U.S. Fish and Wildlife Service

Quinault National Fish Hatchery Fish Exclusion Barrier

Wetland Mitigation and Monitoring Plan

McMILLEN JACOBS ASSOCIATES

March, 2016

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Table of Contents

1.0 Introduction, Purpose and Need 1
1.1 Introduction 1
1.2 Project Location 1
1.3 Background 2
1.4 Purpose and Need 3
1.5 Tribal Trust and Responsibilities 4
1.6 Project Area and Existing Conditions 4
1.6.1 Existing Electric Fish Barrier 5
1.6.2 Access Road 9
1.6.3 Cleared/Disturbed Area 10
1.6.4 Wetlands 11
1.6.5 Waters of the U.S. 13
1.6.6 Water Intake 16
1.7 Agency Consultation 16
2.0 Proposed Project 17
2.1 Overview 17
2.2 Temporary Staging Area 17
2.3 Velocity Fish Barrier 18
2.3.1 Demolition 18
2.3.2 Weir 18
2.3.3 Fishway 18
2.3.4 Control Building 18
2.3.5 Concrete Curb 18
2.4 Access Road Improvements 20
2.5 Construction Work Windows 22
2.6 Project Schedule and Sequencing 22
3.0 Impacts of the Proposed Project 24
3.1 Inundation Analysis 24
3.2 Impacts to Uplands, Wetlands, and Waters of the U.S. 27
3.2.1 Wetland A 27
3.2.2 Wetland B 28
3.2.3 Wetland C 29
3.2.4 Wetland D 30

3.2.5 Wetland E ... 31
3.2.6 Wetland F ... 33
3.2.7 Wetland G ... 34
3.2.8 Stream 1 ... 34
3.2.9 Stream 2 ... 35
3.2.10 Stream 3 ... 35
3.2.11 Uplands ... 35

4.0 Wetland Mitigation ... 41
4.1 Compensatory Mitigation ... 41
4.2 Debit Calculations ... 42
4.3 Credit Calculations ... 45
4.4 Wetland Mitigation Goals and Objectives ... 46
4.4.1 Mitigation Goals ... 46
4.4.2 Mitigation Objectives ... 46

5.0 Monitoring Plan ... 47
5.1 Overview ... 47
5.2 Monitoring Schedule ... 47
5.3 Monitoring Methods ... 47
5.4 Contingency Plan ... 48

6.0 References ... 49

List of Tables

Table 1-1. QNFH Location Description ... 1
Table 1-2. Wetland Classification and Size ... 12
Table 1-3. Waters of the U.S. Classification and Size ... 14
Table 3-1. Inundated Areas at 50% Exceedance Flow ... 27
Table 4-1. Wetland A Debit Calculations ... 43
Table 4-2. Wetland B Debit Calculations ... 43
Table 4-3. Wetland C Debit Calculations ... 43
Table 4-4. Wetland D Debit Calculations ... 44
Table 4-5. Wetland F Debit Calculations ... 44
Table 4-6. Total Debit Calculations ... 44
Table 4-7. Wetland Establishment Credit Calculations ... 46

List of Figures

Figure 1-1. Vicinity Map 2
Figure 1-2. Existing Site Plan 5
Figure 1-3. Existing Electric Fish Barrier 6
Figure 1-4. Channel Slab 7
Figure 1-5. Main Flow Channel 7
Figure 1-6. Low Flow Channel and Fish Entrance 8
Figure 1-7. Control Building 8
Figure 1-8. Access Road 9
Figure 1-9. Access Road 10
Figure 1-10. Cleared/Disturbed Area 10
Figure 1-11. Cleared/Disturbed Area 11
Figure 1-12. Wetlands and Waters of the U.S. 13
Figure 1-13. Cook Creek at the Electric Fish Barrier (high flow) 14
Figure 1-14. Cook Creek upstream of Moclips Highway (low flow) 15
Figure 1-15. Hatchery Creek 15
Figure 2-1. Proposed Site Plan 17
Figure 2-2. Proposed Velocity Fish Barrier 19
Figure 2-3. Proposed Weir and Fishway Sections 20
Figure 2-4. Access Road Improvements 21
Figure 2-5. Downstream and Upstream Maintenance Access Sections 22
Figure 3-1. Extent of Inundation at 50% Exceedance Flow 25
Figure 3-2. Depth of Inundation at 50% Exceedance Flow 26
Figure 3-3. Wetland A at Cook Creek 28
Figure 3-4. Wetland B at Cook Creek 29
Figure 3-5. Wetland C along Cook Creek 30
Figure 3-6. View of Wetland D from the Moclips Highway Bridge (low flow). 31
Figure 3-7. Wetland E 32
Figure 3-8. Depth of Inundation at 95% Exceedance Flow 33
Figure 3-9. View of Wetland F looking downstream along Cook Creek (high flow). 34

Figure 3-10. View of Stream 1, looking downstream toward Cook Creek (low flow). 35

Figure 3-11. Left Bank of Cook Creek Downstream of Moclips Highway Bridge (High Flow) 36

Figure 3-12. New Wetland Area 37

Figure 3-13. Predicted Wetland Habitat in Wetland E and New Wetland Area 38

Figure 3-14. Location of Large Conifers 39

Figure 3-15. Uplands Adjacent to Wetland E 40

Figure 4-1. Credit and Debit Wetlands 42

Appendices

Appendix A Quinault National Fish Hatchery Fish Exclusion Barrier: Wetland and Waters of the U.S. Report

1.0 Introduction, Purpose and Need

1.1 Introduction

The U.S. Fish and Wildlife Service (USFWS) is proposing improvements to the Quinault National Fish Hatchery (QNFH) electric fish barrier located on Cook Creek in Grays Harbor County, Washington (Figure 1-1). The USFWS's QNFH is currently equipped with an electric fish barrier extending across Cook Creek. Recent discovery of infectious haematopoietic necrosis (IHN) in steelhead stocks downstream of the existing fish barrier, public and wildlife safety concerns, operational issues of the barrier system, and the USFWS's desire to have the system operate at maximum efficiency (to the greatest extent practical) during fish migration periods, have identified a need to install a different type of exclusion barrier. There are jurisdictional wetlands and waters of the U.S. located within the project boundary and the primary goal of this document is to analyze impacts to these wetlands and waters of the U.S. This document also proposes mitigation to compensate for project impacts, and documents a plan for monitoring both impacted and new wetlands at the site.

1.2 Project Location

The QNFH is located along Cook Creek, approximately 5.5 miles west-southwest of Neilton, in Grays Harbor County, Washington (Figure 1-1). The QNFH is located on land owned and managed by the USFWS within the boundary of the Quinault Indian Nation reservation. It adjoins the U.S. Forest Service (USFS) Olympic National Forest, which is located to the southeast of the facility. Table 1-1 identifies the legal description, coordinates, and address of the QNFH facility.

Table 1-1. QNFH Location Description

Sections (S)/Township (T)/Range (R)	Coordinates (WGS84)	Address
NE ¼ of S.31 and NW ¼ of S.32 / T.22N / R.10W	47.358478, -123.992543°	3 Sockeye Road, Quinault, WA 98575

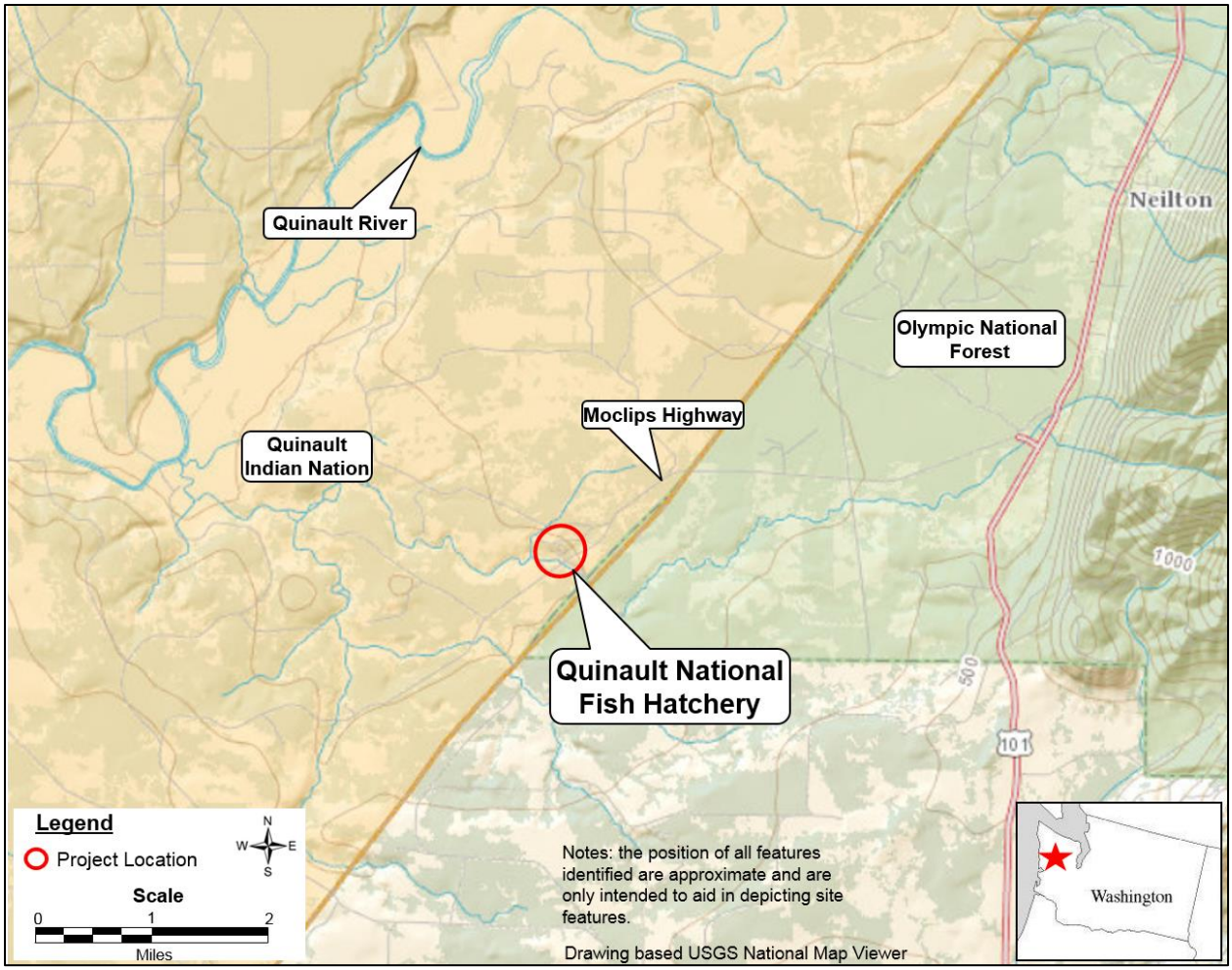

Figure 1-1. Vicinity Map

1.3 Background

The QNFH was established in 1968 to restore and enhance the depleted salmon and steelhead fish runs in the area. A hanging probe electric barrier was originally constructed in 1971 as a preventative measure to ensure that the upstream hatchery water intake was not exposed to fish diseases discovered in the creek. In 2002, the hanging probe fish barrier was replaced with an electric fish barrier consisting of a concrete slab extending across the river, abutments on each bank, and seven electrodes. When energized, the electrodes create an electric field that deters upstream fish passage.

The existing electric fish barrier is not currently functioning as designed and has experienced the following issues:

- Highly variable river conductivity has caused difficulty in setting the electrode current accurately, resulting in failure to prevent upstream fish passage as well as accidental killing of fish.
- Wildlife entering the river during low flows when the electric fish barrier is energized has been killed.

- Individuals have ignored fenced areas/signage and have entered the river near the electric fish barrier, causing safety concerns.
- Large quantities of bed load and debris load in the river have deposited on the electric fish barrier as well as immediately up and downstream of the barrier. This debris disables the function of the barrier and the electrodes must be de-energized to clear the barrier of debris.
- The electric fish barrier is not as effective during low flow conditions as desired.

Additionally, the USFWS has discovered IHN in the steelhead stocks in Cook Creek downstream of the electric barrier. To prevent introduction of IHN into the hatchery water supply, which is located upstream of the barrier, the USFWS desires the fish barrier system to operate at maximum efficiency (to the greatest extent practical) during fish migration periods.

1.4 Purpose and Need

The purpose of the project is to construct a new fish barrier in Cook Creek that operates to maximum efficiency (to the greatest extent practical) for the unique conditions that exist at the creek while maintaining the functionality of the QNFH. The QNFH is on a stretch of low gradient creek with very high sediment and debris loads, particularly in the fall and winter when the barrier is required to be operational. The current fish barrier is experiencing operational issues associated with these high sediment and debris load conditions. The proposed project will fund replacing the existing weir, modifying riprap and an access road, and adding a fish bypass ladder.

Additionally, the proposed project addresses routine maintenance activities, which include cleaning of water intakes and removal of large woody debris and gravel buildup near or on the weir. The repairs and maintenance activities are needed to allow the weir and fish ladder to function properly, allow fish passage, and improve human safety.

The need for the project is to eliminate the human and animal safety concerns, to remedy the operational issues of the existing electric fish barrier system, and to provide a system that reduces the potential for fish diseases to enter the QNFH upstream water supply. The current electric fish barrier system poses a threat to human and animal life. Aquatic and terrestrial wildlife have been killed on the electric fish barrier during low flow conditions. Additionally, the area is commonly used by the public for fishing, and individuals have ignored posted hazard signs and entered the water. Individuals who enter the water at the barrier are in danger of electric shock. Finally, IHN was discovered among the steelhead stocks in Cook Creek downstream of the electric barrier. To prevent introduction of IHN into the hatchery water supply, the hatchery needs a fish barrier system that is capable of preventing fish passage not only during fish migration periods but also during summer low flows and extreme high flows.

