure. The major public infrastructure present in the protected area is the Lynden WWTP. This facility is behind the Lynden Levee and treats wastewater from the community in and around the city of Lynden. There are no utilities present at the damaged sites.

3.9.1 No Action Alternative

The No Action Alternative would allow continued erosion of the damaged levee and a higher risk from flooding to persist that could result in damage to local area traffic, utilities, and infrastructure, such as the Lynden WWTP. This may lead to emergency flood fight measures during a flood event. Damages to the WWTP could cause a loss of critical public services for an extended period of time. However, such an event is expected to be avoided through implementation of emergency flood fighting measures. If flood fighting efforts don't take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, floodwaters would enter into the protected area. Flooding could have detrimental effects that could damage utilities and infrastructure. Utilities such as water and electricity could be interrupted or damaged. Depending on the severity of the flood, operations at the Lynden WWTP could be limited or significantly damaged. Flooding of public roads could limit access and create lengthy detours and exasperate responses to fix or maintain other utilities or infrastructure. The No Action Alternative could cause significant adverse impacts to utilities and infrastructure.

3.9.2 Repair In-Kind Alternative

The Repair In-Kind Alternative would protect utilities and infrastructure from potential damages resulting from flooding up to the pre-damaged LOP. Vehicles and equipment associated with repair activities may disrupt local traffic due to merging, turning, and traveling together. Flaggers and signs would be used, as needed, to direct traffic safely around the construction site. Reuse of materials would reduce the number of truck trips to and from the repair sites. Repairs would not disrupt utilities, including operation of the Lynden WWTP. The Repair In-Kind Alternative would not have significant adverse impacts to utilities and infrastructure.

4 UNAVOIDABLE ADVERSE EFFECTS OF THE PREFERRED ALTERNATIVE

Unavoidable adverse effects associated with the preferred alternative at each site would be: (1) temporary and localized increases in noise, activity, and emissions which may affect fish and wildlife in the area; (2) temporary and localized disruption of local traffic by construction activity and vehicles; (3) irretrievable commitment of fuels and other materials for repairs; (4) temporary and localized increase in turbidity levels during in-water construction which may affect aquatic organisms in the area; and (5) removal of vegetation from within the proposed construction areas in the riparian zone. The vegetation removal has the longest duration of impact due to the length of time needed for vegetation to regrow to a similar size. Vegetation loss and fill into Waters of the U.S. would be mitigated by the proposed mitigation plantings and woody debris placement.

5 COMPENSATORY MITIGATION

As mitigation for loss of vegetation on the riverward slope due to construction activities, as well as fill in the Waters of the U.S., the Corps and Whatcom County would incorporate willow bundles into the levee repair, plant 136 coniferous trees, 75 shrubs, and place woody debris along the levee toe (Appendix D). The willow bundles, trees, and shrubs will provide shade and other beneficial habitat functions to aquatic and terrestrial species. Woody debris will also provide riverine and shoreline complexity as well as velocity breaks during high flow events until it is washed away. When woody debris is washed away, it will continue to provide benefits as it moves down the watershed.

The Corps will coordinate with Whatcom County, the non-Federal sponsor, to ensure that the agreed-on planting survival standards are met. The Corps will inform the sponsor that these plantings are part of the repair mitigation and should only be trimmed to the minimal amount necessary to retain adequate visual fields for inspection. Trees and shrubs planted as part of this project will not be trimmed, as they are outside of the maintenance area of the levee. The Corps will maintain and monitor the willow bundles for one-year after construction to ensure 80 percent survival. If less than 80 percent survival is recorded after one year, the Corps will replace all the dead plants (via mechanical installation or hand installation) and the willows will be monitored for two additional growing seasons. Whatcom County has committed to maintaining and monitoring the tree and shrub plantings for 5 years as outlined in the mitigation plan (Appendix D).

6 COORDINATION

The following agencies and entities have been involved with the environmental coordination of the proposed project:

- USFWS
- NMFS
- Nooksack Indian Tribe
- Suquamish Tribe
- Swinomish Indian Tribal Community
- Tulalip Tribes
- Lummi Nation
- Samish Indian Nation
- WDFW
- Ecology
- Washington State Historic Preservation Officer
- Whatcom County

The Corps issued a Notice of Preparation (NOP) and Public Notice (PN) for the proposed Lynden Levee and Culvert Repair project (PMP-21-02) on April 1, 2021 for a 30-day public review and comment period. Comments were received from WDFW (Appendix G).

7 ENVIRONMENTAL COMPLIANCE

This EA is being prepared pursuant to Sec. 102(C) of the NEPA, and includes compliance with other laws, regulations and Executive Orders (EO) as discussed below (Table 3).

Table 3. Summary of Project Compliance with Environmental Laws, Policies, and Regulations

Law/Policy/Regulation – Federal Acts	Compliance Action
American Indian Religious Freedom Act	Satisfied – No effect.
Bald and Gold Eagle Protection Act	Satisfied – Determination of no harm.
Clean Air Act (PL 91-404)	Satisfied – Once construction completed, project will not be a source of pollutants.
Clean Water Act – Federal Water Pollution Control Act (§ 401 and 404)	Satisfied. Ecology issued a 401 certificate on May 28, 2021(#19995).

Law/Policy/Regulation – Federal Acts	Compliance Action
	The 136 coniferous trees, 75 shrubs, and approximately 72 willow bundles, would mitigate for impacts to water quality.
Coastal Zone Management Act	Concurrence may be presumed. Consultation initiated on April 1, 2021. No response from Ecology within 60 days.
Endangered Species Act (Section 7)	Proposed work is during in-water work window of June 15 to August 31. Consultation was initiated with the USFWS and NMFS on December 23, 2020 and March 8, 2021, respectively. The Corps intends to proceed with construction prior to completion of consultation with the Services pursuant to the “emergency circumstances” provision of the ESA regulations, and to complete ESA consultation after the fact. The applicable regulation is set out at 50 CFR Section 402.05 (a) and (b).
Magnuson-Stevens Fishery Conservation and Management Act	Ongoing – Project includes measures to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action. EFH consultation initiated on March 8, 2021 is ongoing. The Corps intends to proceed with construction prior to completion of consultation with NMFS pursuant to the “emergency Federal actions” provision of the EFH regulations, and to complete EFH consultation after the fact. The applicable regulation is set out at 50 CFR Section 600.920(a).
Migratory Bird Treaty Act	Satisfied. No permit application for “take” of migratory birds is required
National Environmental Policy Act	Based on the analysis in this EA, the proposed project does not constitute a major federal action significantly affecting the quality of the human environment,

Law/Policy/Regulation – Federal Acts	Compliance Action
	and therefore does not require preparation of an EIS.
National Historic Preservation Act	Consultation initiated December 31, 2020. No significant concerns identified. DAHP concurred on April 7, 2021.
Native American Graves Protection and Repatriation Act	Consultation initiated January 2021. No significant concerns identified.
Executive Order 11990 Protection of Wetlands	No effect. No impacts to jurisdictional wetlands anticipated.
EO 11988 Floodplain Management	No effect. No additional damage to or building within the floodplain will occur
ER 12989 Environmental Justice in Minority Populations	Satisfied. Coordination with local Tribe initiated and ongoing throughout project. Project not a permanent facility requiring a siting study.
EO 13007 Native American Sacred Sites	Consultation initiated January 2021. No significant concerns identified.

7.1 AMERICAN INDIAN RELIGIOUS FREEDOM ACT

The American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996) establishes protection and preservation of Native Americans' rights of freedom of belief, expression, and exercise of traditional religions. Courts have interpreted this Act to mean that public officials must consider Native Americans' interests before undertaking actions that might impact their religious practices, including impact on sacred sites.

No alternative is expected to have any effect upon Native Americans' rights of freedom of belief, expression, and exercise of traditional religions. There are no known cultural resources, or any sacred sites, at the project location. Nor were there any identified by the Nooksack Indian Tribe, Suquamish Tribe, Swinomish Indian Tribal Community, Tulalip Tribes, Lummi Nation, or the Samish Indian Nation.

7.2 BALD AND GOLDEN EAGLE PROTECTION ACT

The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) prohibits the taking, possession or commerce of bald and golden eagles, except under certain circumstances. Amendments in 1972 added to penalties for violations of the act or related regulations. No eagle nests were observed within the immediate project vicinity. Repairs are not expected to harm bald or golden eagles.

7.3 CLEAN AIR ACT OF 1972

The Clean Air Act as amended (42 U.S.C. § 7401, et seq.) prohibits Federal agencies from approving any action that does not conform to an approved state or Federal implementation plan. The operation of vehicles and equipment during construction would result in increased emissions and a slight increase in fugitive dust. These effects would be localized and temporary. Whatcom County is in an attainment / unclassified area of Washington (Ecology 2021). The proposed activity constitutes routine repair of an existing facility generating an increase in direct emissions of a criteria pollutant or its precursors. Emissions generated by the construction activity are expected to be minor, short-term, and well below the *de minimis* threshold and is therefore exempted by 40 CFR Section 93.153(c)(2)(iv) from the conformity determination requirements.

7.4 CLEAN WATER ACT – FEDERAL WATER POLLUTION CONTROL ACT

The Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.) is more commonly referred to as the Clean Water Act (CWA). This act is the primary legislative vehicle for Federal water pollution control programs and the basic structure for regulating discharges of pollutants into waters of the United States. The CWA was established to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA sets goals to eliminate discharges of pollutants into navigable waters, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment.

The Corps does not issue Section 404 permits to itself for its own civil works activities but must comply with the substantive requirements of Section 404 and 401 under the CWA. The Corps has determined that the proposed project substantively conforms to the provisions of Nationwide Permit (NWP) 3, Maintenance, which requires an individual Water Quality Certification (WQC) under Section 401 of the CWA. The Corps sought this WQC from Ecology and completed submission of its substantiation that the project is expected to comply with the State's Water Quality Standards with the promulgation of the Section 404 PN on 1 April 1, 2021. Ecology approved the mitigation and water quality monitoring plans on May 10, 2021 and May 11, 2021, respectively. A CWA water quality certificate (WQC; #19995) was issued by Ecology on May 28, 2021 and is provided in Appendix E.

Section 402 of the CWA is triggered when a construction site would have greater than 1 acre of ground disturbance. The project footprint is approximately 1.5 acres. A Stormwater Pollution Prevention Plan has been prepared. Under the National Pollutant Discharge Elimination System (NPDES) Program, operators of construction projects that result in land disturbances equal to or greater than one acre are required to obtain coverage under an NPDES permit for stormwater discharges associated with construction activity. EPA may waive the otherwise applicable permit requirements for stormwater discharges from construction activities that disturb less than five acres if the construction activity will take place during a period when the rainfall erosivity factor is less than five. The Corps coordinated with the EPA and determined the proposed project's rainfall erosivity factor is less than 5. Low Erosivity Waiver Certification was

prepared by the Corps and submitted to the EPA on June 1, 2021 through the NPDES eReporting Tool or “CGP-Net”.

7.5 COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Act (CZMA) of 1972 as amended (16 U.S.C. § 1451-1464) requires Federal agencies to conduct activities in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved State Coastal Zone Management Program. In evaluating compliance with CZMA, the Corps determined that the proposed work was consistent to the maximum extent practicable with the enforceable policies of the approved Washington Coastal Management Program.

The Corps sent a CZMA Consistency Determination to Ecology with public notice issued April 1, 2021 requesting state concurrence with the CZMA Consistency Determination for the proposed repair from Ecology per CZMA Section 307 (c) and 15 CFR 923.33 (a) & (b). State concurrence may be presumed if no response is received after 60 days which would be May 31, 2021. To date the Corps has not received comment or concurrence from Ecology. Since more than 60 days has elapsed, state concurrence may be presumed.

7.6 ENDANGERED SPECIES ACT

In accordance with Section 7(a)(2) of the ESA of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed or proposed threatened or endangered species and designated critical habitat. The Nooksack River contains designated critical habitat for Puget Sound Chinook, Puget Sound Steelhead, and Coastal-Puget Sound bull trout. These species occur within the project area and the river and shoreline is designated as critical habitat.

The Corps has analyzed potential effects to ESA-listed species and prepared a BA that was submitted to the USFWS on December 23, 2020, and to NMFS on March 8, 2021. For Puget Sound Chinook, Puget Sound steelhead, and Coastal/Puget Sound bull trout, the Corps has reached an agency determination that the project may affect and is likely to adversely affect these species and their critical habitat. For SRKW, the project may affect, but is not likely to adversely affect this species and its critical habitat. The project may affect, but is not likely to adversely affect, marbled murrelet and will have no effect to marbled murrelet critical habitat.

The time constraints under which this project is implemented will not allow completion of full consultation with the Services before signing of the FONSI. Though consultation is not complete, the Corps has reached an agency determination of species/habitat effect, based on the best factual and technical information available at the time of decision, and following preliminary coordination with the Services. The Corps notified the Services in September 2019 of the damaged levee and the intent to conduct repairs in order to restore the pre-existing level of flood protection, and has since kept representatives of the Services regularly apprised of the progress of project planning. The Corps notified the Services on May 19, 2021 that if consultation has not been

completed in time to meet the construction schedule, due to the urgent nature of completing the emergency action prior to the oncoming flood season and due to time constraints under which this project is implemented, the Corps intends to proceed with construction prior to completion of the consultation with the Services pursuant to the "emergency circumstances" provisions of the ESA regulations to complete ESA consultation after the fact, and/or expedited consultation provisions. The applicable regulation is set out at 50 CFR Section 402.05 (a) and (b):

> *(a) Where emergency circumstances mandate the need to consult in an expedited manner, consultation may be conducted informally through alternative procedures that the Director determines to be consistent with the requirements of sections 7(a)-(d) of the Act This provision applies to situations involving acts of God, disasters, causalities, national defense or security emergencies, etc.*
>
> *(b) Formal consultation shall be initiated as soon as practicable after the emergency is under control. The Federal agency shall submit information on the nature of the emergency action(s), the justification for expedited consultation, and the impacts to endangered or threatened species and their habitats. The Service will evaluate such information and issue a biological opinion including the information and recommendations given during emergency consultation.*

The Corps will commit to fully funding and performing all Reasonable and Prudent Alternatives necessary to avoid the likelihood of jeopardy to listed species or destruction or adverse modification of designated critical habitat, as well as Reasonable and Prudent Measures (RPMs) necessary and appropriate to minimize the impact of Incidental Take that are described if documents concluding consultation are received from USFWS and NMFS.

This EA will be reevaluated after consultation is complete. If necessary, the EA will be supplemented with necessary and applicable corresponding modifications to the scope and/or nature of the project, the procedures and practices used to implement the project, and/or the type and extent of compensatory mitigation associated with the project, and the associated FONSI will be reassessed.

7.7 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), (16 U.S.C. 1801 *et. seq.*) requires Federal agencies to consult with NMFS on activities that may adversely affect EFH. The objective of an EFH assessment is to determine whether or not the proposed action(s) "may adversely affect" designated EFH for relevant commercial, Federally managed fisheries species within the proposed action area.

According to the Pacific Fishery Management Council, the Nooksack River adjacent to the repair is identified as EFH for Chinook, coho, and odd-year pink salmon (NMFS 2019; PFMC 1999). Effects of the proposed work on EFH are identical to those discussed in Sections 3.5 and 3.6. Potential adverse effects to EFH have been reduced or eliminated by careful alternative analysis, design stipulations, use of conservation measures and BMPs. The Corps of Engineers concludes that proposed repair may

adversely affect EFH for Federally managed fisheries in Washington waters. This determination is based on the scope and duration of the construction and the nature of project impacts and was provided to NMFS in the submission of the BA. Consultation under this act will be completed concurrent with ESA consultation.

7.8 Migratory Bird Treaty Act of 1918 and Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

The Migratory Bird Treaty Act (16 U.S.C. § 703-712) as amended protects over 800 bird species and their habitat, and commits that the U.S. will take measures to protect identified ecosystems of special importance to migratory birds against pollution, detrimental alterations, and other environmental degradations. EO 13186 directs Federal agencies to evaluate the effects of their actions on migratory birds, with emphasis on species of concern, and inform the USFWS of potential negative effects to migratory birds. The USFWS does not issue permits for this kind of project (M. Green, USFWS, personal communication, April 2008). Birds inhabit the riparian area along the Nooksack River yearlong and work will overlap with part of the nesting season (April 1 through September 1). Working in the nesting season is necessary and unavoidable if the Corps is to remain inside the in-water work window (June 15 to August 31). No permit application for “take” of migratory birds is required.

7.9 National Environmental Policy Act

The NEPA (42 U.S.C. § 4321 et seq.) commits Federal agencies to considering, documenting, and publicly disclosing the environmental effects of their actions. It requires that an EIS be included in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The EIS must provide detailed information regarding the proposed action and alternatives, the environmental effects of the alternatives, appropriate mitigation measures, and any adverse environmental effects that cannot be avoided if the proposal is implemented. Agencies are required to demonstrate that decision makers have considered these factors prior to undertaking actions. Major federal actions determined not to have a significant adverse effect on the quality of the human environment may be evaluated through an EA.

This EA evaluates the environmental effects of two federal actions presenting two events requiring NEPA compliance: signing of the Cooperation Agreement (CA) on April 15, 2021 and the proposed 2021 levee repair. The Corps’ obligation under NEPA must be satisfied to the fullest extent possible prior to implementation of the Federal action. The execution of the 2021 repair is prospectively reviewed in this document. Through a combination of considerations requiring that project timelines be expedited – including Corps project priority determinations, changes to the project, complexity of design, and funding timelines –it was not possible for the Corps to complete all NEPA procedures prior to initiating the Federal action, which is the execution of the CA. The following discussion assesses how the Corps has nevertheless complied with NEPA’s requirement.

7.9.1 NEPA / Cooperation Agreement

As a result of a combination of considerations requiring that project timelines be expedited – including Corps project priority determinations, changes to the project, complexity of design, and funding timelines –it was not possible for the Corps to complete all NEPA procedures prior to initiating the first Federal action, which was the execution of the CA. The damaging flood events occurred in November 2017. The Project Information Report (PIR) was approved by the Corps Northwestern Division in March 2018 and funding to proceed to design and execution was received also in March 2018. The Corps entered a rigorous design process that required a culvert replacement at Site 1 that would achieve the complex twin objectives of providing fish passage but also maintaining flood protection. The Corps moved forward with an Architect-Engineering (AE) contract to develop both the design and the environmental compliance documents. This design effort could not commence, and the AE contract could not be awarded until the Corps first collected and developed critical hydraulic, conceptual design, and topographic information and thus was able to provide sufficient data to the contractor to develop this complex culvert design. The data collected by the Corps for integration into the contracted design effort necessarily also included the projected consequences of a conceptual design that Whatcom County had under development for their associated upland regrading project that would impact the flow conditions to be addressed by the replacement culvert; development of the levee repair/culvert replacement work could not proceed until Whatcom County's conceptual design was complete. This intricate, intertwined, and complicated development effort necessitated substantial time and effort for coordination and analysis. Once this data was compiled and the conceptual design was ready a contract was awarded October 2019 and the contracted design product was delivered to the Corps in May 2020. It was only upon completion of this design that the parameters of the project's structural configuration and construction methodology were known with sufficient specificity and degree of confidence to complete the evaluation of the environmental consequences of repair project execution, utilizing the draft documents that had been developed under the AE contract. In light of the dates on which funding was authorized and a design that formed the basis of environmental analysis was completed, the Corps evaluated the impacts of this design and advanced its environmental compliance to the fullest extent possible.

The winter seasons of 2017 through 2020 produced widespread damage to levees throughout the Pacific Northwest and northern Rockies. A total of 54 repair requests were received and evaluated, culminating in 27 proposed projects. The Corps evaluated the number of projects in relation to available labor capacity and determined that it had insufficient labor to complete the required analyses and documents for all projects in compressed periods of time. The Corps concluded that the best alternative was to initiate an AE contract to prepare the documents for a number of the levee rehabilitation projects, including the Lynden Levee.

In addition to the Lynden Levee, during the period of time following availability of the design and construction information commencing in May 2020, the Corps was working on design and coordination for 12 other levee repairs across western and eastern Washington, as well as Montana, necessitated by flood damages. Each of these

projects was slated at that time for construction in summer and fall of 2021. See Table 4 for delineation of the levee repair projects that were under environmental compliance evaluation during the period May 2020 through April 2021. The aggregate effort associated with the simultaneous environmental compliance review of that number of repair projects strained the available Corps' staff resources, as well as the resources of the coordinating agencies, slowing progress on evaluation and coordination of each individual project including the proposed Lynden levee repair. As a result of the overload condition on the Corps and coordinating agency resources, a number of the projects in Table 4 had to be deferred to a future repair in-water work window after environmental compliance work had been initiated and had progressed, despite the urgent nature of each in light of the risk to human life and property posed in a damaged state. The Lynden levee was selected to proceed in 2021 in light of the particular risk posed to the community and its infrastructure due to the damaged state, and the urgency of coordinating construction efforts with those of the non-Federal sponsor which together will provide some amelioration of adverse environmental conditions presented by the existing culverts and the floodplain area immediately adjacent to the Federal project site.

Table 4. Levee projects in design and environmental review at the same time as Lynden Levee repair.

Levee Name	Federal or Non-Federal Levee
Tukwila Levee	federal
St. Regis Levee	non-federal
Horseshoe Bend Levee	federal
Mason Thorson Ells Levee	non-federal
High Cedars Levee	non-federal
Pilchuck – French Slough Levee	non-federal
Marshland Levee	non-federal
Skagit DD-3 Levee	non-federal
Skagit DD-12 Levee	non-federal
Yakima Wastewater Treatment Plant Levee	non-federal
Yakima Right Bank Levee	federal
Greenwater Levee	non-federal

A NOP was issued on April 1, 2021 inviting the public and interested agencies and tribes to comment on the proposed action for a period of 30 days. The comment period ended on May 1, 2021. Comments were received from WDFW (Appendix G). Furthermore, a PN of anticipated discharge of fill material into waters of the United States under Section 404 of the CWA was also issued on April 1, 2021; the promulgation of this PN formally commences the period of review of Corps' request for a WQC under CWA Section 401 from Ecology.

The first federal action was the signing the CA which occurred on April 16, 2021. This step was required to ensure the sponsor had sufficient time to obtain funding to fulfill its statutorily mandated cost-share, necessary to complete the proposed repairs in summer 2021. The non-federal sponsor requires a signed agreement, reflecting a federal commitment to undertake the subject repair, before obtaining through approval of the Whatcom County Council its required share of funding for the repair. Non-federal sponsor provision of funding is necessary, in turn, to meet the current solicitation, contracting, and construction schedule. After receipt of non-federal sponsor funding, under the most aggressive schedule those funds must be processed and submitted to the U.S. Treasury for posting before solicitation of a contract may occur (see Table 5).

The remaining in-water work window, prior to the ensuring flood season in November 2021, to minimize adverse impacts to ESA-listed aquatic species for the Lynden Levee is June 15 to August 31, 2021. This time window dictates the interval during which in-water construction activities must be conducted, and the close of the window thus dictates the date on which in-water actions must be complete.

See Table 5 for a detailed project schedule, which reflects the minimum time interval required for each sequential step in the procurement and execution processes leading up to that deadline for completion of in-water construction. Note that contract award is required an unusual length of time prior to start of construction, to permit the necessary lead time for the custom flap gate culvert to be fabricated. If these dates could not be met, the project was in jeopardy of delay, leaving the levee in the current damaged condition into the upcoming flood season.

Table 5. Project schedule for the 2021 Lynden Levee and Culvert Repair.

CRITICAL PATH	DATE (of occurrence or conclusion)
Sponsor request for assistance	December 5, 2017
PIR approval and funding for project design/execution	March 8, 2018
Non-federal sponsor completion of conceptual design required for integration with the Federal repair project	September 2019
Completion by contract of design of Federal repair project	May 28, 2020
District Commander execution of the Cooperative Agreement	April 16, 2021
Sponsor provides funds to Corps (one week for County Council action and one additional week for County processing)	April 30, 2021
District processing of County funds for submission to U.S. Treasury for posting (one week)	May 6, 2021
Routing of Form 1a (two weeks)	April 12, 2021
Contracting preparation for solicitation (2 weeks)	April 26, 2021
Solicitation date	May 6, 2021
Solicitation period	May 6, 2021- May 28, 2021
FONSI signature	June 5, 2021

Award Date (Funding must be available and FONSI signed by Commander)	June 6, 2021
Time for fabrication of culvert	June 7, 2021 - July 5, 2021
Period of in-water construction	June 15, 2021- August 31, 2021
Completion of construction	August 31, 2021

The work in question is considered an “emergency action” because it is necessary to protect human life and property. Under NEPA, the Corps is required to comply with NEPA to the fullest extent possible. (Section 102). The Corps’ NEPA regulation regarding “Emergency Actions” does allow for completion of NEPA documentation after the fact in emergency situations. Emergency actions are discussed in 33 CFR 230.8 as follows:

> *“Section 230.8 - Emergency actions. In responding to emergency situations to prevent or reduce imminent risk of life, health, property, or severe economic losses, district commanders may proceed without the specific documentation and procedural requirements of other sections of this regulation. District commanders shall consider the probable environmental consequences in determining appropriate emergency actions and when requesting approval to proceed on emergency actions, will describe proposed NEPA documentation or reasons for exclusion from documentation. NEPA documentation should be accomplished prior to initiation of emergency work if time constraints render this practicable. Such documentation may be accomplished after the completion of emergency work, if appropriate. Emergency actions include Flood Control and Coastal Emergencies Activities pursuant to Public Law 84-99, as amended, and projects constructed under sections 3 of the [Rivers and Harbors] Act of 1945 or 14 of the Flood Control Act of 1946 of the Continuing Authorities Program. When possible, emergency actions considered major in scope with potentially significant environmental impacts shall be referred through the division commanders to HQUSACE (CECW-RE) for consultation with CEQ about NEPA arrangements.”*

Completion of the NEPA documentation prior to the federal action of signing the CA, while still fulfilling the agency’s emergency levee rehabilitation authorities and responsibilities under PL 84-99, was impossible in this instance. It was impossible for the Corps to complete all of the following NEPA procedures prior to the date on which the federal action of signing the CA is necessary: public comment period, NHPA determination, CZMA consistency concurrence, and ESA and MFCMA consultation; complete and finalize the EA; determine whether a FONSI is appropriate or an EIS must be prepared; and execute and promulgate a FONSI, if deemed warranted. Therefore, the agency complied with NEPA "to the fullest extent possible" under the circumstances, and the District Commander issued a Determination of Alternative Environmental Procedural Compliance on April 15, 2021 documenting that determination for the record.

7.9.2 NEPA / Proposed Action

The prospective federal action evaluated in this EA is the proposed repair of the Lynden Levee as discussed in the body of this EA. The proposed action would include both the levee repair and mitigation. This EA has been prepared pursuant to NEPA Sec. 102(C). Effects on the quality of the human environment as a result of the proposed levee repair are anticipated to be less than significant. The EA has incorporated any necessary and applicable modifications to the scope and/or nature of the project, any effects to the human environment resulting from these modifications, the procedures and practices used to implement the project, and/or the type and extent of compensatory mitigation associated with the project.

7.9.3 NEPA Summary

A NOP was issued on April 1, 2021 inviting the public, interested agencies, and tribes to comment on the proposed levee repair. The comment period ended on May 1, 2021. Comments were received from WDFW. Public comments and the Corps' responses can be found in Appendix G.

7.10 NATIONAL HISTORIC PRESERVATION ACT OF 1966

Section 106 of the NHPA (16 U.S.C. 470) requires that federal agencies evaluate the effects of federal undertakings on historical, archeological, tribal, and cultural resources and provide the Advisory Council on Historic Preservation opportunities throughout the consultation process to comment on the proposed undertaking and outline concerns or information if there is an adverse effect to an eligible historic property under NRHP. The lead agency must examine whether feasible alternatives would be possible to implement that would avoid causing an adverse effect to an eligible cultural resource or historic property. If an effect cannot reasonably be avoided, measures must be taken to minimize or mitigate potential adverse effects.

The Corps sent DAHP a letter requesting concurrence on the APE for the proposed repair on December 31, 2020. DAHP concurred with the APE determination on January 26, 2021. The Corps made a good faith effort to gather information from affected Tribes identified pursuant to 36 CFR § 800.3(f). The Corps notified the Tribes listed below about the project to identify properties to which they may attach religious or cultural significance or other concerns with historic properties that may be affected.

- Lummi Nation (notified on January 15, 2021)
- Nooksack Tribe (notified on January 15,2021)
- Samish Indian Nation (notified on January 15, 2021)
- Suquamish Tribe (notified on January 15, 2021)
- Swinomish Indian Tribal Community (notified on January 21, 2021)
- Tulalip Tribes (notified on January 21, 2021)

To date, the Corps has received one response from the Lummi Nation on January 20, 2021, requesting the Corps notify them in the event of an inadvertent discovery. After

receiving concurrence from DAHP on the APE determination and sending letters to the six affected tribes, the Corps submitted its determination and findings letter on March 15, 2021 to DAHP that the proposed undertaking would have no adverse effect. The Corps also completed a supplemental HPIF to the WISAARD database for DAHP's records. DAHP concurred with the Corps determination that the undertaking will have no adverse effect in a letter dated April 7, 2021. If human remains or archaeological resources are uncovered during construction, then the project will cease work and will follow an inadvertent discovery plan.

NHPA coordination documents can be found in Appendix H.

7.11 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act (NAGPRA; 25 U.S.C. 3001) addresses processes and requirements for federal agencies regarding the discovery, identification, treatment, and repatriation of Native American and Native Hawaiian human remains and cultural items (associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony). Consistent with procedures set forth in applicable federal laws, regulations, and policies, the Corps will proactively work to preserve and protect natural and cultural resources and establish NAGPRA protocols and procedures.

7.12 Executive Order 11990 Protection of Wetlands

EO 11990 encourages federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking federal activities and programs. No wetlands would be destroyed, lost, or degraded by the proposed action.

7.13 Executive Order 11988 Floodplain Management

EO 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The proposed project is to repair an existing levee to pre-flood conditions and does not include or support construction of any other structures in the flood plain.

7.14 Executive Order 12898, Environmental Justice in Minority Populations and Low-Income Populations

EO 12898 directs federal agencies to take the appropriate steps to identify and address any disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on minority and low-income populations. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population.

The proposed action will not disproportionately affect minority or low-income populations nor have any adverse human health impacts. No interaction with other projects will result in any such disproportionate impacts. No cumulative impacts to Environmental Justice will be expected from interaction of the proposed action with other past, present, and reasonably foreseeable projects. Further, tribal governments that are also environmental justice communities in the project area have been engaged and informed about the proposed action.

7.15 EXECUTIVE ORDER 13007 NATIVE AMERICAN SACRED SITES

EO 13007, Native American Sacred Sites, directs federal agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners. Agencies are to avoid adversely affecting the physical integrity of such sacred sites and to maintain the confidentiality of sacred sites when appropriate. The act encourages government-to-government consultation with tribes concerning sacred sites. Some sacred sites may qualify as historic properties under the NHPA.

No sacred sites in the project area have been previously reported; however, the Corps sent letters to the Nooksack Indian Tribe, Suquamish Tribe, Swinomish Indian Tribal Community, Tulalip Tribes, Lummi Nation, and Samish Indian Nation regarding the proposed APE as described in Section 7.9. The Corps also sent letters to these tribes on March 17 and 18, 2021 soliciting input regarding tribal resources considerations or to schedule a Government-to-Government meeting. To date, no comments have been received.

8 PUBLIC INTEREST EVALUATION FACTORS FOR DISCHARGE OF FILL IN WATERS OF THE UNITED STATES

An evaluation of the discharge of fill into Waters of the United States was conducted in light of the public interest factors prescribed in 33 CFR 336.1(c). These factors include: navigation and the federal standard for dredged material disposal; water quality; coastal zone consistency; wetlands; endangered species; historic resources; scenic and recreation values; fish and wildlife; marine sanctuaries; and applicable state/regional/local land use classifications, determinations, and/or policies. Of these, water quality, wetlands, endangered species, historic resources, scenic values, recreational values, and fish and wildlife have been evaluated in this EA. The factor of marine sanctuaries is not applicable because the project is not located in a marine area.

In accordance with 33 CFR 337.1(a)(14) and 325.3(c)(1), the following additional relevant factors were also considered:

- Land Use. After completion of the levee repairs; residences, commercial properties, roads and other infrastructure will be protected from the potential damages resulting from floods up to the design LOP. No effect to land use is expected.

- Geology and Soils. The proposed levee repair would minimize the erosion of the riverbank.
- Air Quality and Noise. Construction vehicles and heavy equipment would temporarily and locally generate impacts to air quality and noise. However, once construction is complete, effects would return to pre-construction conditions.
- Utilities and Infrastructure. Repair of the levee would prevent potential disruption of utilities, public services, and infrastructure.
- Safety. Construction-related traffic may have caused temporary increases to, and disruption of, local traffic. Flaggers and signs were used, as needed, to direct traffic safely around the construction site.

As provided in 33 CFR sections 335.4, 336.1(c)(1) and 337.6, the Corps has fully considered, on an equal basis, all alternatives that are both reasonable and practicable, i.e., available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. The necessary budget resources, including required items of local responsibility assigned to Whatcom County as non-federal sponsor, are available and adequate to fully support the action. The preferred alternative represents the least costly alternative, constituting the discharge of dredged or fill material into waters of the United States in the least costly manner and at the least costly and most practicable location, is consistent with sound engineering practices, and meets the environmental standards established by the CWA Section 404(b)(1) evaluation process. Execution of the preferred alternative, following consideration of all applicable evaluation factors, would be in the public interest.

9 SUMMARY / CONCLUSION

Based on the above analysis, the proposed 2021 Lynden Levee and Culvert Repair project does not constitute a major federal action significantly affecting the quality of the human environment, and therefore does not require preparation of an EIS.

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12 APPENDICES

(A) Hydraulic Considerations

(B) Project Damages

(C) Project Designs and Plans

(D) Mitigation Plan

(E) Clean Water Act

- Water Quality Monitoring Plan
- Section 404(b)(1)
- Water Quality Certificate

(F) Endangered Species Act

(G) Public Comments

(H) National Historic Preservation Act

APPENDIX A – HYDRAULIC CONSIDERATIONS

5. HYDRAULIC CONSIDERATIONS

This section presents hydraulic considerations for the project.

5.1. HYDROLOGY

According to the United States Army Corps of Engineers (USACE) Periodic Levee Inspection Report (PIR), in its undamaged state, the Lynden Levee provides flood risk reduction against overtopping up to the 10 percent Annual Exceedance Probability (AEP) event (10-year return period) to residential and agricultural properties, and associated utilities and infrastructure. High water and flooding occurred in northwestern Washington because of high river flows in November 2017, resulting in scour of the levee slopes and toe, including loss of riprap and embankment material.

There are two damage sites: 457 feet that has scoured and eroded the riverward embankment toe as well as overtopping damage of the crown and landward slope, and farther downstream, an additional 275 feet also had a damaged riverward levee toe. The damaged Sites 1 and 2 are located between levee stations 103+25 to 107+82 and 33+25 to 36+00, respectively. The total length of repair is approximately 732 feet. In the damaged condition, the levee in those two locations currently provides only a 1-year level of protection (LOP).

The damaged levee segments are located in Lynden, between the United States Geological Survey (USGS) gages on the Nooksack River at Everson, Washington (upstream) and at Ferndale, Washington (downstream). The National Weather Service (NWS) established a flood stage of 18.0 feet (gage height) for the Ferndale gage. The NWS flood stage was exceeded for approximately 13 hours on 24 November 2017. A flood stage has not been established for the Everson gage.

The gage at Everson (USGS Gage 12211200) recorded a peak discharge of 35,500 cubic feet per second (cfs) and a stage of 84.2 feet on 23 November 2017 at 12:00 Pacific Standard Time (PST). The gage near Ferndale (USGS Gage 12213100) recorded a peak discharge of 26,500 cfs and a stage of 19.2 feet on 24 November 2017 at 08:15 PST. Recorded flows are presented in Figure 5-1 and the locations are presented in Figure 5-2. Based on the flood frequency analysis of the Ferndale gage station, this

corresponds approximately to a 40 percent AEP event (2.5-year return period), which is discussed in a subsequent section.

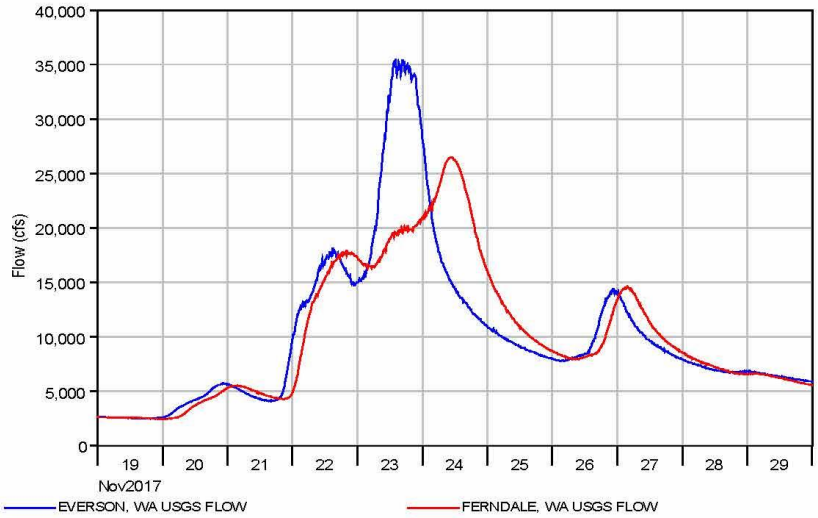

Figure 5-1: USGS Recorded Flows on the Nooksack River, November 2017

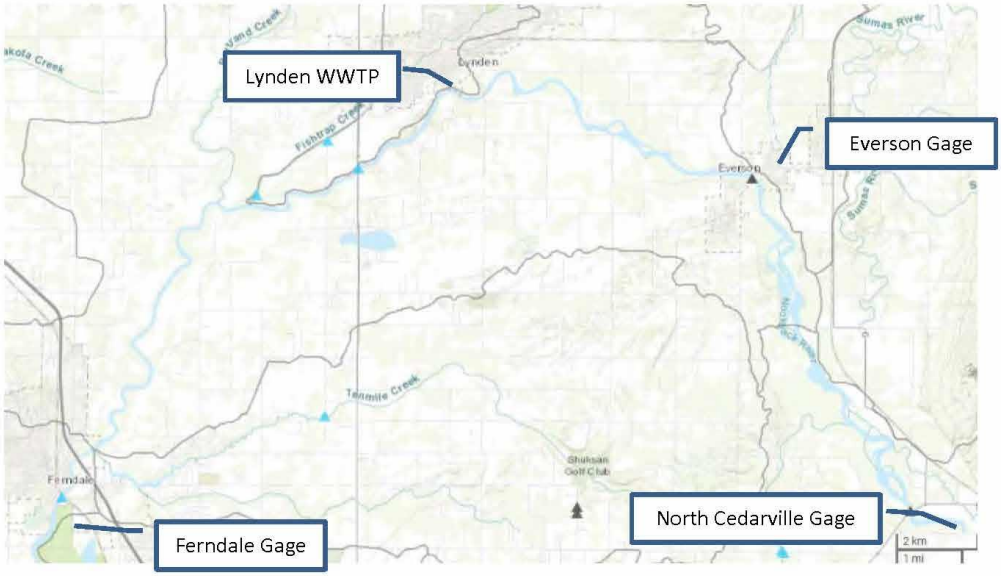

Figure 5-2: USGS Gaging Locations

The PIR identified the 2017 event as a 20-year return interval. However, the USGS revised flows sometime after the PIR was finalized and before the analysis presented in this report. In the PIR, flow at Everson was reported as 39,900 cfs and flow at North Cedarville was 47,800 cfs. As of the date of this report, the USGS website states flows of 35,500 cfs and 34,300 cfs for these locations. The PIR stated that flow at North Cedarville was translated back to the Deming gage and that the 47,800 cfs would translate to a 20-year event. The difference in return intervals reported in this report and the PIR arise from this difference in USGS-reported flows and the use of the Ferndale gage for analyses in this report.

5.2. BULLETIN 17C STATISTICAL ANALYSIS

To estimate the peak magnitude of an AEP flood at project locations, a flood frequency analysis was performed for USGS Gage 12213100 Nooksack River at Ferndale. The gage at Everson (USGS Gage 12211200) would have been more representative of the project; however, this gage does not have a record of annual peak streamflow measurements of at least 15 years of record, which is the minimum years of record for a conservative Bulletin 17C analysis according to the USGS. To advise of the potential uncertainty in estimates, the 90 percent confidence interval was calculated for both the upper and lower bounds of the estimate. The potential range of uncertainty of an AEP estimate at the 90 percent confidence level generally decreases when a larger period of record is available, while similarly, the range of uncertainty will be smaller for more frequent AEP floods.

The flood frequency analysis is based on the methodologies documented in Bulletin 17C, Guidelines for Determining Flood Flow Frequency, 2018. Bulletin 17C revises the procedures of Bulletin 17B, 1982. The most significant differences between the two methodologies are how historical events are treated and the addition of the Multiple Grubbs–Beck method of identifying outliers. A historical event is an event that precedes a gap in the annual peak data series that is larger than any flood event that occurred during the gap. Historical events are identified in the USGS data sets with the code "H" following the historical flow. If there is no code "H" after the last flow prior to the gap, it means that it is unknown whether larger events occurred during the gap. Data with gaps and historical events are now analyzed differently under the 17C guidance. The hydrologist must provide a Perception Threshold and a range of possible values for the missing years. It is typically assumed that the Perception Threshold is the value of the historical event. This assumes that had a larger event occurred, witnesses would have recorded the incident and noted that it was greater than the historical event. If the gap is not preceded by a historical event, the Perception Threshold is set relatively low and the upper bound of the range is infinity.

The Ferndale gage had a period of record from 1918–2017 at the time of this analysis. Unbounded data were recorded from 1918–1945. A historical threshold of 41,600 cfs was recorded in 1946, and there was no record from 1947–1949. So for 1918–1945 an infinity-to-infinity threshold was set and from 1947–1949 the threshold set was 41,600 cfs to infinity as seen below in Figure 5-3. The USGS report titled "Magnitude, frequency, and trends of floods at gaged and ungaged sites in Washington, based on data through water year 2014" (SIR 2016-5118) was also referenced for the selection of station skew for the analysis but this information was not listed for the Ferndale gage. The analysis presented below is for informational purposes and to establish an order of magnitude for flows on the Nooksack River through the project locations. The thresholds used in the analysis can be seen in Figure 5-3 and the results are presented in Table 5-1. The SIR 2016-5118 regression results can be seen in Table 5-2 with a comparison seen in Table 5-3.

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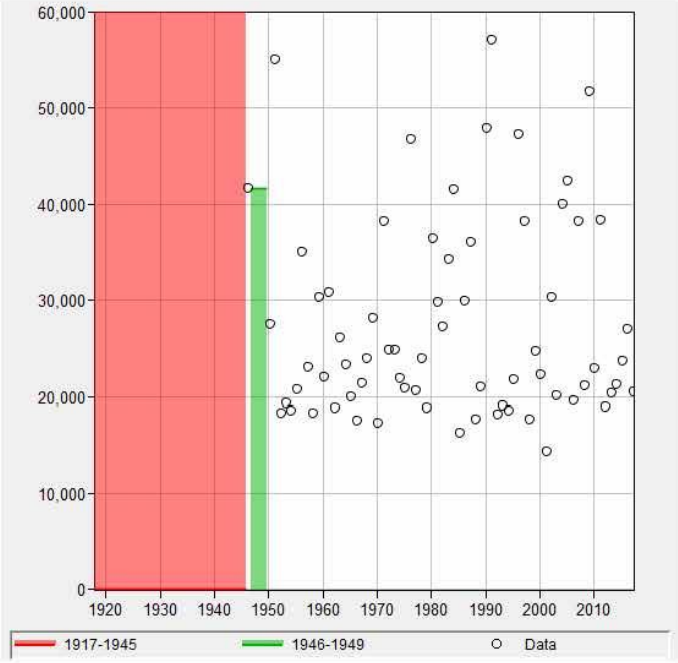

Figure 5-3: Bulletin 17C Perception Thresholds

Table 5-1: Bulletin 17C Results

Percent Chance Exceedance	Return Period (year)	Computed Flow (cfs)	10% Confidence Limit (cfs)	90% Confidence Limit (cfs)
0.2	500	89,000	142,500	71,650
0.5	200	75,300	108,850	62,850
1	100	65,950	88,750	56,550
2	50	57,450	72,250	50,500
5	20	47,300	55,050	42,800
10	10	40,200	44,800	37,100
20	5	33,550	36,250	31,400
25	4	31,450	33,800	29,500
40	2.5	26,950	28,700	25,350
50	2	24,750	26,250	23,350
66.67	1.5	21,650	22,800	20,500
80	1.25	19,250	20,250	18,300

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Table 5-2: SIR 2016-5118 Results

Percent Chance Exceedance	Return Period (year)	Flow (cfs)
0.20	500	78,100
0.50	200	68,600
1.00	100	61,700
2.00	50	55,100
10.00	10	40,600
20.00	5	34,400
50.00	2	25,500

Table 5-3: Bulletin 17C vs. SIR 2016-5118 Results

Percent Chance Exceedance	Return Period (year)	Flow Difference (%)
0.20	500	14.0
0.50	200	9.8
1.00	100	6.9
2.00	50	4.3
10.00	10	-1.0
20.00	5	-2.5
50.00	2	-2.9

5.3. HYDROLOGIC MODELING

This section describes the hydrologic modeling that was conducted for the project.

5.3.1. Basin Delineation

Topography was obtained from the Washington Light Detecting and Ranging (LiDAR) Portal. The Nooksack River Basin LiDAR, collected and processed by Watershed Sciences, Inc. and dated 26 July 2013, was used directly in a 3-foot raster format. Basins were initially delineated with ESRI ArcHydro processes and later manually refined referencing the Drainage Report for Water Treatment Plant Replacement & Historic Business District prepared by Reichhardt & Ebe Engineering, Inc. in November 2012. The basins can be seen in Table 5-4 and Figure 5-4. Hydrology for the drainage area upstream of the Lynden Levee culvert on the Nooksack River was not modeled because it was determined to be of insignificant magnitude in comparison to the flows from the Nooksack River; this is discussed in a subsequent section.

Table 5-4: Basin Area

Subbasin	Area (mi^2)
LL_10200B	0.204
LL_10100B	0.066
LL_10050B	0.002
LL_10000B	0.028

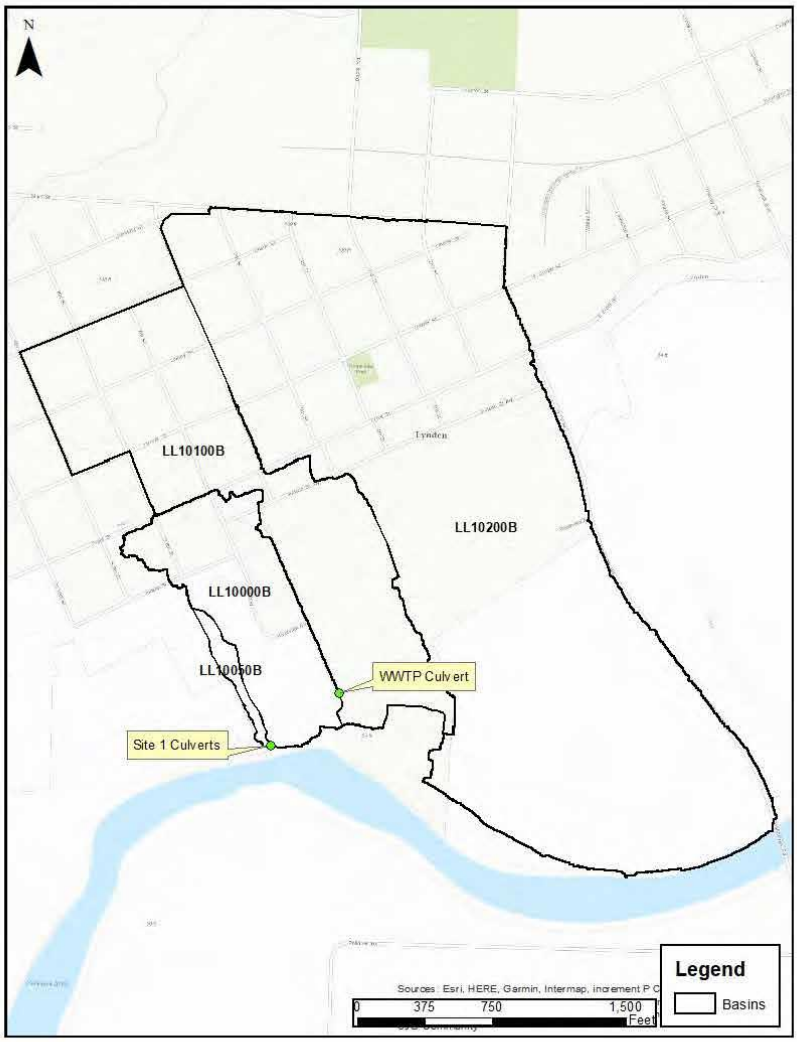

Figure 5-4: Basin Delineation

5.3.2. Continuous-Simulation Methodology

The Western Washington Hydrology Model version 2012 (WWHM2012) was used to generate flows for the contributing drainage area behind the culvert. WWHM2012 is based on WWHM4, which uses Hydrological Simulation Program Fortran (HSPF) as its computational engine. HSPF is the USGS and U.S. Environmental Protection Agency (EPA) continuous-simulation hydrology software package. The HSPF continuous-simulation model is preferred over single-event hydrology models in western Washington because of its ability to compute and keep track of all of the individual components of the hydrologic cycle including surface runoff, interflow, groundwater, soil moisture, and evapotranspiration.