The funding of construction of the new fish barrier in Cook Creek will allow the hatchery to operate at maximum efficiency (to the greatest extent practical) for the unique conditions that exist at the creek.

The specific operational objectives of the project proposed for funding include the following:

- Eliminate the human health and safety risk associated with electric shock from the existing electric weir;
- Comply with National Marine Fisheries Service (NMFS) 2008 Anadromous Salmonid Passage Facility Design criteria for fish exclusion barriers to provide an effective upstream blockage for adult fish;
- Help prevent the introduction of IHN or other fish pathogens into the hatchery water supply;
- Comply with Quinault Indian Nation, U.S. Army Corps of Engineers, and Washington Department Fish and Wildlife in-water work construction requirements;
- Prevent fish kills at low flows due to errors in calibration and disturbances from accumulated gravel that interfere with electrical current in the existing weir; and
- Reduce the need for personnel to enter the river for operation and maintenance of the barrier.

1.5 Tribal Trust and Responsibilities

To comply with Executive Order 13175, the USFWS performed necessary consultation with Indian tribal governments. For this project, the Quinault Indian Nation (QIN) is the only tribal government involved. Consultation letters including project information have been sent to the QIN. Tribal consultation will be ongoing throughout the development of this wetlands monitoring and mitigation plan, and throughout the permitting process for the project.

1.6 Project Area and Existing Conditions

The project area consists of the extents depicted in the Existing Site Plan (Figure 1-2). The project area encompasses the construction limits that will be utilized during the installation of the new fish barrier system.

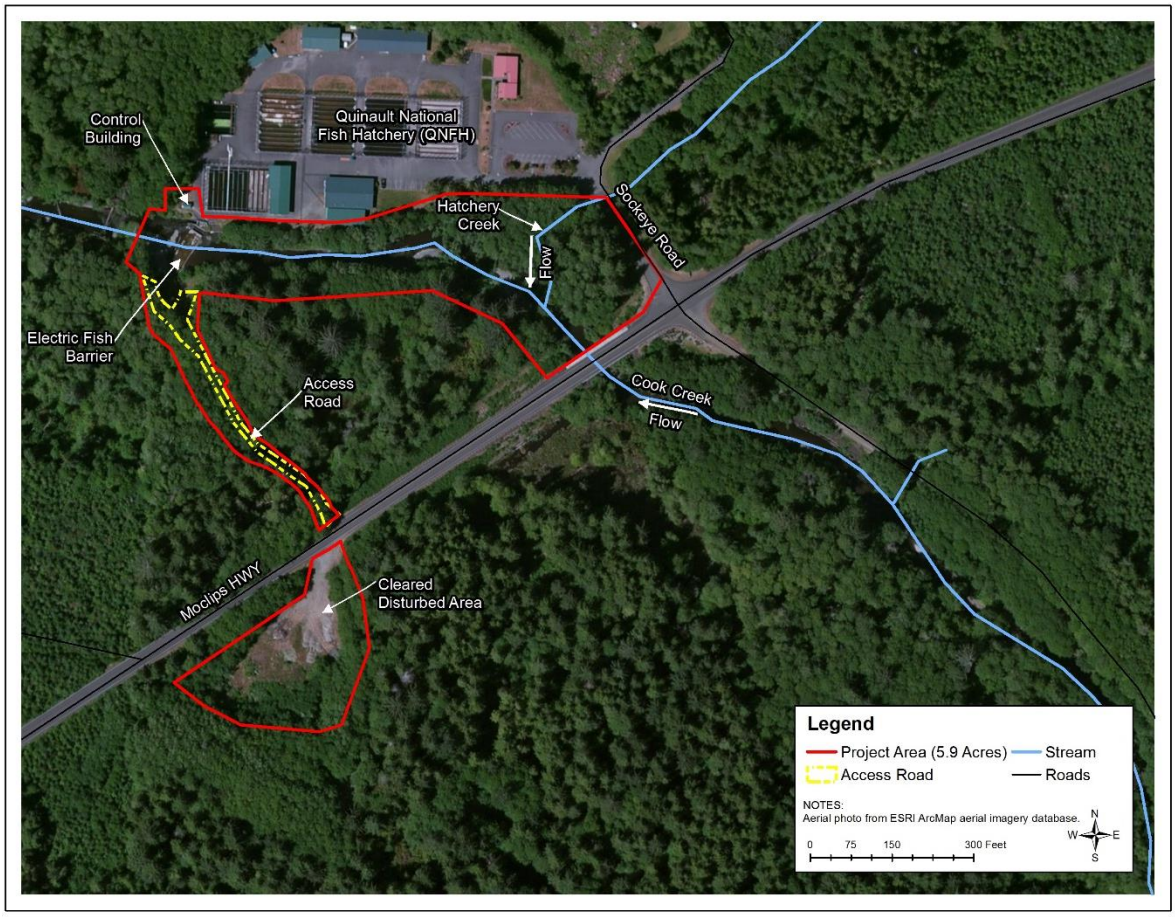

Figure 1-2. Existing Site Plan

1.6.1 Existing Electric Fish Barrier

The existing electric fish barrier system consists of an approximately 104-foot-wide barrier that is skewed 15 degrees from perpendicular to the river flow (Figure 1-3). Seven electrodes extend across a channel slab and up the abutment walls on each side of the channel (Figure 1-4). The barrier was modified from the original design by the addition of a wood weir, with a sill bolted to the upstream side (Figure 1-4). The main flow channel makes up the majority of the barrier (Figure 1-5). Approximately 10 feet of the barrier is a low flow channel that is located on the north side of Cook Creek (right bank). This channel is 1 foot below the main channel elevation and is separated from the main flow channel by a 1-foot-wide, 5-foot-tall concrete abutment wall (Figure 1-6). A fish entrance into the hatchery is located on the right bank adjacent to the low flow channel (Figure 1-6). A 12-foot by 8-foot control building that houses the existing electric fish barrier operation and control equipment is located approximately 30 feet north of the creek (Figure 1-7).

The existing fish barrier operates by creating a pulsed direct electric current between the electrodes that are embedded in the slab. Fish passage is prevented when the electrodes are energized by creating an electric field in the water that the fish sense and will typically avoid. The current increases from downstream to upstream and is automatically adjusted by a computerized control system that senses the water level at the barrier and adjusts the system accordingly. If fish attempt to swim through the electric

field they will encounter a progressively stronger current and will either retreat volitionally or are stunned and swept downstream by the current. During low water level conditions, the electrodes in the main slab can be de-energized while the bypass section remains energized. This function is intended to allow the barrier to continue to prevent fish passage in the low flow section when the water depth is too shallow for safe operation of the main slab electrodes.

Figure 1-3. Existing Electric Fish Barrier
(General view looking south at the existing system.)

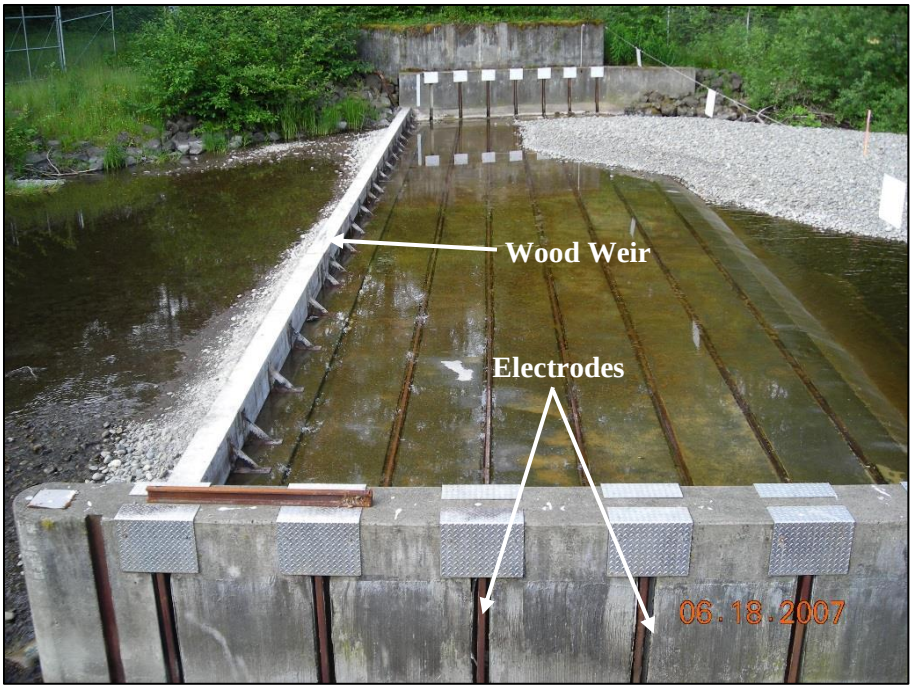

Figure 1-4. Channel Slab
(General view looking southwest across the channel slab.)

Figure 1-5. Main Flow Channel
(General view looking south at the main flow channel.)

Figure 1-6. Low Flow Channel and Fish Entrance
(General view looking east at the low flow channel and fish entrance.)

Figure 1-7. Control Building
(General view looking northwest at the electric fish barrier control building.)

1.6.2 Access Road

An existing access road extends from the Moclips Highway to the electric fish barrier on the south bank of Cook Creek (Figure 1-2). The gravel road is approximately 12 feet wide by 550 feet long. This road provides maintenance access to the south side of the electric barrier, as well as pedestrian access to the south side of Cook Creek. The area directly surrounding the barrier on the south side of Cook Creek is fenced with locked access gates for public safety. A pedestrian access route to Cook Creek extends along the west side of the fenced area and allows public access to the creek approximately 30 feet downstream of the electric barrier. Figures 1-8 and 1-9 below show the existing access road conditions.

Figure 1-8. Access Road

(Looking northwest from the Moclips Highway along the existing access road alignment.)

Figure 1-9. Access Road

(Looking north at the north portion of the existing access road.)

1.6.3 Cleared/Disturbed Area

Across the Moclips Highway (Figure 1-2) from the existing access road, an open area exists that has been disturbed and cleared of vegetation. This area will be utilized as a construction staging area for the proposed project. Figures 1-10 and 1-11 below show the existing conditions of the cleared/disturbed area.

Figure 1-10. Cleared/Disturbed Area

(Standing at the Moclips Highway looking south across the cleared/disturbed area.)

Figure 1-11. Cleared/Disturbed Area
(Looking north-northwest across the cleared/disturbed area.)

1.6.4 Wetlands

Seven wetland features were identified at the QNFH site and were formally delineated by McMillen, LLC in 2012 (Appendix A), using the Wetland Rating System for Western WA (Hruby 2004). The delineation occurred in July 2011 and 2012, and was verified in December 2014. The wetlands were classified according to the Cowardin Classification System and their hydrogeomorphic classification is presented in Table 1-2 (Cowardin et al. 1979). The location of the wetlands is shown in Figure 1-12.

Table 1-2. Wetland Classification and Size

Wetland	Cowardin Classification				Hydrogeomorphic Classification	Size (Acres)	Category
	System	Class	Subclass	Water Regime			
A	Palustrine (P)	Scrub-Shrub (SS)	Deciduous (6)	Seasonally Flooded/Saturated (E)	Riverine	0.06	IV
B	Palustrine (P)	Emergent (EM)	Persistent (1)	Seasonally Flooded/Saturated (E)	Riverine	0.05	IV
C	Palustrine (P)	Emergent (EM)	Persistent (1)	Seasonally Flooded (C)	Riverine	0.08	IV
D	Palustrine (P)	Emergent (EM)	Persistent (1)	Permanently Flooded (H)	Depressional	2.53	III
E	Palustrine (P)	Emergent (EM)	Persistent (1)	Semi-Permanently Flooded (F)	Depressional	0.73	III
F	Palustrine (P)	Emergent (EM)	Persistent (1)	Semi-Permanently Flooded (F)	Slope	0.11	IV
G	Palustrine (P)	Forested (FO)	Deciduous (6)	Saturated (B)	Slope	0.05	IV
					Total	**3.61**	-

The total area of wetland vegetation communities is summarized below:

- Forested: 0.05 acres
- Emergent: 3.5 acres
- Scrub-Shrub: 0.06 acres

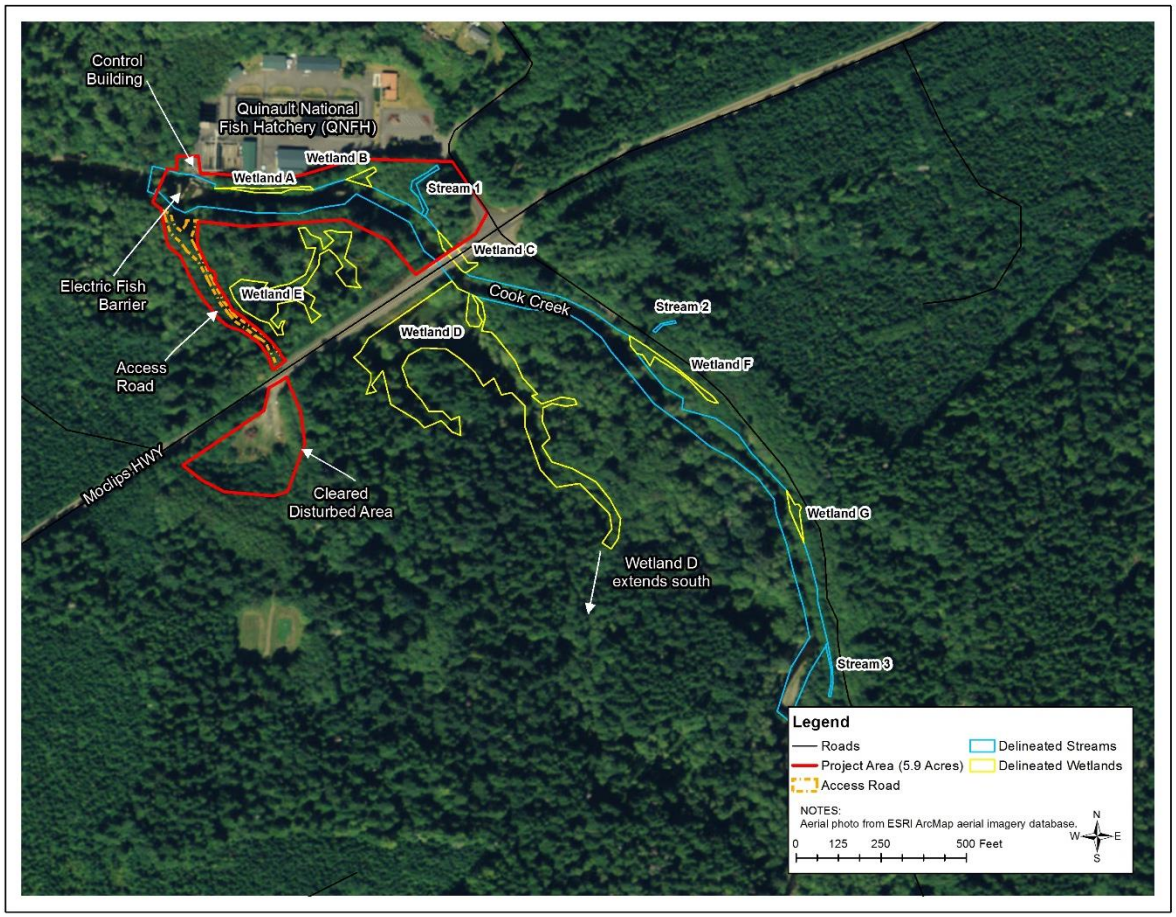

Figure 1-12. Wetlands and Waters of the U.S.

1.6.5 Waters of the U.S.

In 2011, 2012, and 2014, McMillen, LLC performed a delineation of the Ordinary High Water Mark (OHWM) in waters of the U.S. for the QNFH survey area (Figure 1-12). Three streams and Cook Creek were classified according to the Cowardin Classification System during this delineation (Cowardin et al. 1979). Table 1-3 lists the classification and size of Streams 1 through 3 and Cook Creek. Figures 1-13 through 1-15 show Cook Creek and Hatchery Creek.

Table 1-3. Waters of the U.S. Classification and Size

Waters of the US	Cowardin Classification				Length Delineated (Feet)	Stream Type
	System	Subsystem	Class	Subclass		
Stream 1 (Hatchery Creek)	Riverine (R)	Lower Perennial (2)	Unconsolidated Bottom (UB)	Cobble-Gravel (1)	194	F
Stream 2	Riverine (R)	Lower Perennial (2)	Unconsolidated Bottom (UB)	Cobble-Gravel (1)	1,020	F
Stream 3	Riverine (R)	Lower Perennial (2)	Unconsolidated Bottom (UB)	Cobble-Gravel (1)	313	F
Cook Creek	Riverine (R)	Lower Perennial (2)	Unconsolidated Bottom (UB)	Cobble-Gravel (1)	3,021	F

Figure 1-13. Cook Creek at the Electric Fish Barrier (high flow)

(General view looking west at Cook Creek high flow conditions across the electric fish barrier.)

Figure 1-14. Cook Creek upstream of Moclips Highway (low flow)
(General view of Cook Creek upstream of the Moclips Highway, looking east-southeast.)

Figure 1-15. Hatchery Creek
(General view along Hatchery Creek alignment, looking upstream.)

1.6.6 Water Intake

The primary water supply to the QNFH is from Cook Creek. Cook Creek water is diverted to the hatchery using a gravity flow diversion system. The water intake is located south of the hatchery at the end of a dirt road. To help funnel water to the intake, a wooden diversion wall that is approximately 6-feet-wide by 45-feet-long with an adjacent 10-foot-wide by 36-foot-long riprap wall is located on the left bank. From the intake chamber, water flows 900 feet underneath a graveled road through a 48-inch-diameter pipeline to a headbox, screen chamber, and a sediment basin, collectively called the sediment basin. The sediment basin looks like a concrete pool that measures 33.5-feet-wide by 43.5-feet-long with an average depth of 4 feet. When Cook Creek water first reaches the sediment basin, it flows through the headbox or to a bypass pipe that directs water back to Cook Creek. Water that stays in the sediment basin then enters a screen chamber and passes through inclined metal screens measuring approximately 32-feet-wide by 6-feet-long. The screens prevent materials such as leaves and sticks, and fish from entering the settling pond. Screened water then enters a sloped sediment pond, which removes some settleable solids before allowing the water to flow to a 48-inch-diameter outlet pipe that goes to the hatchery.

1.7 Agency Consultation

Informal consultation has occurred with state and Federal agencies about impacts to wetlands and proposed mitigation at the QNFH site. To comply with Section 404 of the Clean Water Act, a Washington State Joint Aquatic Resources Permit Application (JARPA) was submitted to the U.S. Army Corps of Engineers (USACE) for the proposed project on September 3, 2015. The USFWS is completing regulatory compliance with Ecology, WDFW, USFWS (Section 7 of the ESA) and the Quinault Indian Nation (Hydraulic Permit Application).

At a joint agency meeting on November 5, 2015, possibilities for mitigating impacts to wetlands at the QNFH were discussed. A long floodwall had been proposed along the south side of the creek to contain the area of increased inundation caused by the proposed Obermeyer weir, which will raise water levels by 6.5 feet when the weir gate is in the upright position. However, the construction of the floodwall would require construction activities and placement of permanent sheet pile or concrete walls in wetland areas. Instead, the agency staff from the Washington State Department of Ecology (Ecology), U.S. Army Corps of Engineers (USACE), and USFWS concurred that not using an extensive floodwall would be preferable. Under that plan wetland areas would be inundated in some places, and other wetlands would develop in previous upland areas that would become inundated. This proposed plan—that is, constructing a new weir with an Obermeyer gate and no floodwall—is the plan described in this document.

2.0 Proposed Project

2.1 Overview

The proposed action includes the demolition and removal of the existing electric fish barrier system, and funds installation of a velocity fish barrier utilizing an Obermeyer weir. The Obermeyer weir will allow the barrier to be lowered during flood events A concrete curb will be constructed along 588 feet of the north bank of Cook Creek (outside of the existing OHWM) to provide flood protection to the QNFH facility to the north. Improvements will be made to the existing access road that extends from the Moclips Highway to the south bank of Cook Creek. A Proposed Site Plan can be seen in Figure 2-1 below. A detailed description of each improvement is also included below.

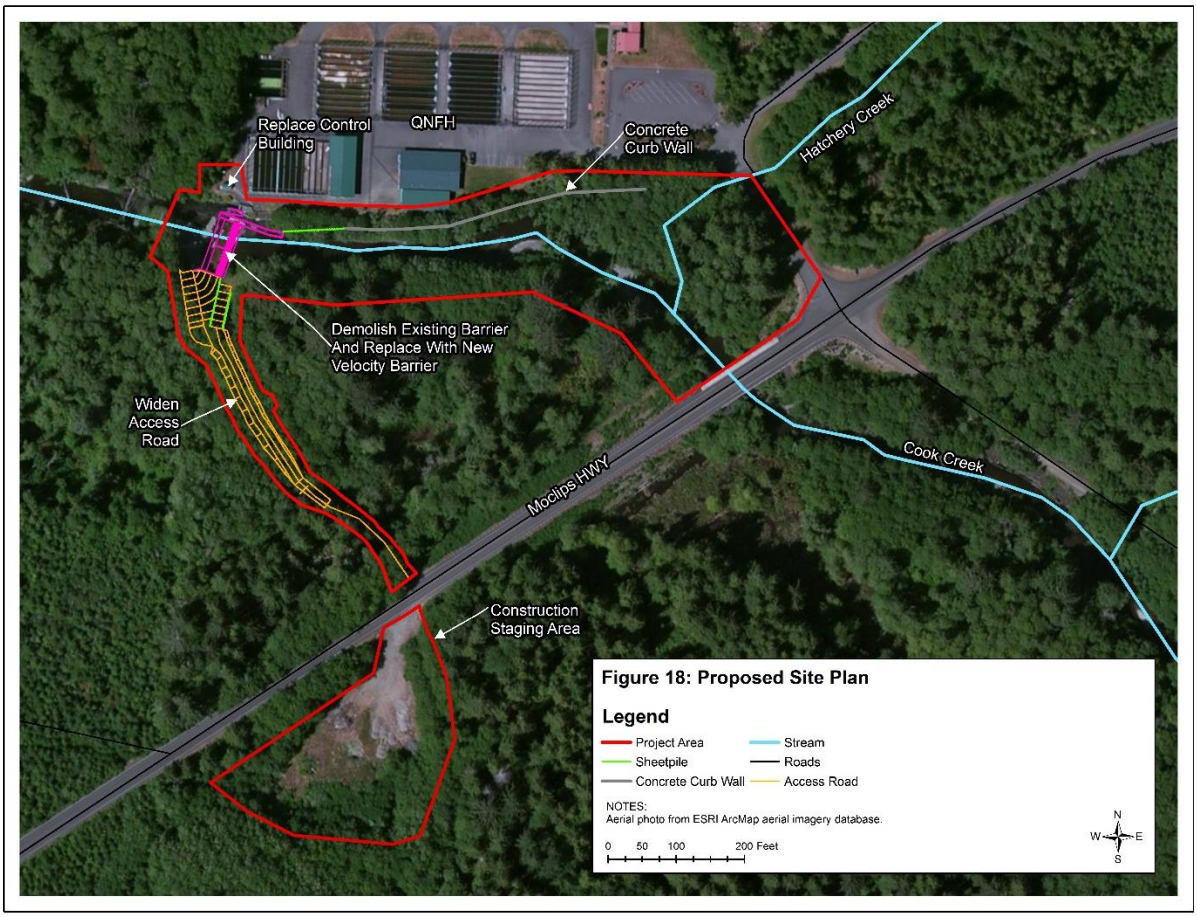

Figure 2-1. Proposed Site Plan

2.2 Temporary Staging Area

The construction staging area will be located off the Moclips Highway in a previously disturbed area (Figure 2-1). There will be no additional clearing of vegetation in this area and the site will be stabilized.

2.3 Velocity Fish Barrier

2.3.1 Demolition

The existing concrete fish barrier structure including the concrete apron, concrete electric fish barrier, and wingwalls will be demolished and removed, along with any remaining conduit or piping. The existing fish ladder leading into the QNFH and adjacent fish ladder walls will be protected during demolition and will remain in place. Backfill on the upstream side of the wingwall will be removed and stockpiled for later use. Demolition debris will be disposed of at an approved off-site location.

2.3.2 Weir

An 80-foot-long by 24-foot-wide velocity barrier consisting of a 20-foot-wide downstream concrete apron will be constructed spanning Cook Creek (Figure 2-2). The velocity barrier will consist of an adjustable Obermeyer weir gate system with a maximum height of 4 feet when fully raised. The Obermeyer weir will consist of two 40-foot-long weir sections that will be operated in conjunction. The velocity barrier will have a cutoff wall at both the upstream and downstream side, protected by rock riprap. An approximately 8-feet-wide by 4-feet-thick layer of 12-inch rock riprap will extend downstream of the cutoff wall and an approximately 4-feet-wide by 4-feet-thick layer of 12-inch rock riprap will extend upstream of the cutoff wall. A cross-section of the velocity barrier can be seen in Figure 2-3 below. The new velocity barrier will raise the OHWM of Cook Creek approximately 6.5 feet, inundating land between the existing OHWM and proposed OHWM.

2.3.3 Fishway

A new 8-foot-wide by 100-foot-long concrete fishway will be constructed on the north side of Cook Creek adjoining the velocity fish barrier structure (Figure 2-2). This fishway will allow upstream fish passage if desired in the future. Aluminum stop logs will be installed in the structure to create fish pools allowing passage. A cross-section of the fishway can be seen in Figure 2-3 below.

2.3.4 Control Building

The existing 4-foot by 8-foot electric weir control building, located approximately 30 feet north of the existing fish barrier structure, will be demolished and replaced with a new 15-foot by 20-foot pre-engineered metal building (Figure 2-2). The new building will house the necessary operation and control equipment for the new Obermeyer weir and will be situated within the limits of the existing QNFH developed area.

2.3.5 Concrete Curb

A small concrete curb 6 inches to 1 foot high will be installed on the berm on the right bank of the creek to protect the hatchery in case of a 100 year flood. A small backhoe will be used to remove vegetation from the top of the berm. Trees greater than 3 inches in diameter will be avoided and allowed to remain on the top of the berm. Construction of the concrete curb is expected to take one week. A trench will be excavated, and then rebar and forms will be set up. The concrete will be poured, and after several days of curing, the rebar and forms will be removed. The area will then be hydroseeded with approved certified weed free native grass mix appropriate to the area.

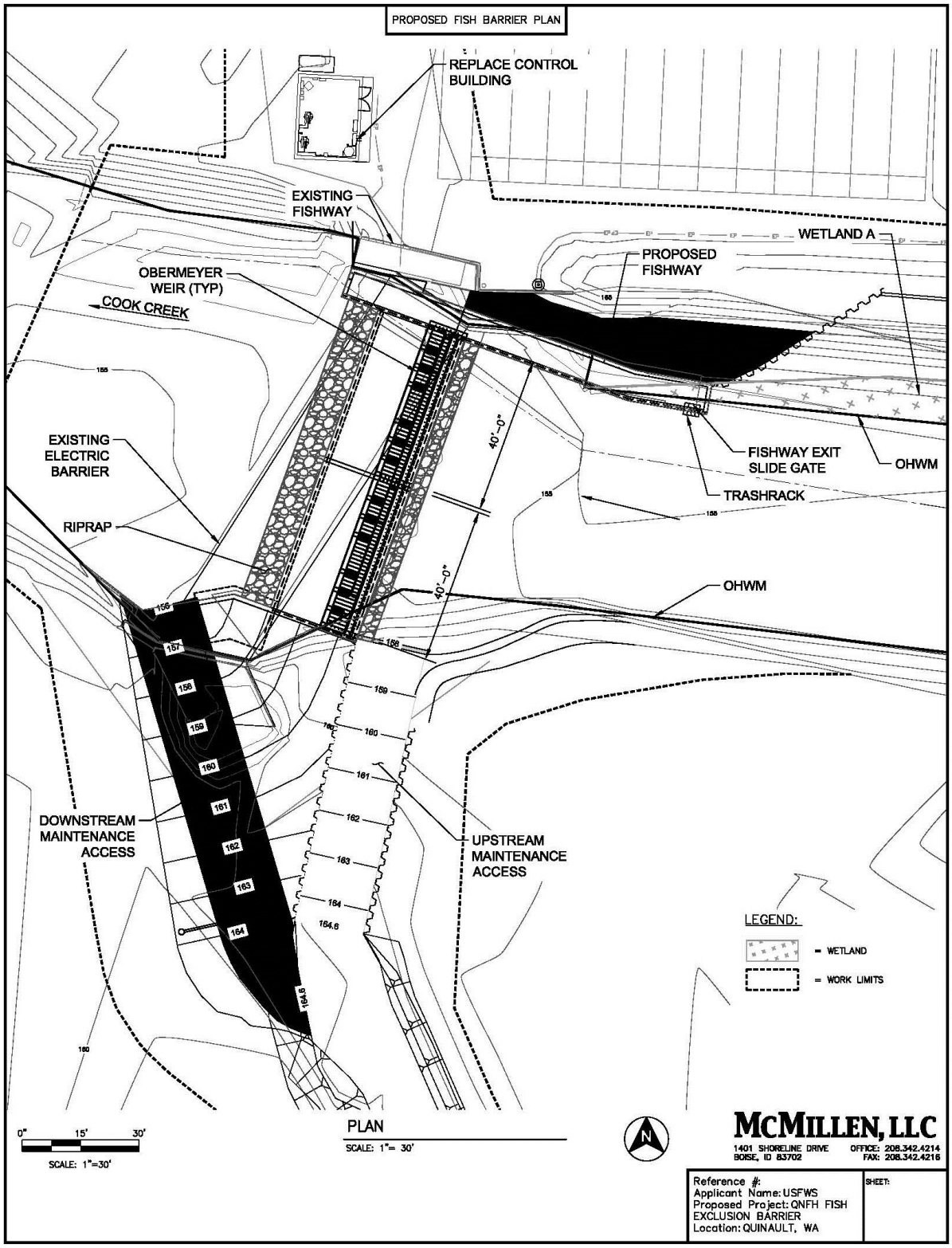

Figure 2-2. Proposed Velocity Fish Barrier

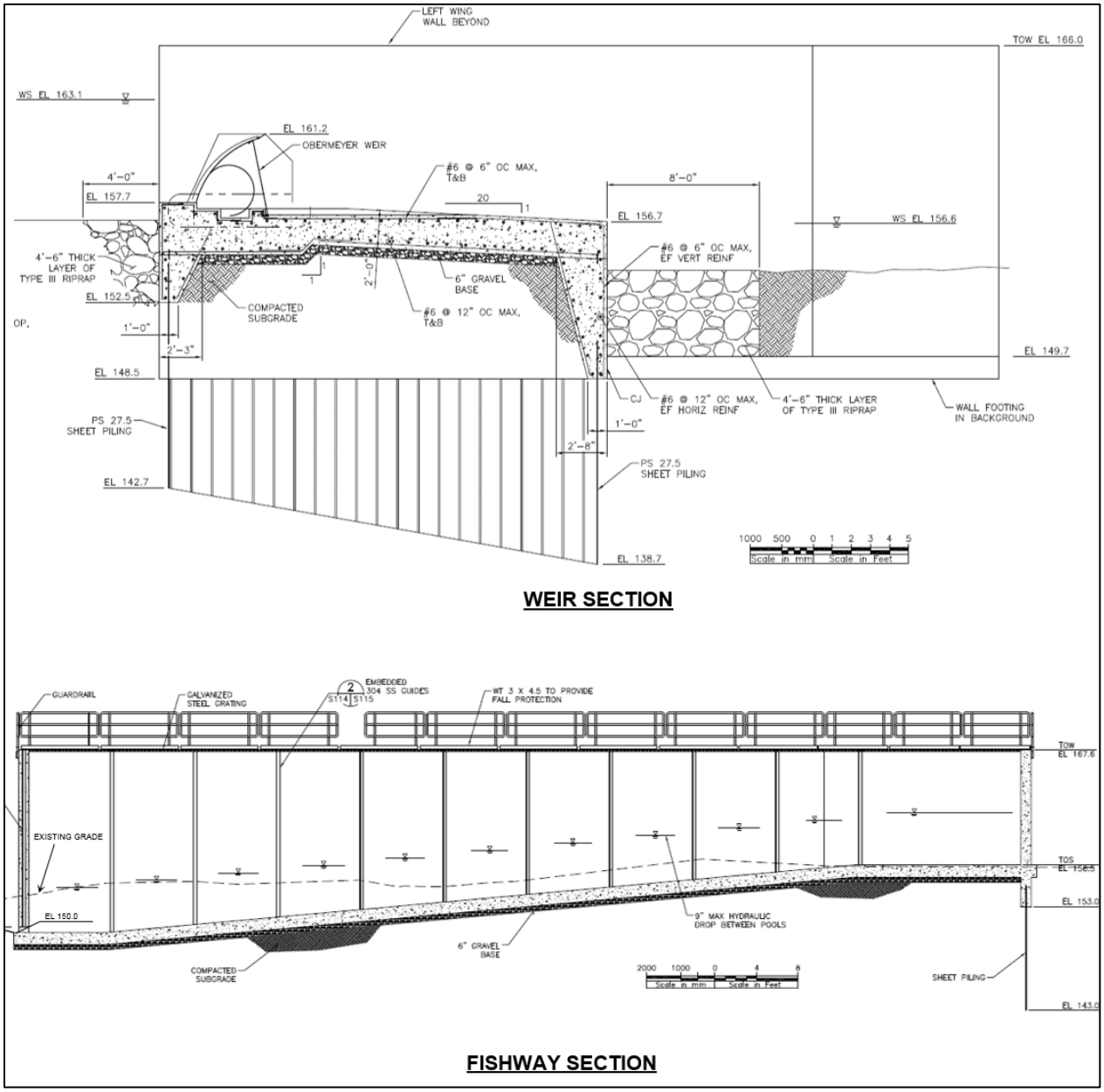

Figure 2-3. Proposed Weir and Fishway Sections

2.4 Access Road Improvements

The existing approximately 12-foot-wide access road to the south bank of the fish exclusion barrier will be widened 2–4 feet to allow construction access and public parking. Clearing and grubbing will take place along the margins of the access road. The existing gate across the access road will be removed to provide public access to the area, and relocated to the entrance of the proposed downstream access ramp. The access routes to the upstream and downstream side of the barrier will be improved to provide maintenance access. The upstream access ramp will be constructed at 20 feet wide and will require a sheet pile wall on either side to protect it from high flood events. This ramp will be fenced off to exclude the public. The downstream access ramp will be constructed at 20 feet wide and will allow access for both

maintenance and public pedestrian traffic to Cook Creek. Access road improvements can be seen in Figure 2-4 below and a section of the access road can be seen in Figure 2-5 below.