5.3.2.1. Precipitation Data

The Blaine precipitation gage was used with a simulation date of 01 October 1948 through 30 September 2009. The Precipitation Scaling Factor was 1.0 and the Pan Evaporation Factor was 0.76. The project location and controls can be seen in Figure 5-5.

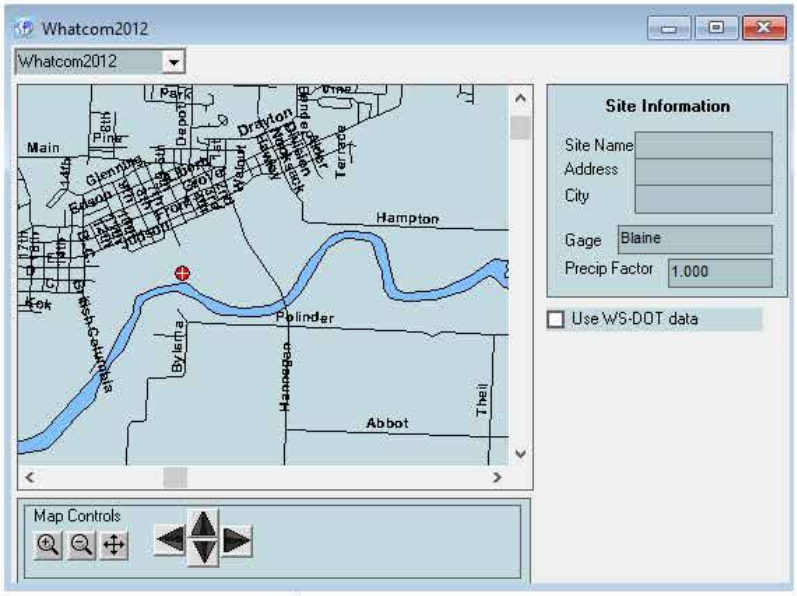

Figure 5-5: WWHM Setup

5.3.2.2. Basin Characteristics

Soils. The soil map units within the watershed are primarily sandy loam, silt loam, or muck in areas of mild slopes as mapped by the Natural Resources Conservation Service (NRCS) (Soil Survey staff). In the upper portions of the drainage area the hydrologic soil group is predominantly Group A, which consists of low runoff potential and high infiltration rates even when thoroughly wetted. However, this is negated to an extent because of the urbanization of the city of Lynden. In the lower portions of the drainage area the hydrologic soil group is predominantly Groups C and D, which consist of low infiltration and high runoff rates. Most of this soil has been deposited over the years from the Nooksack River flooding events. The hydrologic soil groups can be seen in Figure 5-6.

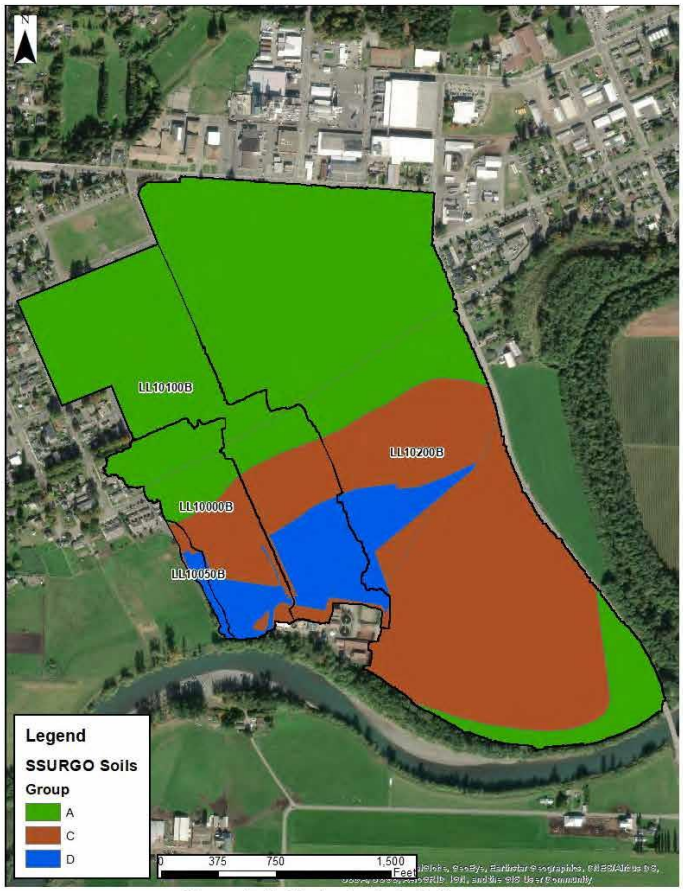

Figure 5-6: Hydrologic Soil Groups

Land Use. Land cover information was developed based on visual inspection of the ground surface using satellite imagery and was classified based on Table 3.1, "Pervious Land Soil Type/Cover Combinations," of the MGSFlood – Proprietary Version User's Manual, 2009. Impervious areas were developed using aerial imagery. Land cover areas were defined using polygons within a geographic information system (GIS) shapefile and categorized using one of the five categories below and as seen in Figure 5-7:

- Forest
- Pasture
- Pasture (D Soil)
- Lawn
- Impervious (Open Water, Pavement, Structure Roof)

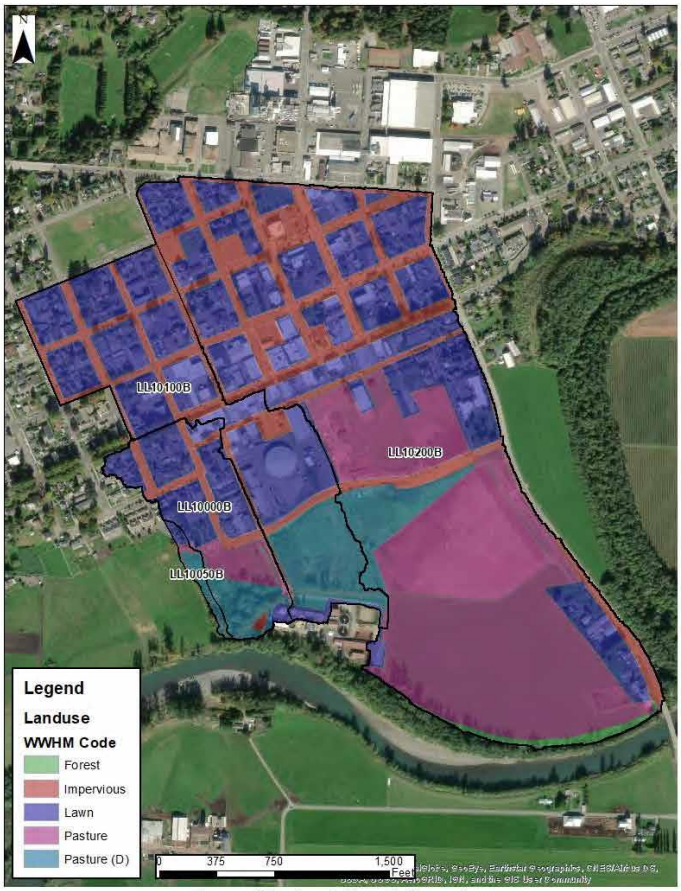

Figure 5-7: Land Use Delineation

5.3.2.3. Results

A 5-minute time step was selected for the computational interval. Traditional precipitation data is recorded at a 15-minute interval. The model's finer time step was selected based on time of concentration for the small watershed so that routing could be spread over more time steps. The model results can be seen in Table 5-5.

Table 5-5: WWHM Frequency Subbasin Runoff (cfs)

Subbasin	2-year	5-year	10-year	25-year	50-year	100-year
LL10200B	14.8	21.6	26.7	33.7	39.4	45.5
LL10100B	4.8	6.8	8.1	9.9	11.3	12.7
LL10050B	0.1	0.1	0.2	0.3	0.3	0.4
LL10000B	1.9	2.9	3.7	4.8	5.6	6.6

5.3.3. Event Simulation Methodology

Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) version 4.3 was used to generate flows for the contributing drainage area behind the culvert for the model calibration events. HEC-HMS allows users to simulate the complete hydrologic processes of dendritic watershed systems, and includes many traditional hydrologic analysis procedures such as event infiltration, unit hydrographs, and hydrologic routing. HEC-HMS was used to develop a hydrologic model that allows easy integration of computed flows to the HEC-RAS hydraulic model specifically to model the calibration events.

Ultimately, the results from the WWHM model were used to validate results from the HEC-HMS model because the runoff derived from HEC-HMS would be used in the HEC-RAS model. WWHM does not have the capability to model a single event.

5.3.3.1. Precipitation Data

Frequency Events. Isopluvial maps prepared by MGS Engineering Consultants of Washington State were referenced for 24-hour rainfall depths. Gridded data sets and shapefiles are available for the entire state for durations of 2 hours and 24 hours for a full range of annual exceedance probabilities and the 100-year 24-hour map can be seen below in Figure 5-8.

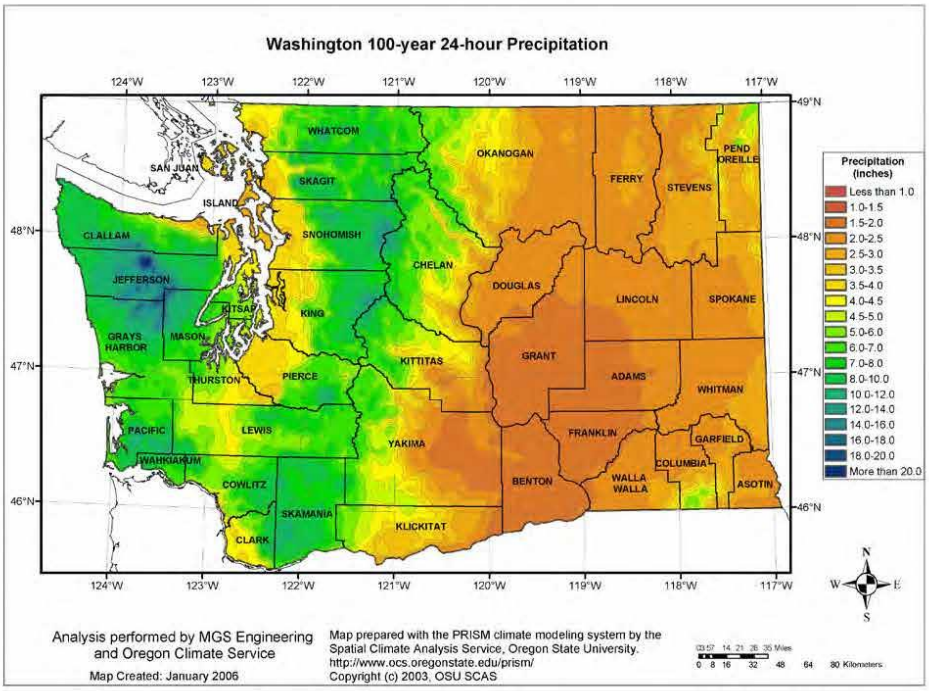

Figure 5-8: Washington 100-year 24-hour Precipitation Map

A hypothetical storm event was selected with a Soil Conservation Service (SCS) Type 1A rainfall distribution. The selected rainfall depths can be seen in Table 5-6.

Table 5-6: Frequency Event Rainfall Depths

Event	Rainfall Depth (in)
2-year	2.25
10-year	3.10
25-year	3.35
50-year	3.70
100-year	4.40

Calibration Events. To refine the calibration of the HEC-RAS model, deriving runoff inflows for the area behind the culvert was considered. Because of the size of the drainage area and potential for error in interpolating precipitation depth, and because of its proximity to Site 1, Weather Underground Station KWALYNDE19 was used for the basis of this information. The station location can be seen in Figure 5-9 and the calibration event depths can be seen in Table 5-7. Precipitation data for the November 2017 levee damaging event were incomplete so it could not be modeled. The selected events were chosen because they occurred during the greatest streamflow events on the Nooksack River where Whatcom County Diver Data was available for model calibration.

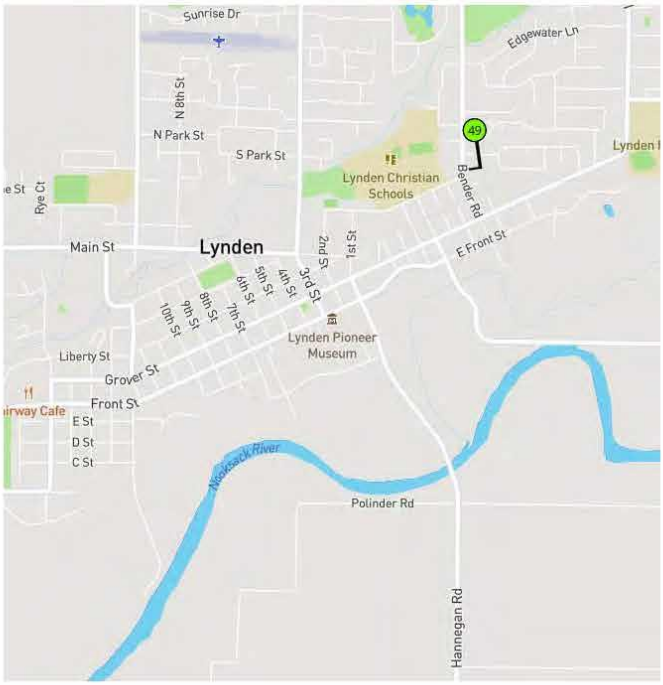

Figure 5-9: East Lynden Weather Station

Table 5-7: Calibration Event Rainfall Depths

Event Name	Event Dates	Rainfall Depth (in)
Early November 2018	10/31/2018 - 11/05/2018	2.77
Late November 2018	11/21/2018 - 11/30/2019	3.42
January 2019	01/02/2019 - 01/05/2019	2.38
January 2020	12/30/2019 - 01/10/2020	4.63
February 2020	01/29/2020 - 02/05/2020	4.70

5.3.3.2. Basin Characteristics

Loss Method. The SCS Curve Number (CN) method was used to calculate incremental losses. The CN method is a widely used infiltration loss model, but it does not account for long-term losses such as evaporation or transpiration. Because the events being modeled were single occurrences, these limitations of the method were not an issue. The CNs used were based on parameters from the WWHM model and can be seen in Figure 5-10 and Table 5-8.

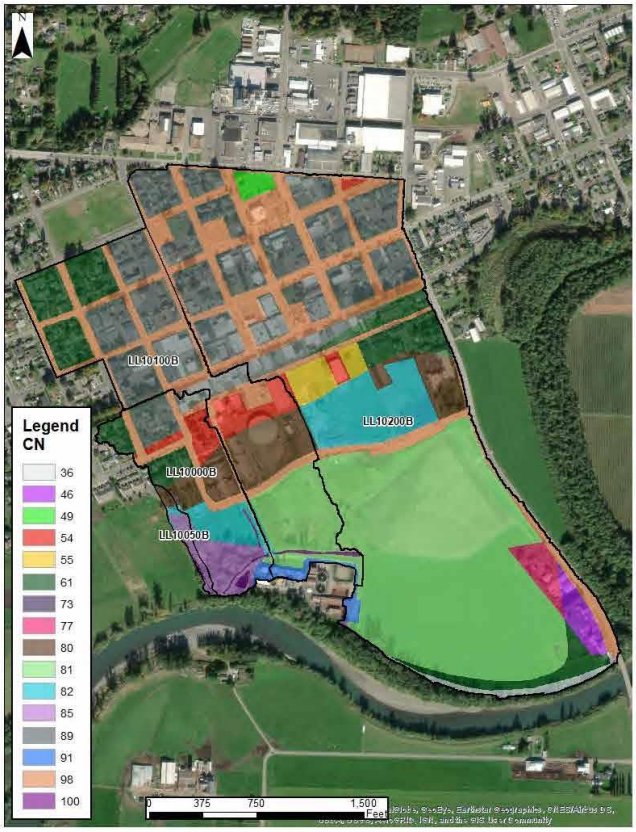

Figure 5-10: Curve Number

Table 5-8: HEC-HMS Curve Numbers

Subbasin	CN	Impervious (%)
LL10200B	83	19.2
LL10100B	82	19.6
LL10050B	84	0.0
LL10000B	81	15.8

Transform Method. The SCS Upland Method was used to approximate subbasin lag time. This method uses the length of the longest flow path divided by the velocity of the overland flow where a summation of various segments was used to represent different conveyances depending on the land use and land slope. Model values can be seen in Table 5-9.

Table 5-9: HEC-HMS Lag Time

Subbasin	Longest Flowpath (ft)	Lag Time (min)
LL10200B	3,609	128
LL10100B	3,400	109
LL10050B	866	74
LL10000B	2,036	117

5.3.3.3. Results

A 1-minute time step was selected for the computational interval and the results can be seen in Table 5-10. A comparison between the WWHM and HEC-HMS frequency event peak flow can be seen in Table 5-11 although a 1:1 match should not be expected because of different methodologies of the software applications. WWHM was used to determine flows for the recurrence intervals since it has more refined methods, such as continuous simulation based on rainfall gages. The magnitude of flow generated by WWHM was used to verify the flow for the recurrence intervals generated by HMS using design storms where antecedent conditions, curve numbers, and time of concentration were checked for reasonableness. HEC-HMS was appropriate to generate runoff for the calibration events since WWHM cannot do such calculations.

Table 5-10: HEC-HMS Frequency Subbasin Runoff (cfs)

Subbasin	2-year	10-year	25-year	50-year	100-year
LL10200B	17.2	26.7	29.6	33.8	42.4
LL10100B	5.8	9.0	10.0	11.5	14.4
LL10050B	0.2	0.3	0.3	0.4	0.5
LL10000B	2.2	3.5	3.9	4.5	5.7

Table 5-11: HEC-HMS vs WWHM Frequency Runoff Comparison (cfs)

Subbasin	2-year	10-year	25-year	50-year	100-year
LL10200B	2.4	0.0	-4.1	-5.6	-3.1
LL10100B	1.0	0.9	0.1	0.2	1.7
LL10050B	0.1	0.1	0.0	0.1	0.1
LL10000B	0.3	-0.2	-0.9	-1.1	-0.9

The peak flows associated with the calibration events can be seen in Table 5-12. Based on the precipitation depths and duration of the events, the peak flow values were all below a 2-year event except for the February 2020 event. Table 5-5 shows the return interval runoffs for WWHM while Table 5-10 does so for HEC-HMS. All events except for January 2020 show that the rainfall/flood events centered over the Lynden WWTP were less than the 2-yr event. This shows that the rainfall on the Nooksack was likely more significant on the upstream portions of the watershed rather than at the WWTP.

Table 5-12: HEC-HMS Calibration Event Runoff (cfs)

Subbasin	Early November 2018	Late November 2018	January 2019	January 2020	February 2020
LL10200B	13.3	11.8	12.9	13.2	27.7
LL10100B	4.5	4.3	4.2	4.3	10.1
LL10050B	0.1	0.2	0.1	0.1	0.4
LL10000B	1.8	1.7	1.7	1.8	3.8

5.4. HYDRAULIC MODEL SELECTION

Whatcom County has developed a calibrated USGS Full Equations (FEQ) model of the Nooksack River. FEQ is a computer model for simulation of one-dimensional (1D) unsteady flow in open channels and through control structures. The structure of the program is designed to follow the structure of a stream system and provide maximum generality and flexibility. FEQ can be applied to simulate a wide range of stream configurations including loops and lateral-inflow conditions. However, the Whatcom County FEQ model has known limitations and questionable calibration at the study areas of interest so it was determined unsuitable for use in this study for these reasons and also because of project time constraints. The limitations of the FEQ model at the Lynden Wastewater Treatment Plant (WWTP) was derived from an email from Peter Gibson of USACE Seattle District to the project team on 8 November 2019 at 06:23 PST.

The USACE Hydrologic Engineering Center (HEC) produces the HEC suite of software, which has become widely used for hydrologic and hydraulic modeling across the United States. The software is freely available to non-USACE users, and is the most commonly used suite of software for the Federal Emergency Management Agency (FEMA) Flood Insurance Studies (FISs). HEC-RAS was selected as the modeling software as its recent enhancements include industry-leading two-dimensional (2D) modeling capabilities, ideally suited to the complex unconfined floodplains found along the Nooksack River. HEC-RAS allows users to perform 1D steady-flow calculations, 1D and 2D unsteady-flow calculations, sediment transport/mobile bed computations, and water temperature/water quality modeling. A full 2D unsteady-flow model was created for the Nooksack River for this project.

5.5. HEC-RAS MODELING

This section describes the HEC-RAS modeling that was conducted for the project.

5.5.1. Topography

Whatcom County supplied DWG files with surveyed topography for Site 1 near the Lynden WWTP. This DWG contained bathymetry for the Nooksack River and increased resolution of the side channel

downstream of the existing culverts near the Nooksack River right overbank along with the upstream drainage channel running along the WWTP perimeter. Surveyed information was also included for both the 2- and 4-foot-diameter circular culverts located through the Lynden Levee as well as the 4-foot-wide by 2-foot-tall double-chambered box culvert located under the WWTP entrance road. This information was exported to a LandXML and subsequently converted to a tin surface using ArcGIS. The tin surface was then converted to a 1-foot raster to be compatible with the HEC-RAS terrain specifications. Overbank topography was obtained from the Washington LiDAR Portal where the DWG did not cover.

The Nooksack River Basin LiDAR collected and processed by Watershed Sciences, Inc. and dated 26 July 2013 was used directly in a 3-foot raster format. Because the channel bathymetry was not readily available for locations other than directly adjacent to Site 1, channel inverts were estimated from the FEQ tabular data supplied by Whatcom County and supplemented with estimates derived from the FEMA FIS Report dated 18 January 2019. However, the channel inverts from the FIS Report were surveyed more than 20 years ago. It should be noted that the Nooksack River has an ever-changing sediment load due to the geological variables present, and that the channel bathymetry estimations used for this modeling are not likely representative of actual conditions. However, a calibration was performed to ensure that hydraulic conditions in the HEC-RAS model are representative of observed data at Sites 1 and 2. So while the HEC-RAS model is reasonably calibrated for these locations, care should be taken when using the model for other locations throughout the model domain. The existing-conditions topography can be seen in Figure 5-11.

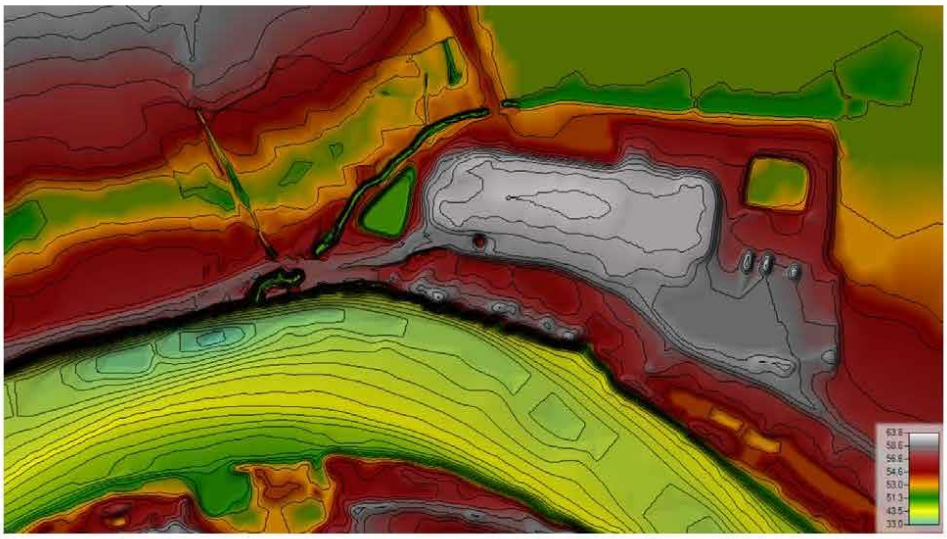

Figure 5-11: Existing Conditions Topography

5.5.2. Extents

The modeling extents for the Nooksack River extend from the upstream limits at the Everson USGS gage to roughly 0.85 mile downstream of Guide Meridian Road, as seen in Figure 5-12. The upstream location

was selected because an inflow hydrograph could be directly used from observed USGS data without having to translate it or make assumptions. The downstream extents were selected because it was far enough downstream to where a boundary condition would not influence results at the study areas of interest.

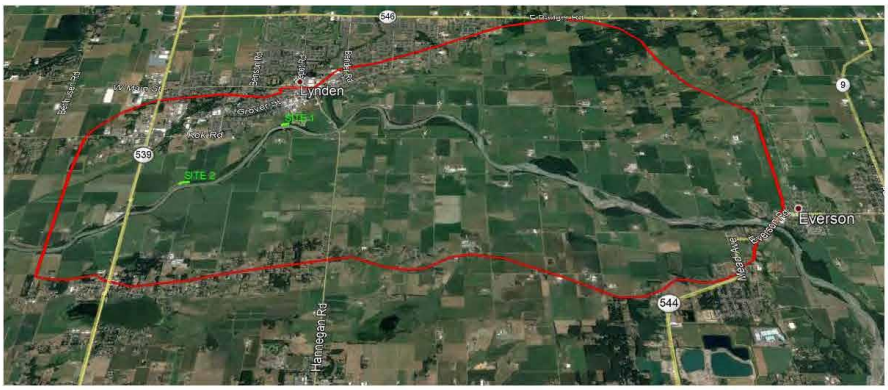

Figure 5-12: Nooksack River HEC-RAS Model Extents.

5.5.3. Calibration

Whatcom County installed and maintained stream recording gages (Diver Data) at a location both upstream and downstream of the Lynden Levee culverts near the WWTP. These locations are identified in Figure 5-13 and Table 5-13. Data were available from 10 October 2018 through 05 January 2019 and 01 November 2019 through 07 February 2020, and a sample of the data can be seen in Figure 5-14 and Figure 5-15.

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Figure 5-13: Lynden WWTP Diver Locations

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Table 5-13: Whatcom County Diver Data

	Upstream	Downstream
Gage height (NAVD88)	**49.74**	**48.85**
Easting (FT)	**1251184.76**	**1250870.89**
Northing (FT)	**711393.90**	**711094.54**

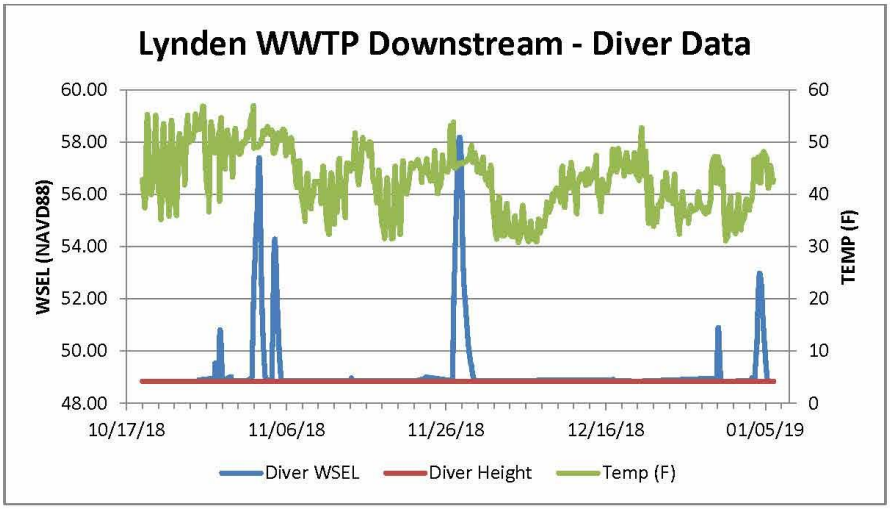

Figure 5-14: Downstream Diver Data Recording

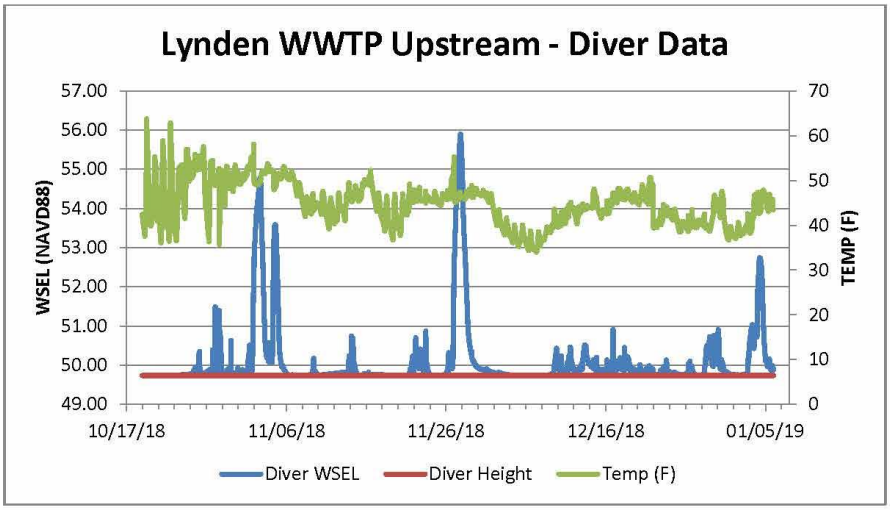

Figure 5-15: Upstream Diver Data Recording

Five events occurred that were significant enough for a modeling calibration basis and these events occurred through a range of flows pertinent to refuge suitability for fish based on the projects team's site visit with the Washington Department of Fish and Wildlife (WDFW) on 15 November 2019. There it was stated that the landward side of the levee acts as refugia for fish from the Nooksack River during high flows and not as a result of the local drainage. Little concern was raised over the velocities associated with the culvert related to fish passage. The five events below produced a stage on the Nooksack River that was high enough to engage the culvert, which is perched under normal conditions:

- 31 October–05 November (2018)
  - Significant and containing another subsequent peak suitable for refilling
    - 26,000 cfs and 19,000 cfs
- 21 November–30 November (2018)
  - Significant and representative of the November 2017 damaging event
    - 27,000 cfs
- 02–05 January (2019)
  - Minor event
    - 16,000 cfs
- 30 December–10 January (2020)
  - Moderate event
    - 21,500 cfs
- 03–05 January (2020)
  - Significant and representative of the November 2017 damaging event
    - 39,000 cfs

To assess HEC-RAS model calibration, the Nash–Sutcliffe model efficiency coefficient (NSE) was used. It is defined as:

$$NSE = 1 - \frac{\sum_{t=1}^{T} (Q_m^t - Q_o^t)^2}{\sum_{t=1}^{T} \left(Q_o^t - \overline{Q}_o\right)^2}$$

where Q_0 is the mean of observed discharges, and Q_m is modeled discharge. Q_0^t is observed discharge at time t.

Nash–Sutcliffe efficiency can range from $-\infty$ to 1. An efficiency of 1 (NSE = 1) corresponds to a perfect match of modeled discharge to the observed data. An efficiency of 0 (NSE = 0) indicates that the model predictions are as accurate as the mean of the observed data, whereas an efficiency less than zero (NSE < 0) occurs when the observed mean is a better predictor than the model or, in other words, when the residual variance (described by the numerator in the expression above) is larger than the data variance (described by the denominator). Essentially, the closer the model efficiency is to 1, the more accurate the model is. Various publications discuss NSE, but [1] below is a great reference while the original guidance is in [2] as seen in Table 5-14.

Table 5-14: Nash-Sutcliffe Efficiency Guidance

Item	Document Reference
[1]	Legates, D.R. and McCabe, G.J., 1999. Evaluating the use of "goodness-of-fit" measures in hydrologic and hydroclimatic model validation. Water Resources Research, 35 (1), 233–241
[2]	Nash, J.E. and Sutcliffe, J.V. (1970) River Flow Forecasting through Conceptual Model. Part 1--A Discussion of Principles. Journal of Hydrology, 10, 282-290.

The Nash–Sutcliffe efficiency for the selected events can be seen in Table 5-15 and Table 5-16, and the HEC-RAS results can be seen in Figure 5-16 through Figure 5-37. These figures show how the simulated model results compare to observed data. Of notable importance for the temporal figures is volume under the curves, timing, and shape. However, because of the scale sometimes figures such as these can be misleading so the data were replotted in a scatter figure. The scatter figures are showing how well the simulated data match the observed data for water surface elevations (WSELs) at each time step as another way to show model fit. For example, in Figure 5-24, the model under-predicts WSEL at high stages because it is below the 1:1 line (perfect fit) and over-predicts WSEL at low stages since it is above the 1:1 line.

Table 5-15: Downstream Diver Data NSE

Date	Simulation Time	NSE
Start	11/1/2018 17:15:00	**0.97**
End	11/3/2018 10:30:00	
Start	11/4/2018 4:30:00	**0.92**
End	11/5/2018 9:45:00	
Start	11/26/2018 20:15:00	**0.97**
End	11/29/2018 12:30:00	
Start	1/3/2019 16:00:00	**0.89**
End	1/5/2019 06:30:00	
Start	1/7/2020 00:00:00	**0.95**
End	1/9/2020 06:00:00	
Start	1/31/2020 12:00:00	**0.97**
End	2/3/2020 12:00:00	

Table 5-16: Upstream County Diver Data NSE

Date	Simulation Time	NSE
Start	11/1/2018 17:15:00	**0.98**
End	11/3/2018 10:30:00	
Start	11/4/2018 4:30:00	**0.90**
End	11/5/2018 9:45:00	
Start	11/26/2018 20:15:00	**0.96**
End	11/29/2018 12:30:00	
Start	1/3/2019 16:00:00	**0.87**
End	1/5/2019 6:30:00	
Start	1/7/2020 00:00:00	**0.86**
End	1/9/2020 06:00:00	
Start	1/31/2020 12:00:00	**0.97**
End	2/3/2020 12:00:00	

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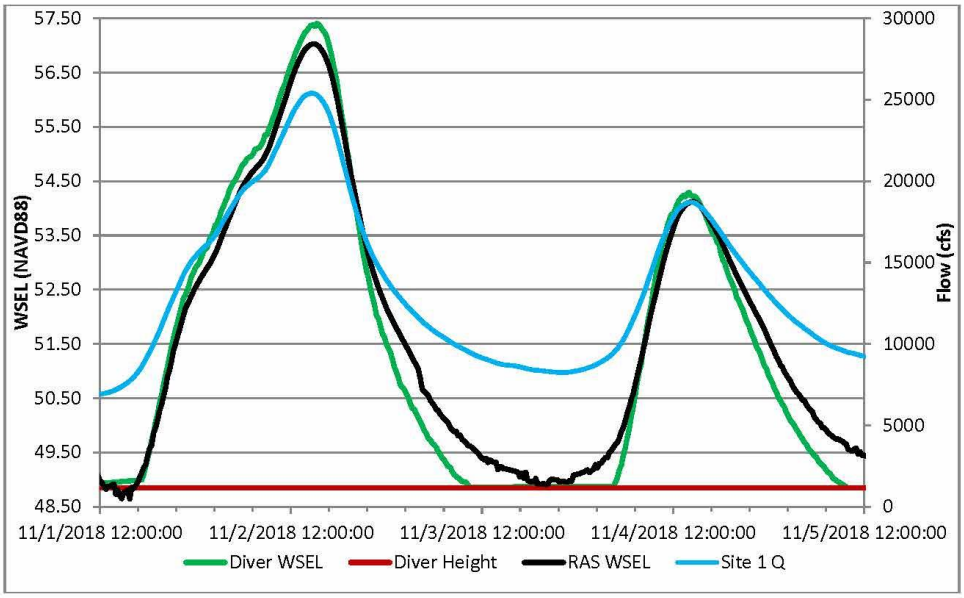