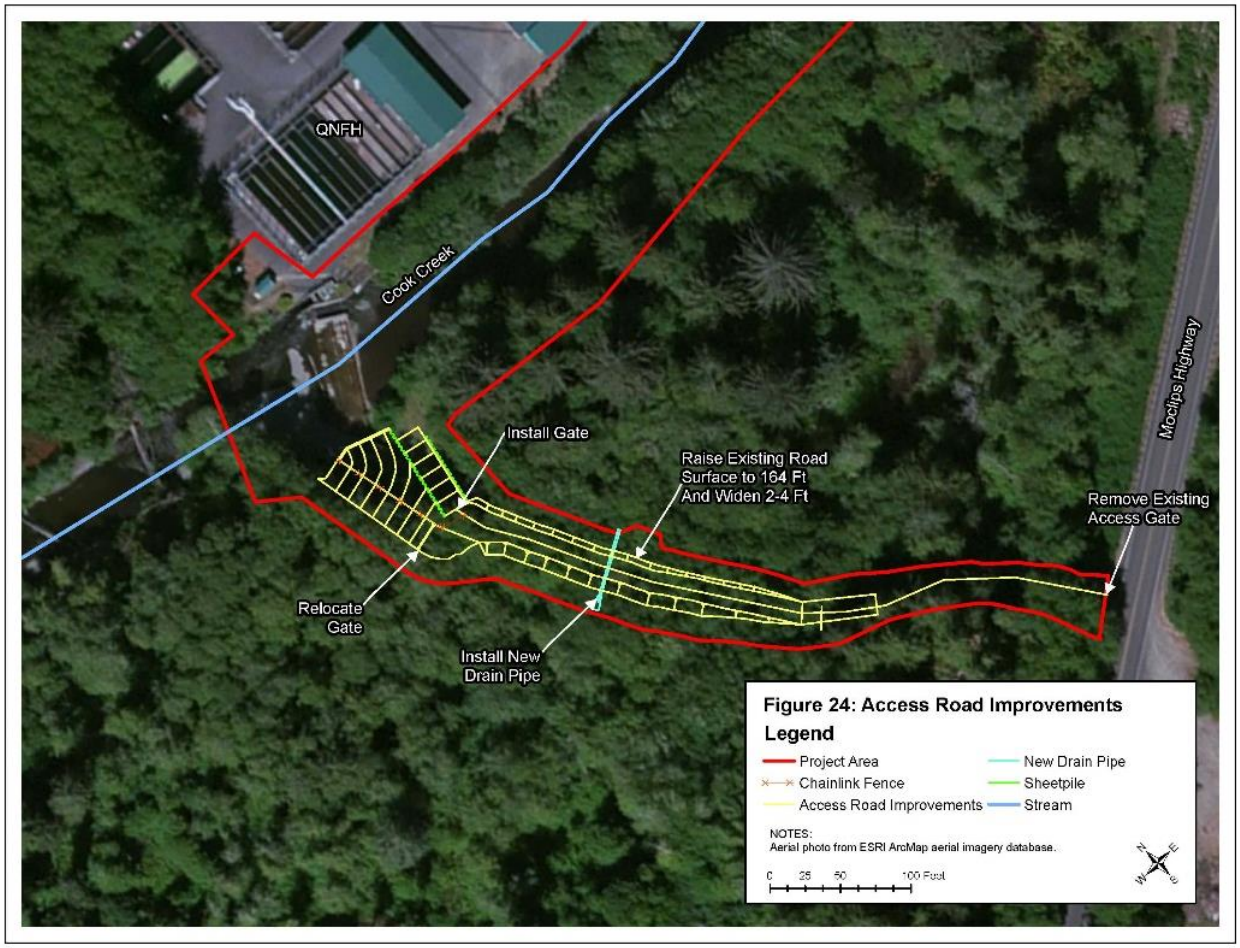

Figure 2-4. Access Road Improvements

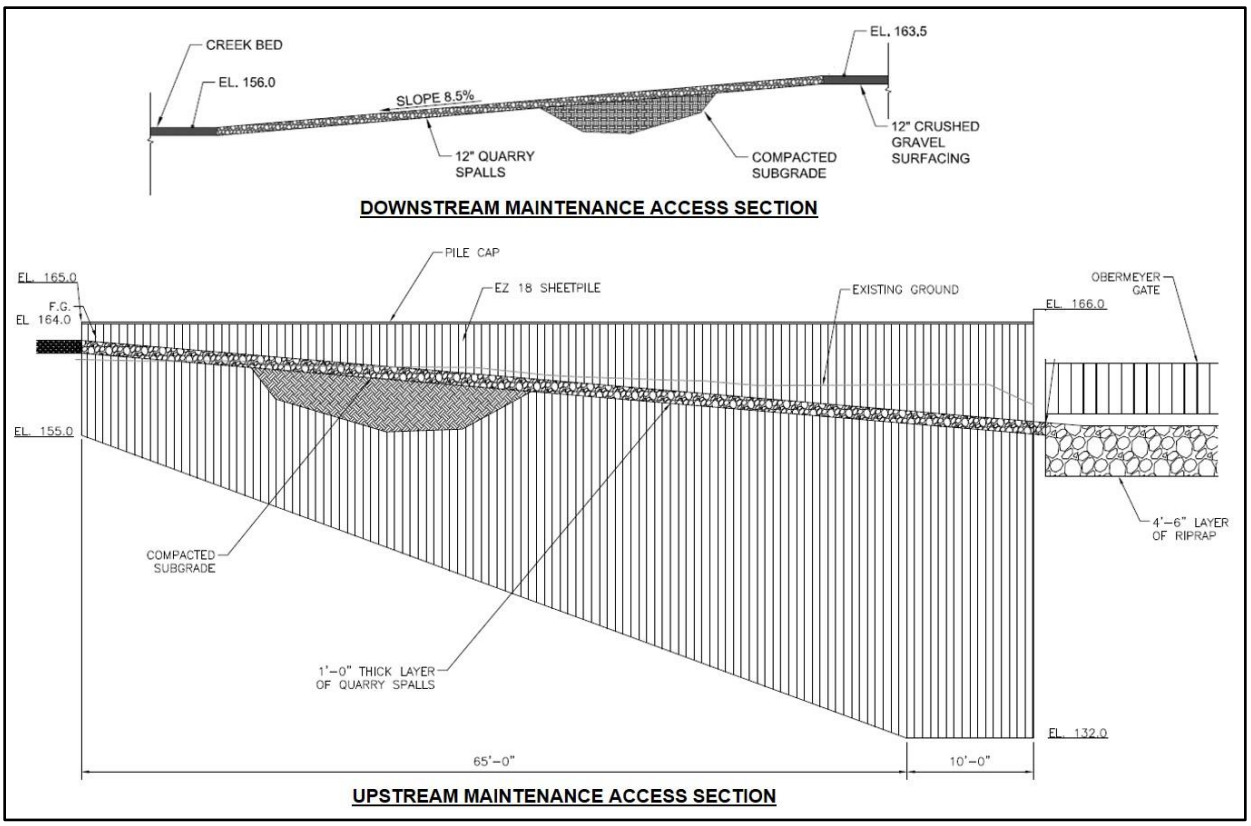

Figure 2-5. Downstream and Upstream Maintenance Access Sections

2.5 Construction Work Windows

The following in-water work windows have been established by the regulatory agencies to minimize impacts to fish species during construction. These work windows are general estimates. Stream and in-water work may be required outside of these windows. Coordination with the regulatory agencies will be performed for proposed in-water work outside of these times.

- U.S. Army Corps of Engineers (USACE) – July 15 through August 31
- Washington Department of Fish and Wildlife (WDFW) – July 16 through October 15

2.6 Project Schedule and Sequencing

The following describes the construction sequencing for the project activities:

May 2016 or earlier

- Mobilize project equipment and materials to site.
- Coordinate utility locating services, staking for construction, and land survey.
- Set up staging and laydown area.
- Install temporary Best Management Practices (BMPs) including silt fence, straw wattles, stabilized construction ingress/egress, and haul roads above and below the OHWM.

- Establish traffic control.
- Demolish the remaining control building, and dispose of material at an approved off-site location.
- Clear vegetation that is not within the wetted width without causing any turbidity.
- Install a new pre-engineered metal building to house the Obermeyer weir gate operation and control equipment.
- Widen the existing access road and construct upstream and downstream maintenance access roads.

June 2016

- Clear vegetation limits for concrete curb on berm. Dispose of cleared woody vegetation on the outside of the concrete wall or at an approved location per direction of USFWS.
- Install a sandbag and ecology block cofferdam (Phase 1) for work on the northern section of the barrier using an excavator.
- Demolish the northernmost section of the existing fish barrier and dispose of the material at an approved off-site location.
- Install the fishway.

July 2016

- Install a sandbag and ecology block cofferdam (Phase 2) for work on the southern section of the fish barrier and remove the cofferdam on the northern section (Phase 1).
- Begin installation of the velocity fish barrier system.

August 2016

- Continue installation of the velocity fish barrier system.

September 2016

- Continue installation of the velocity fish barrier system.

October 2016

- Complete installation of the velocity fish barrier system.
- Demobilize project equipment and materials from the site.

General equipment used during construction activities may consist of excavators, loaders, skid steers, concrete trucks, dump trucks, and compaction equipment.

3.0 Impacts of the Proposed Project

3.1 Inundation Analysis

The replacement of the existing electric fish barrier with an Obermeyer weir is projected to cause a new hydrologic regime in the area just upstream of the weir (McMillen, LLC 2012). A hydraulic model (HEC-RAS numerical model) was used to analyze the impact of the proposed project design on the uplands, wetlands, and streams surrounding the QNFH (McMillen, LLC 2012). The model was initially developed to evaluate site inundation for previous site design concepts in 2012, and was re-run in November 2015 to estimate inundation after the decision was made to exclude the floodwall from the site design. A 50% exceedance flow value (124 cubic feet per second [cfs]) was used to evaluate wetland and upland area inundation because it represents approximately median flow conditions at the site. No long-term flow data exists for Cook Creek, so project design flows were estimated using U.S. Geological Survey (USGS) StreamStats software, which uses regression curves developed from gaged basin streamflow data (USGS 2012). Further discussion of model inputs is provided in a Technical Memorandum (McMillen, LLC 2012). Impacts to delineated wetlands and streams and surrounding upland areas were evaluated based on hydraulic model output. The model output, including the extent and depth of inundation at the QNFH site at 50% exceedance flow conditions, is shown in Figures 3-1 and 3-2, and summarized numerically in Table 3-1.

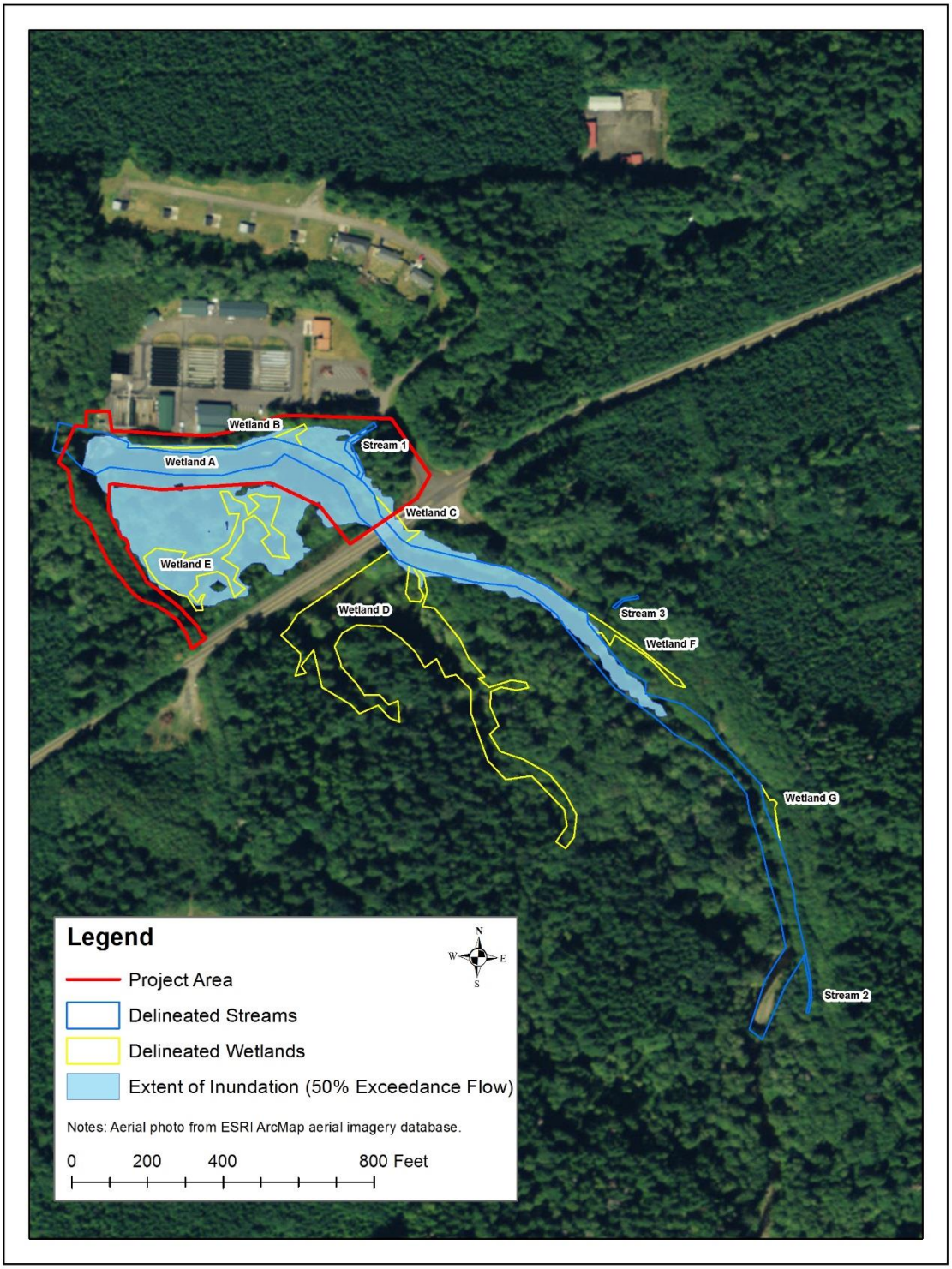

Figure 3-1. Extent of Inundation at 50% Exceedance Flow

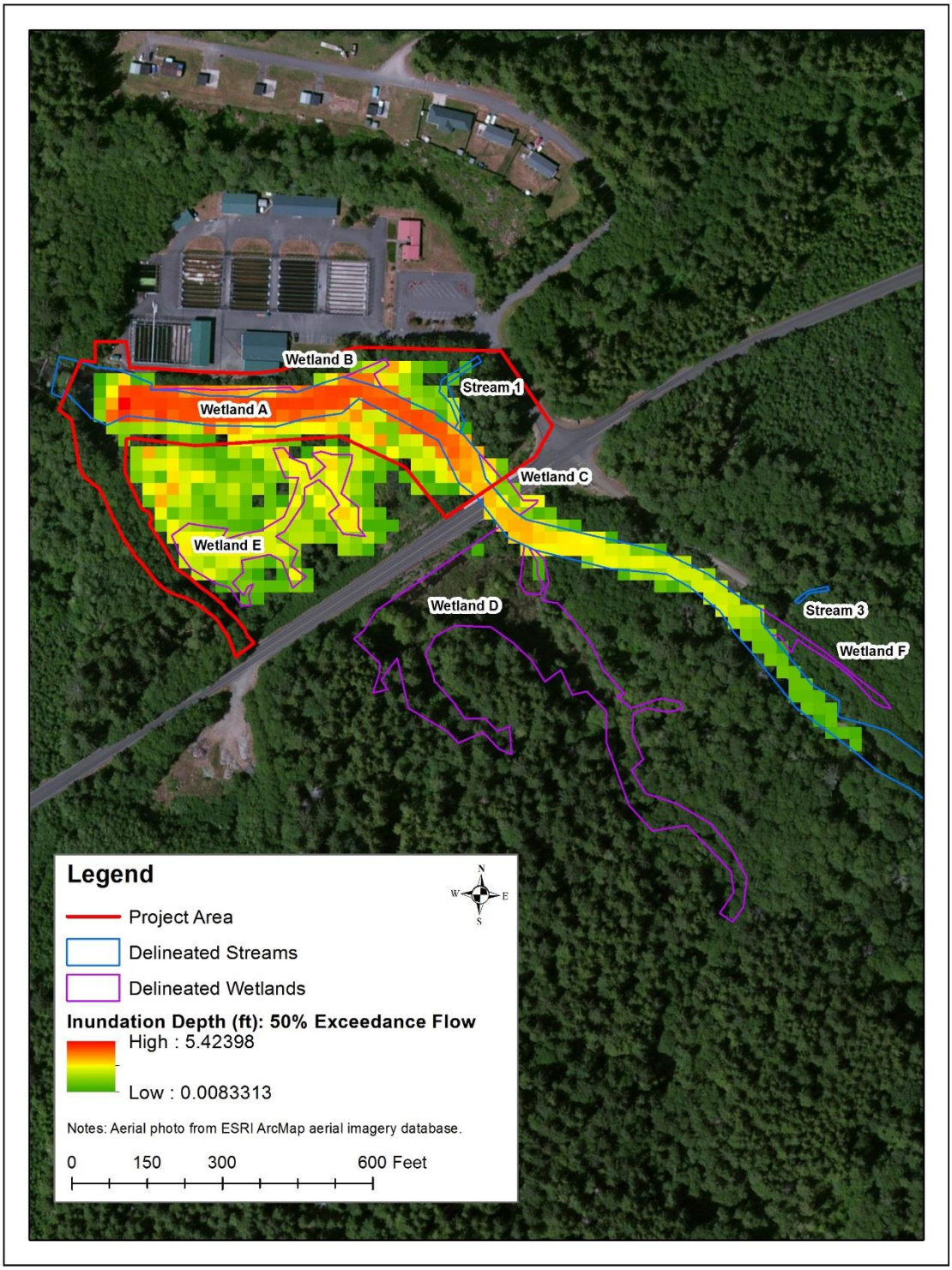

Figure 3-2. Depth of Inundation at 50% Exceedance Flow

Table 3-1. Inundated Areas at 50% Exceedance Flow

Area of Interest	Delineated Area (acres)	Inundated Area (acres)	Percent of Total Area Inundated
Stream 1	0.05	0.04	77%
Stream 2	0.02	0.00	0%
Stream 3	0.01	0.00	0%
Wetland A	0.06	0.06	100%
Wetland B	0.05	0.04	94%
Wetland C	0.08	0.08	95%
Wetland D	2.54	0.03	1%
Wetland E	0.73	0.72	99%
Wetland F	0.11	0.01	9%
Wetland G	0.05	0.00	0%
Upland Area*	n/a	4.23	n/a
Total Stream	0.09	0.04	47%
Total Wetlands	3.61	0.94	26%
Total Uplands*	n/a	4.23	n/a
Grand Total	3.70	5.23	n/a

* Upland areas were not formally delineated, so no percentage of inundation area was calculated.