Figure 5-16: Downstream HEC-RAS Calibration, Early November 2018

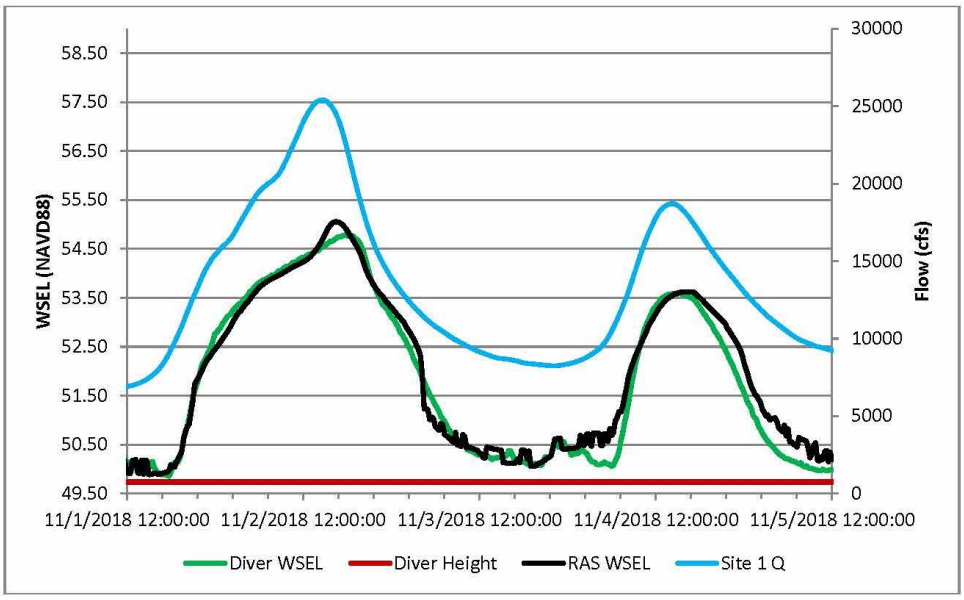

Figure 5-17: Upstream HEC-RAS Calibration, Early November 2018

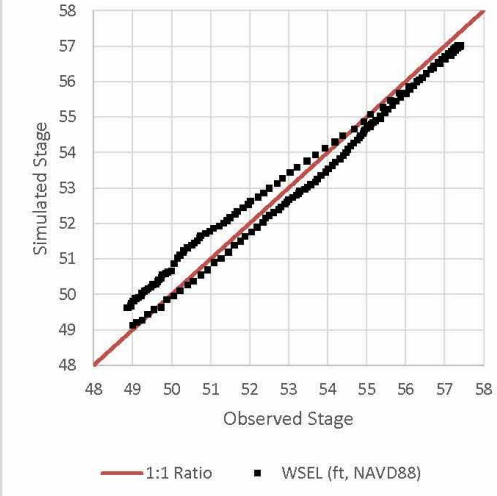

Figure 5-18: Downstream Flow Fit, Early November (1) 2018

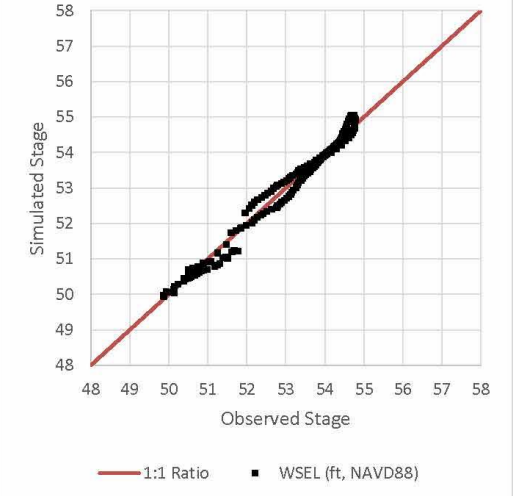

Figure 5-19: Upstream Flow Fit, Early November (1) 2018

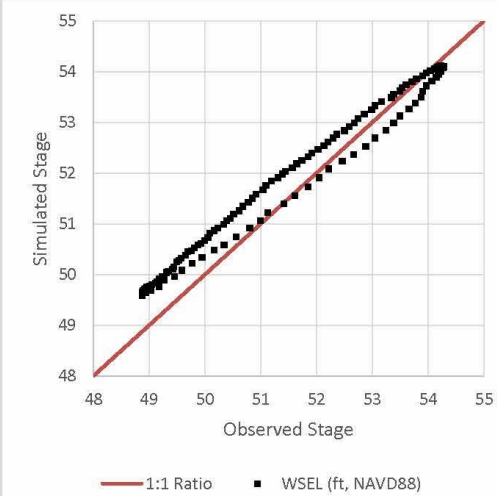

Figure 5-20: Downstream Flow Fit, Early November (2) 2018

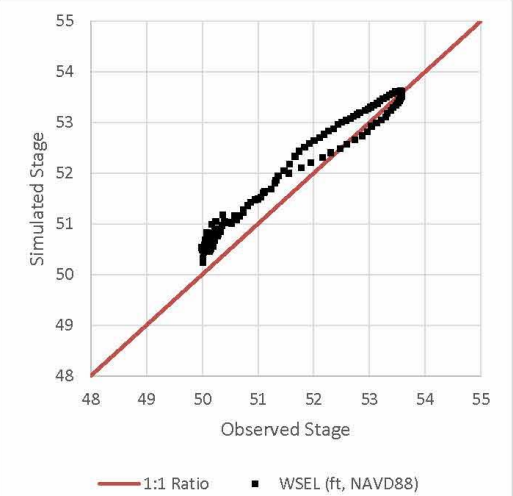

Figure 5-21: Upstream Flow Fit, Early November (2) 2018

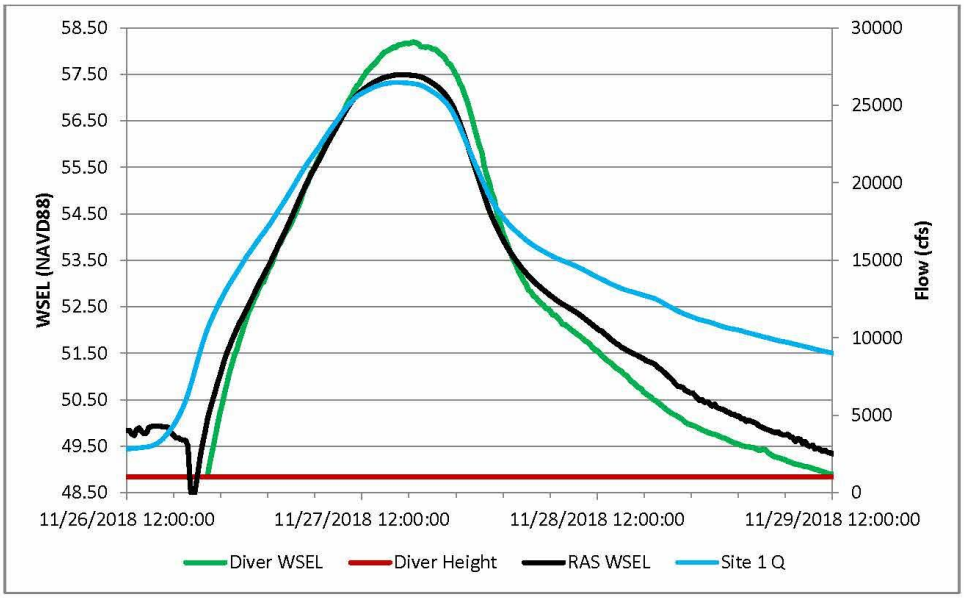

Figure 5-22: Downstream HEC-RAS Calibration, Late November 2018

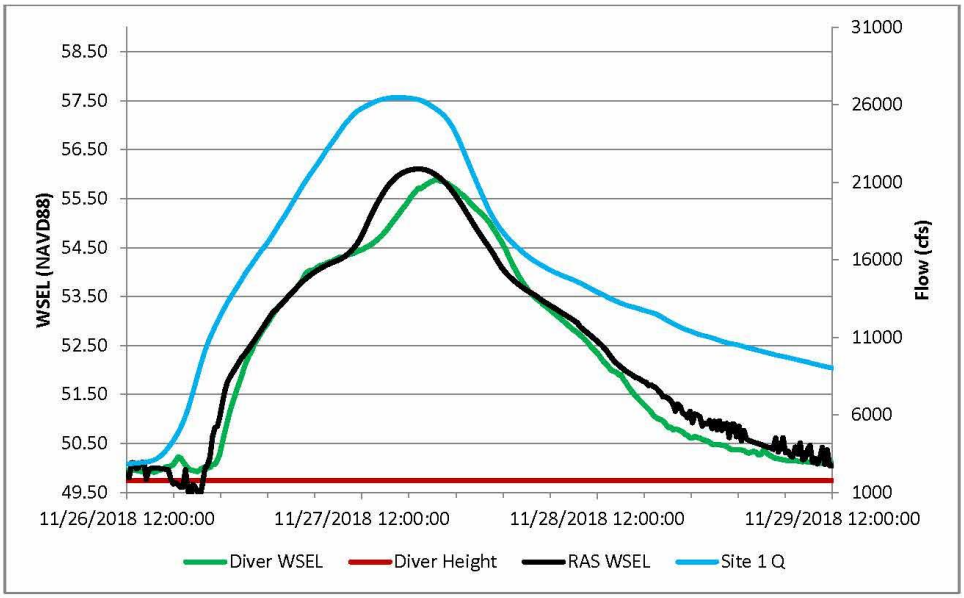

Figure 5-23: Upstream HEC-RAS Calibration, Late November 2018

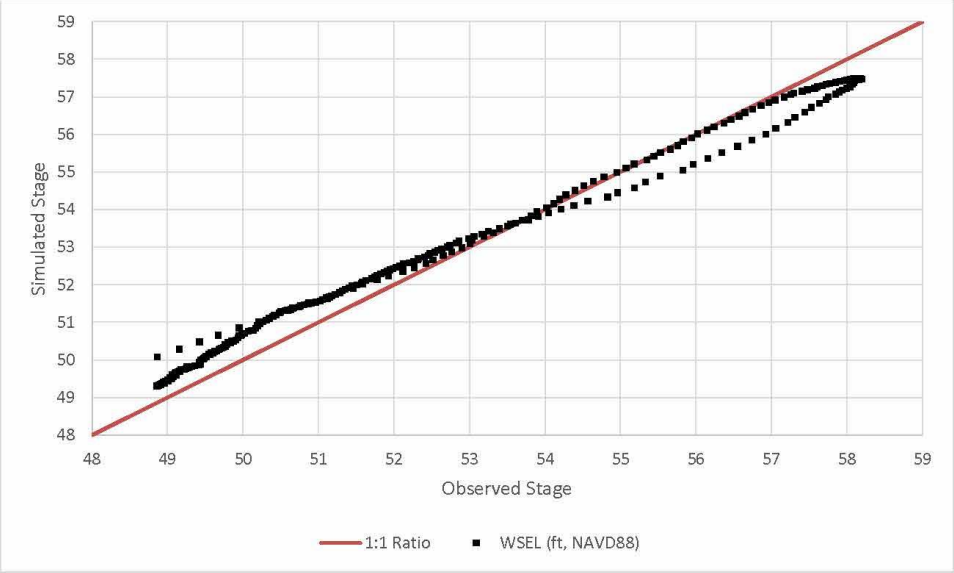

Figure 5-24: Downstream Flow Fit, Late November 2018

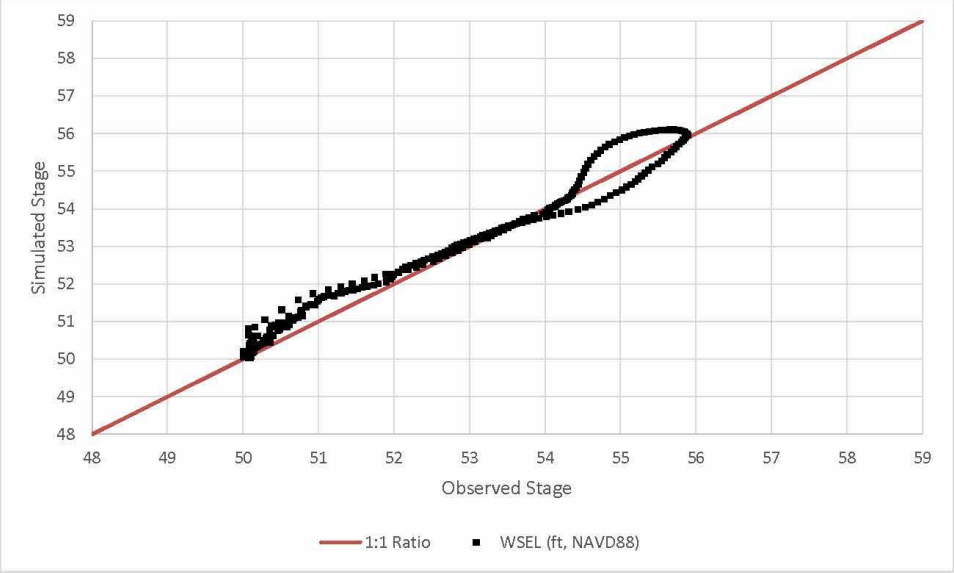

Figure 5-25: Upstream Flow Fit, Late November 2018

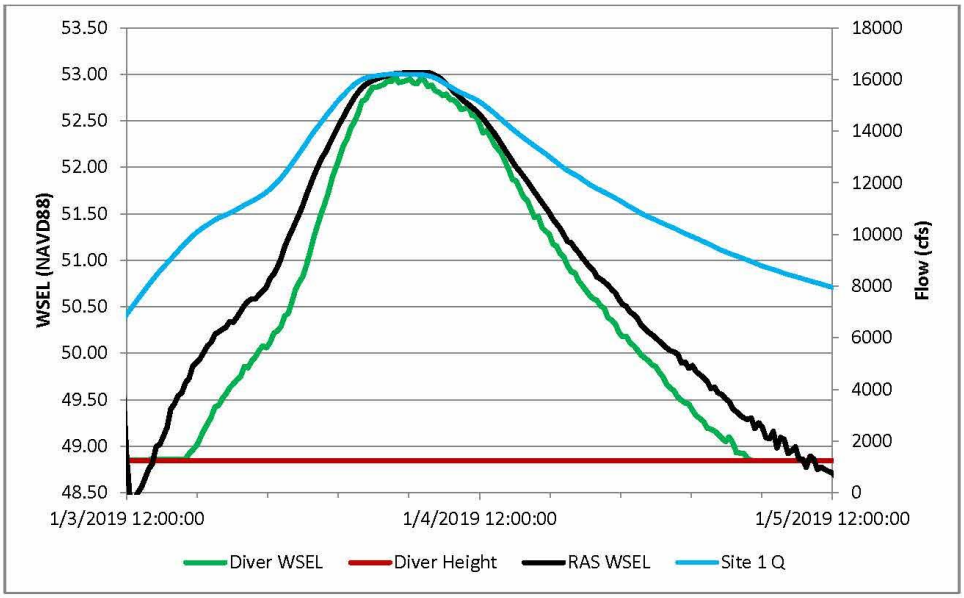

Figure 5-26: Downstream HEC-RAS Calibration, January 2019

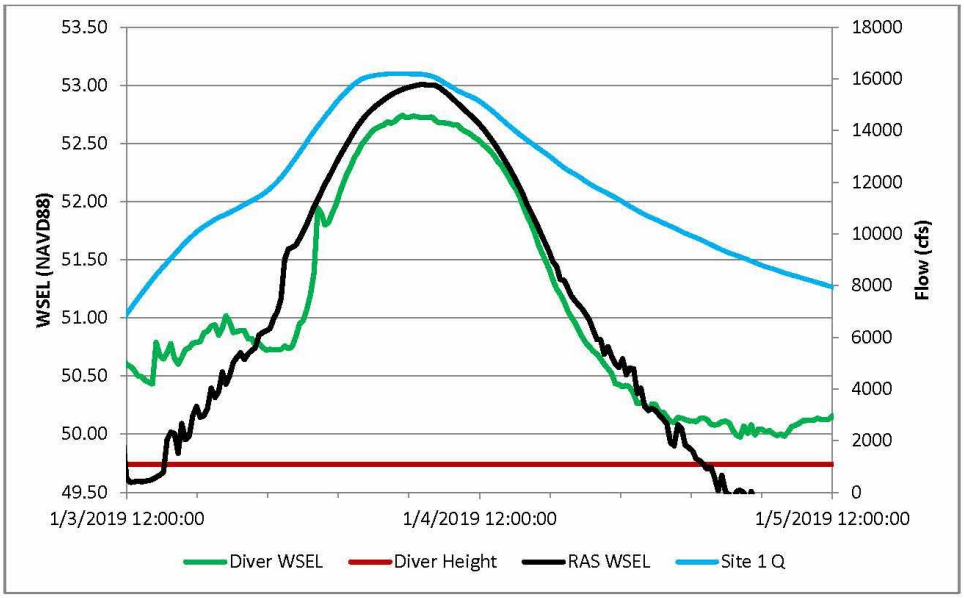

Figure 5-27: Upstream HEC-RAS Calibration, January 2019

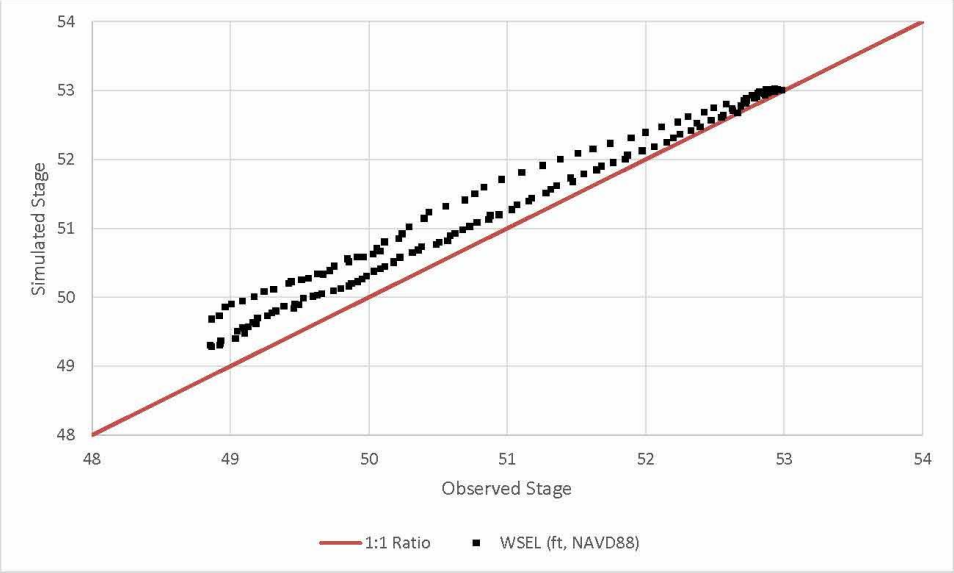

Figure 5-28: Downstream Flow Fit, January 2019

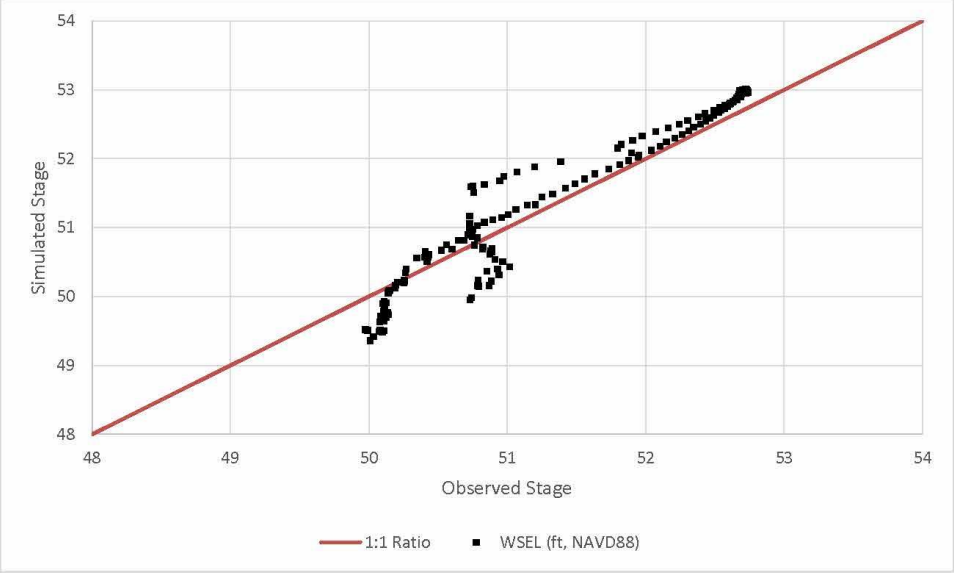

Figure 5-29: Upstream Flow Fit, January 2019

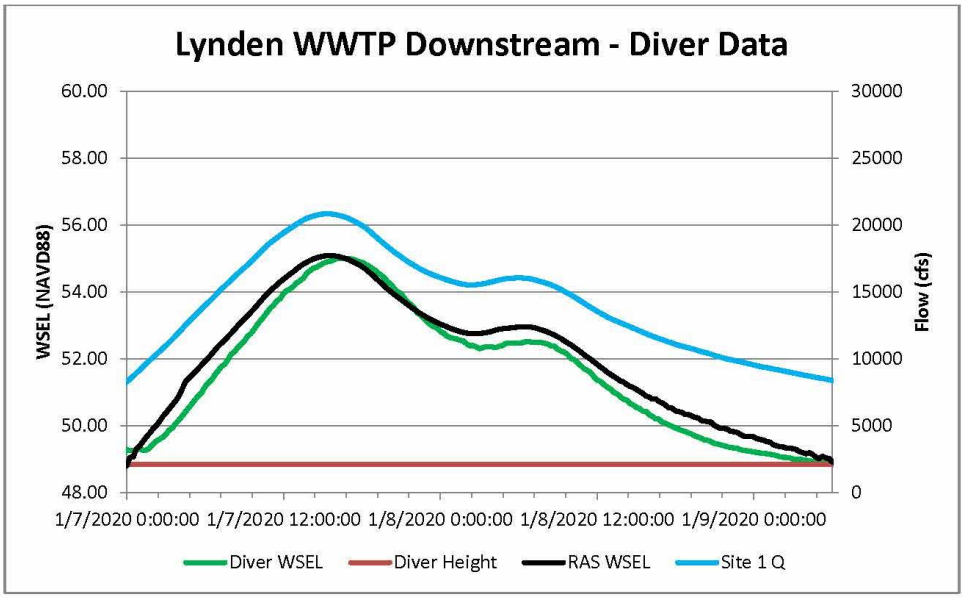

Figure 5-30: Downstream HEC-RAS Calibration, January 2020

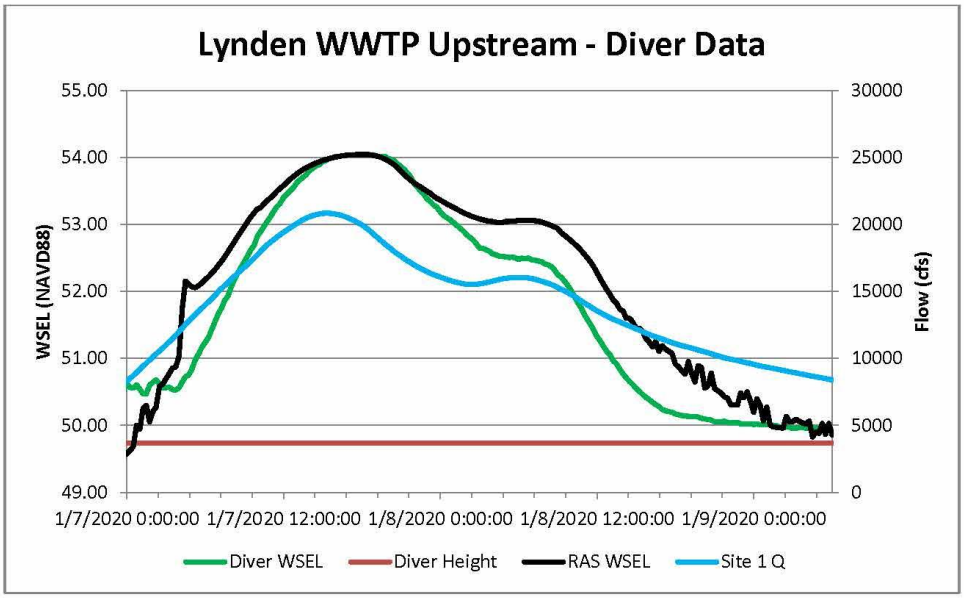

Figure 5-31: Upstream HEC-RAS Calibration, January 2020

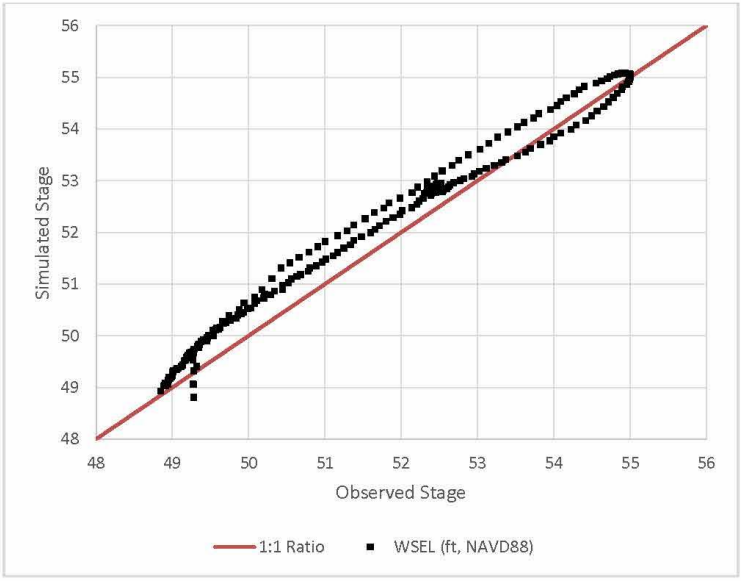

Figure 5-32: Downstream Flow Fit, January 2020

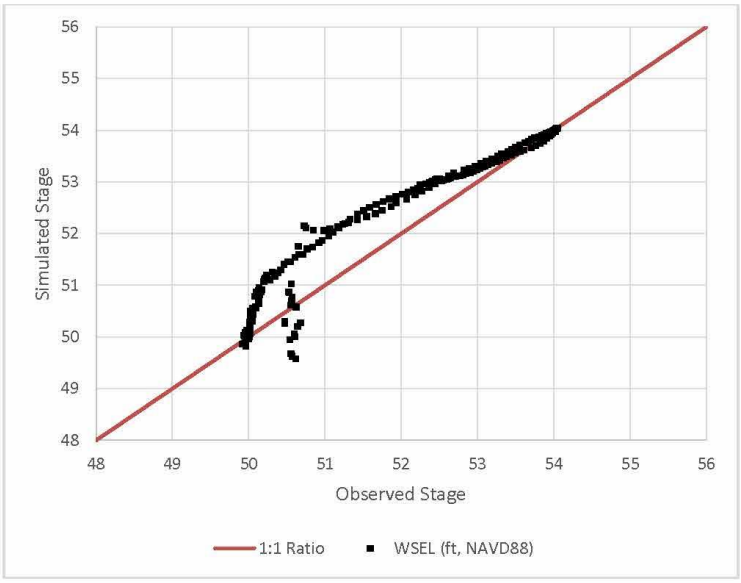

Figure 5-33: Upstream Flow Fit, January 2020

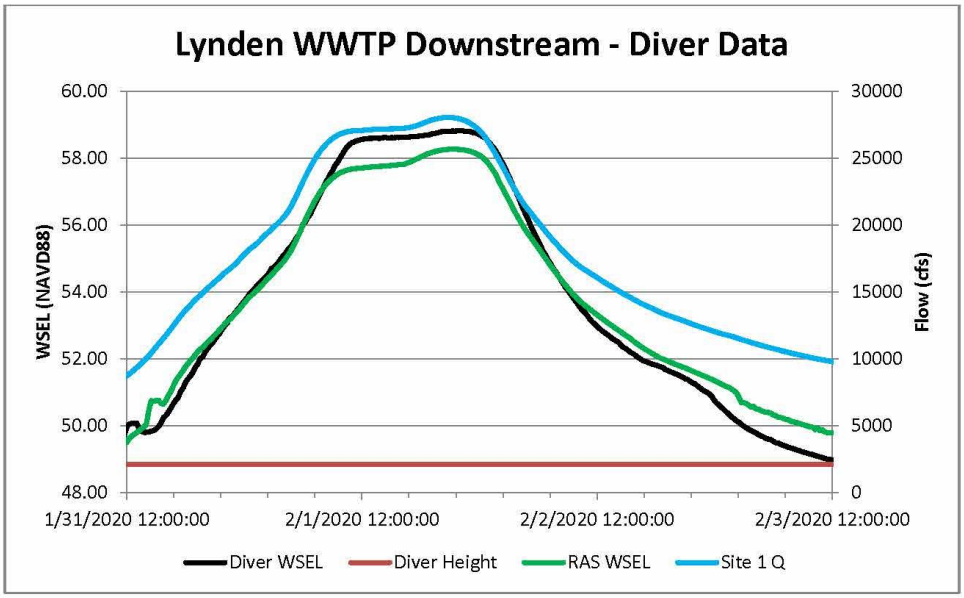

Figure 5-34: Downstream HEC-RAS Calibration, February 2020

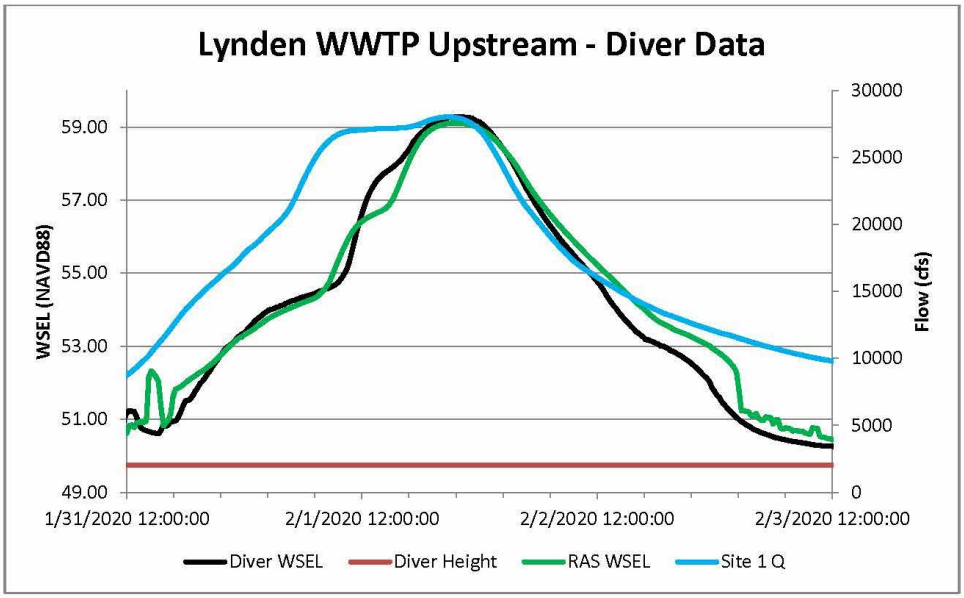

Figure 5-35: Upstream HEC-RAS Calibration, February 2020

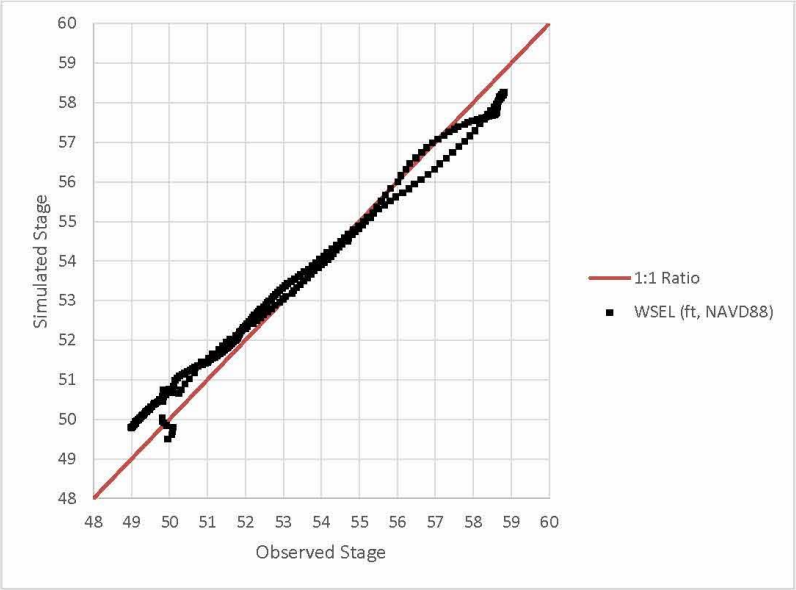

Figure 5-36: Downstream Flow Fit, February 2020

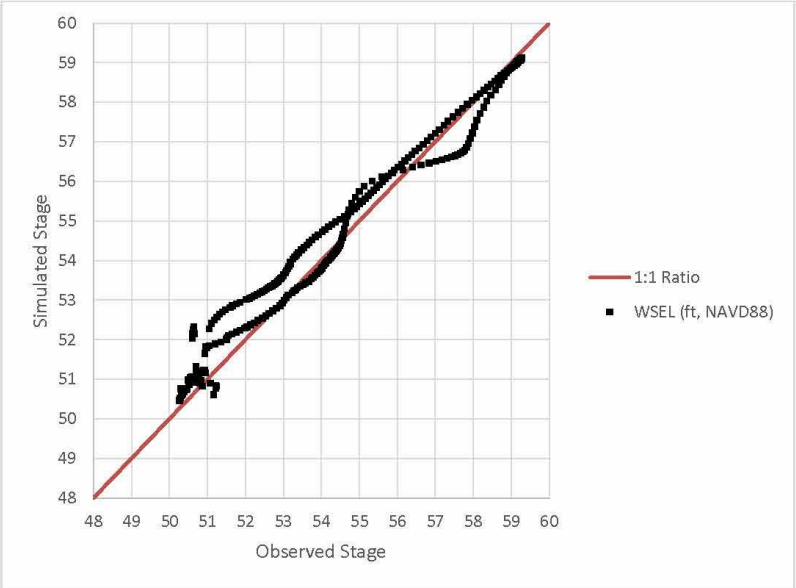

Figure 5-37: Upstream Flow Fit, February 2020

The NSE results for the downstream location are very strong. The simulated hydrograph shapes for all events also correlate very well to observed data. When looking at the peak WSELs, simulated results are at maximum 0.72 foot low, as seen in Table 5-17. Generally speaking, as flow on the Nooksack River increases, the model results diverge; however, all are within an acceptable tolerance considering the magnitude of flows and complexity of the system.

Table 5-17: Downstream Peak Simulation Results

Event Name	Event Dates	WSEL (ft)		
		Observed	Simulated	Delta
Early November (1) 2018	10/31/2018 - 11/05/2018	57.41	57.02	-0.39
Early November (2) 2018		54.29	54.12	-0.17
Late November 2018	11/21/2018 - 11/30/2019	58.20	57.48	-0.72
January 2019	01/02/2019 - 01/05/2019	52.98	53.02	0.04
January 2020	12/30/2019 - 01/10/2020	55.01	55.08	0.07
February 2020	01/29/2020 - 02/05/2020	58.83	58.23	-0.60

The NSE results for the upstream location are similarly very strong. The simulated hydrograph shapes for all events correlate very well to observed data. When looking at the peak WSELs, simulated results are at maximum 0.27 foot high, as seen in Table 5-18. Generally speaking, as flow on the Nooksack River increases, the model results converge; however, all are within an acceptable tolerance considering the magnitude of flows and complexity of the system.

Table 5-18: Upstream Peak Simulation Results

Event Name	Event Dates	WSEL (ft)		
		Observed	Simulated	Delta
Early November (1) 2018	10/31/2018 - 11/05/2018	54.78	55.05	0.27
Early November (2) 2018		53.59	53.62	0.03
Late November 2018	11/21/2018 - 11/30/2019	55.90	56.11	0.21
January 2019	01/02/2019 - 01/05/2019	52.74	53.01	0.27
January 2020	12/30/2019 - 01/10/2020	54.06	54.04	-0.02
February 2020	01/29/2020 - 02/05/2020	59.29	59.12	-0.17

In summary, the HEC-RAS model is considered robustly calibrated for both study areas. While the upstream hydrology for Site 1 on the Nooksack River (between Everson and Site 1) was not considered, it is also important to note the response of flows from the upstream location at Everson to downstream at Ferndale for observed USGS data. According to StreamStats, the drainage area at Everson is 622 square miles (mi2) and at Site 1 it is 633 mi2. For the November 2017 damaging event, the flow at Everson was 35,500 cfs, or 57 cfs per I mi2. Extrapolating that to the Site 1 location would yield an additional 630 cfs, or 36,130 cfs in total (shown by 57 cfs * 633 mi2 = 36,130 cfs/mi2). That is a 1.8 percent increase in flow, which is negligible considering the magnitude of flow in the Nooksack River. It should be noted that the interior drainage area of the culvert (0.3 mi2) was considered in all HEC-RAS simulations as that could have an effect on culvert calculations. This hydrology was previously discussed in Section 5.3.3 of this Design Definition Report (DDR).

The extrapolation technique should be considered a conservative estimate of flow at Site 1. As seen in Figure 5-38, the magnitude of flow at Ferndale is expected to be less than that of the upstream Everson location even though the contributing drainage area is increased by about 158 mi2. This makes sense considering the level of protection of the levee system between these locations; the damaging levee event of November 2017 where flow is lost from the system to the overbanks is an example of this. An example significant overflow/diversion of flow is at Everson Main Street "Everson Overflow" that directs flow north to the Fraser River. Based on a preliminary analysis of the simulated events and the November 2017 event, it is expected that flows would decrease from Everson to Ferndale for magnitudes over 17,000 cfs as measured at Everson. For magnitudes below this threshold, flows would be expected to increase at Ferndale as compared to Everson. It is important to note that this is likely true for only these and similar events and a more detailed analysis of additional data and routing over a wider range of flows is necessary to draw a similar conclusion of the flow data between the two gages. The preliminary data for this can be seen in Figure 5-39.

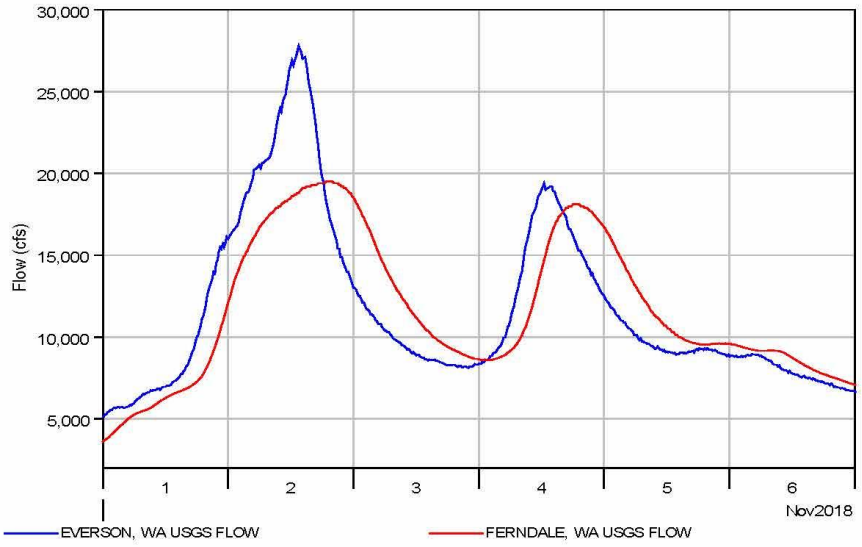

Figure 5-38: Observed Nooksack River Hydrograph Response November 2018

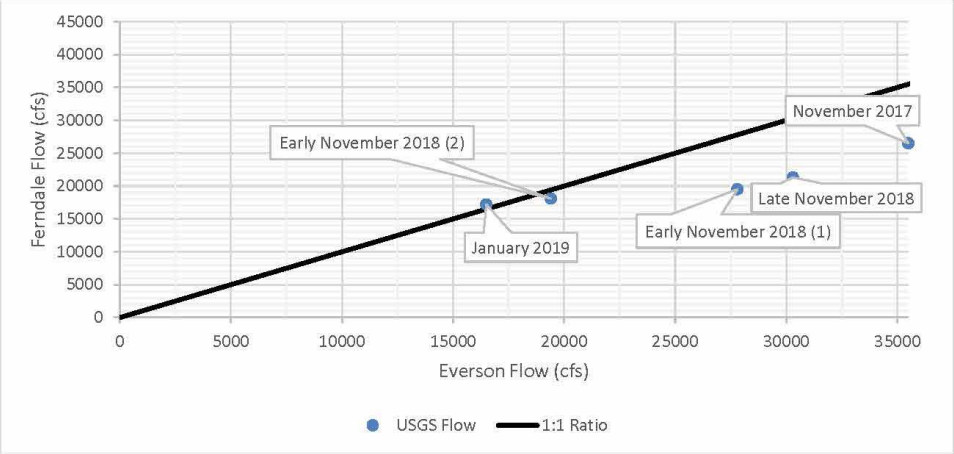

Figure 5-39: Upstream Peak Simulation Results

5.5.4. Existing Conditions

The existing-conditions HEC-RAS model can be seen in Figure 5-40. The 2D mesh was refined with breaklines to enforce hydraulically significant breaklines including the levees for the entire modeling domain.

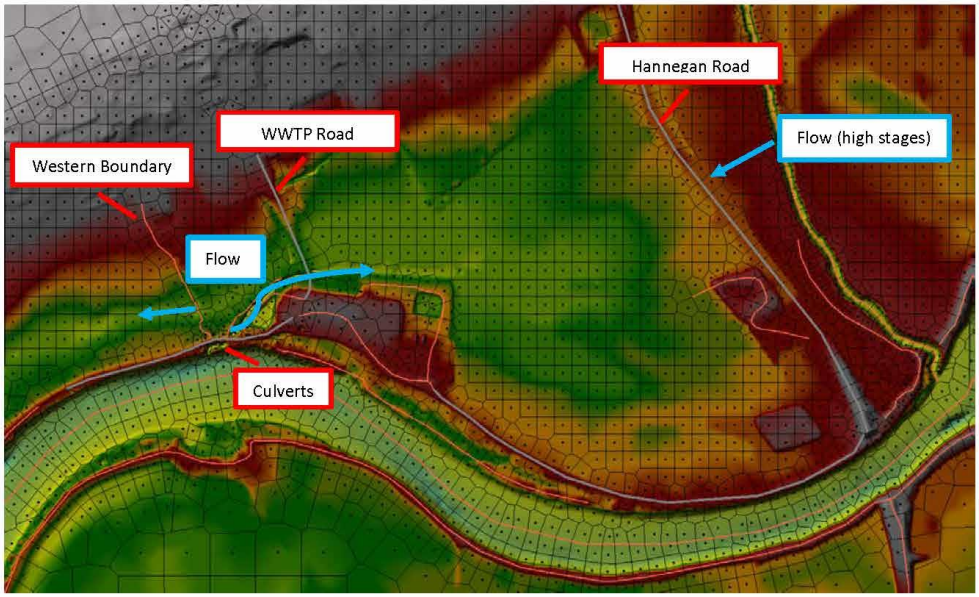

Figure 5-40: Site 1 HEC-RAS Existing Conditions Location Map

Discussions with Whatcom County and USACE Seattle District identified the following major questions:

- At what flow in the Nooksack River do the Lynden Levee culverts become engaged?
- At what flow in the Nooksack River does the WWTP roadway overtop?
- At what flow in the Nooksack River does Hannegan Road overtop?
- At what flow in the Nooksack River does the western watershed boundary of Site 1 become engaged?

The following scenarios were tested:

1) Calibration events including culvert interior drainage runoff from the HEC-HMS model.
2) Multiple scaled hydrographs using the late November 2018 event. This event was deemed suitable based on various hydrograph shapes of the Everson gage location. Culvert interior drainage runoff from the late November 2018 event was also scaled.
3) Constant discharges, which approaches a steady-state condition. A constant discharge is routed in the 2D unsteady-flow model until an equilibrium state is reached, i.e., inflow equals outflow. It was determined that inputting constant inflow discharges at the upstream Everson location from magnitudes ranging from 5,000 cfs to 26,000 cfs would be sufficient to model conditions where the WWTP road is overtopped. A constant inflow will yield a slightly more conservative estimate of WSELs because it negates any potential storage or attenuation associated with topographical features. This is also a good representation of a long-term flooding event.

The existing-conditions results can be seen in Table 5-19 and Table 5-20.

Table 5-19: Existing-Conditions HEC-RAS Results Calibration and Scaled Hydrograph Events

Event	Maximum Everson Location Flow (cfs)[a]	Site 1 Flow (cfs)[b]	Maximum Hannegan Road Flow (cfs)	Maximum WWTP Road WSEL (ft)	Site 1 Time of WWTP Overtopping[c]	Site 1 Overtopping Flow (cfs)[d]
January 2019	16,500	16,231	0	53.01	N/A	N/A
Early November (2) 2018	19,400	N/A	0	53.62	N/A	N/A
January 2020	21,500	20,932	0	54.04	1/7/2020 16:00	20,858
Scaled × 0.733	22,210	21,468	0	54.14	11/27/2018 14:45	21,231
Scaled × 0.825	24,998	23,918	38	54.51	11/27/2018 11:30	22,031
Early November (1) 2018	27,800	25,540	217	55.16	11/2/2018 9:15	21,179
Late November 2018	30,300	26,607	492	56.21	11/27/2018 7:15	22,112
Scaled × 1.086	32,906	26,962	803	56.68	11/27/2018 6:00	22,588
November 2017	35,500	27,145	2,860	58.62	11/23/2017 8:45	24,058
Scaled × 1.172	35,512	27,152	2,350	58.32	11/27/2018 4:45	22,628
February 2020	39,000	27,790	4,758	59.26	2/1/2020 4:30	21,175
Scaled × 1.32	39,996	27,976	5,142	59.35	11/27/2018 2:45	22,670

a. Represents the maximum flow at Everson. There is the potential for flow to be lost from the system because of levee overtopping.
b. Represents the maximum flow in the Nooksack River at Site 1 for the event.
c. Represents time when the WWTP road overtops. This occurs at a WSEL of roughly 54 ft.
d. Represents the flow in the Nooksack River when the WWTP road overtops.

Table 5-20: Existing-Conditions HEC-RAS Results Constant Discharge Events

Everson Location Flow (cfs)[a]	Site 1 Flow (cfs)[b]	Site 1 Riverward WSEL (ft)	Site 1 Landward WSEL (ft)	Watershed Boundary Flow (cfs)	Watershed Boundary WSEL (ft)	Hannegan Road Flow (cfs)	WWTP Road Headwater (east) WSEL (ft)	WWTP Road Tailwater (west) WSEL (ft)
15,000	14,996	52.46	52.45	0	N/A	0	52.46	52.45
16,000	15,998	52.95	52.94	<1	52.81	0	52.95	52.94
17,000	16,999	53.42	53.41	7	53.23	0	53.40	53.41
18,000	17,999	53.84	53.74	26	53.51	0	53.71	53.70
19,000	19,000	54.28	53.98	48	53.74	0	53.92	53.92
20,000	19,992	54.73	54.19	72	53.94	7	54.12	54.11
21,000	20,884	55.15	54.72	175	54.50	116	54.87	54.70
22,000	21,773	55.55	55.12	290	54.91	227	55.28	55.14
23,000	22,669	55.94	55.44	403	55.22	330	55.60	55.47
24,000	23,543	56.32	55.73	529	55.51	445	55.90	55.79
25,000	24,349	56.67	56.00	669	55.78	575	56.19	56.08
26,000	25,056	56.99	56.31	858	56.09	753	56.53	56.42

a. Represents the maximum flow at Everson. There is the potential for flow to be lost from the system because of levee overtopping.
b. Represents the maximum flow in the Nooksack River at Site 1 for the event.

Based on the HEC-RAS results, the following major events occur. Flow values are reported as maximum flow as observed at Everson:

- **16,000 cfs:** Lynden Levee culverts engaged
- **16,000–17,000 cfs:** western basin boundary experiences overflow
- **20,000–22,000 cfs:** WWTP road overtops
  - The low bound represents the most conservative estimate based on no upstream storage. The high bound represents a flow where the WWTP road will overtop regardless of the type of flooding event (flashy or long term).
- **20,000–25,000 cfs:** Levee and Hannegan Road overtopped
  - The low bound represents the most conservative estimate based on no upstream storage. The high bound represents a flow where Hannegan Road will overtop regardless of the type of flooding event (flashy or long term).

5.5.5. Proposed Conditions

The proposed-conditions HEC-RAS model can be seen in Figure 5-41. The 2D mesh was refined with breaklines to enforce hydraulically significant breaklines including the levees for the entire domain and refined at Site 1 per the proposed design. The channel upstream of the culverts was regraded based on Whatcom County's supplied DWG and the existing culverts were replaced with a 110-foot-long, 4-foot-diameter high-density polyethylene (HDPE) culvert at an invert of 46.75 feet in the same approximate location as the existing 2-foot-diameter reinforced concrete pipe (RCP).

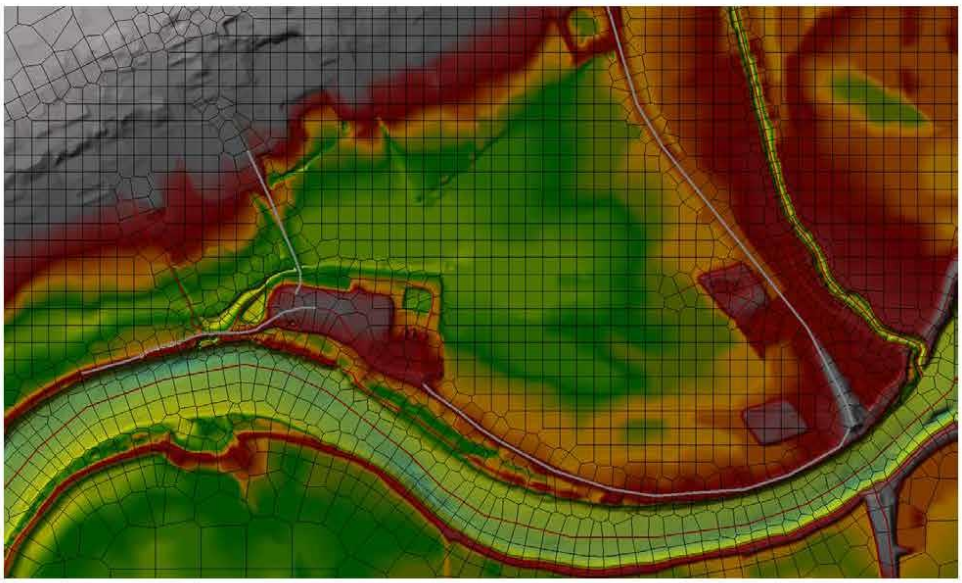

Figure 5-41: Site 1 HEC-RAS Proposed-Conditions Location Map

Based on the HEC-RAS results as seen in Table 5-21 and Table 5-22, the following major events occur, which are all approximately the same as the existing-conditions scenario. The proposed culvert has a different invert and other hydraulic factors from existing conditions and ultimately allows a different flow pattern from the Nooksack River into Site 1. Because the magnitude of modeled flows was to the nearest thousand, this could not be quantified directly. However, a different grading on the landward side of the levee, proposed by Whatcom County, provides additional storage that compensates these effects and ultimately results in lower WSEL. It should be noted that the flows listed below are the same as those listed for the existing conditions. This shows that levee height would not alter flows, meaning it would not significantly divert more flow over other levees.

- **16,000 cfs:** Lynden Levee culverts engaged
- **16,000–17,000 cfs:** western basin boundary experiences overflow
- **20,000–22,000 cfs:** WWTP road overtops
    - The low bound represents the most conservative estimate based on no upstream storage. The high bound represents a flow where the WWTP road will overtop regardless of the type of flooding event (flashy or long term).
- **20,000–25,000 cfs:** levee and Hannegan Road overtopped
    - The low bound represents the most conservative estimate based on no upstream storage. The high bound represents a flow where the Hannegan Road will overtop regardless of the type of flooding event (flashy or long term).

Table 5-21: Proposed-Conditions HEC-RAS Results Calibration and Scaled Hydrograph Events

Event	Maximum Everson Location Flow (cfs) [a]	Site 1 Flow (cfs) [b]	Maximum Hannegan Road Flow (cfs)	Maximum WWTP Road WSEL (ft)	Site 1 Time of WWTP Overtopping [c]	Site 1 Overtopping Flow (cfs) [d]
January 2019	16,500	16,230	0	53	N/A	N/A
Early November (2) 2018	19,400	N/A	0	53.57	N/A	N/A
January 2020	21,500	20,930	0	53.95	N/A	N/A
Scaled × 0.733	22,210	21,466	0	54.04	11/27/2018 16:45	21,439
Scaled × 0.825	24,998	23,913	40	54.4	11/27/2018 12:30	22,591
Early November (1) 2018	27,800	25,532	222	55.08	11/2/2018 10:30	22,493
Late November 2018	30,300	26,589	499	56.14	11/27/2018 8:15	23,075
Scaled × 1.086	32,906	26,933	813	56.61	11/27/2018 6:45	23,359
November 2017	35,500	27,109	2,865	58.59	11/23/2017 9:30	25,324
Scaled × 1.172	35,512	27,117	2,358	58.29	11/27/2018 5:30	23,554
February 2020	39,000	27,738	4,762	59.24	2/1/2020 5:15	22,217
Scaled × 1.32	39,996	27,919	5,145	59.33	11/27/2018 3:30	23,549

a. Represents the maximum flow at Everson. There is the potential for flow to be lost from the system because of levee overtopping.
b. Represents the maximum flow in the Nooksack River at Site 1 for the event.
c. Represents time when the WWTP road overtops. This occurs at a WSEL of roughly 54 ft.
d. Represents the flow in the Nooksack River when the WWTP road overtops.

Table 5-22: Proposed-Conditions HEC-RAS Results Constant Discharge Events

Everson Location Flow (cfs)	Site 1 Nooksack River Flow (cfs)	Site 1 Riverward WSEL (ft)	Site 1 Landward WSEL (ft)	Watershed Boundary Flow (cfs)	Watershed Boundary WSEL (ft)	Hannegan Road Flow (cfs)	WWTP Road Headwater (east) WSEL (ft)	WWTP Road Tailwater (west) WSEL (ft)
15,000	14,995	52.43	52.43	0	N/A	0	52.44	52.43
16,000	15,997	52.94	52.94	<1	52.94	0	52.93	52.94
17,000	16,999	53.37	53.34	12	53.31	0	53.34	53.34
18,000	17,999	53.83	53.63	32	53.56	0	53.63	53.62
19,000	19,000	54.29	53.83	51	53.75	0	53.83	53.82
20,000	19,991	54.76	54.01	73	53.93	9	54.02	54.01
21,000	20,881	55.18	54.58	175	54.49	119	54.82	54.61
22,000	21,770	55.58	55.00	289	54.89	229	55.23	55.05
23,000	22,666	55.98	55.31	402	55.21	333	55.54	55.39
24,000	23,542	56.37	55.61	529	55.50	449	55.84	55.71
25,000	24,345	56.72	55.88	669	55.77	579	56.13	56.00
26,000	25,050	57.03	56.20	862	56.07	758	56.47	56.34

5.5.6. Expected Impacts of Culvert Replacement

At the field meeting with WDFW on 15 November 2019, the primary concern expressed by the WDFW representative was over the change of available habitat behind the levee for juvenile fish seeking refuge during flood events, rather than the upstream adult and juvenile fish migration potential. These two fish passage issues require very different criteria and accommodate very different habitat needs. Upstream migration is important when adult and resident fish are seeking pathways to upstream spawning reaches, none of which are present in the landward refugia area. High-flow refugia for fish is enabled when fish, especially juvenile salmonids, are encouraged to seek out areas of low velocity and lesser turbidity when the main channel of the river is in flood. On the falling limb of the flood event, these fish exit the refugia area and return to the main channel of the river. Hence, the flow velocity criteria for these two purposes are very different. The concern was centered on the extent (area) of refugia habitat available during floods and whether the new culvert design, including the incorporation of a flap gate (discussed in a subsequent section), would decrease the habitat area. Also of concern to USACE and Whatcom County is if the proposed culvert would increase flooding for the interior drainage of the culvert as represented by an increase in WSEL, specifically at the WWTP road.

A comparison of proposed versus existing conditions can be seen in Table 5-23 through Table 5-25. Refuge behind the culvert is increased from two perspectives: (1) a higher bound of flow access from the Nooksack River and (2) increased storage due to grading of the upstream channel.

Table 5-23: Proposed-Conditions vs. Existing-Conditions HEC-RAS Results Comparison

Event	Maximum Everson Location Flow (cfs)[a]	Delta Site 1 Flow (cfs)[b]	Delta Maximum Hannegan Road Flow (cfs)	Delta Maximum WWTP Road WSEL (ft)[c]	Delta Site 1 Overtopping Flow (cfs)[d]
January 2019	16,500	-1	0	-0.01	N/A
Early November (2) 2018	19,400	0	0	-0.05	N/A
January 2020	21,500	-2	0	-0.09	N/A
Scaled × 0.733	22,210	-2	0	-0.1	208
Scaled × 0.825	24,998	-4	1	-0.11	560
Early November (1) 2018	27,800	-9	5	-0.08	1,314
Late November 2018	30,300	-18	7	-0.07	964
Scaled × 1.086	32,906	-29	10	-0.07	771
November 2017	35,500	-36	5	-0.03	1,266
Scaled × 1.172	35,512	-35	8	-0.03	926
February 2020	39,000	-53	4	-0.02	1,041
Scaled × 1.32	39,996	-57	4	-0.02	880

a. Represents the maximum flow at Everson. There is the potential for flow to be lost from the system because of levee overtopping.
b. Represents the maximum flow in the Nooksack River at Site 1 for the event.
c. Represents maximum WWTP road WSEL, headwater or tailwater.
d. Represents the flow in the Nooksack River when the WWTP road overtops.

Table 5-24: Proposed-Conditions vs. Existing-Conditions HEC-RAS Results Comparison

Event	Maximum Everson Location Flow (cfs) [a]	Site 1 Time of WWTP Overtopping [b]		Site 1 Time of WWTP Clearing [c]		Delta Time Overtopped (hr)
		Existing	Proposed	Existing	Proposed	
January 2019	16,500	N/A	N/A	N/A	N/A	N/A
Early November (2) 2018	19,400	N/A	N/A	N/A	N/A	N/A
January 2020	21,500	1/7/2020 16:00	N/A	1/7/2020 20:00	N/A	N/A
Scaled × 0.733	22,210	11/27/2018 14:45	11/27/2018 16:45	11/27/2018 22:30	11/27/2018 21:30	-3:00
Scaled × 0.825	24,998	11/27/2018 11:30	11/27/2018 12:30	11/28/2018 1:00	11/28/2018 0:30	-1:30
Early November (1) 2018	27,800	11/2/2018 9:15	11/2/2018 10:30	11/2/2018 23:00	11/2/2018 22:30	-1:45
Late November 2018	30,300	11/27/2018 7:15	11/27/2018 8:15	11/28/2018 4:45	11/28/2018 4:30	-1:15
Scaled × 1.086	32,906	11/27/2018 6:00	11/27/2018 6:45	11/28/2018 12:00	11/28/2018 11:30	-1:15
November 2017	35,500	11/23/2017 8:45	11/23/2017 9:30	11/24/2017 18:15	11/24/2017 18:15	-0:45
Scaled × 1.172	35,512	11/27/2018 4:45	11/27/2018 5:30	11/28/2018 18:00	11/28/2018 17:30	-1:15
February 2020	39,000	2/1/2020 4:30	2/1/2020 5:15	2/2/2020 20:45	2/2/2020 20:30	-1:00
Scaled × 1.32	39,996	11/27/2018 2:45	11/27/2018 3:30	11/28/2018 22:15	11/28/2018 21:45	-1:15

a. Represents the maximum flow at Everson. There is the potential for flow to be lost from the system because of levee overtopping.
b. Represents time when the WWTP road overtops. This occurs at a WSEL of roughly 54 ft.
c. Represents time when the WWTP road is no longer inundated. This occurs at a WSEL of roughly 54 ft.

Table 5-25: Proposed-Conditions vs. Existing-Conditions HEC-RAS Results Comparison

Everson Location Flow (cfs)	Site 1 Nooksack River Flow (cfs)	Site 1 Riverward WSEL (ft)	Site 1 Landward WSEL (ft)	Watershed Boundary Flow (cfs)	Watershed Boundary WSEL (ft)	Hannegan Road Flow (cfs)	WWTP Road Headwater (east) WSEL (ft)	WWTP Road Tailwater (west) WSEL (ft)
15,000	0	-0.02	-0.01	0	0.00	0	-0.03	-0.02
16,000	0	-0.01	0.00	0	0.13	0	-0.01	0.00
17,000	0	-0.05	-0.07	5	0.08	0	-0.06	-0.07
18,000	0	-0.01	-0.11	5	0.05	0	-0.08	-0.08
19,000	0	0.01	-0.15	3	0.01	0	-0.09	-0.10
20,000	-1	0.04	-0.18	0	-0.01	1	-0.10	-0.10
21,000	-3	0.03	-0.14	1	-0.01	3	-0.05	-0.09
22,000	-2	0.03	-0.12	-1	-0.01	2	-0.05	-0.08
23,000	-3	0.04	-0.12	-1	-0.02	3	-0.06	-0.08
24,000	-2	0.04	-0.12	-1	-0.02	3	-0.06	-0.08
25,000	-4	0.04	-0.12	0	-0.02	4	-0.06	-0.08
26,000	-6	0.04	-0.11	4	-0.01	5	-0.06	-0.08

The flow access can be seen by examining the column "Delta Site 1 Overtopping Flow" in Table 5-23 above. The positive values show that while the WWTP still overtops, it takes a greater magnitude of flow in the Nooksack River for this occur. For example, in the late November 2018 event, Table 5-19 shows a Nooksack River flow of 22,112 cfs at Site 1 for the WWTP road to overtop for existing conditions while Table 5-21 shows a Nooksack River flow of 23,075 cfs for the WWTP road to overtop for proposed conditions—an increase of 964 cfs for fish to access the refugia.

The increased storage can be seen by looking at Table 5-25 and column "Watershed Boundary WSEL." Here a WSEL increase is negligible because there are no damaging flood effects as the WWTP road does not overtop to roughly 20,000 cfs—at which point the watershed boundary WSEL decreases. The watershed boundary WSEL increases and the levee landward side WSEL decreases because the proposed grading has an excavated stilling pool at the culvert inlet. But the excavated stilling pool removes a small bit of ridge on the northwestern bank of the existing channel that connects the WWTP road culvert to the levee culvert. This ridge removal contributes to the increased watershed boundary WSEL.

It is also important to examine the potential effects to the WWTP road from a flooding perspective. The maximum WSEL is decreased in the proposed conditions as seen in Table 5-23 and Table 5-25. And while the roadway still overtops, the inundation time is decreased in the proposed-conditions scenario as seen in Table 5-24. A flap gate will be installed to help alleviate flooding concerns at the WWTP road and this is discussed in a subsequent section.

5.5.7. Flap Gate Design

Based on comments and feedback from USACE and Whatcom County, a flap gate is desired to help alleviate flooding at the WWTP road. The flap gate will be installed on the river side of the culvert through the levee to provide positive closure of the levee protection system for high river levels below the levee overtopping level. The tide gate is intended to limit interior flooding for floods of small magnitude that do not overtop the levee at the project site or upstream reaches that would otherwise flood the interior protected area. The levee foundation materials at Site 1 are anticipated to cause the levee to settle over time and, to accommodate this settlement, the culvert is to be installed with a positive camber in its profile.

Initial settlement is anticipated to result in the culvert centerline alignment at the flap gate end rotating slightly as the middle of the culvert settles. Hence, the flap gate hinge setting is to be adjustable, to enable Whatcom County staff to periodically adjust the hinge plumbness to maintain the proper closure function. Construction timing may result in delay of flap gate installation until after the flood season, in which case it is expected that the interior flooding conditions would not be any different from those under existing conditions because the new culvert size and vertical setting is not significantly different from the existing culvert. If interior flooding equal to the historical condition is unacceptable, culvert inflow may be limited using temporary measures through the winter. The contingency measures may include simple measures such as having SuperSack bags of gravel or concrete Eco-Blocks at the ready to be lifted into place on the riverward end of the culvert to partially obstruct the flow path. Alternately, a steel trench protection sheet might be pre-positioned to drop into place to close the culvert off in the case of flooding.

The project design includes development of a performance specification for such a flap gate system, to be designed by the vendor to attach to the selected type of culvert pipe material and setting. At present, the tide gate is assumed to comprise a vertically hinged, slightly over-center axis, flap gate with a closure trigger mechanism to trip the gate and allow it to close under its own weight on the rising limb of the flood hydrograph on the river channel. The trigger mechanism and the vertical setting of the hinge axis alignment is assumed to be automatic but manually adjustable in order for the County or City of Lynden to change the setting if needed in the future. The hinge axis adjustment will be used in the future to adjust the axis of the gate hinge to match the culvert settlement expected over time. The trigger system is assumed to comprise a float within a wet well or other means of triggering the gate latching system by water level on the landward side of the levee, or perhaps on both the river and landward sides of the culvert. The trigger mechanism will be designed to adjust the closure water level at any stage between 52.5 ft and 54.5 ft. This section discusses the methodology for operation of the flap gate and the design parameters upon which the flap gate is designed.

Section 5.5.3 shows that the model is well-calibrated across a range of flows where the WWTP access road will be overtopped, because that is a primary concern for this project. The following is intended to show that the model is well-calibrated from a timing and stage perspective for the thresholds where flap gate activation is needed. Table 5-26 and Table 5-27 show Diver Data and HEC-RAS model results and Table 5-28 shows a comparison. While the following analysis is based on existing conditions, Table 5-23 and Table 5-25 show that the hydraulics of the Nooksack River are not significantly different enough in the proposed conditions to affect the flap gate operational parameters. The following are the table header descriptions:

- **Downstream WSEL:** The WSEL at the Downstream Diver location.
- **Upstream WSEL:** The WSEL at the Upstream Diver location.
- **Site 1 Flow:** Represents flow in the Nooksack River at Site 1 for the particular time step.
- **Overtop - 1:** The time step that is 15 minutes before the WWTP road overtops.
- **Overtop:** The time step where the WWTP road overtops.
- **Max DS:** The time step when the maximum WSEL at the Downstream Diver location occurs. This is the same thing as the maximum WSEL for the Nooksack River for the entire calibration event.
- **Max WWTP:** The time step when the maximum WSEL at the Upstream Diver location occurs. This is the same thing as the maximum WSEL for the WWTP road tailwater (west outlet) for the entire calibration event.

Table 5-26: Diver Data Analysis for WWTP Road Overtopping

Event	Event	Date + Time	Downstream WSEL (ft)	Upstream WSEL (ft)
Early November 2018	Overtop - 1	11/2/2018 8:15:00	55.16	53.98
	Overtop	11/2/2018 8:30:00	55.24	54.02
	Max DS	11/2/2018 15:15:00	57.41	54.60
	Max WWTP	11/2/2018 17:30:00	56.35	54.78
Late November 2018	Overtop - 1	11/27/2018 6:15:00	55.07	53.97
	Overtop	11/27/2018 6:30:00	55.18	54.01
	Max DS	11/27/2018 17:15:00	58.20	55.59
	Max WWTP	11/27/2018 19:45:00	58.00	55.90
January 2020	Overtop - 1	1/7/2020 15:30:00	54.91	53.98
	Overtop	1/7/2020 15:45:00	54.94	54.00
	Max DS	1/7/2020 16:15:00	55.01	54.02
	Max WWTP	1/7/2020 18:00:00	54.89	54.06
February 2020	Overtop - 1	2/1/2020 2:30:00	54.56	53.99
	Overtop	2/1/2020 2:45:00	54.70	54.02
	Max DS	2/1/2020 22:00:00	58.83	59.28
	Max WWTP	2/1/2020 21:45:00	58.82	59.29

Table 5-27: Existing-Conditions Model Analysis for WWTP Road Overtopping

Event	Reporting	Date + Time	Downstream WSEL (ft)	Upstream WSEL (ft)	Site 1 Flow (cfs)
Early November 2018	Overtop - 1	11/2/2018 9:00:00	55.03	53.98	20,843
	Overtop	11/2/2018 9:15:00	55.12	54.00	21,064
	Max DS	11/2/2018 14:45:00	57.02	54.73	25,405
	Max WWTP	11/2/2018 16:30:00	56.73	55.05	24,472
Late November 2018	Overtop - 1	11/27/2018 7:00:00	55.41	53.96	21,763
	Overtop	11/27/2018 7:15:00	55.51	54.00	21,983
	Max DS	11/27/2018 16:15:00	57.48	56.04	26,467
	Max WWTP	11/27/2018 17:45:00	57.45	56.11	26,344
January 2020	Overtop - 1	1/7/2020 15:45:00	55.08	53.99	20,817
	Overtop	1/7/2020 16:00:00	55.07	54.00	20,778
	Max DS	1/7/2020 15:30:00	55.08	53.98	20,840
	Max WWTP	1/7/2020 18:00:00	54.76	54.04	19,973
February 2020	Overtop - 1	2/1/2020 4:15:00	55.00	53.99	20,794
	Overtop	2/1/2020 4:30:00	55.10	54.02	21,056
	Max DS	2/1/2020 21:15:00	58.23	59.12	28,018
	Max WWTP	2/1/2020 21:30:00	58.23	59.12	27,997

Table 5-28: Comparison of Diver Data and Existing-Conditions Model for WWTP Road Overtopping

Event	Reporting	Delta Time (hr:min)[a]	Downstream WSEL (ft)	Upstream WSEL (ft)
Early November 2018	Overtop - 1	0:45	-0.13	0.00
	Overtop	0:45	-0.12	-0.02
	Max DS	(0:30)	-0.39	0.13
	Max WWTP	(1:00)	0.38	0.27
Late November 2018	Overtop - 1	0:45	0.34	-0.01
	Overtop	0:45	0.33	-0.01
	Max DS	(1:00)	-0.72	0.45
	Max WWTP	(2:00)	-0.55	0.21
January 2020	Overtop - 1	0:15	0.17	0.01
	Overtop	0:15	0.13	0.00
	Max DS	(0:45)	0.07	-0.04
	Max WWTP	0:00	-0.13	-0.02
February 2020	Overtop - 1	1:45	0.44	0.00
	Overtop	1:45	0.40	0.00
	Max DS	(0:45)	-0.60	-0.16
	Max WWTP	(0:15)	-0.59	-0.17

a. Red means model was slower than observed. Green means faster than observed.

The model compares well for the four calibration events where the WWTP road was overtopped. It was 15 to 105 minutes slow in predicting WWTP road overtopping, but 30 to 120 minutes fast in predicting the maximum WSEL at the Upstream Diver location (WWTP road). Maximum WSEL difference ranged from -0.17 foot to 0.27 foot at the WWTP road and -0.72 foot to 0.07 foot at the Downstream Diver location (Nooksack River). Note that as seen in Table 5-19, Hannegan Road overtops at roughly 25,000 cfs flow at Everson for the calibration events and this dynamic is just beyond the flap gate operations because it will likely lead to WWTP road overtopping anyway. Only the January 2020 event was below this threshold and timing matched well for both WWTP road overtopping and maximum WSEL.

The main channel river WSEL is key for gate closure operations, though the gate triggering mechanism will be adjustable by County staff so that the closing water level elevation can be tuned to prevent landward damaging flooding as flood events occur and more is understood about the hydraulics of the main river channel and the landward flooding from overtopping elsewhere in the levee system. Table 5-29 shows the time step of model results for WWTP road overtopping (same as in Table 5-27) as well as the time step for when that magnitude of flow was first seen at the Everson location. This analysis was done by finding the time when the WWTP road overtops, then finding the magnitude of flow in the Nooksack River at the Site 1 location at this time step, and then back-tracking in the USGS recorded hydrograph to when this flow magnitude was seen at Everson. Note that because the USGS recorded only at 15-minute intervals, a perfect match cannot be made with observed versus simulated flows so the closest-value time step was selected for the Everson location. Based on Table 5-20, it can be assumed there is zero to minimal flow loss in the system until about 22,000 cfs, providing

reasonableness to this routing exercise. So a conservative warning time estimate for when a flow recorded at Everson will reach the Site 1 location is 2 hours.

Table 5-29: Nooksack River Timing Based on Existing-Conditions Model for WWTP Road Overtopping

Event	Everson Location		Site 1 Location		Time Delta
	Date + Time	Flow (cfs)	Date + Time	Flow (cfs)	
Early November 2018	11/2/2018 7:00	21,000	11/2/2018 9:15:00	21,064	2:15
Late November 2018	11/27/2018 4:30	22,100	11/27/2018 7:15:00	21,983	2:45
January 2020	1/7/2020 11:30	20,800	1/7/2020 16:00:00	20,778	4:30
February 2020	2/1/2020 2:00	21,000	2/1/2020 4:30:00	21,056	2:30

The following procedure is recommended for flap gate operation:

1) Manual override operation of the gate is assumed to be desired, but typical tide gate closing and opening operation is assumed to be automatically triggered by the river level. A stage of 54.0 feet at the landward (headwater) entrance of the proposed culvert should be notification as seen in Table 5-27. This is a conservative estimate to account for gate closing time. However, the gate closure trigger system should be adjustable and capable of triggering gate closure at any landward water level between 52.5 ft and 54.5 ft. Adjustment will be required in the future by County staff to accommodate localized conditions.
2) The USGS Everson gage is to be used as the primary source of information for flap gate operation adjustment and operator calibration, though the gate triggering mechanism will be directly responsive to the river channel WSEL at the tide gate itself. This gage has continuous sub-hourly reporting and the potential for administering warnings based on flow thresholds. As stated above, this location provides a 2-hour lead time for Site 1.
3) When flow at Everson reaches 20,000 cfs, it is recommended to alert staff that the flap gate may automatically activate at some point as the river rises. Table 5-22 shows this as the minimum threshold when the WWTP may overtop.
4) Continue monitoring the situation. If flow is forecasted to rise above 23,000 cfs, the adjustment on the flap gate closure triggering mechanism should ensure closure of the gate. As Table 5-21 shows, the road may overtop as low as 21,400 cfs.

APPENDIX B – PROJECT DAMAGES

Photo 1: Downstream end of Site 1 showing the damaged toe. See photo below for another view of this photo.

Photo 2: Toe scour into levee prism at the downstream end of Site 1

Photo 3: Embankment scour at Site 1 located within the middle of the damaged length.

Photo 4: Looking upstream from embankment scour shown in photo 3. Arrow points to where the perched outlet from culvert drainage enters into the Nooksack River.

Photo 5: Drainage outflow of culverts. Arrows point to culvert location.

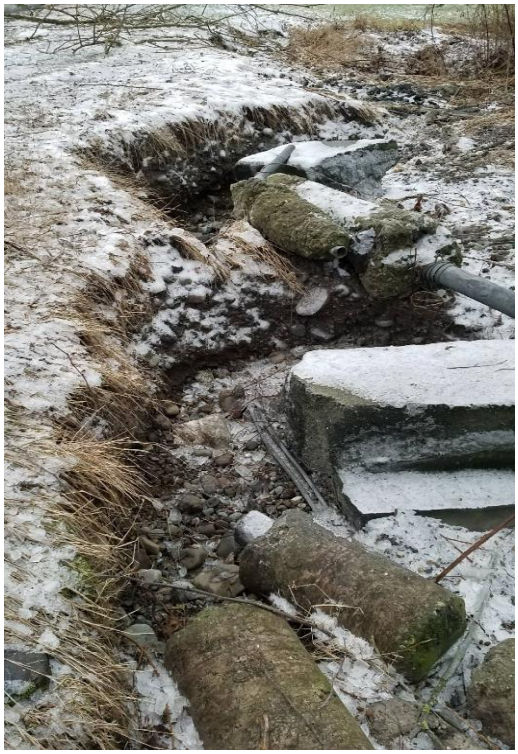

Photo 6: Overtopping damage on the landward crest at Site 1.

Photo 7: Toe scour into levee prism at Site 2.

APPENDIX C – PROJECT DESIGNS AND PLANS

US Army Corps
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FY18 LEVEE REHABILITATION
NOOKSACK RIVER
LYNDEN LEVEE NSK-03-18

WHATCOM COUNTY, WA

VICINITY MAP
NOT TO SCALE

PROJECT LOCATION MAP

PLATE NO.		TITLE
GENERAL		
	G-001	TITLE, VICINITY MAP, PROJECT LOCATION, AND INDEX
	G-002	GENERAL NOTES
CIVIL		
	C-100	ACESS AND STAGING PLAN
	C-101	SITE 1 PLAN AND PROFILE
	C-102	SITE 1 TYPICAL SECTIONS
	C-103	SITE 1 SECTIONS
	C-104	CULVEVT AND FLAP GATE DETAILS
	C-105	SITE 2 PLAN AND SECTION

PN NSK-03-18 FY18

IF SHEET MEASURES LESS THAN 22"x34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.

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US ARMY CORPS OF ENGINEERS
SEATTLE DISTRICT
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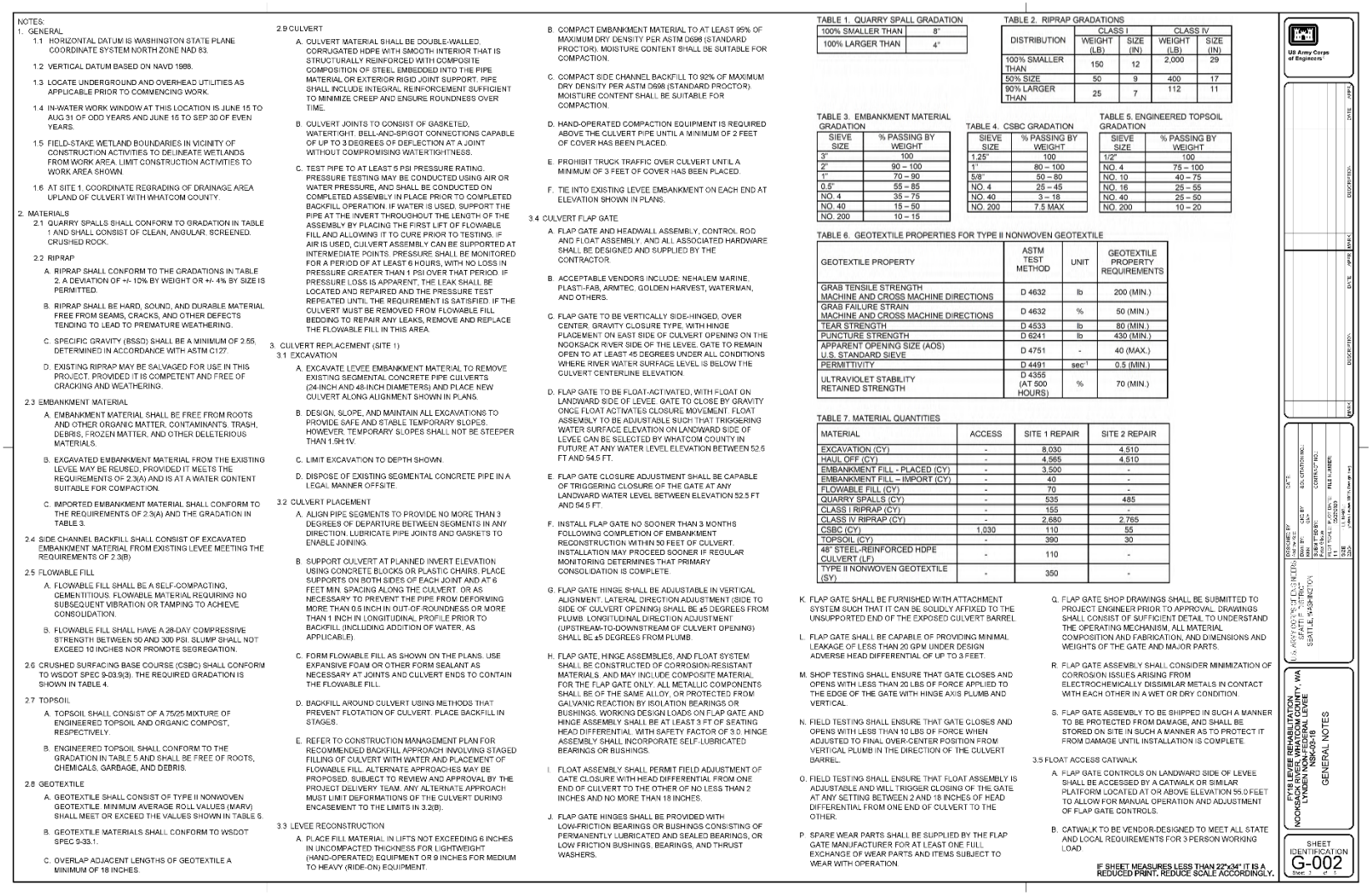
FY18 LEVEE REHABILITATION
NOOKSACK RIVER, WHATCOM COUNTY, WA
LYNDEN INTERNATIONAL LEVEE
NSK-03-18

TITLE VICINITY MAP, PROJECT LOCATION, AND INDEX

SHEET IDENTIFICATION
G-001



NOTES:

1. GENERAL
   - 1.1 HORIZONTAL DATUM IS WASHINGTON STATE PLANE COORDINATE SYSTEM NORTH ZONE NAD 83.
   - 1.2 VERTICAL DATUM BASED ON NAVD 1988.
   - 1.3 LOCATE UNDERGROUND AND OVERHEAD UTILITIES AS APPLICABLE PRIOR TO COMMENCING WORK.
   - 1.4 IN-WATER WORK WINDOW AT THIS LOCATION IS JUNE 15 TO AUG 31 OF ODD YEARS AND JUNE 15 TO SEP 30 OF EVEN YEARS.
   - 1.5 FIELD-STAKE WETLAND BOUNDARIES IN VICINITY OF CONSTRUCTION ACTIVITIES TO DELINEATE WETLANDS FROM WORK AREA. LIMIT CONSTRUCTION ACTIVITIES TO WORK AREA SHOWN.
   - 1.6 AT SITE 1, COORDINATE REGRADING OF DRAINAGE AREA UPLAND OF CULVERT WITH WHATCOM COUNTY.
2. MATERIALS
   - 2.1 QUARRY SPALLS SHALL CONFORM TO GRADATION IN TABLE 1 AND SHALL CONSIST OF CLEAN, ANGULAR, SCREENED, CRUSHED ROCK.
   - 2.2 RIPRAP
     - A. RIPRAP SHALL CONFORM TO THE GRADATIONS IN TABLE 2. A DEVIATION OF +/- 10% BY WEIGHT OR +/- 4% BY SIZE IS PERMITTED.
     - B. RIPRAP SHALL BE HARD, SOUND, AND DURABLE MATERIAL FREE FROM SEAMS, CRACKS, AND OTHER DEFECTS TENDING TO LEAD TO PREMATURE WEATHERING.
     - C. SPECIFIC GRAVITY (BSSD) SHALL BE A MINIMUM OF 2.55, DETERMINED IN ACCORDANCE WITH ASTM C127.
     - D. EXISTING RIPRAP MAY BE SALVAGED FOR USE IN THIS PROJECT, PROVIDED IT IS COMPETENT AND FREE OF CRACKING AND WEATHERING.
   - 2.3 EMBANKMENT MATERIAL
     - A. EMBANKMENT MATERIAL SHALL BE FREE FROM ROOTS AND OTHER ORGANIC MATTER, CONTAMINANTS, TRASH, DEBRIS, FROZEN MATTER, AND OTHER DELETERIOUS MATERIALS.
     - B. EXCAVATED EMBANKMENT MATERIAL FROM THE EXISTING LEVEE MAY BE REUSED, PROVIDED IT MEETS THE REQUIREMENTS OF 2.3(A) AND IS AT A WATER CONTENT SUITABLE FOR COMPACTION.
     - C. IMPORTED EMBANKMENT MATERIAL SHALL CONFORM TO THE REQUIREMENTS OF 2.3(A) AND THE GRADATION IN TABLE 3.
   - 2.4 SIDE CHANNEL BACKFILL SHALL CONSIST OF EXCAVATED EMBANKMENT MATERIAL FROM EXISTING LEVEE MEETING THE REQUIREMENTS OF 2.3(B).
   - 2.5 FLOWABLE FILL
     - A. FLOWABLE FILL SHALL BE A SELF-COMPACTING, CEMENTITIOUS, FLOWABLE MATERIAL REQUIRING NO SUBSEQUENT VIBRATION OR TAMPING TO ACHIEVE CONSOLIDATION.
     - B. FLOWABLE FILL SHALL HAVE A 28-DAY COMPRESSIVE STRENGTH BETWEEN 50 AND 300 PSI. SLUMP SHALL NOT EXCEED 10 INCHES NOR PROMOTE SEGREGATION.
   - 2.6 CRUSHED SURFACING BASE COURSE (CSBC) SHALL CONFORM TO WSDOT SPEC 9-03.9(3). THE REQUIRED GRADATION IS SHOWN IN TABLE 4.
   - 2.7 TOPSOIL
     - A. TOPSOIL SHALL CONSIST OF A 75/25 MIXTURE OF ENGINEERED TOPSOIL AND ORGANIC COMPOST, RESPECTIVELY.
     - B. ENGINEERED TOPSOIL SHALL CONFORM TO THE GRADATION IN TABLE 5 AND SHALL BE FREE OF ROOTS, CHEMICALS, GARBAGE, AND DEBRIS.
   - 2.8 GEOTEXTILE
     - A. GEOTEXTILE SHALL CONSIST OF TYPE II NONWOVEN GEOTEXTILE. MINIMUM AVERAGE ROLL VALUES (MARV) SHALL MEET OR EXCEED THE VALUES SHOWN IN TABLE 6.
     - B. GEOTEXTILE MATERIALS SHALL CONFORM TO WSDOT SPEC 9-33.1.
     - C. OVERLAP ADJACENT LENGTHS OF GEOTEXTILE A MINIMUM OF 18 INCHES.
   - 2.9 CULVERT
     - A. CULVERT MATERIAL SHALL BE DOUBLE-WALLED, CORRUGATED HDPE WITH SMOOTH INTERIOR THAT IS STRUCTURALLY REINFORCED WITH COMPOSITE COMPOSITION OF STEEL EMBEDDED INTO THE PIPE MATERIAL OR EXTERIOR RIGID JOINT SUPPORT. PIPE SHALL INCLUDE INTEGRAL REINFORCEMENT SUFFICIENT TO MINIMIZE CREEP AND ENSURE ROUNDNESS OVER TIME.
     - B. CULVERT JOINTS TO CONSIST OF GASKETED, WATERTIGHT, BELL-AND-SPIGOT CONNECTIONS CAPABLE OF UP TO 3 DEGREES OF DEFLECTION AT A JOINT WITHOUT COMPROMISING WATERTIGHTNESS.
     - C. TEST PIPE TO AT LEAST 5 PSI PRESSURE RATING. PRESSURE TESTING MAY BE CONDUCTED USING AIR OR WATER PRESSURE, AND SHALL BE CONDUCTED ON COMPLETED ASSEMBLY IN PLACE PRIOR TO COMPLETED BACKFILL OPERATION. IF WATER IS USED, SUPPORT THE PIPE AT THE INVERT THROUGHOUT THE LENGTH OF THE ASSEMBLY BY PLACING THE FIRST LIFT OF FLOWABLE FILL AND ALLOWING IT TO CURE PRIOR TO TESTING. IF AIR IS USED, CULVERT ASSEMBLY CAN BE SUPPORTED AT INTERMEDIATE POINTS. PRESSURE SHALL BE MONITORED FOR A PERIOD OF AT LEAST 6 HOURS, WITH NO LOSS IN PRESSURE GREATER THAN 1 PSI OVER THAT PERIOD. IF PRESSURE LOSS IS APPARENT, THE LEAK SHALL BE LOCATED AND REPAIRED AND THE PRESSURE TEST REPEATED UNTIL THE REQUIREMENT IS SATISFIED. IF THE CULVERT MUST BE REMOVED FROM FLOWABLE FILL BEDDING TO REPAIR ANY LEAKS, REMOVE AND REPLACE THE FLOWABLE FILL IN THIS AREA.
3. CULVERT REPLACEMENT (SITE 1)
   - 3.1 EXCAVATION
     - A. EXCAVATE LEVEE EMBANKMENT MATERIAL TO REMOVE EXISTING SEGMENTAL CONCRETE PIPE CULVERTS (24-INCH AND 48-INCH DIAMETERS) AND PLACE NEW CULVERT ALONG ALIGNMENT SHOWN IN PLANS.
     - B. DESIGN, SLOPE, AND MAINTAIN ALL EXCAVATIONS TO PROVIDE SAFE AND STABLE TEMPORARY SLOPES. HOWEVER, TEMPORARY SLOPES SHALL NOT BE STEEPER THAN 1.5H:1V.
     - C. LIMIT EXCAVATION TO DEPTH SHOWN.
     - D. DISPOSE OF EXISTING SEGMENTAL CONCRETE PIPE IN A LEGAL MANNER OFFSITE.
   - 3.2 CULVERT PLACEMENT
     - A. ALIGN PIPE SEGMENTS TO PROVIDE NO MORE THAN 3 DEGREES OF DEPARTURE BETWEEN SEGMENTS IN ANY DIRECTION. LUBRICATE PIPE JOINTS AND GASKETS TO ENABLE JOINING.
     - B. SUPPORT CULVERT AT PLANNED INVERT ELEVATION USING CONCRETE BLOCKS OR PLASTIC CHAIRS. PLACE SUPPORTS ON BOTH SIDES OF EACH JOINT AND AT 6 FEET MIN. SPACING ALONG THE CULVERT, OR AS NECESSARY TO PREVENT THE PIPE FROM DEFORMING MORE THAN 0.6 INCH IN OUT-OF-ROUNDNESS OR MORE THAN 1 INCH IN LONGITUDINAL PROFILE PRIOR TO BACKFILL (INCLUDING ADDITION OF WATER, AS APPLICABLE).
     - C. FORM FLOWABLE FILL AS SHOWN ON THE PLANS. USE EXPANSIVE FOAM OR OTHER FORM SEALANT AS NECESSARY AT JOINTS AND CULVERT ENDS TO CONTAIN THE FLOWABLE FILL.
     - D. BACKFILL AROUND CULVERT USING METHODS THAT PREVENT FLOTATION OF CULVERT. PLACE BACKFILL IN STAGES.
     - E. REFER TO CONSTRUCTION MANAGEMENT PLAN FOR RECOMMENDED BACKFILL APPROACH INVOLVING STAGED FILLING OF CULVERT WITH WATER AND PLACEMENT OF FLOWABLE FILL. ALTERNATE APPROACHES MAY BE PROPOSED, SUBJECT TO REVIEW AND APPROVAL BY THE PROJECT DELIVERY TEAM. ANY ALTERNATE APPROACH MUST LIMIT DEFORMATIONS OF THE CULVERT DURING ENCASEMENT TO THE LIMITS IN 3.2(B).
   - 3.3 LEVEE RECONSTRUCTION
     - A. PLACE FILL MATERIAL IN LIFTS NOT EXCEEDING 6 INCHES IN UNCOMPACTED THICKNESS FOR LIGHTWEIGHT (HAND-OPERATED) EQUIPMENT OR 9 INCHES FOR MEDIUM TO HEAVY (RIDE-ON) EQUIPMENT.
     - B. COMPACT EMBANKMENT MATERIAL TO AT LEAST 95% OF MAXIMUM DRY DENSITY PER ASTM D698 (STANDARD PROCTOR). MOISTURE CONTENT SHALL BE SUITABLE FOR COMPACTION.
     - C. COMPACT SIDE CHANNEL BACKFILL TO 92% OF MAXIMUM DRY DENSITY PER ASTM D698 (STANDARD PROCTOR). MOISTURE CONTENT SHALL BE SUITABLE FOR COMPACTION.
     - D. HAND-OPERATED COMPACTION EQUIPMENT IS REQUIRED ABOVE THE CULVERT PIPE UNTIL A MINIMUM OF 2 FEET OF COVER HAS BEEN PLACED.
     - E. PROHIBIT TRUCK TRAFFIC OVER CULVERT UNTIL A MINIMUM OF 3 FEET OF COVER HAS BEEN PLACED.
     - F. TIE INTO EXISTING LEVEE EMBANKMENT ON EACH END AT ELEVATION SHOWN IN PLANS.
   - 3.4 CULVERT FLAP GATE
     - A. FLAP GATE AND HEADWALL ASSEMBLY, CONTROL ROD AND FLOAT ASSEMBLY, AND ALL ASSOCIATED HARDWARE SHALL BE DESIGNED AND SUPPLIED BY THE CONTRACTOR.
     - B. ACCEPTABLE VENDORS INCLUDE: NEHALEM MARINE, PLASTI-FAB, ARMTEC, GOLDEN HARVEST, WATERMAN, AND OTHERS.
     - C. FLAP GATE TO BE VERTICALLY SIDE-HINGED, OVER CENTER, GRAVITY CLOSURE TYPE, WITH HINGE PLACEMENT ON EAST SIDE OF CULVERT OPENING ON THE NOOKSACK RIVER SIDE OF THE LEVEE. GATE TO REMAIN OPEN TO AT LEAST 45 DEGREES UNDER ALL CONDITIONS WHERE RIVER WATER SURFACE LEVEL IS BELOW THE CULVERT CENTERLINE ELEVATION.
     - D. FLAP GATE TO BE FLOAT-ACTIVATED, WITH FLOAT ON LANDWARD SIDE OF LEVEE. GATE TO CLOSE BY GRAVITY ONCE FLOAT ACTIVATES CLOSURE MOVEMENT. FLOAT ASSEMBLY TO BE ADJUSTABLE SUCH THAT TRIGGERING WATER SURFACE ELEVATION ON LANDWARD SIDE OF LEVEE CAN BE SELECTED BY WHATCOM COUNTY IN FUTURE AT ANY WATER LEVEL ELEVATION BETWEEN 52.5 FT AND 54.5 FT.
     - E. FLAP GATE CLOSURE ADJUSTMENT SHALL BE CAPABLE OF TRIGGERING CLOSURE OF THE GATE AT ANY LANDWARD WATER LEVEL BETWEEN ELEVATION 52.5 FT AND 54.5 FT.
     - F. INSTALL FLAP GATE NO SOONER THAN 3 MONTHS FOLLOWING COMPLETION OF EMBANKMENT RECONSTRUCTION WITHIN 50 FEET OF CULVERT. INSTALLATION MAY PROCEED SOONER IF REGULAR MONITORING DETERMINES THAT PRIMARY CONSOLIDATION IS COMPLETE.
     - G. FLAP GATE HINGE SHALL BE ADJUSTABLE IN VERTICAL ALIGNMENT. LATERAL DIRECTION ADJUSTMENT (SIDE TO SIDE OF CULVERT OPENING) SHALL BE ±5 DEGREES FROM PLUMB. LONGITUDINAL DIRECTION ADJUSTMENT (UPSTREAM-TO-DOWNSTREAM OF CULVERT OPENING) SHALL BE ±5 DEGREES FROM PLUMB.
     - H. FLAP GATE, HINGE ASSEMBLIES, AND FLOAT SYSTEM SHALL BE CONSTRUCTED OF CORROSION-RESISTANT MATERIALS, AND MAY INCLUDE COMPOSITE MATERIAL FOR THE FLAP GATE ONLY. ALL METALLIC COMPONENTS SHALL BE OF THE SAME ALLOY, OR PROTECTED FROM GALVANIC REACTION BY ISOLATION BEARINGS OR BUSHINGS. WORKING DESIGN LOADS ON FLAP GATE AND HINGE ASSEMBLY SHALL BE AT LEAST 3 FT OF SEATING HEAD DIFFERENTIAL, WITH SAFETY FACTOR OF 3.0. HINGE ASSEMBLY SHALL INCORPORATE SELF-LUBRICATED BEARINGS OR BUSHINGS.
     - I. FLOAT ASSEMBLY SHALL PERMIT FIELD ADJUSTMENT OF GATE CLOSURE WITH HEAD DIFFERENTIAL FROM ONE END OF CULVERT TO THE OTHER OF NO LESS THAN 2 INCHES AND NO MORE THAN 18 INCHES.
     - J. FLAP GATE HINGES SHALL BE PROVIDED WITH LOW-FRICTION BEARINGS OR BUSHINGS CONSISTING OF PERMANENTLY LUBRICATED AND SEALED BEARINGS, OR LOW FRICTION BUSHINGS, BEARINGS, AND THRUST WASHERS.

TABLE 1. QUARRY SPALL GRADATION

100% SMALLER THAN	8"
100% LARGER THAN	4"

TABLE 2. RIPRAP GRADATIONS

DISTRIBUTION	CLASS I WEIGHT (LB)	CLASS I SIZE (IN)	CLASS IV WEIGHT (LB)	CLASS IV SIZE (IN)
100% SMALLER THAN	150	12	2,000	29
50% SIZE	50	9	400	17
90% LARGER THAN	25	7	112	11

TABLE 3. EMBANKMENT MATERIAL GRADATION

SIEVE SIZE	% PASSING BY WEIGHT
3"	100
2"	90 – 100
1"	70 – 90
0.5"	55 – 85
NO. 4	35 – 75
NO. 40	15 – 50
NO. 200	10 – 15

TABLE 4. CSBC GRADATION

SIEVE SIZE	% PASSING BY WEIGHT
1.25"	100
1"	80 – 100
5/8"	50 – 80
NO. 4	25 – 45
NO. 40	3 – 18
NO. 200	7.5 MAX

TABLE 5. ENGINEERED TOPSOIL GRADATION

SIEVE SIZE	% PASSING BY WEIGHT
1/2"	100
NO. 4	75 – 100
NO. 10	40 – 75
NO. 16	25 – 55
NO. 40	25 – 50
NO. 200	10 – 20

TABLE 6. GEOTEXTILE PROPERTIES FOR TYPE II NONWOVEN GEOTEXTILE

GEOTEXTILE PROPERTY	ASTM TEST METHOD	UNIT	GEOTEXTILE PROPERTY REQUIREMENTS
GRAB TENSILE STRENGTH MACHINE AND CROSS MACHINE DIRECTIONS	D 4632	lb	200 (MIN.)
GRAB FAILURE STRAIN MACHINE AND CROSS MACHINE DIRECTIONS	D 4632	%	50 (MIN.)
TEAR STRENGTH	D 4533	lb	80 (MIN.)
PUNCTURE STRENGTH	D 6241	lb	430 (MIN.)
APPARENT OPENING SIZE (AOS) U.S. STANDARD SIEVE	D 4751	-	40 (MAX.)
PERMITTIVITY	D 4491	sec^{-1}	0.5 (MIN.)
ULTRAVIOLET STABILITY RETAINED STRENGTH	D 4355 (AT 500 HOURS)	%	70 (MIN.)

TABLE 7. MATERIAL QUANTITIES

MATERIAL	ACCESS	SITE 1 REPAIR	SITE 2 REPAIR
EXCAVATION (CY)	-	8,030	4,510
HAUL OFF (CY)	-	4,565	4,510
EMBANKMENT FILL - PLACED (CY)	-	3,500	-
EMBANKMENT FILL – IMPORT (CY)	-	40	-
FLOWABLE FILL (CY)	-	70	-
QUARRY SPALLS (CY)	-	535	485
CLASS I RIPRAP (CY)	-	155	-
CLASS IV RIPRAP (CY)	-	2,680	2,765
CSBC (CY)	1,030	110	55
TOPSOIL (CY)	-	390	30
48" STEEL-REINFORCED HDPE CULVERT (LF)	-	110	-
TYPE II NONWOVEN GEOTEXTILE (SY)	-	350	-

- K. FLAP GATE SHALL BE FURNISHED WITH ATTACHMENT SYSTEM SUCH THAT IT CAN BE SOLIDLY AFFIXED TO THE UNSUPPORTED END OF THE EXPOSED CULVERT BARREL.
- L. FLAP GATE SHALL BE CAPABLE OF PROVIDING MINIMAL LEAKAGE OF LESS THAN 20 GPM UNDER DESIGN ADVERSE HEAD DIFFERENTIAL OF UP TO 3 FEET.
- M. SHOP TESTING SHALL ENSURE THAT GATE CLOSES AND OPENS WITH LESS THAN 20 LBS OF FORCE APPLIED TO THE EDGE OF THE GATE WITH HINGE AXIS PLUMB AND VERTICAL.
- N. FIELD TESTING SHALL ENSURE THAT GATE CLOSES AND OPENS WITH LESS THAN 10 LBS OF FORCE WHEN ADJUSTED TO FINAL OVER-CENTER POSITION FROM VERTICAL PLUMB IN THE DIRECTION OF THE CULVERT BARREL.
- O. FIELD TESTING SHALL ENSURE THAT FLOAT ASSEMBLY IS ADJUSTABLE AND WILL TRIGGER CLOSING OF THE GATE AT ANY SETTING BETWEEN 2 AND 18 INCHES OF HEAD DIFFERENTIAL FROM ONE END OF CULVERT TO THE OTHER.
- P. SPARE WEAR PARTS SHALL BE SUPPLIED BY THE FLAP GATE MANUFACTURER FOR AT LEAST ONE FULL EXCHANGE OF WEAR PARTS AND ITEMS SUBJECT TO WEAR WITH OPERATION.
- Q. FLAP GATE SHOP DRAWINGS SHALL BE SUBMITTED TO PROJECT ENGINEER PRIOR TO APPROVAL. DRAWINGS SHALL CONSIST OF SUFFICIENT DETAIL TO UNDERSTAND THE OPERATING MECHANISM, ALL MATERIAL COMPOSITION AND FABRICATION, AND DIMENSIONS AND WEIGHTS OF THE GATE AND MAJOR PARTS.
- R. FLAP GATE ASSEMBLY SHALL CONSIDER MINIMIZATION OF CORROSION ISSUES ARISING FROM ELECTROCHEMICALLY DISSIMILAR METALS IN CONTACT WITH EACH OTHER IN A WET OR DRY CONDITION.
- S. FLAP GATE ASSEMBLY TO BE SHIPPED IN SUCH A MANNER TO BE PROTECTED FROM DAMAGE, AND SHALL BE STORED ON SITE IN SUCH A MANNER AS TO PROTECT IT FROM DAMAGE UNTIL INSTALLATION IS COMPLETE.

3.5 FLOAT ACCESS CATWALK

- A. FLAP GATE CONTROLS ON LANDWARD SIDE OF LEVEE SHALL BE ACCESSED BY A CATWALK OR SIMILAR PLATFORM LOCATED AT OR ABOVE ELEVATION 55.0 FEET TO ALLOW FOR MANUAL OPERATION AND ADJUSTMENT OF FLAP GATE CONTROLS.
- B. CATWALK TO BE VENDOR-DESIGNED TO MEET ALL STATE AND LOCAL REQUIREMENTS FOR 3 PERSON WORKING LOAD.

IF SHEET MEASURES LESS THAN 22"x34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.

US Army Corps of Engineers

DESIGNED BY: DRAWN BY: CHECKED BY: DATE: 5/20/2020 FILE NAME: SCALE: AS NOTED

FY18 LEVEE REHABILITATION
NOOKSACK RIVER, WHATCOM COUNTY, WA
LYNDEN AND NORTH FORK LEVEE
NSK-03-18

GENERAL NOTES

SHEET IDENTIFICATION
G-002

SITE 1 ACCESS AND STAGING PLAN
SCALE 1" = 400'

SITE 2 ACCESS AND STAGING PLAN
SCALE 1" = 500'

LEGEND:
WORK AREA
STAGING AREA
ACCESS

NOTES:
1. ACCESS TO SITE 1 VIA LANGAN RD. FOLLOW THE LEVEE WEST APPROXIMATELY 3,350 LF TO SITE 1.
2. ACCESS TO SITE 2 VIA PRIVATE PROPERTY ON NORTH OF LEVEE. FROM WA-539, TAKE KOK RD EAST FOR 0.6 MI, TURN RIGHT ONTO UNIDENTIFIED, PRIVATE GRAVEL DRIVE AND FOLLOW SOUTH THROUGH FARMLAND TO LEVEE. SITE 2 IS LOCATED APPROXIMATELY 800 FEET WEST ALONG LEVEE.
3. PREPARE AND GRADE ACCESS ROUTES AS NECESSARY TO IMPROVE OR ESTABLISH SITE ACCESS. SEE SHEET G-002 FOR VOLUME OF CSBC ESTIMATED TO CONSTRUCT TEMPORARY ACCESS FOR SITES 1 AND 2. SITE 1 QUANTITIES INCLUDE TEMPORARY SURFACING ALONG 200 LF OF THE LEVEE AND IMPROVEMENTS TO 3,200 LF OF ACCESS ROAD, ALONG WITH A TRUCK TURNAROUND. SITE 2 QUANTITIES INCLUDE TEMPORARY SURFACING ALONG 200 LF OF THE LEVEE AND IMPROVEMENTS TO 200 LF OF EXISTING PRIVATE GRAVEL DRIVE, ALONG WITH A TRUCK TURNAROUND.
4. FOLLOWING COMPLETION OF CONSTRUCTION, REMOVE TEMPORARY CSBC SURFACING FROM LEVEE CREST AND HYDROSEED.
5. STAGING AREAS ALSO SHOWN ON INDIVIDUAL SITE PLANS.

IF SHEET MEASURES LESS THAN 22"x34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.