3.2 Impacts to Uplands, Wetlands, and Waters of the U.S.

3.2.1 Wetland A

The hydraulic model output shows that at 50% exceedance flow, Wetland A will be entirely inundated with a water depth of approximately 3.1–4.6 feet (Table 3-1, Figure 3-2). The inundation area is continuous with the active channel of Cook Creek at 50% exceedance flow; thus, as a result of the project, Wetland A will likely become part of the active channel of Cook Creek (Figure 3-2).Wetland A is a riverine wetland that runs parallel to the north bank of Cook Creek adjacent to the QNFH buildings and ponds (Figure 1-12). This wetland sits on the active floodplain of Cook Creek and contains saturated soils and small pockets of standing water (Appendix A; Figure 3-3). Wetland A is approximately 0.06 acres in size and is classified as a palustrine, emergent, seasonally flooded wetland according to the Cowardin Classification system (Table 1-2).

Figure 3-3. Wetland A at Cook Creek

(View looking upstream toward Moclips Highway.)

3.2.2 Wetland B

The hydraulic model output shows that at 50% exceedance flow, Wetland B will be almost entirely inundated with a water depth of approximately 1.8–4.3 feet (Table 3-1, Figure 3-2). The inundation area is continuous with the active channel of Cook Creek at 50% exceedance flow; thus, as a result of the project, Wetland B will likely become part of the active channel of Cook Creek (Figure 3-2). Wetland B is a riverine wetland located approximately 80–100 feet upstream of Wetland A on the north side of Cook Creek (Figure 1-12, Figure 3-4). The wetland is approximately 0.05 acres in size and sits on the active floodplain of Cook Creek. Wetland B is classified as a palustrine, emergent, seasonally flooded wetland according to the Cowardin Classification system (Table 1-2).

Figure 3-4. Wetland B at Cook Creek

(General view looking from Wetland B toward Cook Creek.)

3.2.3 Wetland C

The hydraulic model output shows that at 50% exceedance flow, Wetland C will be almost entirely inundated with a water depth of approximately 0.8–3.0 feet (Table 3-1, Figure 3-2). The inundation area is continuous with the active channel of Cook Creek at 50% exceedance flow; thus, as a result of the project, Wetland C will likely become part of the active channel of Cook Creek (Figure 3-2). Wetland C is a riverine wetland located on the north side of Cook Creek at the Moclips Highway Bridge Figure 1-12, Figure 3-5). The wetland is approximately 0.08 acres in size and sits on the active floodplain of Cook Creek. It is classified as a palustrine, emergent, seasonally flooded wetland according to the Cowardin Classification system (Table 1-2).

Figure 3-5. Wetland C along Cook Creek

(View looking upstream from the right bank.)

3.2.4 Wetland D

The hydraulic model shows that a very small portion of Wetland D at the connection to Cook Creek (0.03 acres) will experience more inundation than it currently does due to the new hydrologic regime (Table 3-1, Figure 3-2).Wetland D is a 2.53-acre depressional wetland located on the south side of Cook Creek upstream from the Moclips Highway Bridge (Figure 1-12). The wetland is semi-permanently flooded, and maintains a connection to Cook Creek that supplies water to the wetland (Appendix A; Figure 3-6). The higher Cook Creek OHWM as a result of the proposed project will likely increase flow into Wetland D, especially during flood events. The alteration to Wetland D's hydrology may cause scouring of vegetation in the area where the wetland connects to Cook Creek. As a result, impacts to 0.03 acres of Wetland D are accounted for in this mitigation plan (see Section 4).

Figure 3-6. View of Wetland D from the Moclips Highway Bridge (low flow).

3.2.5 Wetland E

The hydraulic model results indicate that raising the OHWM of Cook Creek will result in increased inundation of Wetland E. The depth of water is expected to alter the wetland hydrology, soils, and vegetation, but the entire extent of Wetland E is expected to remain a wetland (Table 3-1, Figure 3-2).

Wetland E is a 0.73-acre depressional wetland located on the south side of Cook Creek opposite the hatchery buildings and ponds (Figure 1-12). The wetland contains standing water, saturated soils, and scrub-shrub vegetation (Figure 3-7). Based on the formal wetland delineation at the site, Wetland E is classified as a palustrine, emergent, semi-permanently flooded wetland, according to the Cowardin Classification system (Table 1-2). High groundwater from Cook Creek supports this wetland area.

Figure 3-7. Wetland E

(General view of the interior of Wetland E, looking toward Cook Creek.)

The hydraulic model output shows that at 50% exceedance flow, the majority of the wetland area (99%) will be semi-permanently inundated with a water depth ranging from approximately 0–3.2 feet (Table 3-1, Figure 3-2). The wetland will most likely maintain connectivity with Cook Creek in two general areas on the north side of the wetland (Table 3-1, Figure 3-2). The ground surface within Wetland E is very uneven and water is expected to form a combination of open water areas and emergent wetland areas. Most likely, areas that are inundated with greater than approximately 1 foot of water during 50% exceedance flow conditions will convert to open water wetland areas. Areas within Wetland E that contain less than about 1 foot of water the majority of the time will most likely support emergent vegetation, such as slough sedge. The hydraulic model indicates that approximately 8% (0.06 acres) of Wetland E will be inundated to a depth of less than 1 foot at 50% exceedance flow, while 92% (0.67 acres) of Wetland E will be inundated to a depth of greater than 1 foot (Figure 3-2). The additional flow of water into Wetland E as a result of the project will most likely cause Wetland E to resemble Wetland D over time. Wetland D contains a mixture of open water wetland habitat and emergent habitat, and is permanently flooded, due to a connection to Cook Creek. Slough sedge is prevalent in Wetland D, thus providing a seed bank for Wetland E as wetland hydrology transitions to an open water, permanently flooded condition over time.

A less detailed analysis was conducted using the hydraulic model with 95% exceedance flow, in order to predict wetland hydrology and the extent of open water habitat in Wetland E during low flow periods. Low flow is most likely to occur in mid- to late summer, which coincides with the middle of the wetland vegetation growing period (McMillen LLC 2015). The model output shows that some areas within Wetland E may contain 1–2 feet of water during low flow periods, suggesting that open water habitat may be present in Wetland E year-round (Figure 3-8). Since standard project operation protocol is to lower the

weir as flow decreases to maintain approximately the same flow over the weir, inundation is expected to be relatively consistent year-round.

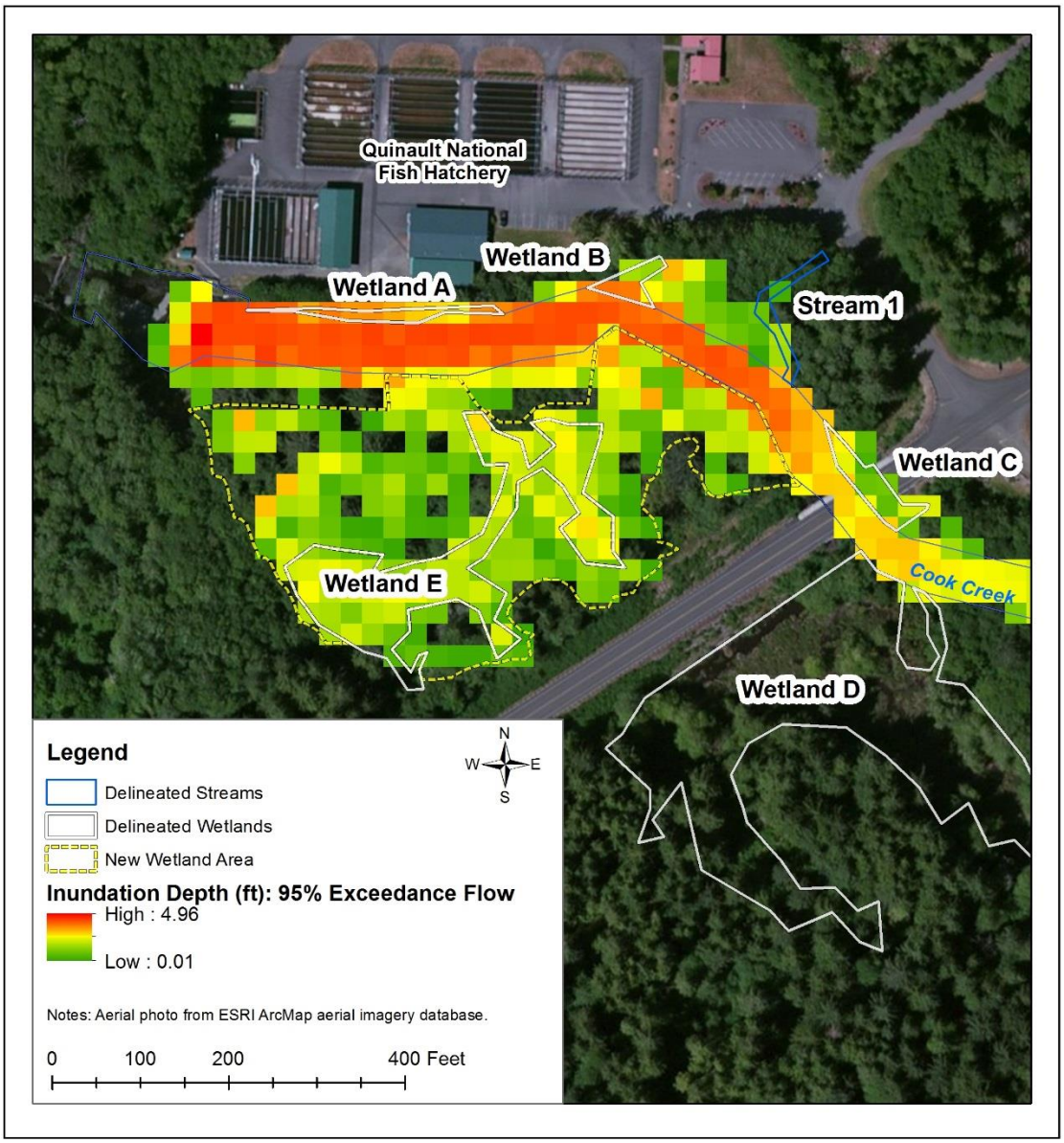

Figure 3-8. Depth of Inundation at 95% Exceedance Flow

3.2.6 Wetland F

According to the model, a small portion (0.01 acres; 9%) of Wetland F along the edge of Cook Creek may be slightly more inundated (Figure 3-2, Table 3-1). The additional inundation at 50% exceedance flow may result in scouring of the vegetation along the edge of Wetland F. These impacts are accounted for in Section 4 of this document. The remainder of Wetland F is outside the area of inundation predicted at

50% exceedance flow (Figure 3-2, Table 3-1)... Wetland F is a 0.11-acre slope wetland situated on the north side of Cook Creek, upstream of the Moclips Highway Bridge (Figure 1-12, Figure 3-9, and Table 1-2).

Figure 3-9. View of Wetland F looking downstream along Cook Creek (high flow).

3.2.7 Wetland G

Wetland G is a 0.05-acre slope wetland located farthest upstream of any wetlands at the QNFH (Figure 1-2). According to the hydraulic model, Wetland G is above the upstream extent of increased inundation (Table 3-1). Therefore, there are no impacts to Wetland G anticipated and there is no mitigation required.

3.2.8 Stream 1

The hydraulic model shows that approximately 170 feet of Stream 1 (Hatchery Creek) will be inundated to a greater extent as a result of replacing the existing electric fish barrier with a weir (Figure 3-2, Figure 3-10, and Table 3-1). According to the model results, Stream 1 will be approximately 3.5 feet deeper at its confluence with Cook Creek. The amount of additional inundation decreases moving upstream on Stream 1 and no additional inundation is expected at the upper end of the delineated length of Stream 1.

Figure 3-10. View of Stream 1, looking downstream toward Cook Creek (low flow).

3.2.9 Stream 2

According to the hydraulic model, Stream 2 is outside the area of increased inundation and will not be impacted by the proposed project. No additional inundation will occur in Stream 2 as a result of the project at 50% exceedance flow (Figure 3-2, Table 3-1).

3.2.10 Stream 3

According to the hydraulic model, Stream 3 is outside the area of increased inundation and will not be impacted by the proposed project. No additional inundation will occur in Stream 3 as a result of the project at 50% exceedance flow (Figure 3-2, Table 3-1).

3.2.11 Uplands

The majority of the upland inundation (3.53 acres) at 50% exceedance flow occurs in the upland areas on the left bank of Cook Creek, downstream from the Moclips Highway Bridge (Figure 3-2, Table 3-1). This area does not include the area occupied by Wetland E. Of the 3.53 acres, 2.15 acres are expected to transition to wetland habitat, and will likely develop wetland characteristics including vegetation, soils, and hydrology similar to those of Wetlands D and E over time. The remaining 1.38 acres of inundation in this area exists along the edge of Cook Creek and is separated from Wetland E by a topographic break (Figure 3-11). The hydraulic model results show that this area will be part of the active channel after weir installation (Figures 3-1 and 3-2). Similar to the structure of Wetland E discussed above, it is expected that areas within the new wetland that are inundated to a depth of greater than 1 foot will become open water habitat, while wetland areas inundated with less than 1 foot of water under typical flow conditions will transition to primarily emergent wetland vegetation (Figure 3-12). Figure 3-13 shows the

approximate location of open water and emergent wetland habitat on the left bank of Cook Creek based on inundation depth provided by the hydraulic model results. According to the hydraulic model, approximately 1.5 acres of the inundated area will be primarily open water habitat, while 1.75 acres will be mainly emergent habitat.