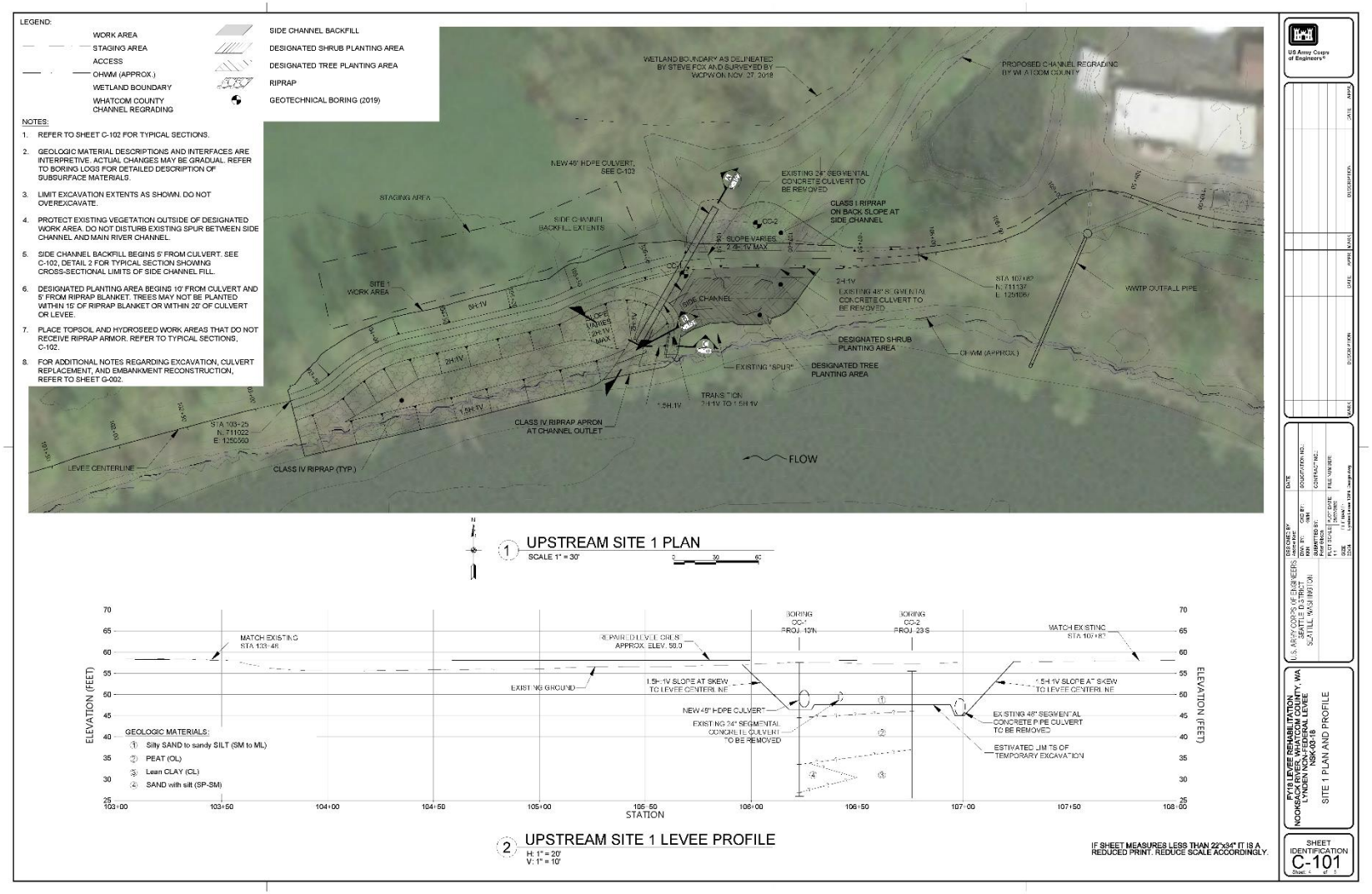
US Army Corps of Engineers

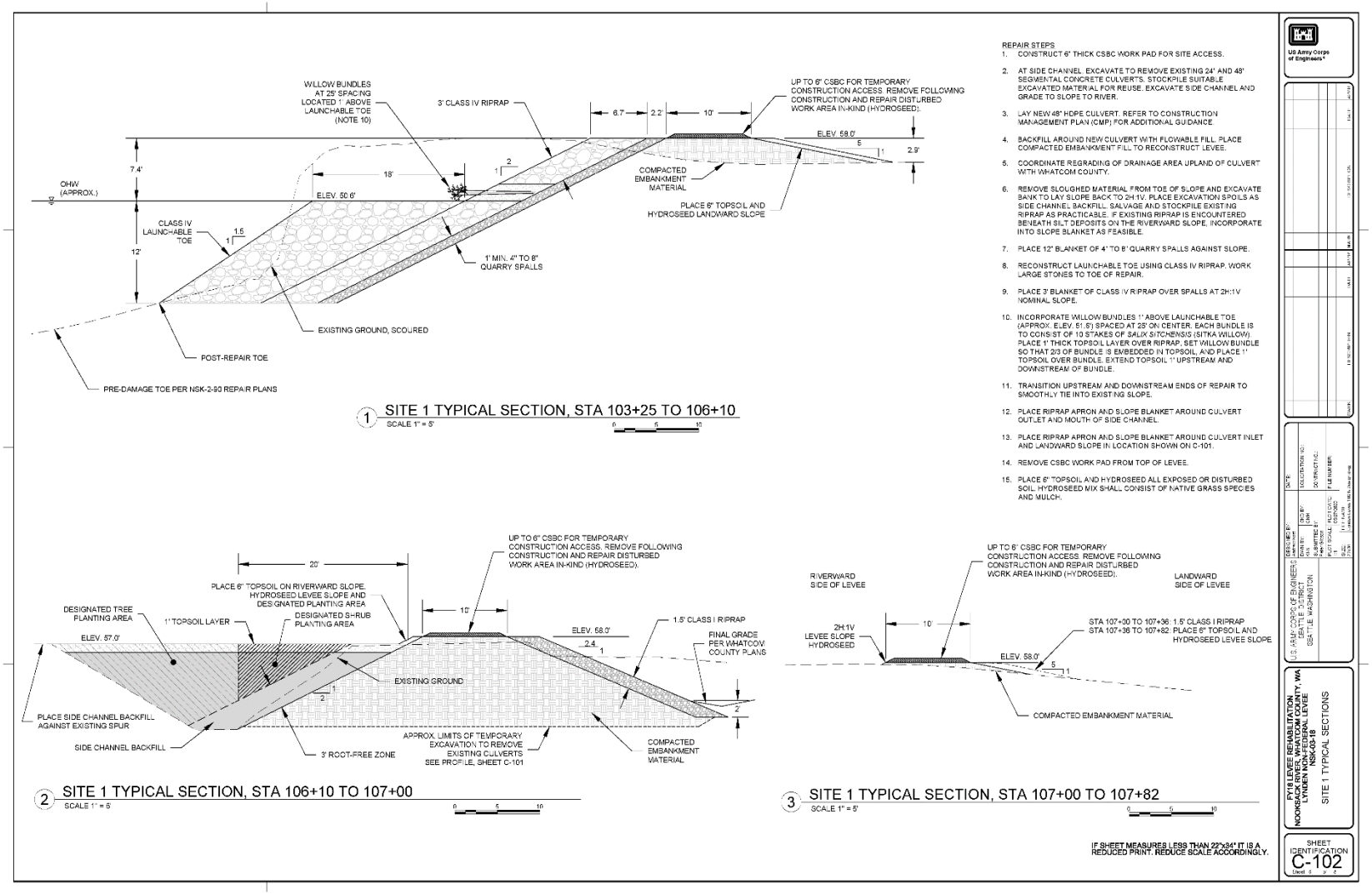
U.S. ARMY CORPS OF ENGINEERS SEATTLE DISTRICT SEATTLE, WASHINGTON

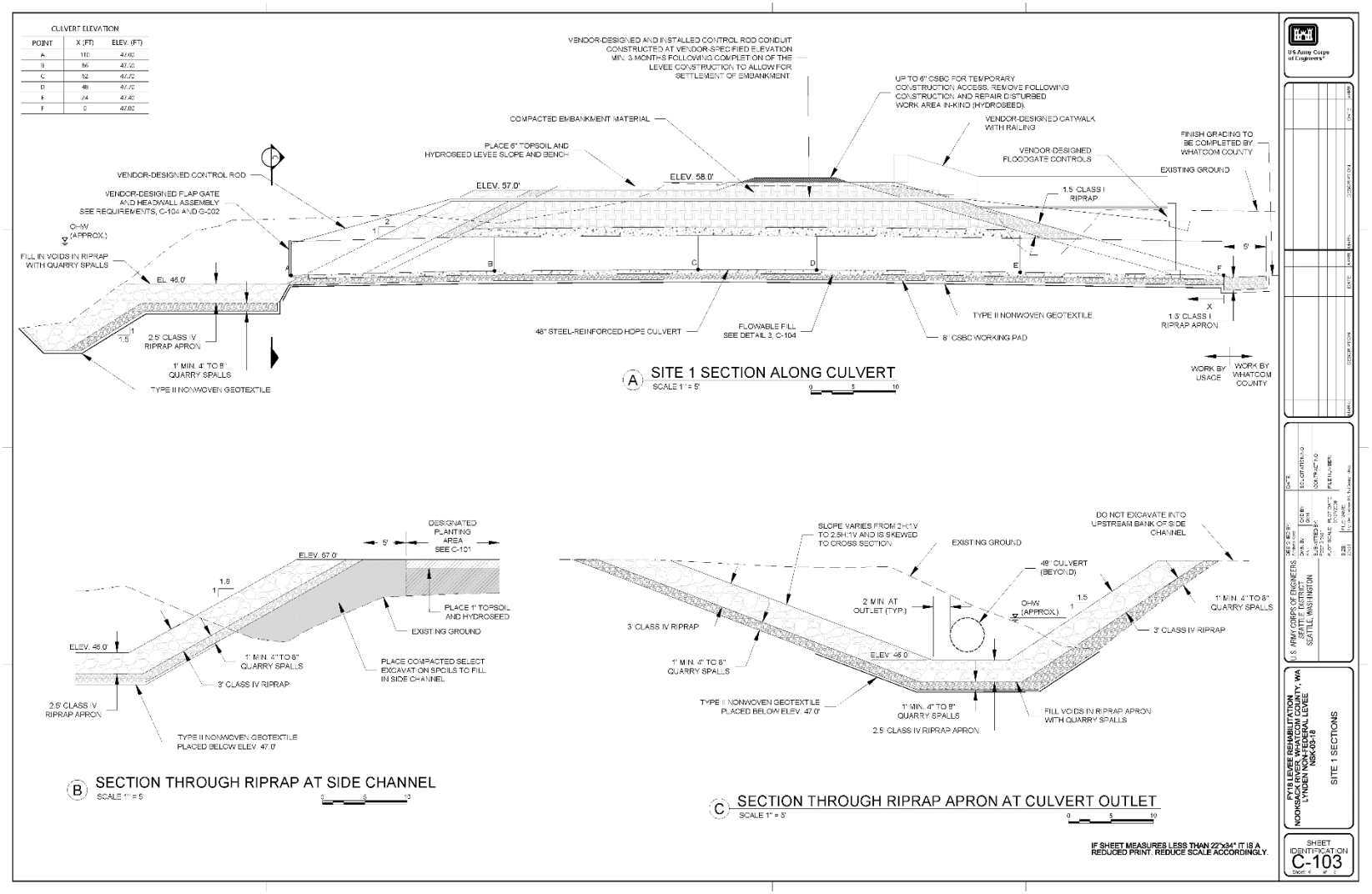
FY18 LEVEE REHABILITATION
NOOKSACK RIVER, WHATCOM COUNTY, WA
LYNDEN NORTH REACH LEVEE
NSK-00-18

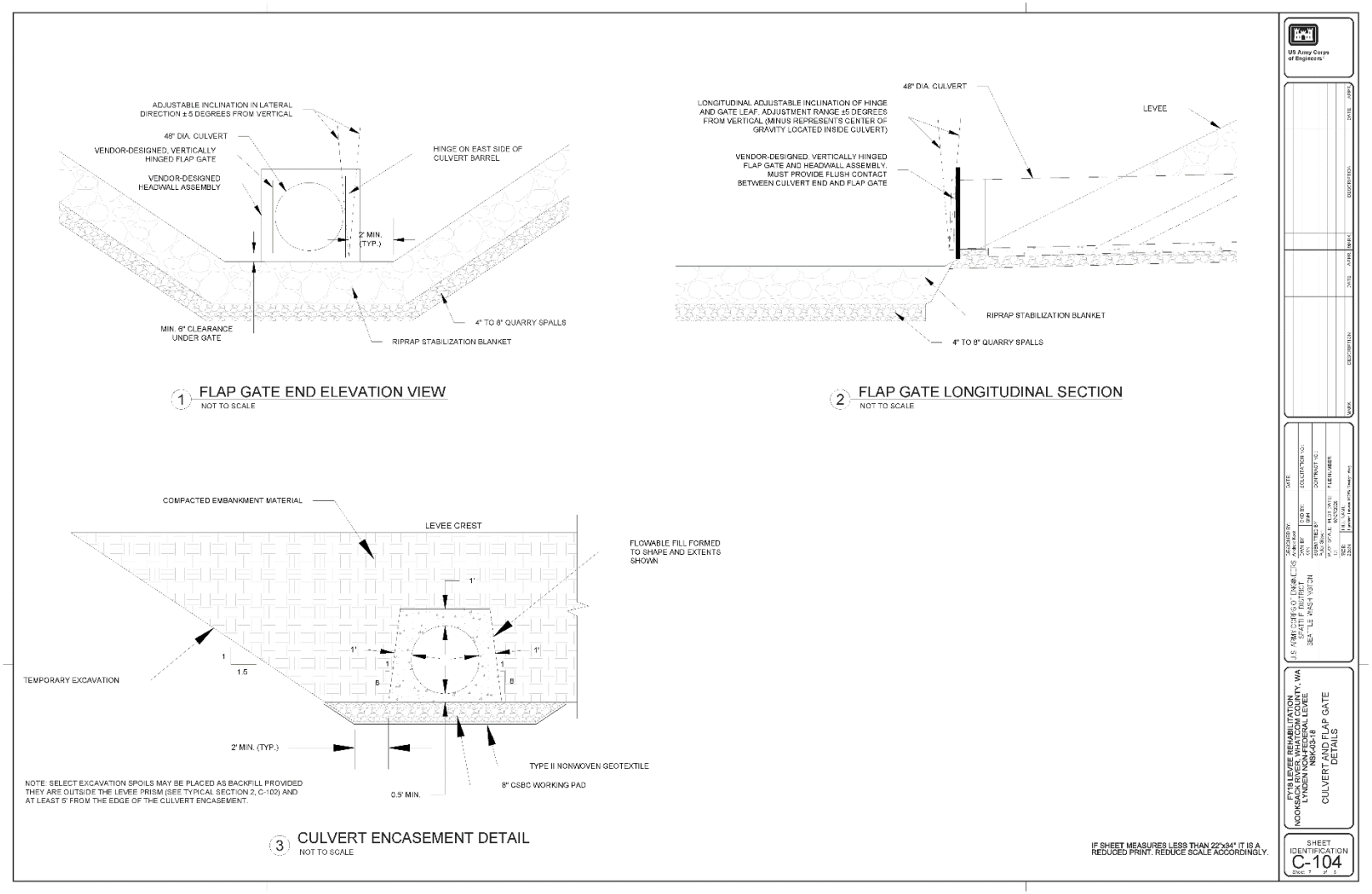
ACCESS AND STAGING PLAN

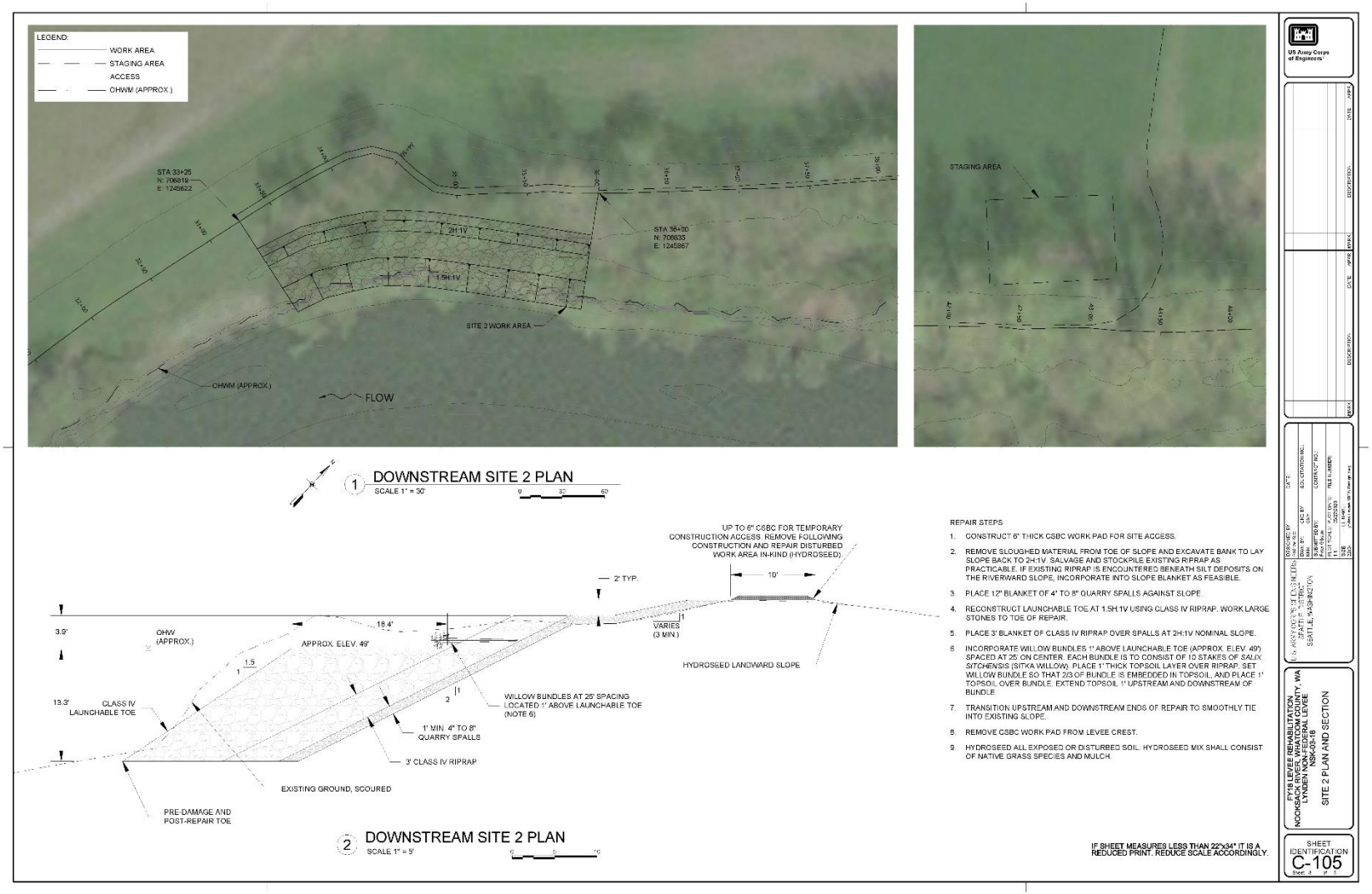
SHEET IDENTIFICATION
C-100


LEGEND:
WORK AREA
STAGING AREA
ACCESS
OHWM (APPROX.)
WETLAND BOUNDARY
WHATCOM COUNTY CHANNEL REGRADING
SIDE CHANNEL BACKFILL
DESIGNATED SHRUB PLANTING AREA
DESIGNATED TREE PLANTING AREA
RIPRAP
GEOTECHNICAL BORING (2019)
NOTES:
1. REFER TO SHEET C-102 FOR TYPICAL SECTIONS.
2. GEOLOGIC MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE. ACTUAL CHANGES MAY BE GRADUAL. REFER TO BORING LOGS FOR DETAILED DESCRIPTION OF SUBSURFACE MATERIALS.
3. LIMIT EXCAVATION EXTENTS AS SHOWN. DO NOT OVEREXCAVATE.
4. PROTECT EXISTING VEGETATION OUTSIDE OF DESIGNATED WORK AREA. DO NOT DISTURB EXISTING SPUR BETWEEN SIDE CHANNEL AND MAIN RIVER CHANNEL.
5. SIDE CHANNEL BACKFILL BEGINS 5' FROM CULVERT. SEE C-102, DETAIL 2 FOR TYPICAL SECTION SHOWING CROSS-SECTIONAL LIMITS OF SIDE CHANNEL FILL.
6. DESIGNATED PLANTING AREA BEGING 10' FROM CULVERT AND 5' FROM RIPRAP BLANKET. TREES MAY NOT BE PLANTED WITHIN 15' OF RIPRAP BLANKET OR WITHIN 20' OF CULVERT OR LEVEE.
7. PLACE TOPSOIL AND HYDROSEED WORK AREAS THAT DO NOT RECEIVE RIPRAP ARMOR. REFER TO TYPICAL SECTIONS, C-102.
8. FOR ADDITIONAL NOTES REGARDING EXCAVATION, CULVERT REPLACEMENT, AND EMBANKMENT RECONSTRUCTION, REFER TO SHEET G-002.
WETLAND BOUNDARY AS DELINEATED BY STEVE FOX AND SURVEYED BY WCPW ON NOV. 27, 2018
PROPOSED CHANNEL REGRADING BY WHATCOM COUNTY
NEW 48" HDPE CULVERT, SEE C-103
EXISTING 24" SEGMENTAL CONCRETE CULVERT TO BE REMOVED
CLASS I RIPRAP ON BACK SLOPE AT SIDE CHANNEL
STAGING AREA
SIDE CHANNEL BACKFILL EXTENTS
SLOPE VARIES 2H:1V MAX
SITE 1 WORK AREA
5H:1V
2H:1V
SIDE CHANNEL
SLOPE VARIES 2H:1V MAX
24-1V
EXISTING 48" SEGMENTAL CONCRETE CULVERT TO BE REMOVED
STA 107+87 N: 711137 E: 1251067
WWTP OUTFALL PIPE
DESIGNATED SHRUB PLANTING AREA
OHWM (APPROX.)
EXISTING "SPUR"
DESIGNATED TREE PLANTING AREA
TRANSITION 2H:1V TO 1.5H:1V
1.5H:1V
CLASS IV RIPRAP APRON AT CHANNEL OUTLET
STA 103+25 N: 711022 E: 1250560
LEVEE CENTERLINE
CLASS IV RIPRAP (TYP.)
FLOW
1 UPSTREAM SITE 1 PLAN
SCALE 1" = 30'
MATCH EXISTING STA 103+48
REPAIRED LEVEE CREST APPROX. ELEV. 59.0
EXISTING GROUND
1.5H:1V SLOPE AT SKEW TO LEVEE CENTERLINE
NEW 48" HDPE CULVERT
EXISTING 24" SEGMENTAL CONCRETE CULVERT TO BE REMOVED
BORING CC-1 PROJ. 12'N
BORING CC-2 PROJ. 23'S
MATCH EXISTING STA 107+87
1.5H:1V SLOPE AT SKEW TO LEVEE CENTERLINE
EXISTING 48" SEGMENTAL CONCRETE PIPE CULVERT TO BE REMOVED
ESTIMATED LIMITS OF TEMPORARY EXCAVATION
ELEVATION (FEET)
STATION
GEOLOGIC MATERIALS:
① Silty SAND to sandy SILT (SM to ML)
② PEAT (OL)
③ Lean CLAY (CL)
④ SAND with silt (SP-SM)
2 UPSTREAM SITE 1 LEVEE PROFILE
H: 1" = 20'
V: 1" = 10'
IF SHEET MEASURES LESS THAN 22"x34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.
US Army Corps of Engineers
PY19 LEVEE REHABILITATION
NOOKSACK RIVER, WHATCOM COUNTY, WA
LYNDEN NOOKSACK RIVER LEVEE
NSK-03-18
SITE 1 PLAN AND PROFILE
SHEET IDENTIFICATION
C-101


WILLOW BUNDLES AT 25' SPACING LOCATED 1' ABOVE LAUNCHABLE TOE (NOTE 10)
3' CLASS IV RIPRAP
UP TO 6' CSBC FOR TEMPORARY CONSTRUCTION ACCESS. REMOVE FOLLOWING CONSTRUCTION AND REPAIR DISTURBED WORK AREA IN-KIND (HYDROSEED).
6.7'
2.2'
10'
ELEV. 58.0'
2.9'
7.4'
18'
OHW (APPROX.)
ELEV. 50.6'
COMPACTED EMBANKMENT MATERIAL
PLACE 6" TOPSOIL AND HYDROSEED LANDWARD SLOPE
CLASS IV LAUNCHABLE TOE
1.5
12'
1' MIN. 4" TO 8" QUARRY SPALLS
EXISTING GROUND, SCOURED
POST-REPAIR TOE
PRE-DAMAGE TOE PER NSK-2-93 REPAIR PLANS
1 SITE 1 TYPICAL SECTION, STA 103+25 TO 106+10
SCALE 1" = 5'
REPAIR STEPS
1. CONSTRUCT 6' THICK CSBC WORK PAD FOR SITE ACCESS.
2. AT SIDE CHANNEL, EXCAVATE TO REMOVE EXISTING 24" AND 48" SEGMENTAL CONCRETE CULVERTS. STOCKPILE SUITABLE EXCAVATED MATERIAL FOR REUSE. EXCAVATE SIDE CHANNEL AND GRADE TO SLOPE TO RIVER.
3. LAY NEW 48" HDPE CULVERT. REFER TO CONSTRUCTION MANAGEMENT PLAN (CMP) FOR ADDITIONAL GUIDANCE.
4. BACKFILL AROUND NEW CULVERT WITH FLOWABLE FILL. PLACE COMPACTED EMBANKMENT FILL TO RECONSTRUCT LEVEE.
5. COORDINATE REGRADING OF DRAINAGE AREA UPLAND OF CULVERT WITH WHATCOM COUNTY.
6. REMOVE SLOUGHED MATERIAL FROM TOE OF SLOPE AND EXCAVATE BANK TO LAY SLOPE BACK TO 2H:1V. PLACE EXCAVATION SPOILS AS SIDE CHANNEL BACKFILL. SALVAGE AND STOCKPILE EXISTING RIPRAP AS PRACTICABLE. IF EXISTING RIPRAP IS ENCOUNTERED BENEATH SILT DEPOSITS ON THE RIVERWARD SLOPE, INCORPORATE INTO SLOPE BLANKET AS FEASIBLE.
7. PLACE 12" BLANKET OF 4" TO 8" QUARRY SPALLS AGAINST SLOPE.
8. RECONSTRUCT LAUNCHABLE TOE USING CLASS IV RIPRAP. WORK LARGE STONES TO TOE OF REPAIR.
9. PLACE 3' BLANKET OF CLASS IV RIPRAP OVER SPALLS AT 2H:1V NOMINAL SLOPE.
10. INCORPORATE WILLOW BUNDLES 1' ABOVE LAUNCHABLE TOE (APPROX. ELEV. 51.6') SPACED AT 25' ON CENTER. EACH BUNDLE IS TO CONSIST OF 10 STAKES OF SALIX SITCHENSIS (SITKA WILLOW) PLACE 1' THICK TOPSOIL LAYER OVER RIPRAP. SET WILLOW BUNDLE SO THAT 2/3 OF BUNDLE IS EMBEDDED IN TOPSOIL, AND PLACE 1' TOPSOIL OVER BUNDLE. EXTEND TOPSOIL 1' UPSTREAM AND DOWNSTREAM OF BUNDLE.
11. TRANSITION UPSTREAM AND DOWNSTREAM ENDS OF REPAIR TO SMOOTHLY TIE INTO EXISTING SLOPE.
12. PLACE RIPRAP APRON AND SLOPE BLANKET AROUND CULVERT OUTLET AND MOUTH OF SIDE CHANNEL.
13. PLACE RIPRAP APRON AND SLOPE BLANKET AROUND CULVERT INLET AND LANDWARD SLOPE IN LOCATION SHOWN ON C-101.
14. REMOVE CSBC WORK PAD FROM TOP OF LEVEE.
15. PLACE 6" TOPSOIL AND HYDROSEED ALL EXPOSED OR DISTURBED SOIL. HYDROSEED MIX SHALL CONSIST OF NATIVE GRASS SPECIES AND MULCH.
20'
PLACE 6" TOPSOIL ON RIVERWARD SLOPE. HYDROSEED LEVEE SLOPE AND DESIGNATED PLANTING AREA
UP TO 6" CSBC FOR TEMPORARY CONSTRUCTION ACCESS. REMOVE FOLLOWING CONSTRUCTION AND REPAIR DISTURBED WORK AREA IN-KIND (HYDROSEED).
DESIGNATED TREE PLANTING AREA
1' TOPSOIL LAYER
DESIGNATED S-RUB PLANTING AREA
ELEV. 57.0'
10'
ELEV. 58.0'
1.5' CLASS I RIPRAP
FINAL GRADE PER WHATCOM COUNTY PLANS
EXISTING GROUND
PLACE SIDE CHANNEL BACKFILL AGAINST EXISTING SPUR
SIDE CHANNEL BACKFILL
3' ROOT-FREE ZONE
APPROX. LIMITS OF TEMPORARY EXCAVATION TO REMOVE EXISTING CULVERTS SEE PROFILE, SHEET C-101
COMPACTED EMBANKMENT MATERIAL
2 SITE 1 TYPICAL SECTION, STA 106+10 TO 107+00
SCALE 1" = 5'
UP TO 6' CSBC FOR TEMPORARY CONSTRUCTION ACCESS. REMOVE FOLLOWING CONSTRUCTION AND REPAIR DISTURBED WORK AREA IN-KIND (HYDROSEED).
RIVERWARD SIDE OF LEVEE
LANDWARD SIDE OF LEVEE
2H:1V LEVEE SLOPE HYDROSEED
10'
STA 107+00 TO 107+36: 1.5' CLASS I RIPRAP
STA 107+36 TO 107+82: PLACE 6" TOPSOIL AND HYDROSEED LEVEE SLOPE
ELEV. 58.0'
COMPACTED EMBANKMENT MATERIAL
3 SITE 1 TYPICAL SECTION, STA 107+00 TO 107+82
SCALE 1" = 5'
IF SHEET MEASURES LESS THAN 22"x34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.
US Army Corps of Engineers
US ARMY CORPS OF ENGINEERS
SEATTLE DISTRICT
SEATTLE WASHINGTON
PY19 LEVEE REHABILITATION
NOOKSACK RIVER, WHATCOM COUNTY, WA
LYNDEN MAIN STEM LEVEE
NSK-05-18
SITE 1 TYPICAL SECTIONS
SHEET IDENTIFICATION
C-102


CULVERT ELEVATION
POINT | X (FT) | ELEV. (FT)
A | 110 | 47.60
B | 86 | 47.50
C | 62 | 47.40
D | 48 | 47.40
E | 24 | 47.40
F | 0 | 47.60
VENDOR-DESIGNED AND INSTALLED CONTROL ROD CONDUIT CONSTRUCTED AT VENDOR-SPECIFIED ELEVATION MIN. 3 MONTHS FOLLOWING COMPLETION OF THE LEVEE CONSTRUCTION TO ALLOW FOR SETTLEMENT OF EMBANKMENT.
UP TO 6" CSBC FOR TEMPORARY CONSTRUCTION ACCESS. REMOVE FOLLOWING CONSTRUCTION AND REPAIR DISTURBED WORK AREA IN-KIND (HYDROSEED).
COMPACTED EMBANKMENT MATERIAL
VENDOR-DESIGNED CATWALK WITH RAILING
PLACE 6" TOPSOIL AND HYDROSEED LEVEE SLOPE AND BENCH
VENDOR-DESIGNED FLOODGATE CONTROLS
FINISH GRADING TO BE COMPLETED BY WHATCOM COUNTY
EXISTING GROUND
VENDOR-DESIGNED CONTROL ROD
ELEV. 57.0'
ELEV. 58.0'
VENDOR-DESIGNED FLAP GATE AND HEADWALL ASSEMBLY SEE REQUIREMENTS, C-104 AND G-002
1.5' CLASS I RIPRAP
O-HW (APPROX.)
FILL IN VOIDS IN RIPRAP WITH QUARRY SPALLS
EL. 46.0'
5'
2.5' CLASS IV RIPRAP APRON
1' MIN. 4" TO 8" QUARRY SPALLS
TYPE II NONWOVEN GEOTEXTILE
48" STEEL-REINFORCED HDPE CULVERT
FLOWABLE FILL SEE DETAIL 3, C-104
8' CSBC WORKING PAD
TYPE II NONWOVEN GEOTEXTILE
1.5' CLASS I RIPRAP APRON
WORK BY USACE
WORK BY WHATCOM COUNTY
A SITE 1 SECTION ALONG CULVERT
SCALE 1" = 5'
DESIGNATED PLANTING AREA SEE C-101
5'
ELEV. 57.0'
1.8
1
PLACE 1' TOPSOIL AND HYDROSEED
EXISTING GROUND
ELEV. 46.0'
1' MIN. 4" TO 8" QUARRY SPALLS
PLACE COMPACTED SELECT EXCAVATION SPOILS TO FILL IN SIDE CHANNEL
3' CLASS IV RIPRAP
2.5' CLASS IV RIPRAP APRON
TYPE II NONWOVEN GEOTEXTILE PLACED BELOW ELEV. 47.0'
B SECTION THROUGH RIPRAP AT SIDE CHANNEL
SCALE 1" = 5'
SLOPE VARIES FROM 2H:1V TO 2.5H:1V AND IS SKEWED TO CROSS SECTION
EXISTING GROUND
DO NOT EXCAVATE INTO UPSTREAM BANK OF SIDE CHANNEL
48" CULVERT (BEYOND)
2 MIN. AT OUTLET (TYP.)
O-HW (APPROX.)
1.5
1
1' MIN. 4" TO 8" QUARRY SPALLS
3' CLASS IV RIPRAP
3' CLASS IV RIPRAP
1' MIN. 4" TO 8" QUARRY SPALLS
ELEV. 46.0'
TYPE II NONWOVEN GEOTEXTILE PLACED BELOW ELEV. 47.0'
1' MIN. 4" TO 8" QUARRY SPALLS
2.5' CLASS IV RIPRAP APRON
FILL VOIDS IN RIPRAP APRON WITH QUARRY SPALLS
C SECTION THROUGH RIPRAP APRON AT CULVERT OUTLET
SCALE 1" = 5'
IF SHEET MEASURES LESS THAN 22"x34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.
US Army Corps of Engineers
U.S. ARMY CORPS OF ENGINEERS SEATTLE DISTRICT SEATTLE, WASHINGTON
PY18 LEVEE REHABILITATION NOOKSACK RIVER, WHATCOM COUNTY, WA LYNDEN NORTH AND SOUTH REACH LEVEE NSK-03-18
SITE 1 SECTIONS
SHEET IDENTIFICATION C-103


ADJUSTABLE INCLINATION IN LATERAL DIRECTION ± 5 DEGREES FROM VERTICAL
48" DIA. CULVERT
VENDOR-DESIGNED, VERTICALLY HINGED FLAP GATE
VENDOR-DESIGNED HEADWALL ASSEMBLY
HINGE ON EAST SIDE OF CULVERT BARREL
2' MIN. (TYP.)
MIN. 6" CLEARANCE UNDER GATE
4" TO 8" QUARRY SPALLS
RIPRAP STABILIZATION BLANKET
1 FLAP GATE END ELEVATION VIEW
NOT TO SCALE
48" DIA. CULVERT
LONGITUDINAL ADJUSTABLE INCLINATION OF HINGE AND GATE LEAF. ADJUSTMENT RANGE ±5 DEGREES FROM VERTICAL (MINUS REPRESENTS CENTER OF GRAVITY LOCATED INSIDE CULVERT)
LEVEE
VENDOR-DESIGNED, VERTICALLY HINGED FLAP GATE AND HEADWALL ASSEMBLY. MUST PROVIDE FLUSH CONTACT BETWEEN CULVERT END AND FLAP GATE
RIPRAP STABILIZATION BLANKET
4" TO 8" QUARRY SPALLS
2 FLAP GATE LONGITUDINAL SECTION
NOT TO SCALE
COMPACTED EMBANKMENT MATERIAL
LEVEE CREST
FLOWABLE FILL FORMED TO SHAPE AND EXTENTS SHOWN
TEMPORARY EXCAVATION
1.5
2' MIN. (TYP.)
0.5' MIN.
TYPE II NONWOVEN GEOTEXTILE
8" CSBC WORKING PAD
NOTE: SELECT EXCAVATION SPOILS MAY BE PLACED AS BACKFILL PROVIDED THEY ARE OUTSIDE THE LEVEE PRISM (SEE TYPICAL SECTION 2, C-102) AND AT LEAST 5' FROM THE EDGE OF THE CULVERT ENCASEMENT.
3 CULVERT ENCASEMENT DETAIL
NOT TO SCALE
IF SHEET MEASURES LESS THAN 22"x34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.
US Army Corps of Engineers
U.S. ARMY CORPS OF ENGINEERS
SEATTLE DISTRICT
SEATTLE WASHINGTON
FY18 LEVEE REHABILITATION
NOOKSACK RIVER, WHATCOM COUNTY, WA
LYNDEN NON-FEDERAL LEVEE
NSK-03-18
CULVERT AND FLAP GATE DETAILS
SHEET IDENTIFICATION
C-104


LEGEND:
WORK AREA
STAGING AREA
ACCESS
OHWM (APPROX.)
STA 33+25
N: 706919
E: 1245622
STA 36+00
N: 706835
E: 1245867
2H:1V
1.5H:1V
SITE 2 WORK AREA
OHWM (APPROX.)
FLOW
STAGING AREA
1 DOWNSTREAM SITE 2 PLAN
SCALE 1" = 30'
UP TO 6" CSBC FOR TEMPORARY CONSTRUCTION ACCESS. REMOVE FOLLOWING CONSTRUCTION AND REPAIR DISTURBED WORK AREA IN-KIND (HYDROSEED)
2' TYP.
10'
3.9'
OHW (APPROX.)
18.4'
APPROX. ELEV. 49'
VARIES (3 MIN.)
HYDROSEED LANDWARD SLOPE
13.3'
CLASS IV LAUNCHABLE TOE
WILLOW BUNDLES AT 25' SPACING LOCATED 1' ABOVE LAUNCHABLE TOE (NOTE 6)
1' MIN. 4" TO 8" QUARRY SPALLS
3' CLASS IV RIPRAP
EXISTING GROUND, SCOURED
PRE-DAMAGE AND POST-REPAIR TOE
2 DOWNSTREAM SITE 2 PLAN
SCALE 1" = 5'
REPAIR STEPS
1. CONSTRUCT 6" THICK CSBC WORK PAD FOR SITE ACCESS.
2. REMOVE SLOUGHED MATERIAL FROM TOE OF SLOPE AND EXCAVATE BANK TO LAY SLOPE BACK TO 2H:1V. SALVAGE AND STOCKPILE EXISTING RIPRAP AS PRACTICABLE. IF EXISTING RIPRAP IS ENCOUNTERED BENEATH SILT DEPOSITS ON THE RIVERWARD SLOPE, INCORPORATE INTO SLOPE BLANKET AS FEASIBLE.
3. PLACE 12" BLANKET OF 4" TO 8" QUARRY SPALLS AGAINST SLOPE.
4. RECONSTRUCT LAUNCHABLE TOE AT 1.5H:1V USING CLASS IV RIPRAP. WORK LARGE STONES TO TOE OF REPAIR.
5. PLACE 3' BLANKET OF CLASS IV RIPRAP OVER SPALLS AT 2H:1V NOMINAL SLOPE.
6. INCORPORATE WILLOW BUNDLES 1' ABOVE LAUNCHABLE TOE (APPROX. ELEV. 49') SPACED AT 25' ON CENTER. EACH BUNDLE IS TO CONSIST OF 10 STAKES OF SALIX SITCHENSIS (SITKA WILLOW). PLACE 1' THICK TOPSOIL LAYER OVER RIPRAP. SET WILLOW BUNDLE SO THAT 2/3 OF BUNDLE IS EMBEDDED IN TOPSOIL, AND PLACE 1' TOPSOIL OVER BUNDLE. EXTEND TOPSOIL 1' UPSTREAM AND DOWNSTREAM OF BUNDLE.
7. TRANSITION UPSTREAM AND DOWNSTREAM ENDS OF REPAIR TO SMOOTHLY TIE INTO EXISTING SLOPE.
8. REMOVE CSBC WORK PAD FROM LEVEE CREST.
9. HYDROSEED ALL EXPOSED OR DISTURBED SOIL. HYDROSEED MIX SHALL CONSIST OF NATIVE GRASS SPECIES AND MULCH.
IF SHEET MEASURES LESS THAN 22"x34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.
US Army Corps of Engineers
FY18 LEVEE REHABILITATION
NOOKSACK RIVER, WHATCOM COUNTY, WA
LYNDEN LEVEE AND CULVERT REPAIR
NSK-03-18
SITE 2 PLAN AND SECTION
SHEET IDENTIFICATION
C-105

APPENDIX D – MITIGATION PLAN

2021 Lynden Levee and Culvert Repair Mitigation Plan

Mitigation Goals

The Salmon Recovery Plan (SRP) for the Nooksack Basin identifies a riparian zone of 150 feet or the site potential tree height measured from the outer edge of the historic channel migration zone as a target for recovery. To achieve properly functioning conditions, the SRP target is for 70 percent or more of this zone to be forested with mature conifers unless hardwoods dominated historically. In areas heavily populated with small to medium size alder or other hardwoods, interplanting of the understory on benches using conifers, such as Sitka spruce (*Picea sitchensis*) and Western red cedar (*Thuja plicata*) would allow for long term succession and beneficial large wood recruitment. Native conifers provide more effective long-term shade over the river, provide more long-lasting floodplain refugia, and will eventually provide long lasting large wood in the channel when the mature trees are recruited into the river. In addition, conifers will replace a combination of canopy structure, vertical habitat, and perch habitat found in existing trees slated for removal.

Mitigation Plan

The Lynden Levee and Culvert Repair project will remove 34 trees between the two repair sites. Eight Pacific willows (*Salix lasiandra*) and 12 red alder (*Alnus rubra*) trees between 30 to 50 feet tall will be removed at Site 1. Three willow trees and 11 red alders approximately 20 to 30 feet tall will be removed at Site 2.

To mitigate for this impact the Corps proposed replacing trees at a 3:1 ratio with 3 years of monitoring. After a meeting with the Washington State Department of Ecology and Washington Department of Fish and Wildlife on April 30, 2021, Whatcom County, the non-Federal sponsor for the repair, committed to increasing the replacement ratio to 4:1. This would increase tree plantings to 136 trees. It also committed to maintenance and monitoring of shrub and tree plantings for no less than 5 years.

Mitigation for the levee repair will include planting native conifers and shrubs at two locations on the riverward side of the Lynden Levee (Table 1; Appendix A). It also includes willow bundles and large woody material.

Table 1. Tree and shrub mitigation plantings.

Species	Site 1	Site 2
Sitka spruce	10	63
Western redcedar	0	63
Pacific Ninebark (*Physocarpus capitatus*)	25	0
Black Twinberry (*Lonicera involuvrata*)	25	0
Salmonberry (*Rubus spectabilis)*	25	0

Note: Another appropriate native plant will be selected by Whatcom County if stock is unavailable.

The proposed tree and shrub mitigation planting sites are shown in Appendix A. Both sites are on an elevated terrace between the Lynden levee and the Nooksack River. The Whatcom County Flood Control Zone District holds an easement over the site allowing access for mitigation planting.

The Corps will incorporate bundles of live willow stakes into the riverward side of the levee during repairs. Each willow bundle consists of 10 stakes of Sitka willow (*Salix sitchensis*) in a lens of topsoil two feet high by about three feet long. The bundles are spaced 10 feet apart for continued levee inspection, above the launchable toe and close to the ordinary high-water mark (Appendix B). Willow bundles will be watered routinely during the repair. The Corps will be responsible for willow bundle installation, monitoring, and replacement.

The Corps will also place woody debris along the riverward toe of the repaired levee (Table 2). Woody debris will be sourced from what is generated at each repair site (Site 1: 20 trees, Site 2: 14 trees). Whatcom County will also provide additional woody material (Table 2; Appendix C). An onsite biologist will identify where to place the woody debris along the repaired levee at each site. The onsite biologist will direct the orientation of the woody debris to provide aquatic benefits (e.g. shoreline complexity, shade, cover). The smaller woody material, such as slash, will be intertwined with the large logs and root wads, similar to Whatcom County's Rutsatz Road Emergency Bank Stabilization project. As much of the riprap will be covered by the woody material as possible.

Table 2. Estimated woody debris placement at the repair sites. See Appendix C for more details.

	Woody Debris Generated Onsite	Whatcom County Provided
Site 1	20 trees, assorted slash	50 logs, 10 root wads, assorted smaller pieces and slash
Site 2	14 trees, assorted slash	0

Mitigation Site Rationale

The mitigation was chosen for a variety of reasons including:

- Close proximity to the levee repair work
- Available woody material
- Tried methods
- A floodplain elevation high enough to support conifer establishment
- Good accessibility
- Currently degraded riparian habitat
- Enough openings in the deciduous canopy to support conifer establishment
- The FCZD holds a perpetual easement allowing for levee repairs/maintenance and associated restoration planting.

Tree and Shrub Mitigation Site Existing Conditions

The tree and shrub planting sites are located on a relatively high right bank bench. Site 1 is within the construction footprint of the repair. Site 2 is fairly diverse with undulating terrain

and several deciduous plant species including Black cottonwood (*Populus trichocarpa*), Red alder, and willow (*Salix. spp).*

Tree and Shrub Mitigation Site Preparation

Whatcom County will complete site preparation in the late summer or early fall 2021. Crews will find areas of fairly open canopy and high ground to mark as planting areas. Brush around and above each planting area will be cleared within 10 feet for trees and 3 feet for shrubs (Appendix D). Competing roots will be grubbed out and removed around each planting. Competing weeds in the planting areas such as Himalayan blackberry (*Rubus armeniacus*), reed canarygrass (*Phalaris arundinacea*), and Japanese knotweed (*Polygonum japonica*) will be controlled using methods appropriate for the site (e.g. mowing and herbicide). Herbicide will be applied in the fall by applicators licensed by the State of Washington with an aquatics endorsement. Blackberries and reed canarygrass will be first mowed in the summer with the herbicide treatment made to re-sprouts in the fall. If present, knotweed will be "bent" during the summer to lower the foliage and create a more controlled environment for treatment. All work will be completed with hand tools. Heavy machinery will not be used to minimize impacts to riparian areas.

Tree and Shrub Mitigation Site Planting

Plantings will be of low elevation Skagit County, Whatcom County or southern British Columbia seed source. Tree plantings will be a minimum of one or two gallon in size and 2'-3' tall. Shrub plantings will be at minimum 2-0 bare root, or similar. Trees and shrubs will be planted at the mitigation sites during their dormant season, and after most flooding threats have passed. Late February and early March are ideal times.

Flagging tape will be used to mark trees and facilitate future maintenance by Whatcom County. GPS will be used to generate an as-built map showing mitigation planting locations. At Site 1, trees and shrubs will be planted in the designated areas shown in the designs (Appendix A). Trees and shrubs will be planted approximately 10 and 4 feet on center, respectively. At Site 2, trees will be planted approximately 20 feet on center but could vary as open planting areas are located.

Maintenance and Monitoring

Whatcom County will submit to the Corp an as-built plan showing planting location, size, and species for the mitigation it completes. Whatcom County has committed to monitor and maintain the plantings for 5 years. All dead plantings within the first year shall be replaced in kind. Plantings shall have a minimum 80 percent survival rate for years 1 through 5. Yearly monitoring reports shall be completed for each year of monitoring and submitted to the Corps. The monitoring reports shall include photographs, a description of the health of the trees, a description of their survival rate, and any observed predation or detrimental effects on the trees.

Maintenance will focus on maintaining a brush free zone around each planting. A 10- or 3-foot brush free opening will be established around each tree and shrub, respectively. Crews will remove brush around each planting twice during the growing season for the first five years.

In the event that the shrub and tree plantings fail to meet performance standards (Table 3) additional plantings will be placed as compensation. Additional plantings will be monitored for 5 years with the same performance standard.

Table 3. Tree and shrub performance standards.

Weed Control	Minimum 10-foot and 3-foot circle of cleared vegetation around each tree and shrub, respectively, at all times.
Year 1 Survival	80 percent survival
Year 2 Survival	
Year 3 Survival	
Year 4 Survival	
Year 5 Survival	

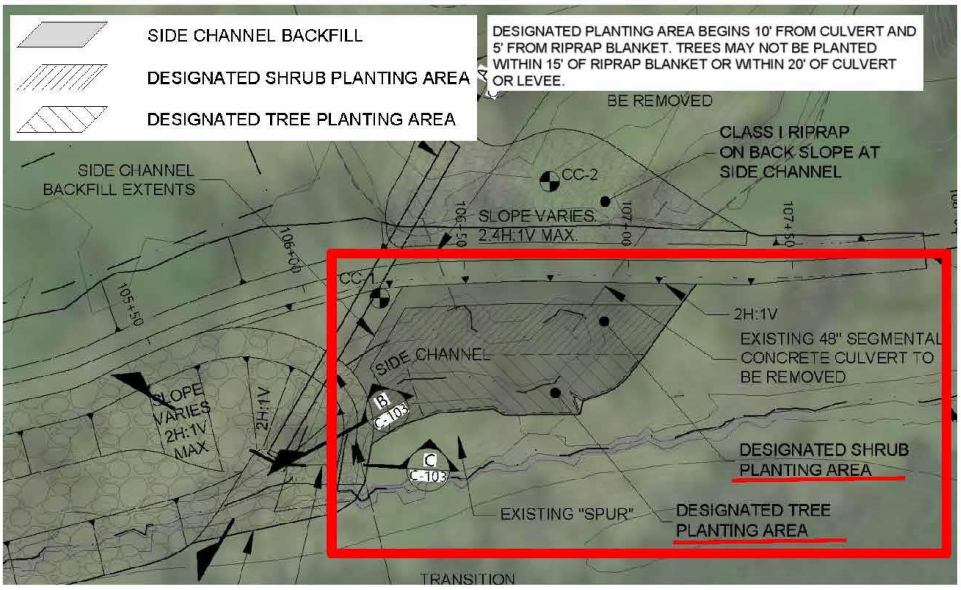
The Corps will be responsible for monitoring and replacement of the willow bundles. Willow bundles will be monitored by the Corps for three years. All failed bundles will be replaced if less than 80 percent survive in the first year. The Corps will continue to monitor the willow bundles for an additional two years during levee inspections.

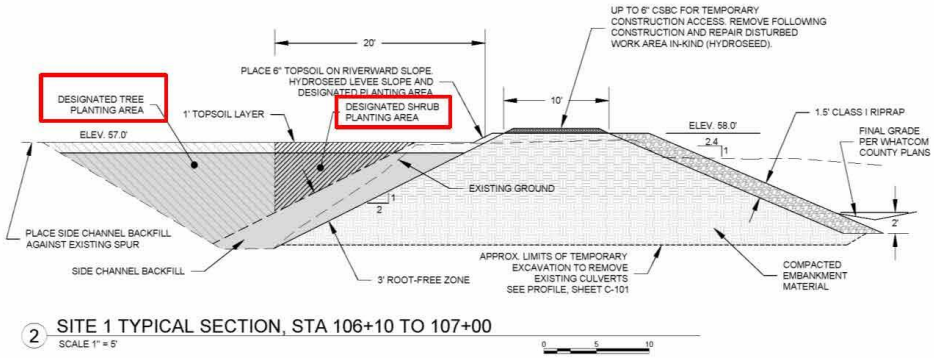
The Corps and Whatcom County will coordinate on adaptive management replacement strategies if plantings totally fail to meet performance standards. Replacement strategies may include planting different species, changing the planting location, or adding pest control or exclusion devices.

Appendix A

Proposed Tree and Shrub Mitigation Planting Area

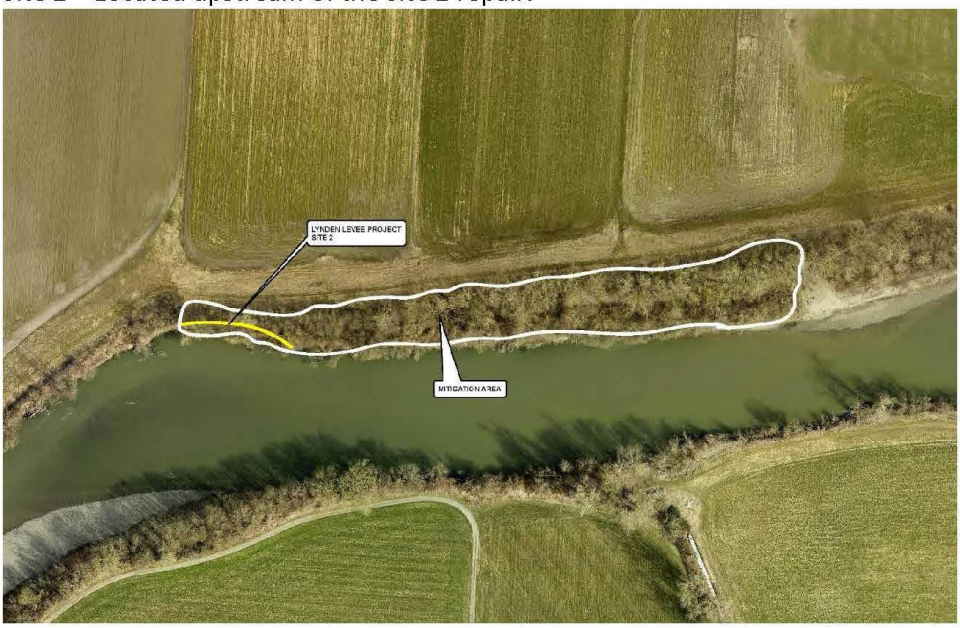
Site 1 - Located in the old perched drainage channel riverward of the Lynden Levee.





2 SITE 1 TYPICAL SECTION, STA 106+10 TO 107+00
SCALE 1" = 5'

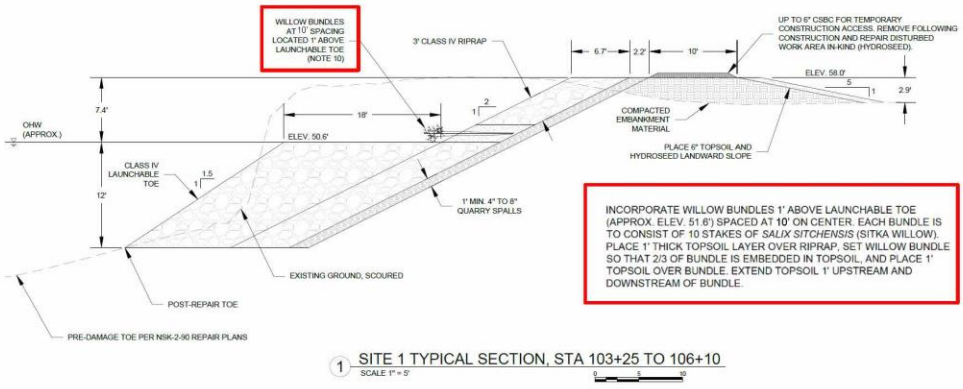
Site 2 – Located upstream of the Site 2 repair.



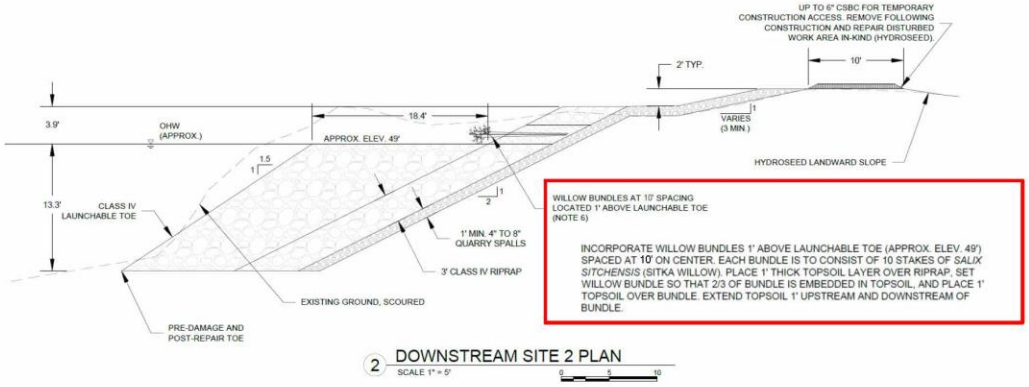
Appendix B

Willow Bundle Installation Details for Site 1 and Site 2

May 10, 2021 Revised Lynden Levee and Culvert Repair Mitigation Plan



1 SITE 1 TYPICAL SECTION, STA 103+25 TO 106+10
SCALE 1" = 5'



2 DOWNSTREAM SITE 2 PLAN
SCALE 1" = 5'

9

Appendix C

Whatcom County Provided Woody Material

May 10, 2021 Revised Lynden Levee and Culvert Repair Mitigation Plan

Whatcom County will provide the woody material stacked in a pile near the levee east of the Lynden Wastewater Treatment Plant. The pile dimension is approximately 90 feet long by 25 feet wide and 12 feet high. The wood is a mostly a mixture of cottonwood, willow, and alder. The following estimates were provided by Whatcom County on May 5, 2021:

- Approximately 50 large logs at 18 to 60 inches in diameter
- Approximately 10 large root wads at 72 to 96 inches in diameter
- Assorted logs/wads cut at 8 to 12-foot lengths
- Assorted smaller pieces and slash.

Whatcom County's woody debris pile located near the Lynden Wastewater Treatment Plant.

11

Appendix D

Whatcom County Brush Clearing Examples

APPENDIX E – CLEAN WATER ACT

- Water Quality Monitoring Plan
- Section 404(b)(1)
- Water Quality Certificate

Water Quality Monitoring Plan

Project: Lynden Levee and Culvert Repair

Date: May 11, 2021

Best Management Practices (BMPs; Attachment A) include water quality monitoring. Water quality monitoring will occur during in-water sediment-generating activities. Each new type of sediment generating activity will be monitored.

Sediment-generating Activities Triggering Monitoring Efforts

- In-water toe or bank excavation,
- Rock placement for toe rock, and
- Rock placement for bank construction.

Monitoring Frequency/Duration

- Point of Compliance monitoring will occur once per hour for the first three hours after the start of each new sediment-generating activity and then once every three hours, if no exceedance is noted, until the end of the workday.
- The following will be taken at the same frequency as the Point of Compliance samples:
  - Early Warning sample
  - Background sample
- If, after a minimum of one full day, the monitoring results verify that turbidity levels from a certain sediment-generating activity are remaining consistently below the stated water quality standards, physical monitoring may be reduced or stopped for that activity. Physical monitoring will be resumed during new sediment-generating activities or if precipitation events or any other changes will result in higher or lower project-related turbidity. Sampling will resume if visual monitoring indicates possible exceedance at the Early Warning or Point of Compliance sample locations. BMPs will be evaluated to see if additional steps can be taken to reduce and control turbidity.
- Visual monitoring will be done continuously for all in-water work.
- Maximum turbidity levels will meet WAC 173-201A-200. Turbidity must not exceed 5 NTU over background when the background is 50 NTU or less; or a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

Sampling Locations

Sampling locations are shown in Attachment B and are located at the following points:

- Background – 100 feet upstream of the repair site or the closest safe accessible location.
- Early Warning – 150 feet downstream of the project site.
- Point of Compliance – 300 feet downstream of the project site.

Sampling Procedures

Water samples will be collected and analyzed for the appropriate parameters, per the monitoring frequency described above, following the equipment and sampling guidelines below:

- Continuous visual monitoring will occur to identify the presence of oil or grease on the water's surface.

- Turbidity will be monitored using a Hach turbidimeter or equivalent.
- The onsite Corps Biologist or Quality Construction Assurance Personnel will conduct the water quality monitoring and are responsible for providing the results to the Washington State Department of Ecology (Ecology).
- A portable turbidity meter will be used in the field. A representative sample should accurately reflect the true condition of the water source from which the sample was taken. The following protocol will be used to ensure a representative sample is analyzed:
    - Use a clean container to obtain a sample from the source.
    - Collect the sample with care to avoid disturbance of sediments and collecting surface contaminants.
    - Gently but thoroughly mix the sample before pouring it into the small vial used to read the sample in the turbidimeter.
    - Without allowing the sample to settle, take turbidity reading according to turbidimeter manufacturer's instructions.
    - Several measurements can be taken, with the average used as the data for comparison.

A calibration check of the turbidimeter using secondary standards will be carried out regularly (at least once per week). The instrument will be recalibrated using primary standards at least once every 3 months, or more when a calibration check indicates there is a problem. The manufacturer's calibration procedures will be followed.

Non-Compliance

The Corps will notify Ecology if either visual or physical monitoring indicates that water quality standards have been exceeded. See the Reporting section of this plan for reporting details. Notifications will be made per the following requirements:

- Notify Ecology within 24 hours of the exceedance.
- Submit a detailed written report to Ecology within 5 days describing the nature of the event, corrective action taken and/or planned, steps to be taken to prevent a recurrence, results of any samples taken, and any other pertinent information.
- Work will stop and cleanup efforts initiated if an oil or grease sheen is observed in the river. Equipment will be inspected to determine the source of the sheen. All oil and grease spills will be reported immediately.

Contingency Sampling

If sample results confirm that water quality is out of compliance with water quality standards, the Corps will modify or stop the activity causing the problem and commence the contingency sampling requirements (Table 1). Contingency Monitoring will also commence if visual monitoring indicates possible exceedances at the Point of Compliance. The Corps shall return to

standard sampling procedures after two consecutive sample periods show compliance with water quality standards.

Table 1. Contingency sampling requirements.

Parameter	Contingency Sampling Location	Contingency Frequency	WQ Standard
Turbidity	Point of Compliance	Hourly	When background < 50 NTU: not to exceed 5 NTU over background When background > 50 NTU: Not to exceed 10% over background
Oil/Grease	Throughout project area	Continuous-Visual	No Sheen

Reporting

All water quality monitoring results (visual and physical) will be recorded on the monitoring form (Attachment C).

Turbidity

All sample results or exceedances will be provided to Ecology at the following email addresses:

- fednotification@ecy.wa.gov
- Rebekah.Padgett@ecy.wa.gov

Sample results will be provided to Ecology 30 days after construction is completed.

Oil/Grease

The following entities will be contacted immediately in the event of an oil or grease spill. Details of the spill will be recorded on the monitoring form.

- Ecology. Additional details available online: <https://ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue/Report-a-spill>
  - fednotification@ecy.wa.gov
  - Rebekah.Padgett@ecy.wa.gov
  - Washington Emergency Management Division, 1-800-258-5990
  - Ecology's Regional Spill Response Office
    - Rob Walls, Spills Manager, 425-649-7130, rob.walls@ecy.wa.gov
  - National Response Center, 1-800-424-8802
- Washington Department of Fish and Wildlife
  - Andy Carlson, Oil Spill Team Manager, 360-902-2530, Andy.Carlson@dfw.wa.gov
  - Joel Ingram, WRIA 1 Habitat Biologist, 360-584-6339, Joel.Ingram@dfw.wa.gov

Attachment A - Best Management Practices

The following list of Best Management Practices (BMPs) will be incorporated into the action. This list may be modified further as a result of consultation with resource agencies.

- In-water work will be limited to the in-water work window (June 15 to August 31) and minimized to the extent practicable.
- A silt curtain will be installed for work in the Nooksack River to control turbidity generated along the shoreline. If the curtain is damaged and cannot be repaired or replaced, the Corps will slow down in-water work to minimize turbidity generation.
- Water quality monitoring for turbidity will be performed as outlined in the Water Quality Monitoring Plan. If a potential exceedance is detected at the early warning sample locations, onsite personnel will evaluate construction activities and take measures to minimize turbidity generation. Examples include slowing down a specific in-water activity, changing the amount of material that is moved below the waterline, and inspecting the silt curtain.
- In-water excavation will be completed slowly to minimize turbidity generation. Care will be taken to reduce discharge from saturated material excavated below the waterline from entering back into the river. A bench with a concave surface will be created on the levee slope during deconstruction of the damaged levee. Wet material will be placed in the bench, so water drains downward through the levee and not directly back into the river. This material will be reused onsite (e.g., levee embankment and willow bundles). Material not used for reuse will be transported offsite for disposal at an approved, permitted location.
- Vegetation removal will be limited to the repair sites.
- Noxious weeds will be disposed of separately from other organic materials at an approved off-site location.
- Equipment used near and in water will be cleaned prior to construction.
- Drive trains will not work in the water. Only the excavator bucket with thumb attachment will extend into the water.
- Fueling will occur on the back side of the levee, and biodegradable hydraulic fluids will be used as appropriate in any portion of the equipment that will work in the water.
- Construction equipment shall be regularly checked for drips or leaks and fixed.
- At least one fuel spill kit with absorbent pads will be onsite at all times.
- Material placed into the water will be placed individually or in small bucket loads. No end dumping of rock into the water will occur.
- Rock placement will occur only within the project footprint.
- Rock placement and underwater excavation will occur from the upstream end of the project to the downstream end. Rock is placed shortly after excavation so it will act as a localized flow deflector and help manage flows in the installation areas.
- After construction is complete, the sites will be reseeded using a native grass seed mix including a mulch base.

- At least one biologist will be onsite during construction. Corps or other agency biologists may visit construction site. All visits will be coordinated with the Project Manager and Construction Manager.
- Fish will be excluded from the work sites in the Nooksack River by a silt curtain and from Site 1 by a net upstream of the sump. The Corps will coordinate with NMFS, USFWS, WDFW, and Whatcom County to complete fish rescues in the excluded areas.
- Woody debris generated during construction and provided by Whatcom County will be placed along the riverward toe of the repaired levee. The onsite biologist will direct the orientation of the woody debris to provide aquatic benefits (e.g. shoreline complexity, shade, cover). Smaller woody material like slash will be intertwined with larger logs and root wads. As much of the riprap will be covered by the woody material as possible.
- All trash and unauthorized fill generated during the repair will be removed from the project and staging areas after work is complete, including concrete blocks or pieces, bricks, asphalt, metal, treated wood, glass, floating debris, and paper.
- A pre-construction meeting should be conducted to look at existing conditions and any possible fine-tuning that should be done for BMPs or environmental requirements. The pre-construction meetings will include outside resources agencies like USFWS or NMFS.

Attachment B - Sampling Locations

Sample locations for the two repair sites are identified in the figures below.

Figure Key

Background

Early Warning

Point of Compliance

Overview of Site 1 and Site 2 with their monitoring locations.

Site 1: In-water work in the Nooksack River will occur between the downstream repair limit and the perched outlet. At the perched outlet work moves in-land from the river and will be above the waterline of the Nooksack River. Work in this area will be in the dry because flow from the drainage basin above Site 1 is diverted to a sump and pumped around the work area.

Note: alternate background has safe access to the river if primary background location does not.

Site 2: In-water work in the Nooksack River will occur between the downstream and upstream repair limit.

Attachment C - Sample Monitor Results Reporting Form

Date:	Weather:		Site Designation/Location:				
Time of Day	Construction Activity	Background Sample (NTU)	Early Warning Sample (NTU)	Point of Compliance Sample (NTU)	Background & Compliance Change (NTU)	Description of visible plume (length downstream, width as % of channel)	Description of visible sheen (length downstream, width as % of channel)
Example: 0700	Excavation and toe rock placement	20.2	22	21.1	+0.9	Visible plume 50 ft long, <10% of channel width	Visible sheen 12ft long, 1 to 5% of channel width

Notes:

Clean Water Act Section 404 (b)(1) Analysis

Lynden Levee and Culvert Repair

Rehabilitation of Flood Control Works

Nooksack River, Whatcom County, Washington

Substantive Compliance for

Clean Water Act Section 404(b)(1) Evaluation

1. Introduction. The purpose of this document is to record the U.S. Army Corps of Engineers (Corps) compliance evaluation of the repair of the Lynden Levee on the Nooksack River, Whatcom County, Washington, pursuant to the Section 404 of the Clean Water Act (CWA), the Rivers and Harbors Act (RHA), and the General Regulatory Policies of USACE. Specifically, this document addresses substantive compliance issues, including where CWA 404(b)(1) Guidelines require an evaluation of impacts for work involving discharge of fill material into the waters of the U.S. [40 CFR § 230.12(a)]; and the USACE General Regulatory Policies [33 CFR § 320.4(a)], which is used as a reference, that provides measures for evaluating permit applications for activities undertaken in navigable waters.

The main body of this document summarizes the information presented with Attachment A and includes relevant information from the Environmental Assessment (EA) for the project that was collected pursuant to the National Environmental Policy Act (NEPA) of 1969 [42 U.S.C. §4321 et seq.]. Attachment A provides the Corps' specific analysis of compliance with the CWA 404(b)(1) and the Public Interest factors (33 CFR § 320.4(a), used as a reference) requirements.

2. Project Description. The Lynden Levee is located on the right bank of the Nooksack River near the City of Lynden, Whatcom County, Washington. It is a non-federal levee system constructed by local interests and protects public infrastructure, residential, commercial, and agricultural properties from recurring flooding from the Nooksack River. It is owned and operated by Whatcom County. The levee forms one segment of a three-segment system, which also includes Bertrand Creek Left Bank and River Road Levees. The Lynden Levee ties into Hannegan Road at its upstream end and River Road Levee near Guide Meridian Road at its downstream end. The levee is approximately 13,800 linear feet (LF) long and is 3 to 6 feet high on the landward side. The levee crown is approximately 10 to 12 feet wide. The riverward slope and toe is armored with Class IV riprap. Based on onsite conditions, best professional judgment by engineers, and available historical and technical data, the Lynden Levee at the repair site had adequate scour protection as originally designed and constructed by the local

entity that resembles an armored launchable toe. In its undamaged state, the levee provides flood risk reduction up to the 10 percent (10-year return period) annual chance of exceedance (ACE) event.

In November 2017, high flows occurred along the Nooksack River with a peak flow of 39,900 cubic feet per second (cfs) at the Everson U.S. Geological Survey gage 12211200, corresponding to an ACE of 40 percent (2.5-year return period). For more information regarding the flood event and the hydraulic considerations for the project, see Appendix A in the EA.

Flooding scoured the levee's riverward slope and toe at two locations, Site 1 and Site 2, resulting in loss of riprap and embankment material from within the levee prism. In areas the damage extended up the riverward slope to the levee crest. Shortly after the damage occurred, Corps inspections found material missing up to 30 feet deep into the levee prism. The Corps estimates that the levee at Site 1 lost approximately 8,333 cubic yards (CY) and 6,111 CY at Site 2. Vegetation such as trees, shrubs, and sod were washed away from the riverward slope also took with them levee material. At Site 1, flooding also damaged two segmented concrete culverts and overtopped the levee, scouring the levee crest and landward slope. The two culverts (24- and 48-inch-diameter), which transport runoff from the City of Lynden through the Lynden Levee, exhibit evidence of sedimentation, joint separation, and/or settlement.

In the damaged condition, the level of protection (LOP) provided by the Lynden Levee is diminished from 10 percent (10-year return period) to 100 percent (1-year return period) ACE event to residential and agricultural properties, and associated utilities and infrastructure.

The Corps proposes to construct a more permanent repair to the damaged levee in 2021. The proposed repair would repair the levee in-kind at each damaged site within the designed and pre-damage footprint. Levee embankment and riverward armor would be restored at Site 1 and Site 2. In addition, repairs to Site 1 would replace two segmented concrete culverts with a flap gate culvert and repair the crown and landward slope to pre-flood conditions. Minor deviations in the structure's configuration would be integrated due to changes in materials, construction techniques, and safety standards that are necessary to make the repair. Minor deviations include an increase in riprap size at both repair sites and changes in the levee alignment and armored area at Site 1 to accommodate the new culvert and to reduce scour and erosion potential within the project reach. The deviations would not shift the levee into the river. The levee's riverward toe would remain within the pre-damaged footprint, while the landward toe would be shifted approximately 25 feet inland from the current location at the downstream end at Site 1 to accommodate the culvert. The culvert replacement is necessary to facilitate runoff from the city of Lynden and to reduce flooding landward of the levee, particularly the access road to the Lynden wastewater treatment plant (WWTP), while maximizing off-channel refuge habitat for juvenile fish during high flows. Additionally, there would be a slight increase in rock size (approximately 7 inches wider in diameter) above what is currently present. The proposed rock size and launchable toe design is based on hydraulic analysis using the HEC-RAS model and Corps design

guidance (Engineer Manual (EM) 1110-2-1601). The hydraulic analysis that was completed provided an estimated river velocity. This expected velocity was used to size appropriate riprap size for scour protection. Based on scour calculations, the volume and class size needed was determined to be Class IV riprap. These changes are necessary to meet sound engineering principles consisting of the application of updated technology and construction techniques and reflect Corps design requirements in the interest of levee safety when conducting repairs under Public Law (PL) 84-99.

Construction length at Site 1 and 2 are 457 LF and 275 LF, respectively, for a total of 732 LF, including any necessary transitions, at the two sites. All repairs would occur within or landward of the pre-damage footprint of the levee.

The Corps has developed a list of conservation measures and incorporated these into the levee repair to reduce environmental impacts of the repair. Best Management Practices (BMPs) would be employed to minimize project impacts, such as a silt curtain to isolate to control turbidity. Project construction includes environmental enhancements to compensate for temporary construction impacts and long-term loss of vegetation on the levee slope and to protect water quality.

3. Project Purpose and Need. The action is needed because the Lynden Levee was damaged by flooding and no longer provides the designed LOP against flooding. If the Lynden Levee were to fail, there would be an increased risk to life safety, improved property, and public infrastructure. The purpose of the project is to restore the LOP exhibited by the Lynden Levee prior to the damaging event to protect lives and property from subsequent flooding. Per Public Law 84-99, the Corps is authorized to repair damaged flood control works to the pre-flood LOP.

4. Availability of Environmentally Acceptable Practicable Alternatives to Meet the Project Purpose. The alternatives evaluated for this project were as follows;

a. Alternative 1 – No Action. Under the No Action Alternative, the levee would remain in the current damaged state. This alternative would not meet the project purpose because the levee would likely be further damaged in future flood events and could fail, which would endanger lives and property. During any flood event threatening the integrity of the levee system, the Corps or other federal and non-federal agencies may act under emergency authorities to preserve the levee system and, to the extent possible, maintain protection of life and property landward of the levee. However, responding to damages during a flood event, would be temporary, less certain of success, potentially more expensive, and could be less protective of environmental and cultural resources. If flood fighting efforts don’t take place in time or are unsuccessful, there is an increased risk of levee failure. Should failure occur, floodwaters would enter into the protected area. Flooding could have detrimental effects including transporting debris, sediment, and/or pollutants into the community and surrounding areas, as well as transporting the polluted mix back into the river. Depending on the scope of the flood, this could cause substantial impacts.

The No Action Alternative is not recommended because it does not meet the project purpose and need. While the No Action Alternative is not recommended, it is carried forward for further evaluation to serve as a base condition for evaluation of other alternatives.

b. Alternative 2 – Nonstructural Alternative. This alternative consists of floodplain management strategies that involve changes in land use offered by other federal and state programs. Such strategies would include zoning, easements, flood warning, floodplain evacuation, and flood insurance. Nonstructural strategies involve acquisition, relocation, elevation, and flood proofing existing structures. The costs and timeframe for implementing this alternative makes it impractical with the costs too high as compared with the value of the benefit received. Furthermore, the participation of the non-federal sponsor would be required to implement a nonstructural alternative, and Whatcom County has not agreed to meet its various obligations in executing a nonstructural alternative. Therefore, this alternative will be eliminated from detailed consideration.

c. Alternative 3 – Levee Setback Alternative. This alternative would shift the alignment of the levee landward of the riverbank. Typically, the setback levee would be a newly constructed earth embankment structure and the existing levee located on the riverbank would be abandoned. In this instance, a setback levee may be more costly than other alternatives due to more extensive embankment material and real estate requirements. Such an approach could also encroach on existing structures, privately-owned land, and public infrastructure. It could leave important public utilities, like the Lynden WWTP, unprotected from flooding. This alternative would require participation of the non-federal sponsor to implement, and Whatcom County has not agreed to meet its various obligations in executing a setback alternative. Therefore, this alternative will be eliminated from detailed consideration.

d. Alternative 4 – Repair In-Kind. This alternative repairs the levee by returning it to the pre-flood condition with minor change to the character, scope, or size of the levee. This alternative largely maintains the levee at the repair locations as it existed prior to the flood damage. The design uses updated engineering techniques including slightly larger rock size (approximately 7 inches wider in diameter) above what is currently present.

Findings: The Corps rejected Alternative 1 because it would not meet the project purpose and need because it would not fulfill the Corps' authorization to restore the pre-existing LOP, and due to the high likelihood of damage to protected infrastructure and homes during future flood events. The Corps rejected Alternative 2 because the Corps does not have authority to pursue a nonstructural alternative in the absence of participation by the non-federal interest. Alternative 3 was rejected because the Corps does not have authority to pursue a setback alternative in the absence of participation by the non-federal interest. Alternative 4 would restore the levee in place within the existing real estate easement. Alternative 4, the Repair In-Kind Alternative, was selected as the preferred alternative. Although the larger rock size constitutes fill in

Waters of the United States and would require mitigation, it meets the project purpose and need and is authorized.

5. Significant Degradation, either Individually or Cumulatively, of the Aquatic Environment

Effects on Physical, Chemical, or Biological Characteristics of the Aquatic Ecosystem. Impacts to aquatic resources from the completed flood fight included possible injury or displacement of aquatic species as a result of placing riprap into the water along the slope of the damaged levee. Projected impacts to aquatic resources from the proposed permanent repair action, the Repair In-Kind (Alternative 4), include possible displacement or injury due to excavation and placement of riprap along the slope of the levee, temporary degraded water quality associated with excavation, and potential impacts to aquatic organisms.

Given the location of proposed repairs, use of a silt curtain and block net to exclude fish from the in-water work areas, and relatively slow speed of excavation; it is reasonably certain that the risk of injury to aquatic species from the proposed excavation activities is low but not insignificant. Short-term, localized project-related increases in turbidity levels would likely occur as a result of in-water toe or bank excavation, rock placement for toe rock, and rock placement for bank construction during the proposed repair. Short-term increases in turbidity around the action areas resulting from work below the ordinary high-water mark (OHWM) would be temporary and are not expected to result in long-term adverse effects to aquatic species, or significant net change in function of the in-stream habitat.

Disturbance from vibration from the proposed action is possible during construction, stemming from delivery and dumping of rock on land as it is staged for construction, and as a result of excavation and placement of rock along the riverward face of the levee. Vibrational disturbance during the proposed construction would be minimized by working from the top of the bank and placing rock individually or in small bucket loads (no end-dumping into the river). Following these construction techniques, it is reasonably certain that impacts to aquatic species resulting from equipment use or rock placement during construction would be minimal, but not entirely insignificant or discountable for injury or long-term adverse behavioral effects.

Fish moving past the in-water work locations at the time of construction may be temporarily delayed at the construction site due to noise. If construction does interfere with fish movement past the repairs, breaks in the work during the day or overnight would allow fish to continue past, minimizing any effect. The degree to which aquatic species use the specific project locations for spawning is unknown. The area affected would be limited to the portion of the channel adjacent to the levee and the proposed actions would likely have no long-term effect on the movement or spawning of fish species.

Repairs to the Lynden Levee would remove 34 trees between the two repair sites. Clearing at Site 1 would remove eight Pacific willows; 12 red alder trees between 30 to 50 feet tall; and an understory of red elderberry, snowberry and salmonberry. Clearing at Site 2 would be similar with three willow trees and 11 red alders approximately 20 to 30 feet tall on the riverward slope. Mitigation for the levee repair includes willow bundles, woody debris, and planting native conifers and shrubs at two locations on the riverward side of the Lynden Levee. Mitigation measures are discussed in Section 6.

Following levee repairs, in late February and early March 2022 Whatcom County would plant 136 native trees and 75 native shrubs at two locations. In the NOP, the Corps initially proposed replacing trees at a 3:1 ratio with three years of monitoring. After a meeting with the Washington State Department of Ecology (Ecology) and WDFW on April 30, 2021, Whatcom County committed to increasing the tree replacement ratio to 4:1 with 5 years of monitoring which is outlined in the mitigation plan.

The overcompensation in numbers of planted trees versus lost trees is intended to compensate for the temporal lag until full maturity, as well as the loss of sod cover on portions of the riverward armored slope. Tree plantings would consist of coniferous trees rather than deciduous trees because native conifers provide more effective long-term shade over the river, long-lasting floodplain refugia, and would eventually provide long lasting large wood in the channel when the mature trees are taken by the river. The proposed mitigation would compensate for impacts to riparian habitat (e.g., canopy structure, large woody debris, cover, high flow velocity breaks) and water quality (e.g., thermal buffers, shade).

a) *Effects on Recreational, Aesthetic, Historical, and Economic Values.* The Lynden Levee is not a recreational structure though pedestrians use it as an unofficial walking path. To ensure public safety during construction, access to the project site would be prohibited, temporarily interrupting pedestrian use. The levee repair would not affect recreational boating or fishing from a boat in the river.

Prior to the damage, the levee system provided 10-year LOP to residential and agricultural properties, and associated utilities and infrastructure. The proposed action would restore the LOP and is not expected to change existing land uses.

Lynden Levee is likely more than 50 years old making the structure eligible for review under the National Historic Preservation Act (NHPA). The Corps' evaluation focused on just two small sections of a much larger feature. Based on those sections, the Corps made the determination that the levee is potentially eligible for the National Register of Historic Places (NRHP). There are no properties listed in the National Register of Historic Places (NRHP) or the Washington State Historic Site Register in the project vicinity. No cultural resources have been previously recorded within the area of potential effect (APE). The Corps coordinated with the Department of Archaeology and Historic Preservation (DAHP; Washington's State Historic Preservation Office), Lummi

Nation, Nooksack Tribe, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and Tulalip Tribes as required by the NHPA. The Corps submitted its determination and findings letter on March 15, 2021 to DAHP that the proposed undertaking would have no adverse effect. DAHP concurred with the Corps determination that the undertaking will have no adverse effect in a letter dated April 7, 2021.

Findings. This work is not exempt from Section 404 of the CWA. The Corps does not issue permits for its own civil works activities. Nevertheless, the Corps has accepted responsibility for the compliance of its civil works projects with Section 404 of the CWA, as well as the obligation to seek water quality certification under Section 401. The Corps received a CWA Section 401 permit (#19995) from Ecology on May 28, 2021.

This alternative would have no adverse impact on cultural resources, as there are no cultural resources within the project APE. There would also be no change to recreational opportunities at the site.

The Corps has determined that the proposed work would have beneficial economic impacts and no significant adverse impacts to aquatic ecosystem functions, recreational, and aesthetic values

6. Appropriate and Practicable Measures to Minimize Potential Harm to the Aquatic Ecosystem

a) *Impact Avoidance and Minimization Measures*. The proposed action will employ typical Conservation Measures and BMPs to avoid and minimize adverse effects. These measures will be written into the Construction Management Plan (CMP). A Corps employee will act as Construction Manager for the effort and will ensure that these measures will be employed per the CMP. Conservation Measures and BMPs include:

<u>Conservation Measures</u>

- Hydroseed with a native seed mix and mulch would be placed on disturbed areas not armored with rock.
- Repairs would start at the upstream end and continue downstream. This would allow the repaired levee to act as a localized flow deflector and help manage flows in the work area, reducing turbidity.
- Willow bundles and tree and shrub plantings are incorporated into the repair. Monitoring and adaptive management, including replacement and maintenance, would be conducted by the Corps and Whatcom County. The Corps and Whatcom County will coordinate on adaptive management replacement strategies if plantings totally fail to meet performance standards (Appendix D in the EA). Replacement strategies may include planting different species, changing the planting location, or adding pest control or exclusion devices. The Corps would report the success of the mitigation plantings to the resource agencies coordinated with for the repair.

- Rock would be placed individually or in small bucket loads, with no uncontrolled dumping of rocks in-water or along the levee slope. Large rock would be placed and manipulated using the thumb attachment. Small rock that is impracticable to manipulate with the thumb attachment, such as quarry spalls, would be transferred from the bucket to the levee slope in a pouring motion.
- In-water work would be limited to the in-water work window (June 15 to August 31) to limit impacts to aquatic species, particularly salmon.

Best Management Practices (BMPs)

BMPs would be employed to minimize project impacts. Some are integrated into the repair, while others are guides to operation and care of equipment. Note, some of these have been mentioned above.

- In-water work would be limited to the in-water work window (June 15 to August 31) and minimized to the extent possible.
- A silt curtain would be installed for work in the Nooksack River to control turbidity generated along the shoreline. If the curtain is damaged and cannot be repaired or replaced, the Corps would slow down in-water work to minimize turbidity generation.
- Water quality monitoring for turbidity would be performed as outlined in the Water Quality Monitoring Plan (Appendix E in the EA). If a potential exceedance is detected at the early warning sample locations, onsite personnel would evaluate construction activities and take measures to minimize turbidity generation. Examples include slowing down a specific in-water activity, changing the amount of material that is moved below the waterline, and inspecting the silt curtain.
- In-water excavation would be completed slowly to minimize turbidity generation. Care would be taken to reduce discharge from saturated material excavated below the waterline from entering back into the river. A bench with a concave surface would be created on the levee slope during deconstruction of the damaged levee. Wet material would be placed in the bench, so water drains downward through the levee and not directly back into the river. This material will be reused onsite (e.g., levee embankment and willow bundles). Material not used for reuse would be transported offsite for disposal at an approved, permitted location.
- Vegetation removal would be limited to the repair sites.
- Noxious weeds would be disposed of separately from other organic materials at an approved off-site location.
- Equipment used near and in water would be cleaned prior to construction.
- Drive trains would not work in the water. Only the excavator bucket with thumb attachment would extend into the water.
- Fueling would occur on the landward side of the levee, and biodegradable hydraulic fluids would be used as appropriately in any portion of the equipment that would work in the water.
- Construction equipment shall be regularly checked for drips or leaks and fixed.
- At least one fuel spill kit with absorbent pads would be onsite at all times.

- Material placed into the water would be placed individually or in small bucket loads. No end dumping of rock into the water would occur.
- Rock placement would occur only within the project footprint.
- Rock placement and underwater excavation would occur from the upstream end of the project to the downstream end. Rock is placed shortly after excavation so it would act as a localized flow deflector and help manage flows in the installation areas.
- After construction is complete, the sites would be reseeded using a native grass seed mix including a mulch base.
- At least one biologist would be onsite during construction. Corps or Service biologists may visit construction site. All visits would be coordinated with the Project Manager and Construction Manager.
- Fish would be excluded from the work sites in the Nooksack River by a silt curtain and from Site 1 by a net upstream of the sump. The Corps would coordinate with NMFS, USFWS, WDFW, and Whatcom County to complete fish rescues in the excluded areas in accordance to the fish rescue plan.
- Woody debris generated during construction and provided by Whatcom County would be placed along the riverward toe of the repaired levee. The onsite biologist would direct the orientation of the woody debris to provide aquatic benefits (e.g., shoreline complexity, shade, cover). Smaller woody materials like slash would be intertwined with larger logs and rootwads. As much of the riprap would be covered by the woody material as possible.
- All trash and unauthorized fill (including concrete blocks or pieces, bricks, asphalt, metal, treated wood, glass, floating debris, and paper) generated during the repair would be removed from the project and staging areas after work is complete.
- A pre-construction meeting would be conducted to look at existing conditions and any possible fine-tuning that should be done for BMPs or environmental requirements. The pre-construction meetings would include outside resources agencies like USFWS or NMFS.

Compensatory Mitigation

Mitigation is proposed to compensate for project impacts to riparian vegetation and water quality at the two repair sites (Appendix D in the EA). Repairs to the Lynden Levee would require removal of vegetation within the construction footprint. At Site 1, the Corps estimates eight Pacific willows (*Salix lasiandra*) and 12 red alder (*Alnus rubra*) trees between 30 to 50 feet tall, with an understory of red elderberry (*Sambucus racemose)*, snowberry (*Symphoricarpos albus)*, and salmonberry (*Rubus spectabilis)* would be removed. Site 2 is similarly vegetated, although it has fewer understory shrubs. Site 2 has 11 red alders and three willow trees approximately 20 to 30 feet tall on the riverward slope that would be removed. Mitigation includes vegetation plantings (willow bundles, shrubs, and trees) and woody debris to compensate for habitat and water quality impacts from the repair.

The Corps would incorporate approximately 72 willow bundles into the riverward side of the levee. Willow bundles consist of 10 live willow stakes of Sitka willow (*Salix sitchensis*) in a lens of topsoil two feet high by about three feet long. The planting bundles would be spaced 10 feet apart for continued levee inspection and would be placed just above the launchable toe and close to the OHWM. The Corps would also place woody debris along the riverward toe of the repaired levee. Woody debris would come from materials generated at each repair site and from pieces Whatcom County has accumulated (Appendix D in the EA). This woody debris would be placed to provide aquatic benefits (e.g., shoreline complexity, shade, and cover). Smaller woody material, such as slash, would be intertwined with the large logs and root wads. The riprap would be covered by the woody material as much as possible.

Following levee repairs in late February and early March, Whatcom County would plant 136 native trees and 75 native shrubs at two locations (Appendix D in the EA). The Corps initially proposed replacing trees at a 3:1 ratio with three years of monitoring. After a meeting with Ecology and WDFW on April 30, 2021, Whatcom County committed to increasing the tree replacement ratio to 4:1 with 5 years of monitoring which is outlined in the mitigation plan (Appendix D in the EA).

The overcompensation in numbers of planted trees versus lost trees is intended to compensate for the temporal lag until full maturity, as well as the loss of sod cover on portions of the riverward armored slope. Tree plantings would consist of coniferous trees rather than deciduous trees because native conifers provide more effective long-term shade over the river, long-lasting floodplain refugia, and would eventually provide long lasting large wood in the channel when the mature trees are taken by into the river. The proposed mitigation would compensate for impacts to riparian habitat (e.g., canopy structure, large woody debris, cover, high flow velocity breaks) and water quality (e.g., thermal buffers, shade).

Findings. The Corps has determined that all appropriate and practicable measures have been taken to minimize potential harm to the environment and appropriate mitigation is proposed to compensate for unavoidable impacts. There are no practicably available fill alternatives that would be less costly and still be consistent with engineering and environmental requirements, while meeting the project need.

7. Other Factors in the Public Interest

a. *Fish and Wildlife.* The Corps has analyzed potential effects to ESA-listed species and prepared a BA that was submitted to the USFWS on December 23, 2020, and to NMFS on March 8, 2021. For Puget Sound Chinook, Puget Sound steelhead, and Coastal/Puget Sound bull trout, the Corps has reached an agency determination that the project may affect and is likely to adversely affect these species and their critical habitat. For SRKW, the project may affect, but is not likely to adversely affect this species and its critical habitat. The project may affect, but is not likely to adversely affect, marbled murrelet and will have no effect to marbled murrelet critical habitat. The Corps intends to proceed with construction prior to completion of consultation with the Services pursuant to the “emergency circumstances” provision of the ESA regulations,

and to complete ESA consultation after the fact. The applicable regulation is set out at 50 CFR Section 402.05 (a) and (b). The Corps will commit to fully funding and performing all Reasonable and Prudent Alternatives necessary to avoid the likelihood of jeopardy to listed species or destruction or adverse modification of designated critical habitat, as well as Reasonable and Prudent Measures (RPMs) necessary and appropriate to minimize the impact of Incidental Take that are described if documents concluding consultation are received from USFWS and NMFS.

b. *Water Quality*. The Corps has concluded that this project will not violate Washington State Water Quality Standards. Limited in-water work will be completed and BMPs will limit turbidity impacts and concerns for spills or leaks from construction equipment. Water quality monitoring will ensure compliance with state standards. A CWA water quality certificate (#19995) was issued by Ecology on May 28, 2021. The proposed repairs include a minor deviation in the levee design which constitutes fill into the Waters of the U.S. This will be mitigated by the willow bundles, woody debris, and tree and shrub plantings.

c. *Historical and Cultural Resources*. As required under Section 106 of the NHPA, the Corps coordinated with DAHP and consulted with the Lummi Nation, Nooksack Tribe, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and Tulalip Tribes. To date, the Corps has received one response from the Lummi Nation on January 20, 2021, requesting the Corps notify them in the event of an inadvertent discovery. The Corps submitted its determination and findings letter on March 15, 2021 to DAHP that the proposed undertaking would have no adverse effect. DAHP concurred with the Corps determination that the undertaking will have no adverse effect in a letter dated April 7, 2021.

d. *Environmental Benefits*. The project purpose is to restore the LOP of the Lynden Levee. While the project purpose is not to create environmental benefits, the design of the flap gate at Site 1 maximizes the time fish are able to access off-channel refuge landward of the levee before the flap gate closes, and opens it up again as soon as the danger of flooding passes so fish can return to the main channel during the falling limb of the flood event. Furthermore, the project includes mitigation to compensate for impacts from the action.

Findings. The Corps has determined that this project is within the public interest based on review of the public interest factors.

8. Conclusion. Based on the analyses presented in the EA, as well as the following 404(b)(1) Evaluation, the Corps finds that this project complies with the substantive elements of Section 404 of the Clean Water Act.

ATTACHMENT A

Clean Water Act 404(b)(1) Evaluation [40 CFR § 230]

404(b)(1) Evaluation [40 CFR § 230]

Potential Impacts on Physical and Chemical Characteristics [Subpart C]:

1. Substrate [230.20]

The Lynden Levee is located on the right bank of the Nooksack River near the City of Lynden, Whatcom County, Washington. The levee is approximately 13,800 linear feet (LF) long and is 3 to 6 feet high on the landward side. The levee top is approximately 10 to 12 feet wide. The riverward slope and toe is armored with Class IV riprap. Based on onsite conditions, best professional judgment by engineers, and available historical and technical data, the Lynden Levee at the repair site had adequate scour protection as originally designed and constructed by the local entity that resembles an armored launchable toe. In its undamaged state, the levee provides flood risk reduction up to the 10 percent (10-year return period) annual chance of exceedance (ACE) event. Geotechnical investigations at Site 1 indicated that the levee embankment, consisting of silty sand with gravel, overlies silty sand and sandy silt to a depth of about 12 to 13 feet below the levee crest. At this depth, a 9- to 11-foot-thick layer of very soft peat was encountered. The peat is underlain by sand and lean clay to the bottom of the borings, which extended 30 to 32 feet below the levee crest. Site 2 soils are mapped as quaternary alluvium. Well logs from the vicinity of Site 2 were reviewed and indicated materials consisting of sand, silty sand, sandy silt, and clay, with some gravels intermixed. According to the Natural Resource Conservation Service, soils at both sites are primarily classified as Briscot silt loam, with areas of Pangborn muck located landward of the levee at Site 1. Briscot silt loam is poorly drained, has a moderately high to high capacity to transmit water, and is formed in floodplains on alluvium. Both sites are vegetated with deciduous trees and shrubs. Post-construction at both sites, the levee would be riprap with willow bundles inserted every 10 feet on center at the ordinary high-water (OHW).

2. Suspended particulates/turbidity [230.21]

Minimal turbidity is expected during construction. Best management practices (BMPs) for sediment control will be used throughout construction to minimize any potential turbidity issues, including a silt curtain. Turbidity monitoring will ensure compliance with state standards.

3. Water [230.22]

The work is not expected to add any nutrients to the water that could affect the clarity, color, odor, or aesthetic value of the water, or that could reduce the suitability of the Nooksack River for aquatic organisms or recreation. There will be a time lag before plantings fully restore the pre-flood riparian function at this site.

4. Current patterns and water circulation [230.23]

The Corps expects minimal disruption of current patterns and water circulation during or after construction. A Hydraulic Engineer assisted with the design of the project to determine rock size and design details to restore flood protection and minimize disturbance. No change to current patterns or water circulation is expected after completion.

5. Normal water fluctuations [230.24].

The levee repair work will have no effect on normal water fluctuations.

6. Salinity gradients [230.25]

The Nooksack River is entirely freshwater river system and the proposed repair will not introduce saline materials; therefore, the levee repair work with have no effect to salinity gradients.

Potential Impacts on Biological Characteristics of the Aquatic Ecosystem [Subpart D]:

1. Threatened and endangered species [230.30]

The Corps has analyzed potential effects to ESA-listed species and prepared a Biological Assessment (BA) that was submitted to the U.S. Fish and Wildlife Service (USFWS) on December 23, 2020, and to the National Marine Fisheries Service (NMFS) on March 8, 2021. For Puget Sound Chinook, Puget Sound steelhead, and Coastal/Puget Sound bull trout, the Corps has reached an agency determination that the project may affect and is likely to adversely affect these species and their critical habitat. For SRKW, the project may affect, but is not likely to adversely affect this species and its critical habitat. The project may affect, but is not likely to adversely affect, marbled murrelet and will have no effect to marbled murrelet critical habitat. The Corps intends to proceed with construction prior to completion of consultation with the Services pursuant to the “emergency circumstances” provision of the ESA regulations, and to complete ESA consultation after the fact. The applicable regulation is set out at 50 CFR Section 402.05 (a) and (b). The Corps will commit to fully funding and performing all Reasonable and Prudent Alternatives necessary to avoid the likelihood of jeopardy to listed species or destruction or adverse modification of designated critical habitat, as well as Reasonable and Prudent Measures (RPMs) necessary and appropriate to minimize the impact of Incidental Take that are described if documents concluding consultation are received from USFWS and NMFS.

2. Fish, crustaceans, mollusks, and other aquatic organisms in the food web [230.31]

Fish crustaceans, mollusks, and other aquatic organisms may be temporarily impacted by small turbidity increases and increased noise. Similar habitat exists upstream and downstream and any impacted areas would be expected to be recolonized quickly by surrounding aquatic organisms.

3. Other wildlife [230.32]

Birds and other wildlife may be temporarily displaced during construction due to noise, construction vehicles, and riprap placement. Similar habitat exists nearby for their use. Loss of vegetation would temporarily reduce available habitat function at the project sites. However, willow bundles, woody debris, and tree and shrub plantings would compensate for this loss.

Potential Impacts on Special Aquatic Sites [Subpart E]:

1. Sanctuaries and refuges [230.40]

The proposed and completed actions will have no effect on sanctuaries and refuges as none are in or adjacent to the project vicinity.

2. Wetlands [230.41]

No wetlands are located within the repair areas. Access roads and staging areas will not be located in jurisdictional wetlands.

3. Mud flats [230.42]

No mud flats are in the project vicinity and therefore will not affected.

4. Vegetated shallows [230.43]

No vegetated shallows are present at the project site; therefore, the proposed action will have no effect on vegetated shallows.

5. Coral reefs [230.44]

Not applicable.

6. Riffle and pool complexes [230.45]

No riffle and pool complexes are present at the project site; therefore, the proposed and completed action would have no effect on riffle and pool complexes.

Potential Effects on Human Use Characteristics [Subpart F]:

1. Municipal and private water supplies [230.50]

The proposed and completed action would have no effect on municipal or private water supplies. The repair would alleviate flooding at the Lynden WWTP Road, preserving access to the facility for a longer period of time during flood events.

2. Recreational and commercial fisheries [230.51]

During construction, access to the levee will be restricted due to required safety measures; however, fishing access on the rest of the river is not affected by the repair. The proposed and completed action would have no effect on recreational and/or commercial fisheries.

3. Water-related recreation [230.53]

As construction would be only at the river's edge, the repairs to the levee would have no impacts to boating traveling past in the Nooksack River.

4. Aesthetics [230.53]

During construction, there would be minor disturbance form heavy equipment noise and exhaust. After construction, the shoreline would look different because the riprap bank stabilization structure would have replaced the previous shoreline condition. The repair sites would look less natural initially, but plantings would be done to compensate for these impacts. It is expected that foliage would begin to develop relatively quickly and the repairs would blend in more with the surroundings.

5. Parks, national and historic monuments, national seashores, wilderness areas, research sites and similar preserves [230.54]

The Nooksack levee is not located in or immediately adjacent to parks, national and historic monuments, national seashores, wilderness areas, research sites, and or similar preserves.

Evaluation and Testing [Subpart G]:

1. General evaluation of dredged or fill material [230.60]

Bank stabilization material would consist of quarry spalls and Class IV. All imported material would be free from contamination and obtained for a permitted local quarry.

2. Chemical, biological, and physical evaluation and testing [230.61]

No soil sampling is required as no contamination is known or expected. Turbidity monitoring would be completed during in-water work to ensure compliance with state water quality standards during construction.

Actions to Minimize Adverse Effects [Subpart H]:

1. Actions concerning the location of the discharge [230.70]

Since the Corps is not selecting a disposal site, but rather repairing a flood control structure, the actions that would be taken are necessary for the location.

2. Actions concerning the material to be discharged [230.71]

Bank stabilization material would be required to meet Corps standards for placement of riprap. Material would be imported from an approved, clean source.

3. Actions controlling the material after discharge [230.72]

Following placement of the materials for the armoring and repair, no further dispersion is expected, therefore no measures to control placement of these materials are considered necessary.

4. Actions affecting the method of dispersion [230.73]

The riprap placed below the water line would be placed individually or in small, controlled bucket loads. The excavator would work from the crown of the levee or the riverward bank. A silt curtain would contain turbidity generated during in-water work in the Nooksack River. Dump trucks would deliver material and dump it onto levee crown or in the staging area away from the water's edge. No end dumping into the river would occur. Turbidity impacts are expected to be minor and temporary.

5. Actions related to technology [230.74]

The technology used in the proposed project is considered acceptable for this scope of work. No other specific actions to minimize effects related to technology are needed.