Low flow (95% exceedance flow) conditions were also evaluated for the upland areas, in order to predict whether open water conditions would persist when flows diminished. The hydraulic model shows that most of the new wetland area will be inundated with less than 1 foot of water during low flow conditions (Figure 3-8). The model results suggest that emergent wetland vegetation will be supported by the new hydrologic regime, and will likely be more prevalent than open water habitat during low flow conditions.

Figure 3-11. Left Bank of Cook Creek Downstream of Moclips Highway Bridge (High Flow)

(View looking upstream toward the bridge.)

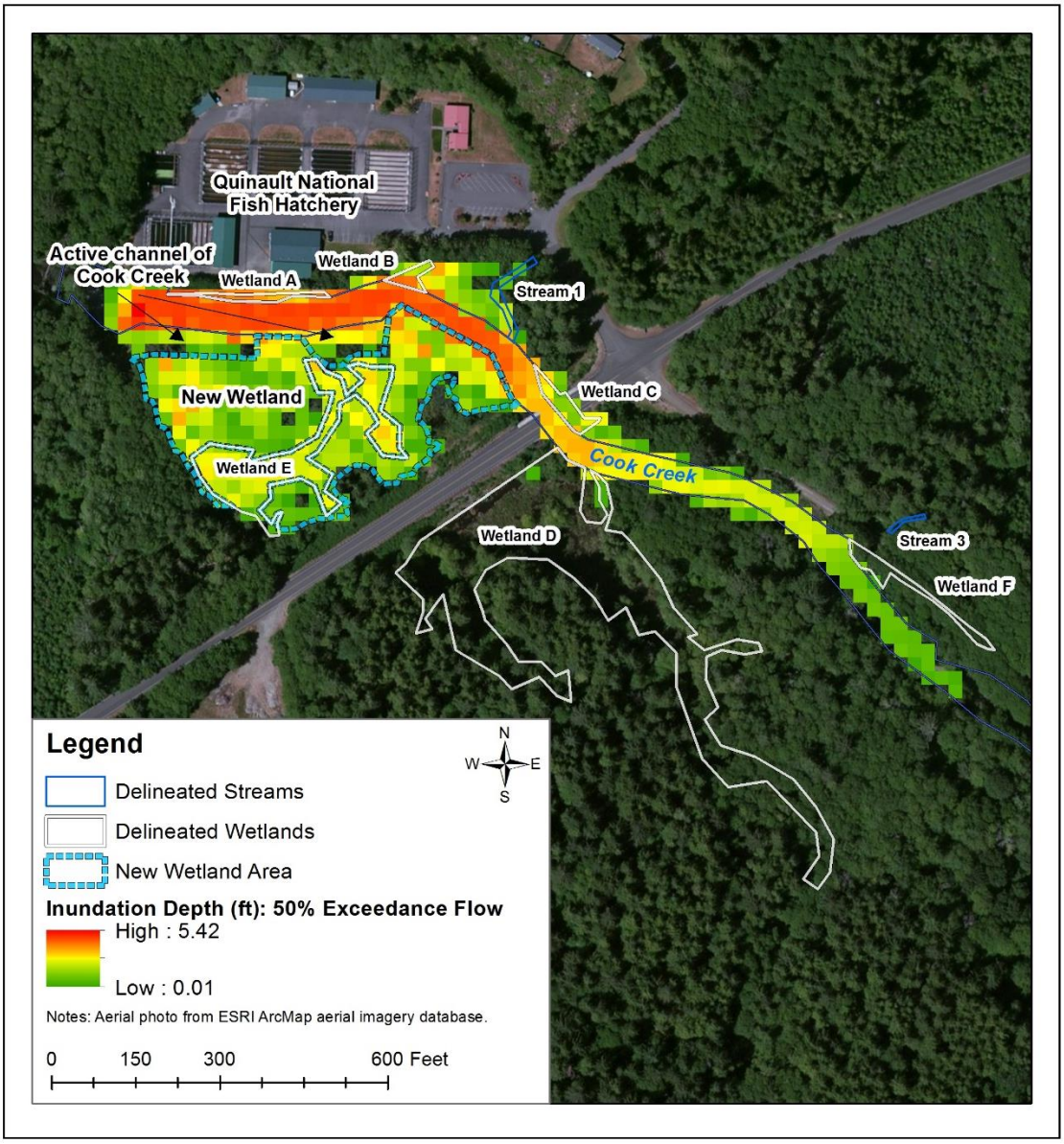

Figure 3-12. New Wetland Area

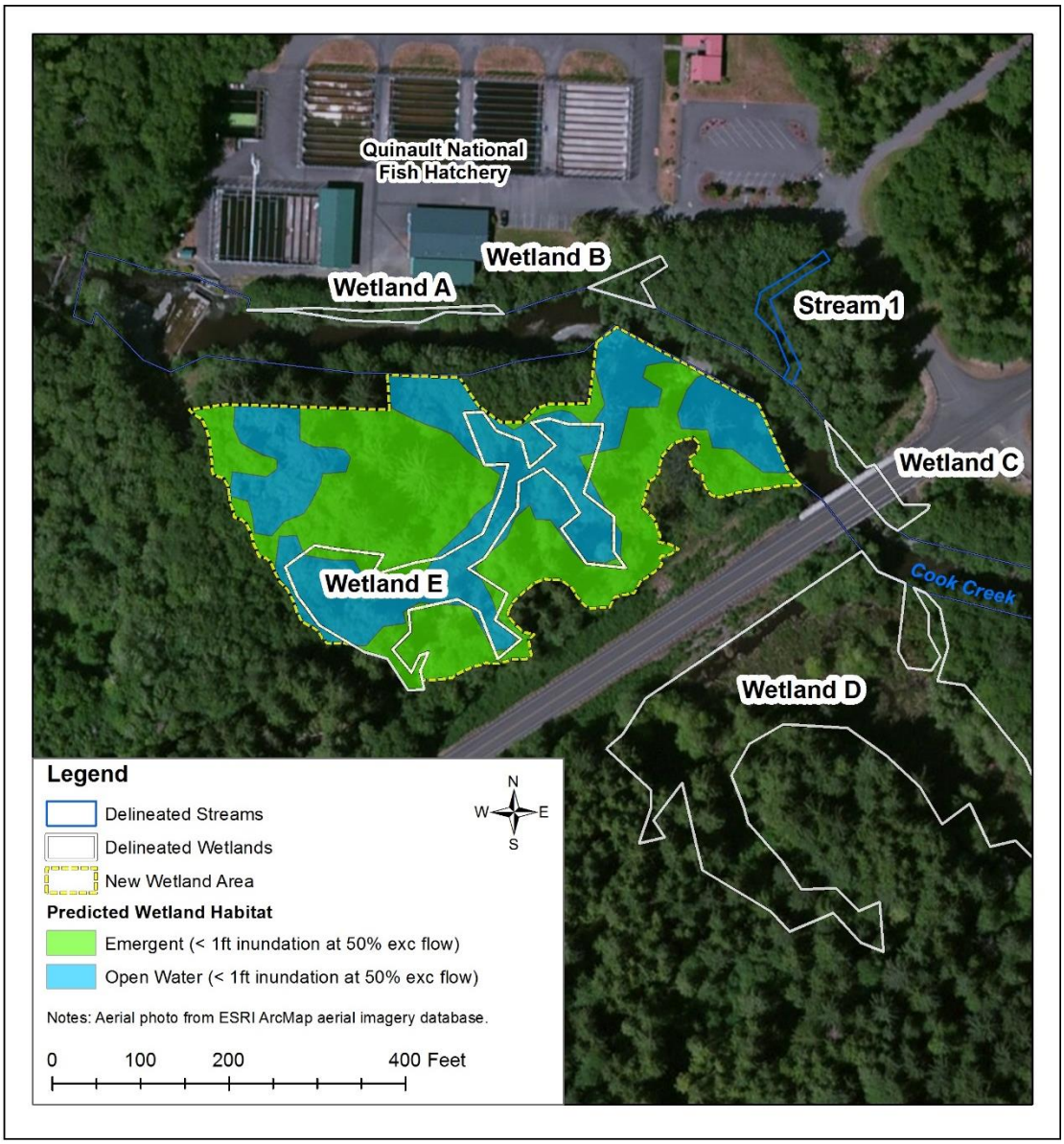

Figure 3-13. Predicted Wetland Habitat in Wetland E and New Wetland Area

Slough sedge is expected to be a predominant species in the emergent wetland areas, similar to the characteristics of Wetland D under current conditions. The topography is uneven and hummocky in this area, and higher elevation areas at the edge of inundation may support scrub-shrub vegetation such as hardhack, Schouler's willow, and salmonberry (all species that are present in Wetlands D or E). Thirty-one large conifer trees (> 24 inches diameter at breast height) exist in the uplands on the left bank of Cook Creek downstream of the Moclips Highway Bridge (Figure 3-14); portions of these uplands will be inundated as a result of the new hydrologic regime (Figure 3-2). Many of the trees are located near the periphery of the area expected to be inundated as a result of the proposed project (Figure 3-14). Neither the hydraulic model nor the existing topographic data for the site are high resolution enough to predict whether individual trees will experience inundation to the extent that they will perish. Individual trees in the interior of the new wetland area may persist on higher elevations within the uneven, hummocky

topography. Several Sitka spruce trees are present within Wetland E, and individuals that are located at a high enough elevation may survive because Sitka spruce is capable of tolerating intermittent inundation, particularly in the winter (Minore 1968). Lower-elevation Sitka spruce trees experiencing constant inundation will likely perish due to greater inundation than the species generally tolerates. Western hemlock is less flood tolerant than Sitka spruce, and will likely not survive the increased inundation that will occur in this area (Minore 1968). Trees that perish as a result of inundation may stand as snags, or fall and provide higher-elevation habitat as nurse trees or large woody debris within the wetland. Upland small trees, scrub-shrub, and understory species that currently inhabit the upland areas (pineland sword fern, red elderberry, Rocky Mountain maple, and red alder) will also likely perish as inundation in this area increases. Figure 3-15 shows typical vegetation in the upland areas on the left bank of Cook Creek downstream of the Moclips Highway Bridge.

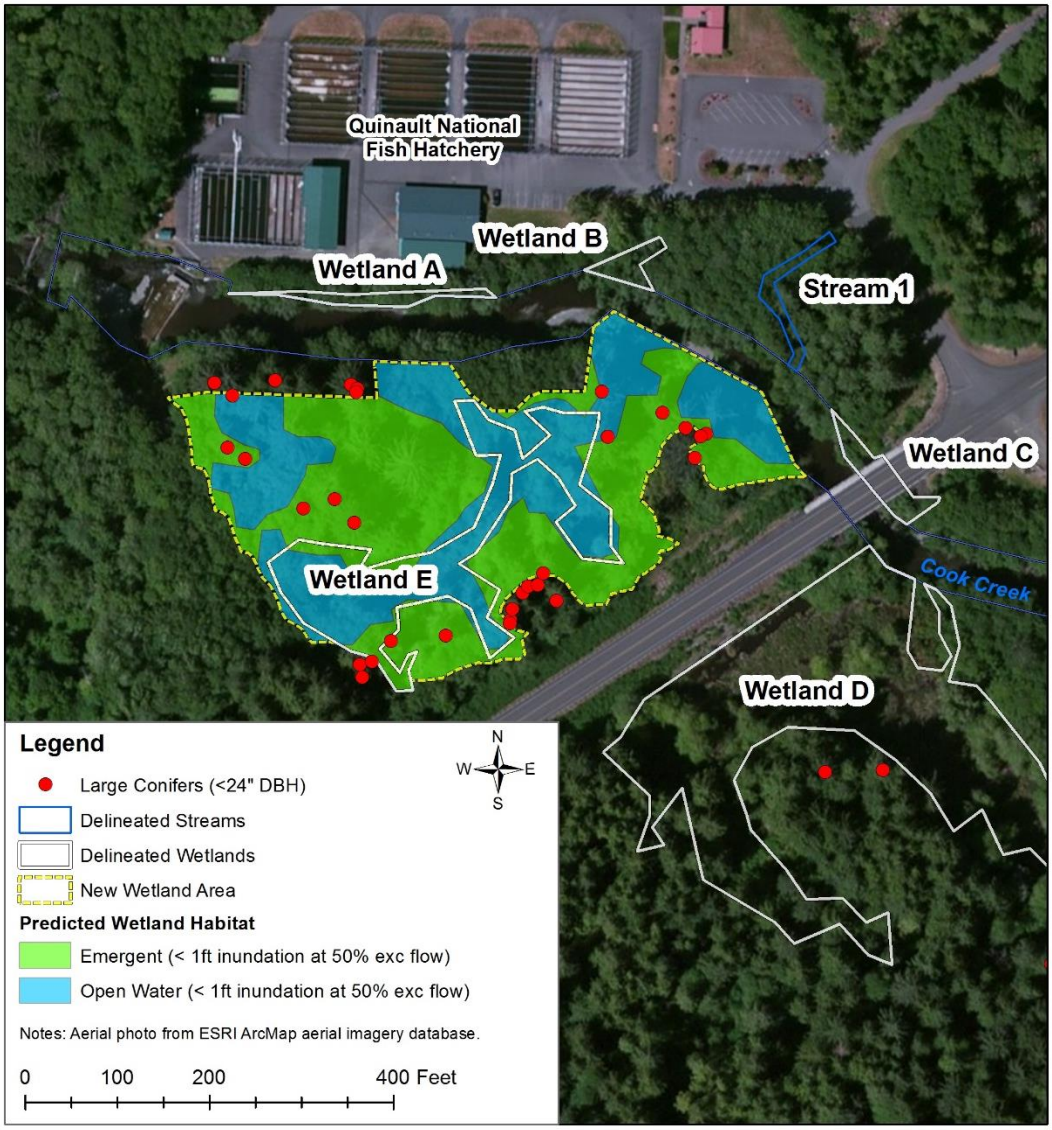

Figure 3-14. Location of Large Conifers

Figure 3-15. Uplands Adjacent to Wetland E

(General view looking south at uplands.)