6. Actions affecting plant and animal populations [230.75]

The Corps has coordinated construction activities with state and federal resource agencies, as well as interested tribes, to minimize impacts to fishery and wildlife resources. There would be temporary disturbance to wildlife in the project vicinity due to noise from operation of machinery. Timing of construction avoids and minimizes impacts to sensitive species.

7. Actions affecting human use [230.76]

The Corps has taken all appropriate and practicable steps to assure minimal impacts to human use, safety and general appreciation of the area. Traffic would not need to be detoured around the area during construction. Signs and flaggers would be used as needed to minimize impacts and improve safety. Construction would occur during

daylight hours to minimize noise impacts to nearby houses. Repair of the flood control structure is not expected to diminish water quality.

8. Other actions [230.77]

BMPs would be used in the proposed construction to ensure that no unnecessary damage to the environment occurs.

Application by Analogy of the General Policies for the Evaluation of the Public Interest [33 CFR § 320.4, used as a reference]

1. Public Interest Review [320.4(a)]

The Corps finds this repair to flood control structures to be in compliance with the 404(b)(1) guidelines and in the public interest.

2. Effects on wetlands [320.4(b)]

No wetlands are located within the repair sites.

3. Fish and wildlife [320.4(c)]

The Corps has consulted and continues to consult with state and federal resource agencies, tribes and other interested members of the public on this action. Mitigation is proposed to compensate for the minor deviations requiring fill in the Waters of the U.S.

4. Water quality [320.4(d)]

This work is not exempt from Section 404 of the CWA. The Corps does not issue permits for its own civil works activities. Nevertheless, the Corps has accepted responsibility for the compliance of its civil works projects with Section 404 of the CWA, as well as the obligation to seek water quality certification under Section 401. The proposed repair action would require work in the active channel with some work below the elevation of OHWM. Construction could be expected to cause minor, temporary, localized increases in turbidity. BMPs, including silt curtains, restrictions on fueling, and prevention of fluid leaks from construction equipment would be employed that would minimize discharge of pollutants into the river. A CWA water quality certificate (#19995) was issued by the Washington State Department of Ecology (Ecology) on May 28, 2021. The proposed repair includes a minor deviation in the levee design which constitutes fill into the Waters of the U.S. This would be mitigated by the willow bundles, woody material, and tree and shrub plantings.

5. Historic, cultural, scenic, and recreational values [320.4(e)]

The project has been determined to have no potential cause effect, as the area has been surveyed and contains no historic properties. The Department of Archaeology and

Historic Preservation (Washington's State Historic Preservation Office) concurred with the Corps determination that the undertaking will have no adverse effect in a letter dated April 7, 2021.

6. Effects on limits of the Territorial Sea [320.4(f)]

Not applicable.

7. Consideration of property ownership [320.4(g)]

Access for construction equipment and materials would be via public rights-of-way and real estate rights of entry provided by Whatcom County, the non-federal sponsor of the repairs. No change in property ownership would occur.

8. Activities affecting coastal zones [320.4(h)]

The proposed work complies with the policies, general conditions, and general activities specified in the Whatcom County Shoreline Management Program. The proposed action is consistent to the maximum extent practicable with the State of Washington Shoreline Management Program. State concurrence may be presumed if no response is received after 60 days which would be May 31, 2021. To date the Corps has not received comment or concurrence from Ecology. Since more than 60 days has elapsed, state concurrence may be presumed.

9. Activities in marine sanctuaries [320.4(i)]

Not applicable.

10. Other federal, state, or local requirements [320.4(j)]

The Corps has initiated formal consultation with the NMFS and USFWS on the findings of the BA for the proposed repair. A mitigation plan has been proposed to compensate for project impacts on fill in waters of the U.S. The mitigation plan was approved by Ecology and provided to the USFWS and NMFS on May 10, 2021. Consultation with USFWS and NMFS is ongoing.

11. Safety of impoundment structures [320.4(k)]

Not applicable.

12. Floodplain Management [320.4(l)]

The project is in compliance. The Corps considered alternatives to reduce hazards and risks associated with floods and to minimize the impact of floods on human safety, health and welfare, and restoring and preserving the natural and beneficial values of the base floodplain. The project maintains the status quo of the level of flood protection.

13. Water supply and conservation [320.4(m)]

Not applicable.

14. Energy conservation and development [320.4(n)]

Not applicable.

15. Navigation [320.4(o)]

This project would not impede current navigability within the Nooksack River.

16. Environmental benefits [320.4(p)]

The District Engineer has weighed the beneficial and detrimental environmental aspects of the project. No net detriments are expected.

17. Economics [320.4(q)]

Economic studies were undertaken which included studies enumerating and evaluating damages related to the existing economic development protected by the levee, sensitivity evaluations and optimization scenarios evaluating the benefits and costs of alternative project scopes. The outcome of these evaluations combined with engineering, environmental, and local sponsor considerations have led to the selection of the recommended plan. Repairing the levee was found to be economically justified based on a comparison of the annualized benefits (damages prevented by restoring the levee) and the annualized cost of repairs.

18. Mitigation [320.4(r)].

Mitigation is proposed to compensate for project impacts to riparian vegetation and water quality at the two repair sites. Repairs to the Lynden Levee would require removal of vegetation within the construction footprint. At Site 1, the Corps estimates eight Pacific willows (*Salix lasiandra*) and 12 red alder (*Alnus rubra*) trees between 30 to 50 feet tall, with an understory of red elderberry (*Sambucus racemose)*, snowberry (*Symphoricarpos albus)*, and salmonberry (*Rubus spectabilis)* would be removed. Site 2 is similarly vegetated, although with fewer understory shrubs. Site 2 has 11 red alders and three willow trees approximately 20 to 30 feet tall on the riverward slope that would be removed. Mitigation includes vegetation plantings (willow bundles, shrubs, and trees) and woody debris to compensate for habitat and water quality impacts from the repair.

The Corps would incorporate approximately 72 willow bundles into the riverward side of the levee. Willow bundles would consist of 10 live willow stakes of Sitka willow (*Salix sitchensis*) in a lens of topsoil two feet high by about three feet long. The planting bundles would be spaced 10 feet apart for continued levee inspection and would be placed just above the launchable toe and close to the OHWM. The Corps would also place woody debris along the riverward toe of the repaired levee. Woody debris would come from what is generated at each repair site and pieces accumulated by Whatcom County (Appendix D in the EA). This woody debris would be placed to provide aquatic benefits (e.g., shoreline complexity, shade, cover). Smaller woody material, such as

slash, would be intertwined with the large logs and root wads. The riprap would be covered by the woody material as much as possible.

Following levee repairs, in late February and early March 2022, Whatcom County would plant 136 native trees and 75 native shrubs at two locations (Appendix D in the EA). After a meeting with the Ecology and WDFW on April 30, 2021, Whatcom County committed to increasing the tree replacement ratio to 4:1 with 5 years of monitoring. A mitigation plan outlines the maintenance and monitoring for the willow bundles and tree and shrub plantings.

The overcompensation in numbers of planted trees versus lost trees is intended to compensate for the temporal lag until full maturity, as well as the loss of sod cover on portions of the riverward armored slope. Tree plantings would consist of coniferous trees rather than deciduous trees because native conifers provide more effective long-term shade over the river, long-lasting floodplain refugia, and would eventually provide long lasting large wood in the channel when the mature trees are taken by into the river. The proposed mitigation would compensate for impacts to riparian habitat (e.g., canopy structure, large woody debris, cover, high flow velocity breaks) and water quality (e.g., thermal buffers, shade).

Water Quality Certificate

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • PO Box 330316 • Shoreline, Washington 98133-9716 • (206) 594-0000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

May 28, 2021

U.S. Army Corps of Engineers – Seattle District
Attn: Zachary Martin Wilson
PO Box 3755
Seattle, WA 98124

RE: Water Quality Certification Order No. 19995 for Lynden Levee and Culvert Repair Project, Lynden, Whatcom County, Washington

Dear Zachary Martin Wilson:

On March 3, 2021, U.S. Army Corps of Engineers – Seattle District submitted a request for a Section 401 Water Quality Certification (WQC) under the federal Clean Water Act for the Lynden Levee and Culvert Repair project, Whatcom County, Washington; however, the Department of Ecology did not consider it a valid request until March 8, 2021.

On behalf of the state of Washington, the Department of Ecology certifies that the work described in the Section 401 Request and supporting documents complies with applicable provisions of Sections 301, 302, 303, 306, and 307 of the Clean Water Act, as amended, and applicable state laws. This WQC is subject to the conditions contained in the enclosed Order.

If you have any questions about this decision, please contact Rebekah Padgett at (425) 365-6571. The enclosed Order may be appealed by following the procedures described within the Order.

Sincerely,

Joe Burcar, Section Manager
Shorelands and Environmental Assistance Program

Sent by electronic mail: Zachary.m.wilson@usace.army.mil

Enclosure

e-cc: Joel Ingram, Washington Department of Fish and Wildlife
Terry Swanson, Ecology
Chris Luerkens, Ecology
Chad Yunge, Ecology
Amy Jankowiak, Ecology
Grant Yang, Ecology
Loree' Randall, Ecology
ecyrefedpermits@ecy.wa.gov

IN THE MATTER OF GRANTING A WATER QUALITY CERTIFICATION TO U.S. Army Corps of Engineers – Seattle District pursuant to 33 U.S.C. 1341 (FWPCA § 401), RCW 90.48.120, RCW 90.48.260 and Chapter 173-201A WAC	)))))))	**ORDER No. 19995** Lynden Levee and Culvert Repair Project, Nooksack River located in Whatcom County, Washington.

U.S. Army Corps of Engineers – Seattle District
Attn: Zachary Martin Wilson
PO Box 3755
Seattle, WA 98124

On September 17, 2020, the U.S. Army Corps of Engineers - Seattle District (Corps) submitted a pre-filing meeting request to the Department of Ecology (Ecology). Ecology and Corps conducted a pre-filing meeting on November 6, 2021. Then the Corps on March 3, 2021, submitted a request for a Section 401 Water Quality Certification (WQC) under the federal Clean Water Act for the Lynden Levee and Culvert Repair Project, Nooksack River located in Whatcom County, Washington. On March 8, 2021, the Corps submitted additional information and Ecology considered the Request valid on this date. On March 19, 2021, the Corps informed Ecology that the deadline for making a decision on this project would be May 17, 2021. But then on April 12, 2021 the Corps revised the deadline to May 31, 2021. Ecology issued a public notice for the project on March 12, 2021.

The proposed project entails repair of approximately 732 linear feet of the Lynden Levee at two locations, including replacement of two culverts (24- and 48-inch-diameter) with one flap gate culvert (48-inch-diameter) at Site 1. The excavation area at Site 1 is approximately 7-feet-deep and 19-feet-wide, with a total volume of approximately 1,300 cubic yards. The excavation area at Site 2 is approximately 9-feet-deep and 25-feet-wide, with a total volume of approximately 1,900 cubic yards. Approximately 50 logs, 10 root wads, and a mix of smaller pieces of woody material will be placed along the levee repair. Plantings will be installed at Site 1 and upstream of Site 2 as mitigation for impacts to vegetation.

The project sites are located on the right bank of the Nooksack River (approximately River Mile 17.3), near the Lynden Wastewater Treatment Plant, in Lynden, Whatcom County, Washington, Section 20, Township 40 N., Range 3 E., within Water Resource Inventory Area (WRIA) 01 Nooksack River. Specifically, the two site locations are:

- Site 1: approximately 457 linear feet on the right bank, located next to the Lynden Wastewater Treatment Plant.
- Site 2: approximately 275 linear feet on the right bank, located approximately 1.3 miles downstream of the Lynden Wastewater Treatment Plant.

AUTHORITIES

In exercising authority under 33 U.S.C. § 1341, RCW 90.48.120, and RCW 90.48.260, Ecology has reviewed the WQC request pursuant to the following:

1. Conformance with applicable water quality-based, technology-based, and toxic or pretreatment effluent limitations as provided under 33 U.S.C. §§1311, 1312, 1313, 1316, and 1317;

2. Conformance with the state water quality standards contained in Chapter 173-201A WAC and authorized by 33 U.S.C. §1313 and by Chapter 90.48 RCW, and with other applicable state laws;

3. Conformance with the provision of using all known, available, and reasonable methods to prevent and control pollution of state waters as required by RCW 90.48.010; and,

4. Conformance with Washington's prohibition on discharges that cause or tend to cause pollution of waters of the state of Washington. RCW 90.48.080.

With this Water Quality Certification (WQC) Order, Ecology is granting with conditions, the Corps request for a Section 401 Water Quality Certification for the Lynden Levee and Culvert Repair Project, Nooksack River, located in Whatcom County. Ecology has determined that the proposed discharges will comply with all applicable state water quality requirements, provided the project is conducted in accordance with the Section 401 Water Quality Certification request that Ecology received on March 3, 2021 and March 8, 2021, the supporting documents referenced in Table 1 below, **and the conditions of this WQC Order**.

Table 1. Supporting Documents

Date Received	**Document Type**	**Title & Date**	**Author**
March 3, 2021	Memorandum	Memorandum from Corps to Loree' Randall, Ecology, Subject: Section 401 Water Quality Certification Request for Repairs to the Lynden Levee near the City of Lynden, Washington (dated March 2, 2021).	Laura Boerner, Corps
March 3, 2021	Joint Aquatic Resources (JAR) Form	Joint Aquatic Resources Form (undated)	Corps

March 3, 2021	Drawings	Sheets 1 of 8 to 8 of 8 (Plates G-001, G-002, and C-100 to C-105) (dated May 27, 2020)	Corps
March 3, 2021	Memorandum	Memorandum from Corps to Federal Consistency Coordinator, Department of Ecology, RE: Lynden Levee Repairs near Lynden, Whatcom County, Washington. Determination of functional analogy to Nationwide Permit (NWP) 3 (dated March 3, 2021)	Zachary Wilson, Corps
April 1, 2021	National Environmental Policy Act Public Notice	Notice of Preparation/Clean Water Act Public Notice, Reference: PMP-21-02, Name: Lynden Levee and Culvert Repair (dated April 1, 2021)	Corps
April 23, 2021	Biological Assessment	Biological Assessment, Lynden Levee Repairs Whatcom, Washington (dated December 2020)	Corps
May 6, 2021	E-mail	E-mail to Rebekah Padgett, Ecology, RE: Lynden Levee Repairs – Plantings (dated May 6, 2021, 3:51 PM)	Zachary Wilson, Corps
May 10, 2021	Plan	Draft Fish Exclusion and Rescue Plan, Project: Lynden Levee and Culvert Repair (dated May 10, 2021)	Corps
May 10, 2021	Mitigation Plan	2021 Lynden Levee and Culvert Repair Mitigation Plan (dated May 10, 2021)	Corps
May 11, 2021	Water Quality Monitoring Plan	Water Quality Monitoring Plan, Project: Lynden Levee and Culvert Repair (dated May 11, 2021)	Corps

Issuance of this Section 401 Water Quality Certification for this proposal does not authorize U.S. Army Corps of Engineers – Seattle District to exceed applicable state water quality standards (Chapter 173-201A WAC), ground water quality standards (Chapter 173-200 WAC) or sediment quality standards (Chapter 173-204 WAC). Furthermore, nothing in this WQC absolves the

Corps from liability for contamination and any subsequent cleanup of surface waters, ground waters, or sediments resulting from project construction or operations.

A. General Conditions

Clean Water Act (CWA) Section 401 certification is granted with conditions to the Corps. Ecology has determined that any discharge from the proposed project will comply with water quality requirements, as defined by 40 CFR 121.1(n), subject to the following conditions pursuant to Section 33 USC §1341(d). Additionally, the following conditions shall be incorporated into the Corps project and strictly adhered to by the Corps. This WQC Order does not authorize direct, indirect, permanent, or temporary impacts to waters of the state or related aquatic resources, except as specifically provided for in conditions of this WQC Order.

Specific condition justifications and citations required by 40 CFR 121.7(d)(1) are provided below each condition in *italic text.*

1. In this WQC Order, the term "Project Proponent" shall mean the U.S. Army Corps of Engineers – Seattle District and its agents, assignees, and contractors.
   - *Justification – Ecology needs to identify that conditions of this WQC Order apply to anyone conducting work on behalf of the Project Proponent to ensure compliance with the water quality standards and other applicable state laws.*
   - *Citation – 40 CFR 121.1(j), Chapter 90.48 RCW, Chapter 90.48.080 RCW, Chapter 90.48.120 RCW, Chapter 90.48.260 RCW, Chapter 173-200 WAC, Chapter 173-201A WAC, and Chapter 173-225-010 WAC.*

2. All submittals required by this WQC Order shall be sent to Ecology's Headquarters Office, Attn: Federal Permit Manager, via e-mail to fednotification@ecy.wa.gov and cc to Rebekah.Padgett@ecy.wa.gov. The submittals shall be identified with Order #19995 and include the Project Proponent's name, project name, project contact, and the contact phone number.
   - *Justification – Ecology needs to identify where information and submittals are to be submitted to be in compliance with the requirements of this WQC Order.*
   - *Citation – 40 CFR 121, Chapter 90.48 RCW, Chapter 90.48.120 RCW, Chapter 90.48.260 RCW, Chapter 173-201A WAC, and Chapter 173-225-010 WAC.*

3. Work authorized by this WQC Order is limited to the work described in the WQC request package received by Ecology on March 3, 2021 and March 8, 2021 and the supporting documentation identified in Table 1 above.
   - *Justification – Ecology has the authority to prevent and control pollution of state waters. By authorizing a discharge into a water of the state, through a WQC, Ecology is certifying the project as proposed will not negatively impact our state's water quality. Therefore, it is imperative the project is conducted as it was presented during the review process. Any deviations from information within the WQC Request*

package and this WQC Order must be disclosed prior to the initiation of the planned work.

- *Citation – 40 CFR 121, Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.120 RCW, Chapter 90.48.260 RCW, Chapter 173-200 WAC, Chapter 173-201A WAC, Chapter 173-204 WAC, and Chapter 173-225-010 WAC.*

4. The Project Proponent shall keep copies of this WQC Order on the job site and readily available for reference by Ecology personnel, the construction superintendent, construction managers and lead workers, and state and local government inspectors.
   - *Justification – All parties (including on-site contractors) must be aware of and comply with the WQC Order for the protection of water quality.*
   - *Citation – 40 CFR 121.3, Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 173-201A WAC, and Chapter 173-225-010 WAC.*

5. The Project Proponent shall provide access to the project site and all mitigation sites upon request by Ecology personnel for site inspections, monitoring, and/or necessary data collection, to ensure that conditions of this Order are being met.
   - *Justification – Ecology must be able to investigate and inspect construction sites and facilities for compliance with all state rules and laws.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.090 RCW, Chapter 173-201A WAC, and Chapter 173-225-010 WAC.*

6. The Project Proponent shall ensure that all project engineers, contractors, and other workers at the project site with authority to direct work have read and understand relevant conditions of this Order and all permits, approvals, and documents referenced in this Order. The Project Proponent shall provide Ecology a signed statement (see Attachment A for an example) before construction begins.
   - *Justification – Ecology needs to ensure that anyone conducting work at the project, on behalf of the Project Proponent, are aware of and understand the required conditions of this WQC Order to ensure compliance with the water quality standards and other applicable state laws.*
   - *Citation – 40 CFR 121.1(j), Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 173-201A WAC, and Chapter 173-225-010 WAC.*

7. This Order does not authorize direct, indirect, permanent, or temporary impacts to waters of the state or related aquatic resources, except as specifically provided for in conditions of this Order.
   - *Justification – Ecology has the authority to prevent and control pollution of state waters, and to protect designated uses. By authorizing a discharge into a water of the state, through a water quality certification, we are certifying the project as proposed will not negatively impact our state's water quality and will comply with the state's water quality requirements. Therefore, it is imperative the project is conducted as it was presented during the review process, and as conditioned herein.*

- *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 173-201A WAC, Chapter 173-201A-300(2)(e)(i) WAC, Chapter 173-201A-310 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

8. Failure of any person or entity to comply with the WQC Order may result in the issuance of civil penalties or other actions, whether administrative or judicial, to enforce the state's water quality standards.
   - *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses; civil penalties and other enforcement actions are the primary means of securing compliance with water quality requirements.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.037 RCW, Chapter 90.48.080 RCW, Chapter 90.48.120 RCW, Chapter 90.48.142 RCW, Chapter 90.48.144 RCW, and Chapter 173-225-010 WAC.*

B. Notification Requirements

1. The following notification shall be made via phone or e-mail (e-mail is preferred) to Ecology's Federal Permit Manager via e-mail to fednotification@ecy.wa.gov and cc to Rebekah.Padgett@ecy.wa.gov. Notifications shall be identified with Order #19995 and include the Project Proponent name, project name, project location, project contact and the contact phone number.
   a. Immediately following a violation of state water quality standards or when the project is out of compliance with any conditions of this Order.
   b. At least ten (10) days prior to all pre-construction meetings
   c. At least ten (10) days prior to conducting initial in-water work activities.
   d. Within seven (7) days of completing in-water work activities.
   - *Justification – Ecology must be aware of when a project starts and ends and whether there are any issues. This allows Ecology to evaluate compliance with the state water quality requirements.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204 WAC, and Chapter 173-225-010 WAC.*

2. In addition to the phone or e-mail notification required under B.1.a. above, the Project Proponent shall submit a detailed written report to Ecology within five (5) days that describes the nature of the event, corrective action taken and/or planned, steps to be taken to prevent a recurrence, results of any samples taken, and any other pertinent information.
   - *Justification – Ensure the Project Proponent remains in full compliance with state water quality requirements for the duration of the project.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.120 RCW, Chapter 173-201A WAC, and Chapter 173-225-010 WAC.*

C. Timing

1. This Order will expire December 31, 2028.
   - *Justification – Certifications are required for any license or permit that authorizes an activity that may result in a discharge. Ecology needs to be able to specify how long the WQC Order will be in effect.*
   - *Citation – 40 CFR 121 and Chapter 173-225-010 WAC.*

2. The following in-water work windows apply to the project:
   a. All activities within the wetted perimeter of the Nooksack River may be conducted between June 15 and August 31 of any year. To the extent practicable, work within the wetted perimeter of the Nooksack River work shall be conducted after July 1.
   b. All activities in the drainage channels shall be conducted between June 15 and September 30 of any year. To the extent practicable, work within the drainage channels shall be conducted after July 1.
   - *Justification – This condition is reaffirming the project will take place during a time period that will not harm fish or other aquatic species.*
   - *Citation – Chapter 77.55 RCW, Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300 WAC, Chapter 173-201A-330 WAC, Chapter 173-225-010 WAC, and Chapter 220-660 WAC.*

D. Project Mitigation Conditions

1. The Project Proponent shall implement the *2021 Lynden Levee and Culvert Repair Mitigation Plan*, prepared by U.S. Army Corps of Engineers – Seattle District, dated May 10, 2021 [hereafter referred to as "Mitigation Plan"], or as modified by this Order.
   - *Justification – This condition is necessary to ensure that unavoidable physical alterations are properly mitigated for the protection of water quality and beneficial uses*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.74 RCW, Chapter 90.74.005-040 RCW, Chapter 173-201A WAC, Chapter 173-201A-300 WAC, Chapter 173-201A-310 WAC, Chapter 173-204-120 WAC, Chapter 173-225-010 WAC, and Chapter 220-660 WAC.*

2. The Project Proponent shall submit any changes to the Mitigation Plan in writing to Ecology (see A2 prior to implementing the change. Please note that substantial changes could require a new WQC.
   - *Justification – Ecology must be able to understand the scope of changes to the Mitigation Plan to ensure that unavoidable physical alterations are properly mitigated for the protection of water quality and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.74 RCW, Chapter 90.74.005-040 RCW, Chapter 173-201A WAC, Chapter 173-201A-300(2)(e)(i) WAC, Chapter 173-201A-310 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

3. The Project Proponent shall submit an As-Built Report per Condition A2 within 90 days of completion of planting, showing planting location, size, and species, describing any changes in related to the mitigation components, and including photos of the plantings, and large woody debris.
   - *Justification – To ensure the mitigation was implemented as reviewed and authorized to provide commensurate water quality functions and beneficial uses lost as a result of the project.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.74 RCW, Chapter 90.74.005-040 RCW, Chapter 173-201A WAC, Chapter173-201A-300(2)(e)(i) WAC, Chapter 173-201A-310 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

4. The Project Proponent shall submit monitoring reports annually, by December 31 of each year, to Ecology (see A2) documenting mitigation site conditions for years 1, 2, 3, 4, and 5. The reports shall include monitoring results for the plants, such as survival and areal coverage of riparian vegetation, photographs, and a discussion on whether the performance standards are being met and contingency measures to be taken. Status of the willow bundles and large woody debris also shall be included in the reports.
   - *Justification – To ensure the mitigation was implemented as reviewed and authorized to provide commensurate water quality functions and beneficial uses lost as a result of the project.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.74 RCW, Chapter 90.74.005-040 RCW, Chapter 173-201A WAC, Chapter173-201A-300 WAC, Chapter 173-201A-310 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

5. If the Project Proponent has not met all conditions, including performance standards for the mitigation site at the end of the monitoring period, the Project Proponent shall provide a plan for additional monitoring and/or additional mitigation.
   - *Justification – To ensure the mitigation was implemented as reviewed and authorized to provide commensurate water quality functions and beneficial uses lost as a result of the project.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.74 RCW, Chapter 90.74.005-040 RCW, Chapter 173-201A WAC, Chapter173-201A-300 WAC, Chapter 173-201A-310 WAC, and Chapter 173-225-010 WAC.*

E. Water Quality Monitoring & Criteria

1. This Order does not authorize the Project Proponent to exceed applicable turbidity standards beyond the limits established in WAC 173-201A-200(1)(e)(i).

- *Justification – This condition provides citation to the appropriate water quality standard criteria to protect surface waters of the state. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
- *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

2. The Project Proponent shall conduct water quality monitoring as described in the approved *Water Quality Monitoring Plan, Project: Lynden Levee and Culvert Repair* (hereafter referred to as the WQMP), prepared by U.S. Army Corps of Engineers – Seattle District, dated May 11, 2021.
   - *Justification – This condition is necessary to ensure that the monitoring as proposed by the Project Proponent and authorized by Ecology is conducted to protect water quality. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

3. Monitoring results shall be submitted monthly to Ecology's Federal Permit Manager, per condition A2.
   - *Justification – This information is necessary for Ecology to determine if the project was implemented as approved by the WQC Order and that no adverse impacts to water quality or beneficial uses occurred.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

4. Visible turbidity anywhere beyond the temporary area of mixing (point of compliance) from the activity shall be considered an exceedance of the standard.
   - *Justification – This condition specifically informs the Project Proponent of when they would be out of compliance with the water quality standards and an obvious sign of water quality degradation. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

5. If water quality exceedances for turbidity are observed outside the point of compliance, the Project Proponent or the contractor shall assess the cause of the water quality problem and take immediate action to modify or stop, contain, and correct the problem and prevent further water quality turbidity exceedances.

- *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution and know if there are exceedances of the water quality standards that protect aquatic life and beneficial uses.*
- *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

F. Construction

General Conditions

1. All work in and near waters of the state shall be conducted to minimize turbidity, erosion, and other water quality impacts. Construction stormwater, sediment, and erosion control Best Management Practices (BMPs) suitable to prevent exceedances of state water quality standards shall be in place before starting maintenance and shall be maintained throughout the duration of the activity.
   - *Justification – Disturbed areas without appropriate BMP's and construction methods can discharge excess sediment to waters of the state and degrade water quality. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

2. All clearing limits, stockpiles, staging areas, and trees to be preserved shall clearly be marked prior to commencing construction activities and maintained until all work is completed for each project.
   - *Justification – Ensures that the project proponent preserves sensitive areas from discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

3. No stockpiling or staging of materials shall occur at or below the OHWM of any waterbody.
   - *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

4. The Project Proponent shall obtain the Construction Stormwater Permit (National Pollutant Discharge Elimination System – NPDES) from the Environmental Protection Agency for this project.

- *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
- *Citation – 40 CFR 122, Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

5. No petroleum products, fresh concrete, lime or concrete, chemicals, or other toxic or deleterious materials shall be allowed to enter waters of the state.
   - *Justification – Concrete, petroleum products or other waste materials are detrimental to water quality. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

6. All construction debris, excess sediment, and other solid waste material shall be properly managed and disposed of in an upland disposal site approved by the appropriate regulatory authority.
   - *Justification – Ecology must be assured that the Project Proponent is managing and disposing of material to protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

<u>Equipment & Maintenance</u>

7. Staging areas will be located a minimum of 50 feet and, where practical, 200 feet, from waters of the state including wetlands.
   - *Justification – Requiring a minimum setback ensures that material will not end up in waters of the state. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

8. Equipment used for this project shall be free of external petroleum-based products while used around the waters of the state, including wetlands. Accumulation of soils or debris shall be removed from the drive mechanisms (wheels, tires, tracks, etc.) and the undercarriage of equipment prior to its use around waters of the state, including wetlands.

- *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
- *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, Chapter 173-225-010 WAC.*

9. No equipment shall enter, operate, be stored or parked within any sensitive area except as specifically provided for in this Order.
   - *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

10. Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc., shall be checked regularly for drips or leaks, and shall be maintained and stored properly to prevent spills into state waters.
    - *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
    - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

11. Wash water containing oils, grease, or other hazardous materials resulting from washing of equipment or working areas shall not be discharged into state waters. The Project Proponent shall set up a designated area for washing down equipment.
    - *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
    - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

12. Turbidity curtains shall be properly deployed and maintained in order to minimize turbidity and re-suspension of sediment.

- *Justification – This condition would ensure containment and limit movement of sediment that could cause water quality exceedances. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
- *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

Culvert Work & Stream Bypass

13. All culvert work shall be conducted in the dry or in isolation from stream flow.
    - *Justification – This condition would limit re-suspension of sediment that could cause water quality exceedances. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
    - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

14. Stream flow isolation work shall not scour the stream channel or banks of the waterbody in which the work is being done.
    - *Justification – Scour and erosion could cause long term instability of the project and contribute to water quality impacts. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
    - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

15. To minimize sediment releases into downstream water, water reintroduced to the channel shall be done gradually and at a rate not exceeding the normal stream flow.
    - *Justification – Maintaining natural stream flow rate is important for maintaining beneficial uses and preventing water quality impacts. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
    - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

16. Culverts shall be installed to avoid inlet scouring and prevent downstream bank erosion.

- *Justification – Scour and erosion could cause long term instability of the project and contribute to water quality impacts .Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
- *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

17. Fill associated with culvert installation shall be protected from erosion to the 100-year peak flow.
    - *Justification – Erosion could cause long term instability of the project and contribute to water quality impacts. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
    - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

Levee Repair Work

18. Placement of rip-rap and embankment materials shall be conducted in a controlled manner, in compliance with water quality standards for turbidity.
    - *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
    - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

19. Excavation activity both in-water and above the Ordinary High Water Mark shall be conducted in a controlled manner, in compliance with water quality standards for turbidity.
    - *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
    - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, and Chapter 173-225-010 WAC.*

G. Emergency/Contingency Measures

1. The Project Proponent shall develop and implement a spill prevention and containment plan for this project.
    - *Justification – Ecology must ensure that the Project Proponent has a plan to prevent pollution from entering waterways. Ecology must protect waters of the state from all*

discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.

- *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 90.56.280 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, Chapter 173-225-010 WAC, and Chapter 173-303-145 WAC.*

2. The Project Proponent shall have adequate and appropriate spill response and cleanup materials available on site to respond to any release of petroleum products or any other material into waters of the state.
   - *Justification – Ecology must have assurance that the Project Proponent has the material readily available in order to address any spills that might occur to protect waters of the state. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 90.56.280 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, Chapter 173-225-010 WAC, and Chapter 173-303-145 WAC.*

3. Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc., shall be checked regularly for drips or leaks, and shall be maintained and stored properly to prevent spills into state waters.
   - *Justification – Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 90.56.280 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, Chapter 173-225-010 WAC, and Chapter 173-303-145 WAC.*

4. Work causing distressed or dying fish and discharges of oil, fuel, or chemicals into state waters or onto land with a potential for entry into state waters is prohibited. If such work, conditions, or discharges occur, the Project Proponent shall notify Ecology's Federal Permit Manager per condition A2 and immediately take the following actions:
   a. Cease operations at the location of the non-compliance.
   b. Assess the cause of the water quality problem and take appropriate measures to correct the problem and prevent further environmental damage.
   c. In the event of a discharge of oil, fuel, or chemicals into state waters, or onto land with a potential for entry into state waters, containment and cleanup efforts shall begin immediately and be completed as soon as possible, taking precedence over normal work. Cleanup shall include proper disposal of any spilled material and used cleanup materials.

d. Immediately notify Ecology's Regional Spill Response Office and the Washington State Department of Fish & Wildlife with the nature and details of the problem, any actions taken to correct the problem, and any proposed changes in operation to prevent further problems.
e. Immediately notify the National Response Center at 1-800-424-8802, for actual spills to water only.

- *Justification – This condition is necessary to prevent oil and hazardous materials spills from causing environmental damage and to ensure compliance with water quality requirements. The sooner a spill is reported, the quicker it can be addressed, resulting in less harm. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
- *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 90.56.280 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, Chapter 173-225-010 WAC, and Chapter 173-303-145 WAC.*

5. Notify Ecology's Regional Spill Response Office immediately if chemical containers (e.g. drums) are discovered on-site or any conditions present indicating disposal or burial of chemicals on-site that may impact surface water or ground water.
   - *Justification – Oil and hazardous materials spills cause environmental damage.The sooner a spill is reported, the quicker it can be addressed, resulting in less harm. Ecology must protect waters of the state from all discharges and potential discharges of pollution that can affect water quality to protect aquatic life and beneficial uses.*
   - *Citation – Chapter 90.48 RCW, Chapter 90.48.030 RCW, Chapter 90.48.080 RCW, Chapter 90.56 RCW, Chapter 90.56.280 RCW, Chapter 173-201A WAC, Chapter 173-201A-300–330 WAC, Chapter 173-204-120 WAC, Chapter 173-225-010 WAC, and Chapter 173-303-145 WAC.*

YOUR RIGHT TO APPEAL

You have a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do both of the following within 30 days of the date of receipt of this Order:

- File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503 **Pollution Control Hearings Board** 1111 Israel Road SW STE 301 Tumwater, WA 98501	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608 **Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

CONTACT INFORMATION

Please direct all questions about this Order to:

Rebekah Padgett
Department of Ecology
(425) 365-6571
Rebekah.Padgett@ecy.wa.gov

MORE INFORMATION

- **Pollution Control Hearings Board Website**
  http://www.eluho.wa.gov/Board/PCHB
- **Chapter 43.21B RCW - Environmental and Land Use Hearings Office – Pollution Control Hearings Board**
  http://app.leg.wa.gov/RCW/default.aspx?cite=43.21B
- **Chapter 371-08 WAC – Practice And Procedure**
  http://app.leg.wa.gov/WAC/default.aspx?cite=371-08
- **Chapter 34.05 RCW – Administrative Procedure Act**
  http://app.leg.wa.gov/RCW/default.aspx?cite=34.05
- **Chapter 90.48 RCW – Water Pollution Control**
  http://app.leg.wa.gov/RCW/default.aspx?cite=90.48
- **Chapter 173.204 WAC – Sediment Management Standards**
  http://apps.leg.wa.gov/WAC/default.aspx?cite=173-204
- **Chapter 173-200 WAC – Water Quality Standards for Ground Waters of the State of Washington**
  http://apps.leg.wa.gov/WAC/default.aspx?cite=173-200

- **Chapter 173-201A WAC – Water Quality Standards for Surface Waters of the State of Washington**
  http://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A

SIGNATURE

Dated this 28th day of May, 2021, at the Department of Ecology, Shoreline, Washington

Joe Burcar, Section Manager
Northwest Regional Office
Shorelands and Environmental Assistance Program

Attachment A

Statement of Understanding
Water Quality Certification Conditions

Lynden Levee and Culvert Repair Project

Water Quality Certification Order #19995

As the Project Proponent for the Lynden Levee Repairs project, I have read and understand the conditions of Washington State Department of Ecology Order #19995, and any permits, plans, documents, and approvals referenced in the Order. I have and will continue to ensure that all project engineers, contractors, and other workers at the project site with authority to direct work have read and understand the conditions of this Order and any permits, plans, documents, and approvals referenced in the Order.

_____ _____

Signature Date

_____ _____

Title Phone

_____

Company

V.2020

APPENDIX F –ENDANGERED SPECIES ACT

- Fish Rescue Plan

Fish Exclusion and Rescue Plan

Project: Lynden Levee and Culvert Repair

Date: May 10, 2021

General

SITE 1

The Seattle District U.S. Army Corps of Engineers (Corps) will place an exclusion net upstream of the sump at Site 1 to exclude fish in the drainage basin from entering the project area. The exact placement will be coordinated with Whatcom County to ensure it does not interfere with the County's project. The net will remain in place throughout construction. The Corps will remove fish from the drainage channel downstream of the net before the sump and pump are installed. The Corps will coordinate with the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and Washington Department of Fish and Wildlife (WDFW) to determine if fish rescue is necessary upstream of the exclusion net. Rescued fish will be released outside of the project footprint, such as downstream of repair work in the Nooksack River. The Corps' onsite biologist will inspect the fish exclusion net and drainage area daily and determine if additional fish rescues are needed.

NOOKSACK RIVER

The Corps will place a silt curtain along the shoreline to isolate the work area in the Nooksack River. The silt curtain will be approximately 400 feet long and 10 feet deep. The Curtain will be fastened to the riverbank above the construction site, and anchors will hold the curtain away from the excavation footprint. The bottom of the silt curtain is weighted. The curtain will remain in place until riprap has been installed to an elevation above the summer water level. The Corps will remove fish from between the silt curtain and the shoreline after it is installed, before in-water work starts. The Corps' onsite biologist will inspect the silt curtain daily and determine if further fish rescues are needed.

Fish Rescue Protocols

1. Place fish exclusion device (see Figure 1 and 2 for approximate placements).
2. Biologists would work from an upstream to downstream direction capturing fish. Electrofishing and nets would be used for fish capture. Where possible, beach seines would be used.
3. Additional fish rescues may occur if it is determined necessary by the onsite Biologist or through coordination with resource agencies.

NOTES

- Refer to the "Recommended Fish Exclusion, Capture, Handling, and Electroshocking Protocols and Standards" (USFWS 2012) for guidance on fish rescues, including electroshocking; net placement; fish handling, holding, and release; and reintroduction of flow and fish to the isolated work area.
- Fish rescue will not occur if conditions are deemed unsafe in the Nooksack River.
- The onsite biologist will coordinate fish rescue activities with NMFS, USFWS, and WDFW.
- Electroshocking will likely be used during at the initial fish rescue at each site. If subsequent rescues are necessary, the onsite biologist and resource agencies will determine if additional electroshocking is necessary or if netting can be used alone.

- Captured fish would be released into the mainstem of the Nooksack River to lower the chance of them returning to the work area.
- Exclusion devices may be moved or adjusted if required for the repair. Another fish rescue may occur within the new area, as necessary.
- The Corps has 3 exclusion nets that are 47 x 10.5 feet with 3/8-inch netting. A lead line is present along the bottom. One of these nets will be used to block fish access upstream of the sump at Site 1.

Reporting

The following information will be tracked during rescue activities and shared with NMFS, USFWS, and WDFW.

- Species and number of fish
- Condition (e.g., healthy, dead, injured)
- Size/age class

Points of Contact

The following individuals will be coordinated with for fish rescue activities. This list may be amended. The lead agency point of contact is marked with an asterisk (*).

Entity	Name	Phone	Email
Corps	*Jess Jordan	206-316-3967	dale.j.jordan@usace.army.mil
	Zach Wilson	206-316-3896	zachary.m.wilson@usace.army.mil
	Fred Goetz	206-764-3515	frederick.a.goetz@usace.army.mil
NMFS	*David Price	253-317-1498	david.price@noaa.gov
USFWS	*Molly Good	360-753-5822	molly_good@fws.gov
Whatcom County	*Deb Johnson	360-778-6288	djohnson@co.whatcom.wa.us
	Jason Buehler	360-778-6305	jbuehler@co.whatcom.wa.us
	Steve Fox	360-815-3809	sfox@co.whatcom.wa.us
WDFW	*Joel Ingram	360-584-6339	joel.ingram@dfw.wa.gov

Figure 1. Site 1 fish exclusion sites.

Figure 2. Site 2 fish exclusion site.

APPENDIX G – PUBLIC COMMENTS

NOTICE OF PREPARATION PUBLIC COMMENTS

The Corps released a Notice of Preparation (NOP) of an Environmental Assessment (EA) for the Lynden Levee and Culvert Repair Project on April 1, 2021. The comment period expired on May 1, 2021. Comments from the Washington Department of Fish and Wildlife (WDFW) on the NOP were received on April 29, 2021. The Corps reviewed WDFW's comments and has prepared responses below. Yellow highlighting marks the text that WDFW's commented on. Additional text from the NOP may be included for background purposes.

COMMENT 1

NOP text	Based on onsite conditions, best professional judgment by engineers, and available historical and technical data, the Lynden Levee at the repair site had adequate scour protection as originally designed and constructed by the local entity that resembles an armored launchable toe.
Comment	Are previous designs or as built drawings available? How was the adequacy assessed, volume of rock?
Response	Previous designs or as-builts are not available. Pre-flood designs are based on site conditions, best professional judgement by Corps engineers, and available historical and technical data. The repair was designed based on modern design criteria and standards for levee repairs.

COMMENT 2

NOP text	Repairs would occur at two sites between the Lynden wastewater treatment plant (WWTP) and Guide Meridian Road (State Route 539; Figure 1). Two culverts are located at Site 1. The culverts are not gated and transport flood water behind the levee, contributing to flooding roads and blocking access to the Lynden WWTP.
Comment	WWTP Rd@WSEL 54 Hannegan Rd @ WSEL River Rd @ WSEL ?? Flynn Rd @WSEL ?? River Rd and Flynn Rd affected by floodwaters backing up Fish Trap Creek at confluence with Nooksack. Unknown with information provided if these roads are affected by flooding from a different direction then water entering the floodplain at WWTP culverts.

Response	With a water surface elevation (WSEL) of 54 feet at the WWTP road, Hannegan Rd has not overtopped and no water will be seen over the road. Regarding sources of water for the flooding at Fish Trap Creek there is the flow coming from upstream of the WWTP from the overtopping of Hannegan Road at higher flows and there would be water backing up Fish Trap Creek from the Nooksack River. We did not evaluate impact of WSELs at Fish Trap Creek, however at the western boundary of the site we do demonstrate that there is only a very minor change in WSEL between the existing and proposed condition. Up to flows of 20,000 cfs we show an increase in WSEL of up to 0.13 feet and above 20,000 cfs we show a decrease in WSEL of a maximum of -0.02 feet. This is due to the fact that there is a very small window between when the flap gate closes and when Hannegan road overtops. Also that the flow added from the culvert is very small compared to the flow coming over Hannegan Road, on the order of a maximum of 30 cfs from the culvert and flows exceed 10 times that from Hannegan Road (@ flows of 23,000 in the Nooksack, flows over Hannegan are estimated at 333 CFS).

COMMENT 3

NOP text	WDFW's comment referenced two sentences in the NOP. • In November 2017, high flows occurred along the Nooksack River with a peak flow of 39,900 cubic feet per second (cfs) at the Everson USGS gage 12211200, corresponding to an annual chance of exceedance (ACE) of 40 percent (2.5-year return period). • The purpose of the project is to restore the level of flood protection exhibited prior to the damaging event to protect lives and property from subsequent flooding.
Comment	How can the level of protection be assessed at a 10 yr return period level of protection when the levee crest is overtopped by a 2.5 yr return period event?
Response	The 10-year level of protection was determined by the Corps during the initial eligibility of the levee into the PL 84-99 program. Additionally, the 2.5 year return period was calculated using the Ferndale gage downstream of the site, and is not necessarily indicative of the return period at the repair sites. The Ferndale gage was used to calculate the

	return period because it is the closest gage with the necessary period of record to determine the flood return interval.

COMMENT 4

NOP text	When describing the No Action Alternative, the NOP stated the following: "Responding to damages during a flood event, however, would be temporary, less certain of success, potentially more expensive, and could be less protective of environmental and cultural resources. A response would also take time to activate and execute, so there is risk that it would not prevent levee failure, such as overtopping or breaching."
Comment	Overtopping should not be considered levee failure. Is this included in a standard USACE definition of levee failure?
Response	Correct, overtopping is not the same as levee failure, but levee overtopping can damage a levee and make it less reliable for future events, which is what occurred at Site 1. The Corps has removed "…overtopping or…" from this sentence in the EA.

COMMENT 5

NOP text	All in-water work would occur in the fish window (June 15 to August 31).
Comment	Times when spawning or incubating salmonids are least likely to be within WA stat Freshwaters, WDFW publication 2018, Project specific timing. Typical for this section of river in an odd year is July 15-Sept 1
Response	The Corps' specified in-water work window come from a Corps Regulatory document created in consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). The Corps uses these windows for projects requiring ESA consultation. Specific to Lynden, the Corps evaluated WDFW's in-water work window and determined it is not feasible. However, the Corps will attempt to delay in-water work in the Nooksack until July, but the schedule is dependent on the delivery of the culvert. All of the work at Site 1 needs to be completed by the end of July when the Corps turns the site over to Whatcom County so the Corps needs to start construction on 15 June. There are two distinct construction activities at Site 1 (culvert installation and the Nooksack river work). Ideally, the Corps will start with the culvert installation and then do the Nooksack River work in July. But, if the culvert is not ready (manufactured), the Corps will need to start with the Nooksack river work in June.

COMMENT 6

NOP text	The new culvert at Site 1 would have a flap gate that operates to reduce flooding to the Lynden WWTP and roadway
Comment	Reduces flooding over existing conditions = flood regime change
Response	Without the flap gate on the culvert the new culvert would slightly increase the flooding of the WWTP road, making flooding worse and impeding access to the Lynden WWTP. Overall, the flap gate has a negligible effect on the system as demonstrated by the comparison of existing vs proposed conditions (see response to comment 2), except at the WWTP road where it delays flows overtopping of the WWTP road by 1 to 3 hours. The gate remains open when flows in the Nooksack River are below 20,000 cfs.

COMMENT 7

NOP text	A closure trigger mechanism would allow the flap gate to close under its own weight on the rising limb of the flood hydrograph on the Nooksack River channel. The trigger mechanism and the vertical setting of the hinge alignment would be automatic but manually adjustable for Whatcom County or the City of Lynden to change the setting if needed. The ability to manually override operation of the gate is desired, but typical gate closing and opening operation is automatically triggered by the river level.
Comment	Manipulation of the gate closing water surface elevation is unacceptable and is not consistent with the level of protection statements and purposes elsewhere in documents. further impacts fish access to the floodplain over existing conditions.
Response	The Corps will install the flap gate and complete an initial calibration to maintain a 10-year level of protection. After repairs, operation of the flap gate is the responsibility of Whatcom County, the non-federal sponsor. Whatcom County has indicated their written intention to maximize fish passage with the periodic need for flood control. Whatcom County will work with regional partners, such as WDFW, the Nooksack Tribe, and the City of Lynden to outline coordination practices when it revises the O&M Plan to ensure maximum fish passage.

COMMENT 8

NOP text	Trees would be planted at a 3:1 ratio for mitigation of tree loss at each repair site.

Comment	The state negotiated ratio in Nooksack for tree removal riverward of the levee crest is 4:1. Agreed to through Nooksack River SWIF, an USACE approved plan for vegetation maintenance along PL-84-99 levees.
Response	The Corps revised the mitigation plan after coordinating with the Washington State Department of Ecology (Ecology). The plan was provided to Ecology, Whatcom County, WDFW, NMFS, and USFWS on May 10, 2021. The new mitigation plan replaces trees at a 4:1 ratio, among other changes. Ecology reviewed and approved the plan on May 10, 2021. The mitigation plan is provided in Appendix D of the EA.

COMMENT 9

NOP text	Repairs would remove a total of 34 trees, which corresponds to 102 tree plantings. Tree plantings would consist of conifer trees rather than deciduous trees, such as western red cedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*), and grand fir (*Abies grandis*). Shrub plantings would be native species for the area. Available stock would determine final species make-up. Based on best professional judgement by Corps biologists, the shrub plantings in the approximately 1,125 square foot shrub planting area and willow stakes installed along the repair at each site compensate for impacts to an estimated 260 feet of shoreline that supports low density understory vegetation by providing shade along the repair length (willow bundles) and understory habitat (willow bundles and shrub plantings).
Comment	Is a planting plan available? would like to see species for both tree and shrub component, spacing / density, coverage areas, prep for planting, monitoring for success, invasive species control, seeding and other site stabilization methods
Response	The Corps revised the mitigation plan after coordinating with Ecology. The plan was provided to Ecology, Whatcom County, WDFW, NMFS, and USFWS on May 10, 2021. The new mitigation plan increases the number of willow bundles, tree and shrub plantings, planting locations, and amount of woody debris originally proposed in the NOP. Tree and shrub plantings include the following species: Sitka spruce (*Picea sitchensis*), western redcedar (*Thuja plicata*), pacific ninebark (*Physocarpus capitatus*), black twinberry (*Lonicera involuvrata*), and salmonberry (*Rubus spectabilis*). Spacing, planting locations, site preparation, maintenance, and monitoring are described in the mitigation plan. Ecology approved the mitigation plan on May 10, 2021. The mitigation plan is provided in Appendix D of the EA.

COMMENT 10

NOP text	General comment made in the "Conservation Measures" section of the NOP. No specific text was referenced.
Comment	There is no mitigation being performed for the inclusion of additional riprap to the system. The original condition of the levee states that there was rock present along the toe but does not document an amount. This rock now resides in the bottom of the river somewhere and is inconsistent with habitat features that are found in this section of the river. As part of the project new riprap will be placed increasing the overall riprap load to the river and displacing additional habitat features. Riprap placement results in an increase in velocity and reduced complexity and diversity along the channel margins, thereby diminishing habitat value. Riprap also tends to transfer energy downstream. An increase in bank erosion and /or loss of habitat in an adjacent reach should be expected. The science on fish usage along riprap reinforced banks is well documented and suggests that the decrease in complex bank and edge types through the placement of riprap reduces overall fish use and density within these areas. When used, riprap should be mitigated for its effects on aquatic species and the habitat on which they require to [live] out their life cycles. Mitigation for this type of bank treatment typically includes the placement of large woody material across the face of the revetment structure to increase cover, create variable hydraulics, reduce velocities, and move shear stress off the bank. Mitigation elements should be considered especially important in systems where ESA listed species are present. The Nooksack River has 3 ESA listed fish species, PS Chinook, PS Steelhead, and Bull trout. Within the PS Chinook classification the Nooksack has two evolutionary significant units (SF Nooksack Chinook and NF/MF Nooksack Chinook) that are both required to be recovered as part of the ESA de-listing criteria.
Response	The Corps revised the mitigation plan after coordinating with Ecology. The plan was provided to Ecology, Whatcom County, WDFW, NMFS, and USFWS on May 10, 2021. The new mitigation plan increases the number of willow bundles, tree and shrub plantings, planting locations, and amount of woody debris originally proposed in the NOP. The woody debris proposed for mitigation in the NOP was to come from what was generated onsite from clearing 34 trees. After coordinating with Whatcom County, an additional 50 pieces of large woody debris, 10 rootwads, and an assortment of smaller pieces and slash were added. All of this material is to be placed along the repaired levee to benefit the aquatic environment (e.g., cover, create variable hydraulics, reduce velocities). Ecology approved the mitigation plan on May 10, 2021. The mitigation plan is provided in Appendix D of the EA.

COMMENT 11

NOP text	Final selection of the preferred alternative and finalization of the design, including any additional environmental measures, would occur during the NEPA process and before construction. Any recommendations that emerge from the Endangered Species Act (ESA) and Clean Water Act Section 401 evaluations would be considered
Comment	Where do these other permitting elements stand? Will these discussions and comments be forwarded to the reviewing agencies.
Response	5/11/2021: ESA consultation is ongoing. The Corps has coordinated with USFWS and NMFS. NMFS has provided draft T&Cs. USFWS is aware of the timeline. NMFS and USFWS are coordinating with each other. The Corps has provided the updated mitigation plan, revised water quality monitoring plan, BMPs, and fish rescue plan to NMFS, USFWS, Ecology, and WDFW. Ecology approved the mitigation plan on May 10, 2021 and coordination continues on the water quality monitoring plan.

COMMENT 12

NOP text	At flows exceeding 8,000 cfs fish may also arrive in the area behind the levee from flows that overtop Hannegan Road from Stickney Slough to the east.
Comment	Stickney slough (Kamm Creek) is a leveed system and high bank area and was recently repaired to provide similar levee protection from over topping as Lynden levee. Statement is inaccurate.
Response	Overtopping is expected to occur in any levee system with high enough flows. Whatcom County provided an equivalent WSEL of 54.1 feet at the WWTP road at the time when flows overtop Hannegan road.

COMMENT 13

NOP text	This off-channel refuge habitat is only accessible by the culverts or overtopping flows during rising flood events, up to the elevation that overtops Hannegan Road from Stickney Slough to the east (Figure 3). When floodwater overtops Hannegan Road, water from the Nooksack River flows into the culverts. During the receding flood, the culverts become a drain for the system.
Comment	Flooding in the area does not seem consistent with local knowledge. The culverts are the source for water entering the floodplain. If the water volume in the river is enough the basin on the interior of the levee will fill to the point of crossing over Hannegan Rd (water flowing to the east across Hannegan). As river levels increase further, Stickney Slough Levee (Kamm Creek) over tops, changing the direction of water flow

	across Hannagan to a full westerly flow and completely inundating the floodplain interior.
Response	Whatcom County reviewed and agreed with the Corps' hydraulic model and analysis that describes existing conditions. See bullets points below. The culverts are the first pathway for water and fish to enter the floodplain during rising flows. Other pathways occur when flooding overtops Stickney Slough or the Lynden Levee. Flows entering the floodplain do not come only through the culverts, but from overtopping flows, such as at Hannegan Road. See response to Comment 2 for additional details. • Below approximately 5,000 cfs: The Nooksack River is below the perched outlet of the culvert's drainage basin. • At approximately 5,000 cfs: The Nooksack River WSEL rises and fish in the river can access the perched channel but not the culverts. • At approximately 7,000 to 8,000 cfs: The Nooksack River WSEL meets the culvert inverts. Fish can start accessing the landward side of the levee. • 16,000 cfs: Floodwater from the Nooksack River starts flowing through the culverts and behind the levee. Based on calibrated model and observed data, the culvert invert is approximately 6 feet below WSEL at this point. • 16,000–17,000 cfs: The western basin boundary experiences overflow. Floodwaters start moving west towards Fish Trap Creek and the Duffner ditch. • 20,000–22,000 cfs: WWTP road overtops. The low bound represents the most conservative estimate based on no upstream storage. The high bound represents a flow where the WWTP road would overtop regardless of the type of flooding event (flashy or long term). • 20,000–25,000 cfs: Levee and Hannegan Road overtopped. The low bound represents the most conservative estimate based on no upstream storage. The high bound represents a flow where Hannegan Road would overtop regardless of the type of flooding event (flashy or long term).

COMMENT 14

NOP text	After the area is flooded from overtopping flows, water either remains in low areas landward of the levee or continues flowing west to Fish Trap

	Creek, the nearest waterway landward and down gradient from the repair site. As flood water recedes, it drains back into the Nooksack River through the culverts or west towards Fish Trap Creek.
Comment	Including draining out through the Bertrand Levee at Duffner Ditch.
Response	Thank you for this information. It has been included into the EA.

COMMENT 15

NOP text	After the area is flooded from overtopping flows, water either remains in low areas landward of the levee or continues flowing west to Fish Trap Creek, the nearest waterway landward and down gradient from the repair site. As flood water recedes, it drains back into the Nooksack River through the culverts or west towards Fish Trap Creek. Fish that remain in the drainage connected to the culverts can access the Nooksack River if existing culvert conditions (e.g. debris and joint separation) allow.
Comment	Fish can also return via Fish Trap Cr and Duffner ditch crossing through Bertrand levee.
Response	Thank you for this information. It has been included into the EA.

COMMENT 16

NOP text	Fish that do not remain in this drainage may become stranded or follow flows west towards Fish Trap Creek. These fish are exposed to receding water and high summer temperatures, as well as predation from birds and wildlife.
Comment	The interior floodplain area is agricultural in nature with various drainage networks that run to a main channel (Fish Trap Creek or Duffner Ditch) providing some egress for fish trapped in the interior floodplain post flood. Floodplain stranding and predation does occur naturally on the falling limb of a flood and can be exacerbated by local land uses. An unknown portion of fish will access the floodplain and exit the system via the culverts, Fish Trap or Duffner = biological benefit of highwater refugia. An unknown number of fish will get stranded in the floodplain on falling limb of flood and parish = biological cost of maintaining highwater refugia. The project will alter the access to floodplain areas with an assumption that the biological benefit and cost of floodplain refugia are equal. The project will delay access to the broader floodplain area over existing conditions for any flood event that would have a WSEL above 54 ft until the levee at Stickney Slough is over topped and fully inundates the interior. My view is that the existing biological benefit outweighs the cost, especially considering other changes being made to these systems and the

	potential for future management of these areas. Alterations to the flood regime and access for fish entering this space should be considered a permanent loss for the duration of time and the difference in flood recurrence levels needed to inundate the interior floodplain from existing condition to proposed condition.
Response	The Corps will note in the EA that there will be a decrease in floodplain access. Hydraulic modelling and analysis found that closing the gate at a WSEL of 54 feet maximizes the amount of time off-channel refuge is accessible by fish through the culverts, while minimizing flooding behind the levee and maximizing access to the Lynden WWTP. Analysis by Whatcom County found that if a flap gate was present during the 2020 flood it would have been closed for 1.3 days if closed at WSEL 54 feet. If there was a flap gate during the 100-yr flood, it would have been closed for 2.7 days if closed at WSEL 54 feet. It also needs to be considered that flows begin overtopping Stickney Slough not long after flows begin overtopping the road to the Lynden WWTP. At this point the whole right floodplain is inundated (this occurs between 20-25,000 cfs). Flows begin overtopping the Lynden Levee not long after that. Therefore, fish can access the floodplain across multiple locations, and not just through a 48-inch culvert.

APPENDIX H – NATIONAL HISTORIC PRESERVATION ACT

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Planning, Environmental and Cultural Resources Branch

December 22, 2020

Allyson Brooks, Ph.D.
State Historic Preservation Officer
Department of Archaeology and Historic Preservation
Post Office Box 48343
Olympia, Washington 98504-8343

SUBJECT: PL-84-99 Lynden Levee Rehabilitation Project: Whatcom County, WA (DAHP Log.: 2020-12-07840)

Dear Dr. Brooks:

The U.S. Army Corps of Engineers (Corps) proposes to repair a damaged portion of the Lynden Levee (undertaking) located on the Nooksack River near the town of Lynden, Whatcom County, Washington (Figures 1, 1-1, and 2). The purpose of the project is to repair the Lynden Levee to a 10-year level of flood protection. The proposed levee repairs are the result of Whatcom County's request for assistance. The Corps has determined and documented the area of potential effect (APE) for the undertaking and is consulting with your office under Section 106 as provided at 36 C.F.R.§ 800.4(a). The letter requests agreement with the Corps' APE determination.

On November 24, 2017 a flood event damaged approximately 732 linear feet (LF) of the levee at two locations. Repairs will be made In-Kind to restore adequate and reliable flood protection to the same level provided by the levee prior to the November damaging flood event. The total length of repair is approximately 800 ft (Figure 1-1). Site 1 is located next to the Lynden Wastewater Treatment Plant (WWTP) and was damaged along 457 LF on the right bank. At Site 1, the Corps will replace two damaged segmented concrete culverts with a vendor-designed flap gate culvert. The new culvert is designed to minimize flooding behind the levee while maximizing the time juvenile fish can access off-channel refuge. Site 2 is approximately 1.3 miles downstream of the WWTP and was damaged along 275 LF on the right bank. Repairs at Site 2 will consist of excavating the unsuitable material from the damaged area, restoring any sloughed embankment material, replacing the spall layer, and re-sloping the eroded levee riprap.

The undertaking is located in Sections 20 and 30, Township 40 North, Range 3 East in Whatcom County, Washington (Figure 2). The Corps has determined the APE for the Lynden Levee Rehabilitation Project to be the length of the levee repairs (800 ft), as well as all staging and access zones (Figure 3). The APE for both direct and indirect effects encompasses approximately 614.4 acres (0.96 mi^2). The Corps believes that the APE is sufficient to identify and consider both direct and indirect effects of the proposed project (Figure 4).

The Corps is making a good faith effort to gather information from affected Tribes identified pursuant to 36 C.F.R.§ 800.3(f). We have notified the Lummi Nation, Nooksack Tribe, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and the Tulalip Tribes about the project to identify properties to which they may attach religious or cultural significance or other concerns with historic properties that may be affected.

The Corps requests your review and agreement with our determination of the APE. If you have any questions or desire additional information, please contact the project Archaeologist, Sarah MacIntosh, at sarah.macintosh@usace.army.mil or 206.764.6942. I may be contacted at laura.a.boerner@usace.army.mil or (206) 764-6761.

Sincerely,

PUNKE.MATTHEW.M.1151361001

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Date: 2020.12.31 08:37:54 -08'00'

Laura Boerner, LG, LHG
Chief, Planning, Environmental and
Cultural Resources Branch

Enclosures:

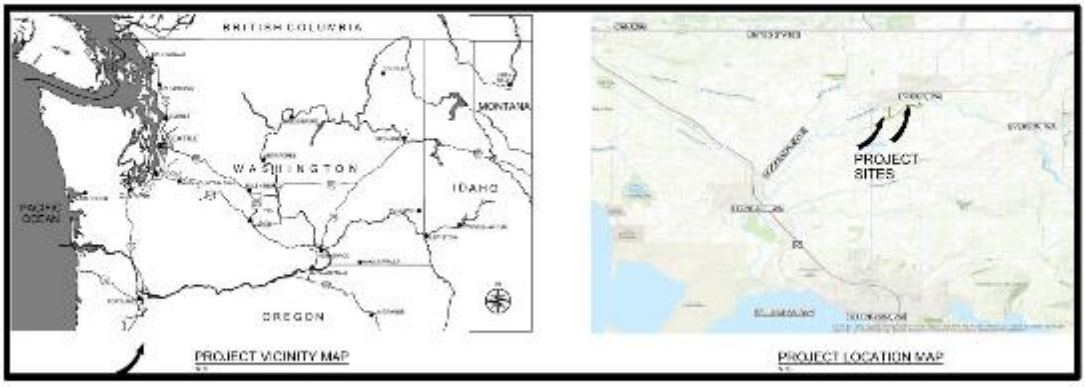


Figure 1. Project location mapping.

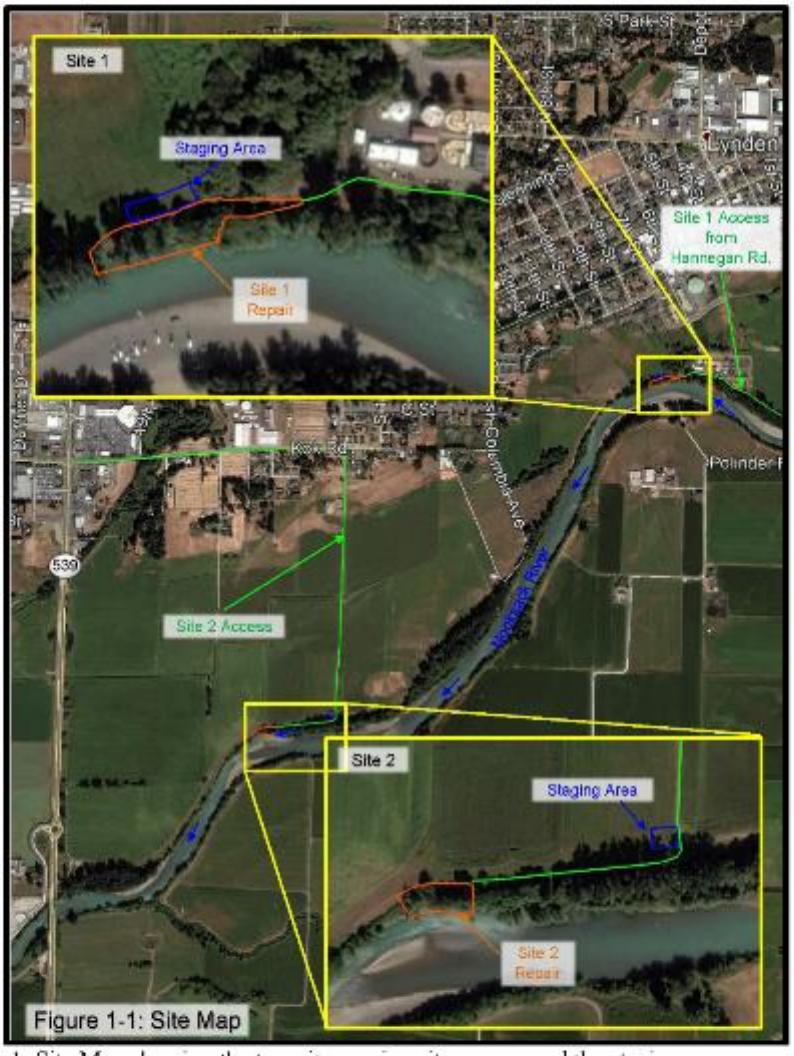


Figure 1-1: Site Map showing the two site repairs, site access, and the staging areas.

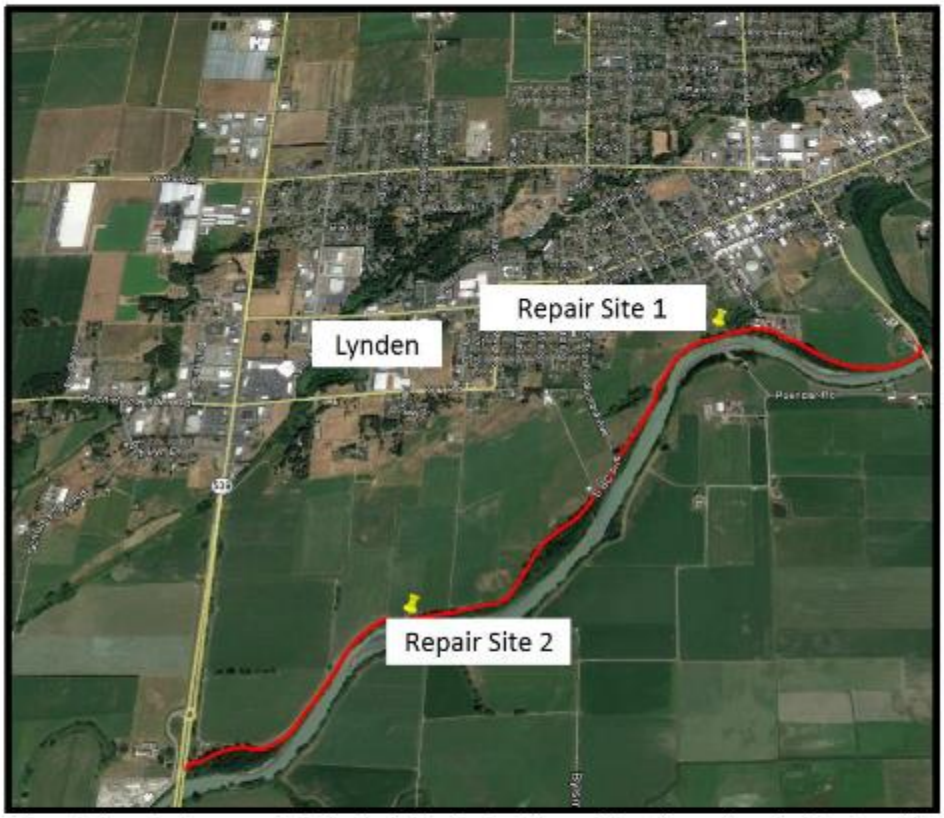


Figure 2. Lynden Levee on right bank of Nooksack River and locations of repair sites 1 and 2.

Figure 3. Aerial showing Lynden levee, repair site 2, access road and staging area.

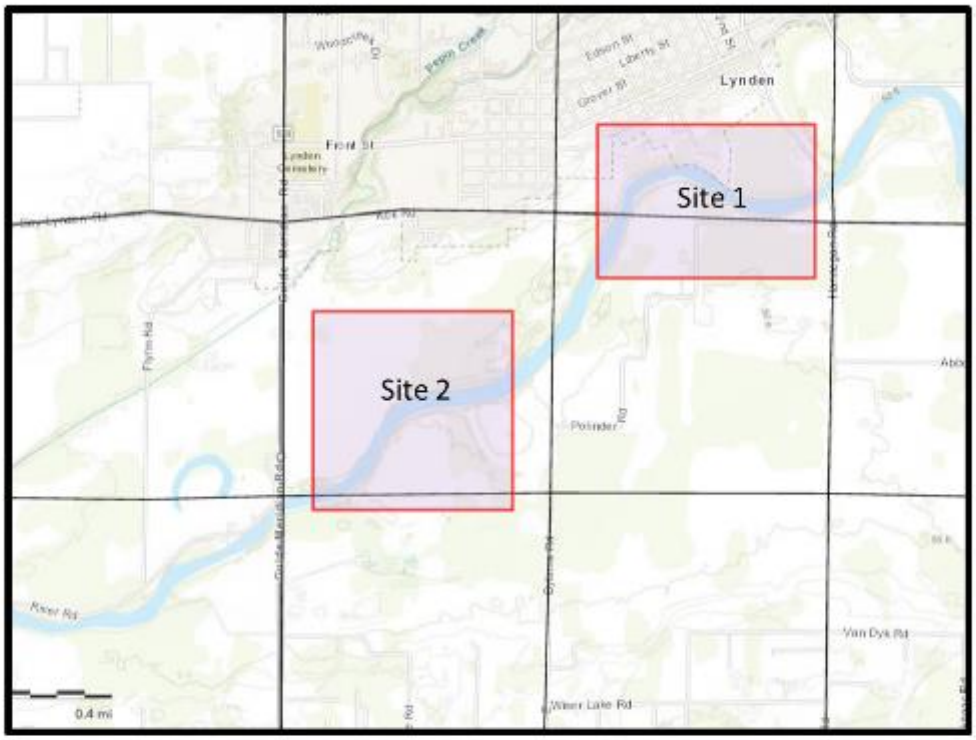


Figure 4. Map showing the APE for the Lynden Levee Rehabilitation Project for Site 1 and Site 2.

This letter is representative of all tribal letters sent by the Corps on January 15 and 21, 2021.

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Planning, Environmental, and Cultural Resources Branch January 4, 2021

The Honorable Lawrence Solomon
Chairman, Lummi Nation
2665 Kwina Road
Bellingham, Washington 98226

SUBJECT: PL-84-99 Lynden Levee Rehabilitation Project: Whatcom County, WA (DAHP Log.: 2020-12-07840)

Dear Chairman Solomon:

The U.S. Army Corps of Engineers (Corps) proposes to repair a damaged portion of the Lynden Levee (undertaking) located on the Nooksack River near the town of Lynden, Whatcom County, Washington (Figures 1, 1-2, and 2). The purpose of the project is to repair the Lynden Levee to a 10-year level of flood protection. The proposed levee repairs are the result of Whatcom County's request for assistance. To assist in our review, we are notifying you about the project, requesting your assistance in identifying any issues or concerns you might have, and seeking information to identify properties which may be of religious or cultural significance that may be affected by the project as specified by the implementing regulations for Section 106 at 36 C.F.R. § 800.4(a)(4).

On November 24, 2017 a flood event damaged approximately 732 linear feet (LF) of the levee at two locations. Repairs will be made In-Kind to restore adequate and reliable flood protection to the same level provided by the levee prior to the November damaging flood event. The total length of repair, including Site 1 and 2, is approximately 800 LF (Figure 1-1). Site 1 is located next to the Lynden Wastewater Treatment Plant (WWTP) and was damaged along 457 LF on the right bank. At Site 1, the Corps will replace two damaged segmented concrete culverts with a vendor-designed flap gate culvert. The new culvert is designed to minimize flooding behind the levee while maximizing the time juvenile fish can access off-channel refuge. Site 2 is approximately 1.3 miles downstream of the WWTP and was damaged along 275 LF on the right bank. Repairs at Site 2 will consist of excavating the unsuitable material from the damaged area, restoring any sloughed embankment material, replacing the spall layer, and re-sloping the eroded levee riprap.

The undertaking is located in Sections 20 and 30, Township 40 North, Range 3 East in Whatcom County, Washington (Figure 2). The Corps has determined the Area of Potential Effect (APE) for the Lynden Levee Rehabilitation Project to be the length of the levee repairs (800 ft), as well as all staging and access zones (Figure 3). The APE for both direct and indirect effects encompasses approximately 614.4 acres (0.96 mi^2). The Corps believes that the APE is sufficient to identify and consider both direct and indirect effects of the proposed project (Figure 4).

We would like to summarize efforts taken to date to identify cultural resources within the APE. The Corps staff archaeologist has conducted a records search and literature review of the Washington Information System Architectural and Archaeological Records Database (WISAARD). The literature review and records search revealed that there have been no cultural resource investigations within the project APE. There are no properties listed in the National Register of Historic Places or the Washington State Historic Site Register in the project vicinity. No cultural resources have been previously recorded within the APE.

If the Tribe has information or concerns regarding properties which may be of religious or cultural significance that you believe may be affected by this project, please contact us as soon as possible. A copy of this letter with enclosures will be furnished to: Lena Tso, Lummi Nation, 2665 Kwina Road, Bellingham, Washington 98226.

If you have any questions or desire additional information, please contact the Project Archaeologist, Sarah MacIntosh, at sarah.macintosh@usace.army.mil or (206) 764-6942. You may also contact Ms. Lori Morris, Tribal Liaison, at (206) 764-3625 or by email at frances.morris@usace.army.mil. I may also be be contacted at laura.a.boerner@usace.army.mil or (206) 764-6761. Thank you for your assistance with this undertaking.

Sincerely,

PUNKE.MATTHEW.M.1151361001

Digitally signed by PUNKE.MATTHEW.M.1151361001
Date: 2021.01.15 10:00:46 -08'00'

Laura Boerner, LG, LHG
Chief, Planning, Environmental and
Cultural Resources Branch

Enclosures:

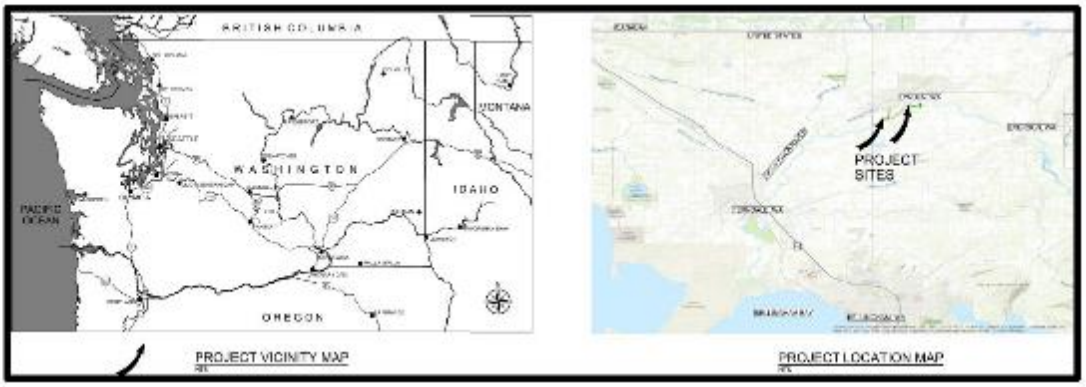


Figure 1. Project location mapping.

Figure 1-1: Site Map showing the two site repairs, site access, and the staging areas.

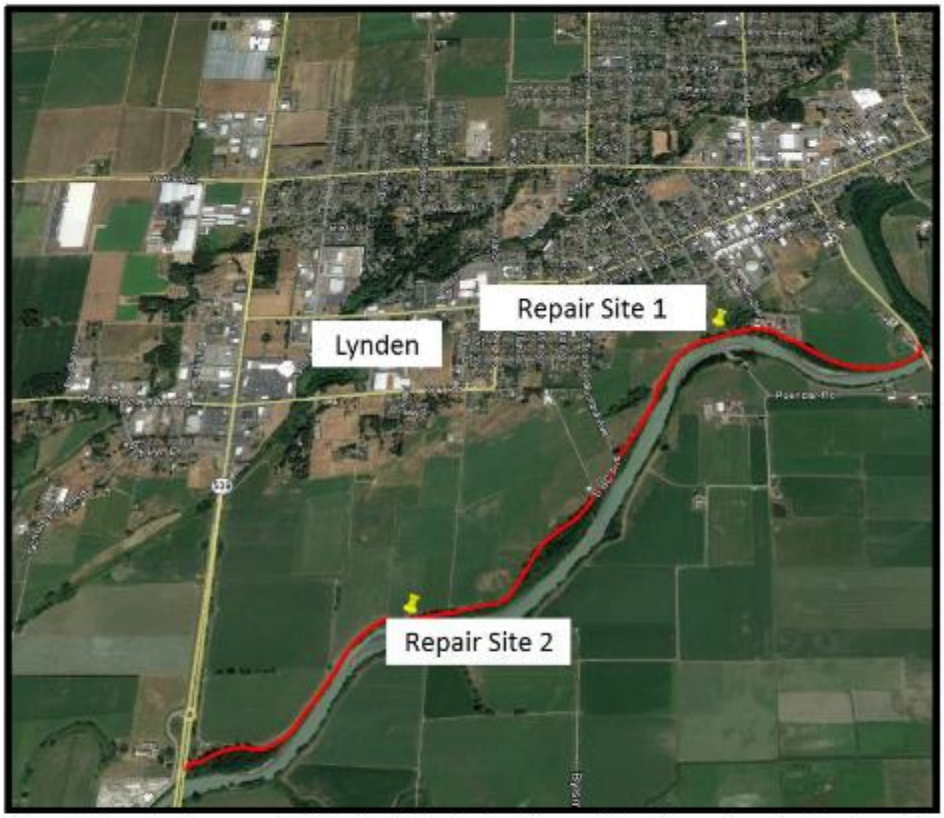


Figure 2. Lynden Levee on right bank of Nooksack River and locations of repair sites 1 and 2.

Figure 3. Aerial showing Lynden levee, repair site 2, access road and staging area.

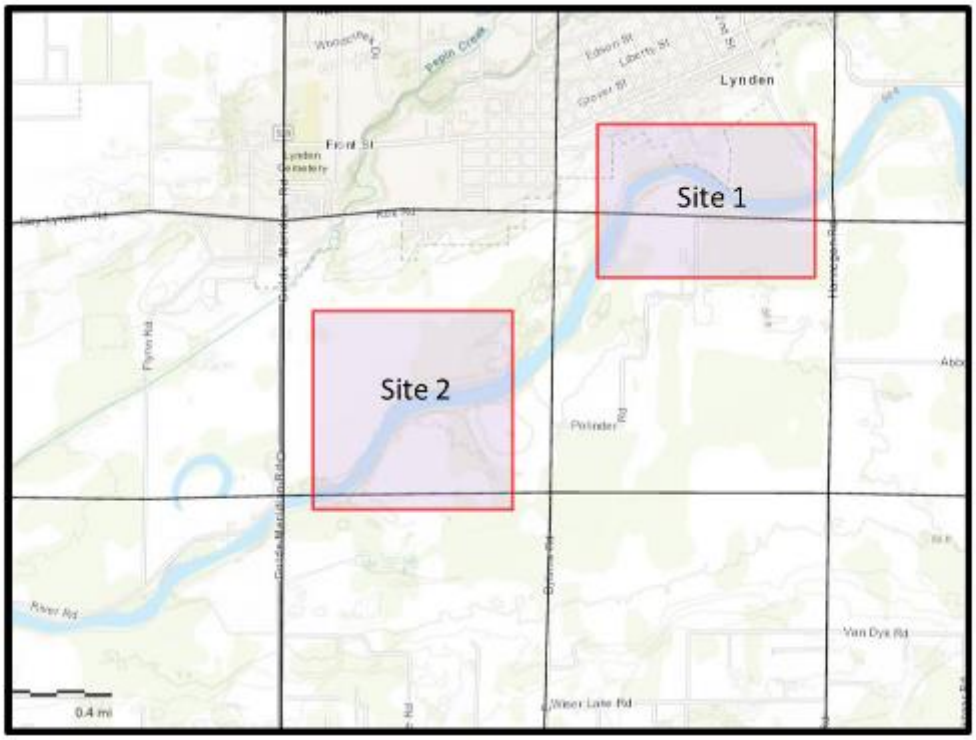


Figure 4. Map showing the APE for the Lynden Levee Rehabilitation Project for Site 1 and Site 2.

From:	Lena A. Tso
To:	MacIntosh, Sarah R CIV USARMY CENWS (USA); "Rob.Whitlam@dahp.wa.gov"; Gregg Dunphy
Subject:	[Non-DoD Source] Re: PL-84-99 Lynden Levee Rehabilitation Project: Whatcom County, WA (DAHP Log.: 2020-12-07840)
Date:	Wednesday, January 20, 2021 2:22:08 PM

Dear Sarah,

The Lummi Nation has received notice of the above-referenced permit and is responding as an affected Tribe.

The Lummi Nation Tribal Historic Preservation Office (LNTHPO) has coordinated an internal review using records on file with the Lummi Nation's Cultural Resource Management Program. Based on the review, an archaeological assessment is not recommended at this time. While the presence of cultural resources is not anticipated, please insert the following inadvertent discovery language:

Should archaeological materials (e.g. shell midden, faunal remains, stone tools) or human remains be observed during project activities, all work in the immediate vicinity shall stop, and the area shall be secured. The Washington State Department of Archaeology and Historic Preservation 360-586-3065 and the Lummi Nation Tribal Historic Preservation Office 360.961.7752 shall be contacted immediately in order to help assess the situation and determine how to preserve the resource(s). Compliance with all applicable laws pertaining to archaeological resources is required.

These comments are based on the information available at the time of the review. The LNTHPO should review any changes related to the proposed project activities. Should you have any questions or concerns, please do not hesitate to call me at 360.961.7752 or via email at lenat@lummi-nsn.gov

Sincerely,

Lena A. Tso
Tribal Historic Preservation Office, Compliance Officer
Lummi Repatriation Office, Manager

Lummi Indian Business Council
2665 Kwina Road, Bellingham, WA 98226
Direct line: 3609617752
LIBC Maine line: 3603122000

"To Preserve, Promote and Protect Our Sche'lang'en"

From: MacIntosh, Sarah R CIV USARMY CENWS (USA) <Sarah.MacIntosh@usace.army.mil>
Sent: Friday, January 15, 2021 4:23 PM
To: Lawrence Solomon <LawrenceS@lummi-nsn.gov>; Lena A. Tso <LenaT@lummi-nsn.gov>
Subject: PL-84-99 Lynden Levee Rehabilitation Project: Whatcom County, WA (DAHP Log.: 2020-12-07840)

Greetings,

Please find enclosed a letter regarding Section 106 of the National Historic Preservation Act consultation. Under normal circumstances we would have sent a hard copy of this letter to you, but given the current situation, we are sending an email with the letter attached knowing you and your staff may not be working from your offices. To reduce the spread of COVID-19 we are also maximizing telework and would appreciate a response via email.

Please let me know if you have any questions.

Sincerely,
Sarah MacIntosh

--
Sarah MacIntosh
Archaeologist
U.S. Army Corps of Engineers, Seattle District
Email: sarah.macintosh@usace.army.mil
Phone: (206) 764-6942

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

January 26, 2021

Laura Boerner, LG, LHG
Chief, Planning, Environmental and
Cultural Resources Branch
US Army Corps of Engineers - Seattle District

In future correspondence please refer to:
Project Tracking Code: 2020-12-07840
Property: PL-84-99 Lynden Levee Rehabilitation Project: Whatcom County, WA
Re: APE Concur

Dear Laura Boerner:

Thank you for contacting the State Historic Preservation Officer (SHPO) and Department of Archaeology and Historic Preservation (DAHP) regarding the above referenced project. In response, we have reviewed your description and map of the area of potential effect (APE).

We concur with your definition of the APE. Please provide us with your survey methodology before proceeding with any inventories. Along with the results of the inventory we will need to review your consultation with the concerned tribes, and other interested/affected parties. Please provide any correspondence or comments from concerned tribes and/or other parties that you receive as you consult under the requirements of 36 CFR 800.4(a)(4).

These comments are based on the information available at the time of this review and on behalf of the SHPO in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36 CFR 800. Should additional information about the project become available, our assessment may be revised.

Finally, please note that in order to streamline our responses, DAHP requires that Resource documentation (HPI, Archaeology sites, TCP) and reports be submitted electronically. Correspondence must be emailed in PDF format to the appropriate compliance email address. For more information about how to submit documents to DAHP please visit: https://dahp.wa.gov/project-review. To assist you in conducting a cultural resource survey and inventory effort, DAHP has developed Guidelines for Cultural Resources Reporting. You can view or download a copy from our website.

Thank you for the opportunity to review and comment. Please ensure that the DAHP Project Number (a.k.a. Project Tracking Code) is shared with any hired cultural resource consultants and is attached to any communications or submitted reports. If you have any questions, please feel free to contact me.

Sincerely,

Holly Borth
Project Compliance Reviewer
(360) 890-0174
holly.borth@dahp.wa.gov

State of Washington • **Department of Archaeology & Historic Preservation**
P.O. Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3065
www.dahp.wa.gov

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT
PO BOX 3755
SEATTLE, WA 98124-3755

March 15, 2021

Allyson Brooks, Ph.D.
State Historic Preservation Officer
Department of Archaeology and Historic Preservation
Post Office Box 48343
Olympia, Washington 98504-8343

SUBJECT: PL-84-99 Lynden Levee Rehabilitation Project: Whatcom County, WA (DAHP Log.: 2020-12-07840)

Dear Dr. Brooks:

The U.S. Army Corps of Engineers (Corps) is continuing consultation on the proposed repair to a damaged portion of the Lynden Levee (undertaking) located on the Nooksack River near the town of Lynden, Whatcom County, Washington (Figures 1, 1-1, and 2). In our letter dated 29 December 2020, the Corps documented the area of potential effects (APE) with which your office agreed to on 26 January 2021. This letter provides a brief project description, summarizes the efforts to identify historic properties, and provides the agency determinations and findings as provided at 36 C.F.R.§ 800.4(d). We request your concurrence with our finding that there will be no adverse effect by the proposed undertaking.

The non-federal levee was constructed to provide flood protection from periodic recurring flooding from the Nooksack River (Figures 1, 1-1, and 2). The levee is approximately 13,800 linear feet (ft) and is constructed of local earthen materials with sod and riprap riverward revetment. This levee is vegetated with grass, and it protects agricultural, residential areas, commercial areas, and public infrastructure including the only intake structure for the City of Lynden's water supply. In the undamaged condition, the levee is designed to provide 10-year level of protection (LOP). In the damaged condition, the levee provides a 1-year LOP. On November 24, 2017 a flood event damaged approximately 732 linear feet (LF) of the levee at two locations. The high river flows resulted in scour of the levee slope and toe at two damage locations. Repairs will be made In-Kind to restore adequate and reliable flood protection to the same level provided by the levee prior to the November damaging flood event. The total length of repair is approximately 800 ft (Figure 1-1).

The undertaking is located in Sections 20 and 30, Township 40 North, Range 3 East in Whatcom County, Washington (Figure 2). At this time, the Corps is requesting the Washington SHPO's agreement with our determination and finding that the undertaking will have no adverse effect to Lynden Levee. The Corps staff archaeologist has conducted a records search and literature review of the Washington Information System Architectural and Archaeological Records Database (WISAARD). Research suggests that the Lynden Levee was likely constructed by individual landowners and eventually the individual sections were conjoined by the mid-

1930s. There are no properties listed in the National Register of Historic Places or the Washington State Historic Site Register in the project vicinity. No cultural resources have been previously recorded within the APE. A pedestrian survey was conducted by two staff archaeologists at the Corps on March 8, 2021. They walked parallel transects across the APE and made the determination that the undertaking will have no adverse effect (Figure 3). As stated earlier Lynden levee is likely more than 50 years old making the structure eligible for review under the NHPA. The Corps did not evaluate the entire levee system as it was considered out of scope with the limited nature of the repair. As the levee is being repaired in-kind the Corps has determined that this work will have no adverse effect on the levee system, assuming the system is eligible for the NRHP.

The Corps made a good faith effort to gather information from affected Tribes identified pursuant to 36 C.F.R.§ 800.3(f). We have notified the Lummi Nation, Tulalip Tribe, Swinomish Indian Tribal Community, Suquamish Indian Tribe, Samish Indian Nation, and the Nooksack Indian Tribe to assist in identifying properties which may be of religious and cultural significance. To date, we have received one response from the Lummi Nation, who requests that we notify them in the event an inadvertent discovery is made.

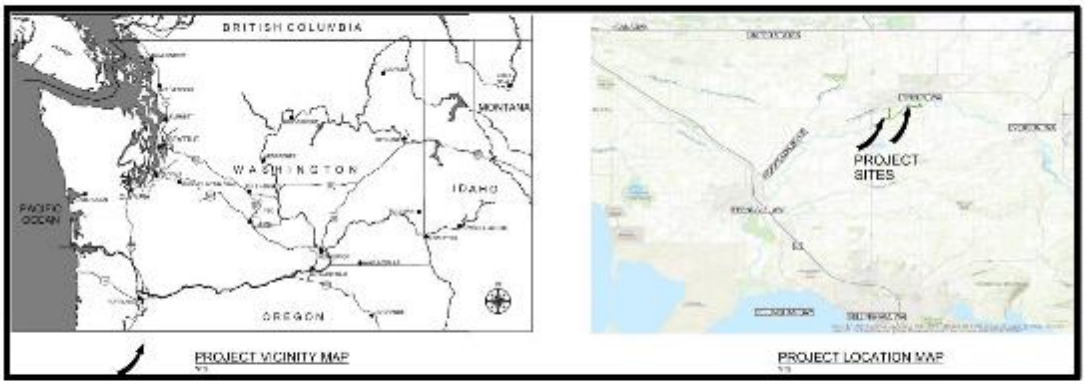
We appreciate your consideration of our request. If you have any questions or desire additional information, please contact the Project Archaeologist, Ms. Sarah MacIntosh, at sarah.macintosh@usace.army.mil or (206) 764-6942. I may also be contacted at laura.a.boerner@usace.army.mil or (206) 764-6761. Thank you for your assistance with this undertaking.

Sincerely,

PUNKE.MATTHEW.M.1151361001 Digitally signed by PUNKE.MATTHEW.M.1151361001 Date: 2021.03.17 10:55:06 -07'00'

Laura Boerner, LG, LHG
Chief, Planning, Environmental and
Cultural Resources Branch

Enclosures:



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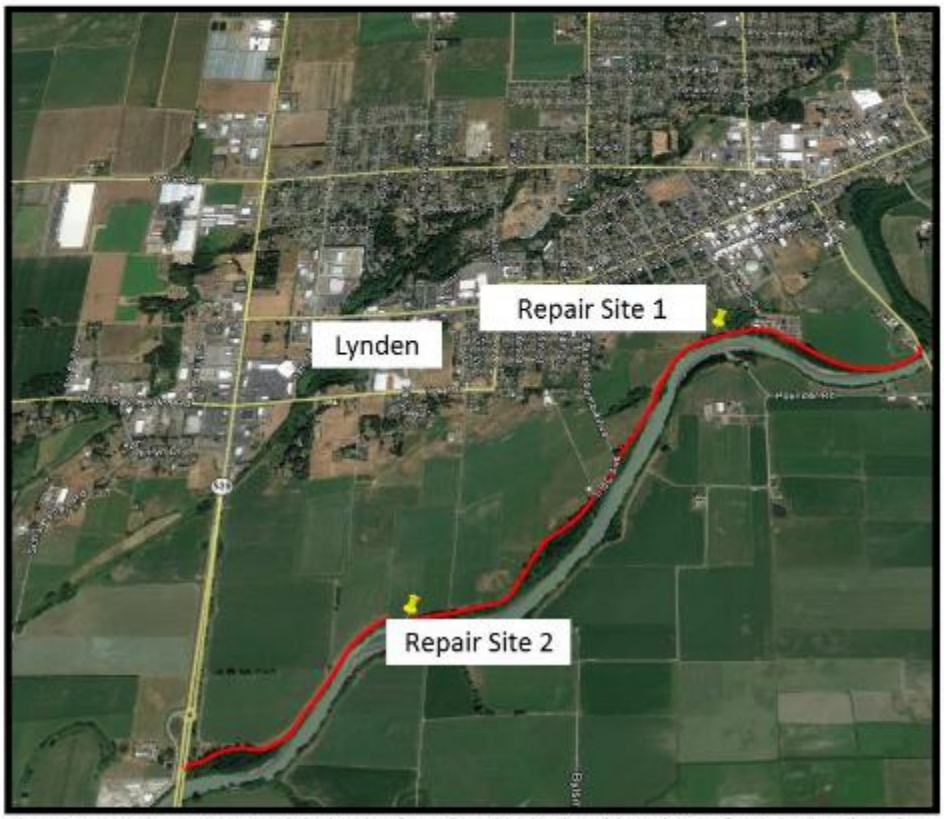

Figure 2. Lynden Levee on right bank of Nooksack River and locations of repair sites 1 and 2.

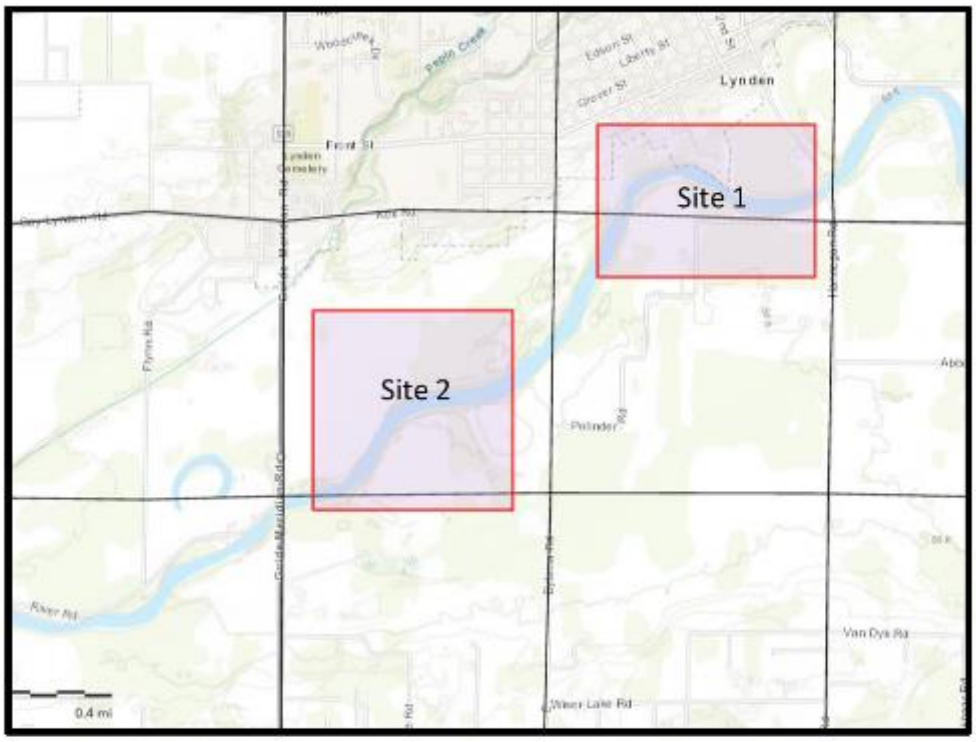

Figure 4. Map showing the APE for the Lynden Levee Rehabilitation Project for Site 1 and Site 2.

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

April 7, 2021

Laura Boerner, LG, LHG
Chief, Planning, Environmental and Cultural Resources Branch
US Army Corps of Engineers - Seattle District

In future correspondence please refer to:
Project Tracking Code: 2020-12-07840
Property: PL-84-99 Lynden Levee Rehabilitation Project: Whatcom County, WA
Re: NO Adverse Effect

Dear Laura Boerner:

Thank you for contacting the State Historic Preservation Officer (SHPO) and Department of Archaeology and Historic Preservation (DAHP) regarding the above referenced proposal. This action has been reviewed on behalf of the SHPO under provisions of Section 106 of the National Historic Preservation Act of 1966 (as amended) and 36 CFR Part 800. Our review is based upon documentation contained in your communication.

First, we concur that Property ID: 724375, Lynden Levee is eligible for listing in the National Register of Historic Places. We also concur that the current project as proposed will have "NO ADVERSE EFFECT" on historic properties within the APE that are listed in, or determined eligible for listing in, the National Register of Historic Places. As a result of our concurrence, further contact with DAHP on this proposal is not necessary. However, if new information about affected resources becomes available and/or the project scope of work changes significantly, please resume consultation as our assessment may be revised. Also, if any archaeological resources are uncovered during construction, please halt work immediately in the area of discovery and contact the appropriate Native American Tribes and DAHP for further consultation.

Thank you for the opportunity to review and comment. Please ensure that the DAHP Project Number (a.k.a. Project Tracking Code) is shared with any hired cultural resource consultants and is attached to any communications or submitted reports. If you have any questions, please feel free to contact me.

Sincerely,

Holly Borth
Project Compliance Reviewer
(360) 890-0174
holly.borth@dahp.wa.gov