4.0 Wetland Mitigation

4.1 Compensatory Mitigation

The compensatory mitigation discussed in this plan is intended to account for the increase in natural inundation that will occur as a result of the proposed project. It does not include the establishment or enhancement of wetland areas from construction activities that disturb the ground. The wetland mitigation described in this plan is on-site and in-kind for wetland impacts. The use of natural inundation to establish the new wetland area results in a relatively low risk of wetland failure and colonization by non-native species compared to other methods such as excavation and planting (Hruby 2012).

Ecology has recently published a new method for calculating the amount of compensatory mitigation required as a result of wetland impacts (Hruby 2012). This method, known as the Credit-Debit Method, estimates whether a compensatory mitigation project will adequately replace lost wetland functions and values. Using this method, losses in functions and values at an impact site are transformed into acre-points, called “debits”. Gains in functions at a proposed mitigation site are also calculated in acre-points and termed “credits”. The factors involved in the calculations using this method incorporate the latest scientific knowledge about wetland functions and values (Hruby 2012).

The Credit-Debit Method was selected for quantifying the total loss (debits) of Wetlands A, B, and C, the partial loss (debits) of Wetlands D and F, and the gain in wetland functions and values (credits) generated by inundating the uplands and creating a new wetland adjacent to Wetland E (Figure 4-1). Wetland E, which will experience greater inundation under the new hydrologic regime was not evaluated as either a credit or debit wetland.

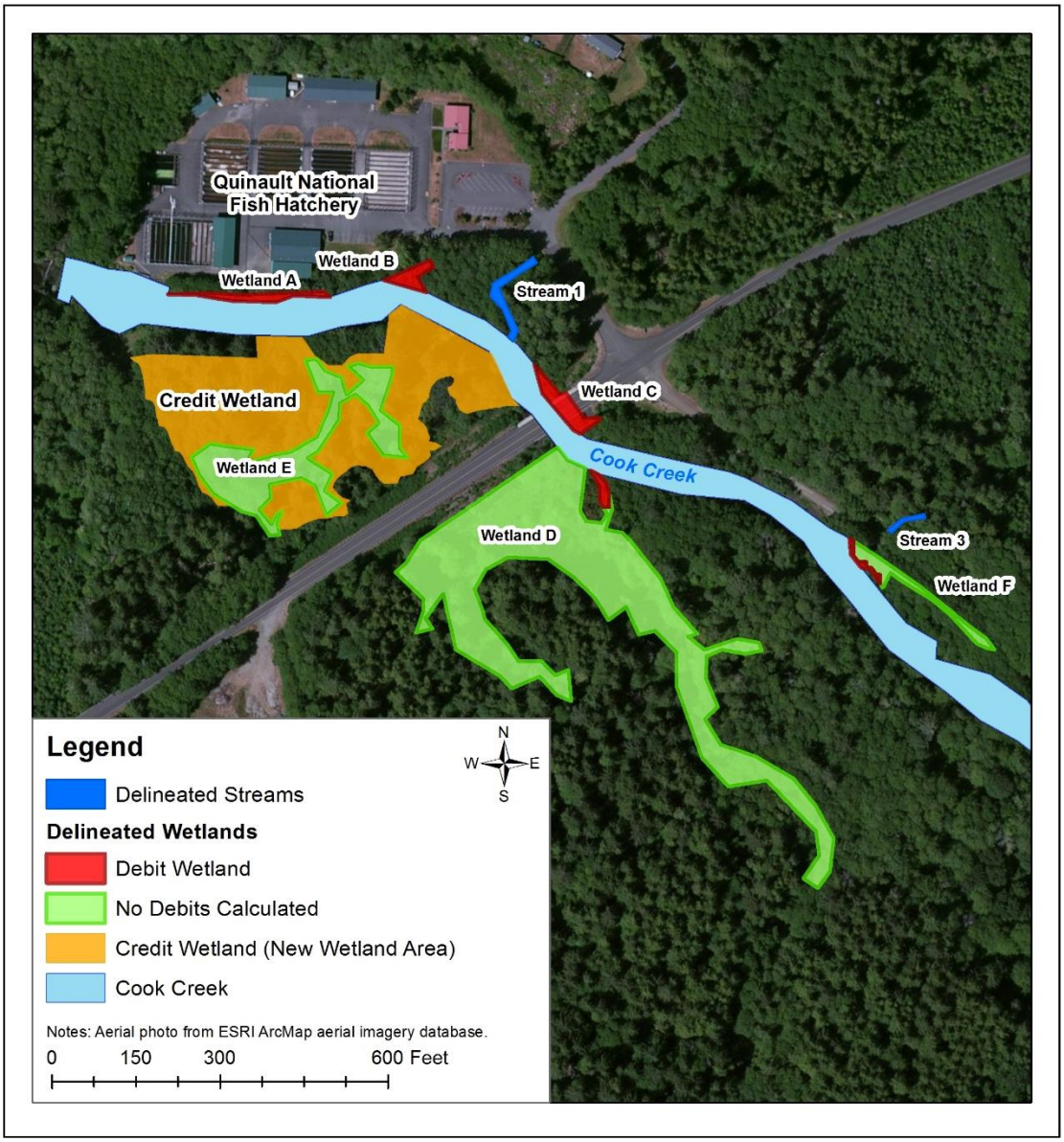

Figure 4-1. Credit and Debit Wetlands

4.2 Debit Calculations

Debit calculations begin with multiplying the area of impact by the wetland function scores (improving water quality, hydrologic, and habitat) to determine the basic mitigation requirement (BMR). The function scores from the wetland delineation performed at the site (McMillen, LLC 2015) were used in the debit calculations for all five wetlands (A, B, C, D, and F). A Temporal Loss Factor (TLF) is then applied to the BMR in order to account for the time that particular types of wetlands require to mature. A value of 1.5 was used as the TLF because the timing of mitigation is concurrent with impacts at the site, and impacts will occur at an emergent or shrub community for all three wetlands. The total mitigation required in acre-points is calculated by multiplying the BMR by the TLF (Hruby 2012). Debit

calculations are presented in Tables 4-1 through 4-5 below. Total debits for Wetlands A, B, C, D, and F are presented in Table 4-6 below.

Table 4-1. Wetland A Debit Calculations

Calculations	Improving Water Quality	Hydrologic	Habitat
Score for Wetland Unit (McMillen, LLC 2015)	5	4	6
Impact: acres of non-forested areas *(same for all functions)*	0.06		
Basic mitigation requirement (BMR) = *Score for function x acres impacted*	0.3	0.24	0.36
Temporal loss factor (TMF)	1.5	1.5	1.5
Mitigation Required (Acre-points) DEBITS = BMR x TLF	0.45	0.36	0.54

Table 4-2. Wetland B Debit Calculations

Calculations	Improving Water Quality	Hydrologic	Habitat
Score for Wetland Unit (McMillen, LLC 2015)	4	4	6
Impact: acres of non-forested areas *(same for all functions)*	0.05		
Basic mitigation requirement (BMR) = *Score for function x acres impacted*	0.2	0.2	0.3
Temporal loss factor (TMF)	1.5	1.5	1.5
Mitigation Required (Acre-points) DEBITS = BMF x TLF	0.3	0.3	0.45

Table 4-3. Wetland C Debit Calculations

Calculations	Improving Water Quality	Hydrologic	Habitat
Score for Wetland Unit (McMillen LLC 2015)	4	4	6
Impact: acres of non-forested areas *(same for all functions)*	0.08		
Basic mitigation requirement (BMR) = *Score for function x acres impacted*	0.32	0.32	0.48

Calculations	Improving Water Quality	Hydrologic	Habitat
Temporal loss factor (TMF)	1.5	1.5	1.5
Mitigation Required (Acre-points) DEBITS = BMF x TLF	0.48	0.48	0.72

Table 4-4. Wetland D Debit Calculations

Calculations	Improving Water Quality	Hydrologic	Habitat
Score for Wetland Unit (McMillen, LLC 2015)	5	5	7
Impact: acres of non-forested areas *(same for all functions)*	0.03		
Basic mitigation requirement (BMR) = *Score for function x acres impacted*	0.15	0.15	0.21
Temporal loss factor (TMF)	1.5	1.5	1.5
Mitigation Required (Acre-points) DEBITS = BMR x TLF	0.23	0.23	0.32

Table 4-5. Wetland F Debit Calculations

Calculations	Improving Water Quality	Hydrologic	Habitat
Score for Wetland Unit (McMillen, LLC 2015)	3	3	6
Impact: acres of non-forested areas *(same for all functions)*	0.01		
Basic mitigation requirement (BMR) = *Score for function x acres impacted*	0.03	0.03	0.06
Temporal loss factor (TMF)	1.5	1.5	1.5
Mitigation Required (Acre-points) DEBITS = BMR x TLF	0.05	0.05	0.09

Table 4-6. Total Debit Calculations

Calculations	Improving Water Quality	Hydrologic	Habitat
Total Mitigation Required Sum of Wetland A, B, and C Debits (Acre-points)	1.51	1.42	2.12

4.3 Credit Calculations

On-site wetland establishment in the upland areas surrounding Wetland E presents an opportunity to mitigate for the loss of wetland functions and values due to the inundation of Wetlands A, B, C, D (partial), and F (partial) (Figures 3-13 and 4-1). The new wetland, located in the uplands along the left bank of Cook Creek downstream from the Moclips Highway Bridge, is predicted to have the same wetland functions and values as Wetland E had at the time of the formal wetland delineation in 2012 (McMillen, LLC 2015) (Appendix A). Wetland E is immediately adjacent to the new wetland and these two areas are expected to form one contiguous wetland unit as a result of the mitigation (Figure 3-13).

Credit calculations for a site with no wetland functions prior to mitigation (such as upland areas) are assigned a wetland function score of zero before mitigation (Hruby 2012). The new wetland area is 2.15 acres in size. The Basic Mitigation Credit (BMC) is calculated by multiplying the acres of mitigation area by the increase in wetland function score. A risk factor that accounts for the possibility of failure of the wetland mitigation project is then applied to the BMC to determine the overall credits for the project. A Risk Factor (RF) of 0.5 was used for wetland credit calculations. This value was selected because Ecology's site selection guide was not used, since mitigation is to be performed on-site. Also, the 0.5 RF is the appropriate value when mitigation involves establishment of an emergent community with data showing there is adequate water to maintain wetland conditions 5 years out of every 10, meaning that the site is expected to mature relatively quickly compared to other types of wetland vegetation and hydrology (Hruby 2012, Hruby et al. 2009). Wetland mitigation credit calculations for the new wetland area are presented in Table 4-7. The results of the calculations show that wetland mitigation credits generated by creating a new on-site wetland exceed debits generated by the loss of Wetlands A, B, C, D (partial), and F (partial) by a ratio of more than 3:1 for all wetland function and value categories.

Table 4-7. Wetland Establishment Credit Calculations

Calculations	Improving Water Quality	Hydrologic	Habitat
Score for Wetland Unit before mitigation (*B*)	0	0	0
Score for Wetland Unit after mitigation (*A*) (McMillen, LLC 2015)	5	5	7
Increase in Score at mitigation Site (*A*-*B*)	5	5	7
Impact: acres of non-forested areas *(same for all functions)*	2.15		
Basic mitigation credit (BMC) = *Increase in Score for function x acres impacted*	10.75	10.75	15.05
Risk factor (RF)	0.5	0.5	0.5
Mitigation Credits Available (Acre-points) CREDITS = BMC x RF	5.38	5.38	7.53

4.4 Wetland Mitigation Goals and Objectives

4.4.1 Mitigation Goals

The proposed on-site wetland mitigation is expected to establish approximately 2.15 acres of wetland habitat through establishment of a species-rich and structurally diverse native plant community. These features will provide wildlife habitat and wetland buffer functions, and expand the complex of wetland units already present at the QNFH site.

4.4.2 Mitigation Objectives

Mitigation objectives are specific actions that are necessary to achieve the overall mitigation goal as stated above. The mitigation objectives for the new wetland area are as follows:

Objective 1: Allow native wetland vegetation to establish naturally under the new hydrologic regime, relying on the seed bank present at the site.

Objective 2: Increase structural complexity of the wetland habitat by leaving trees that perish on-site as a result of inundation in the wetland either as standing snags or nurse trees, unless the trees pose a threat to human safety or QNFH operations.

Objective 3: Promote native vegetation cover by controlling invasive species if the overall percent cover of invasive species exceeds 20% cover in any monitoring period.

Objective 4: Retain species richness of at least 5–19 species that cover at least 10 square feet within the mitigation area, as Wetland E did at the time of formal wetland delineation (Appendix A).

5.0 Monitoring Plan

5.1 Overview

A monitoring effort will be initiated at the site following completion of construction activities. The purposes of the monitoring effort are to ensure that the mitigation wetland meets previously described objectives, to identify problems, and to prescribe remedial actions.

5.2 Monitoring Schedule

The mitigation site will be monitored for 5 years after completion of construction activities at the site. Year 1 of the mitigation monitoring will commence 1 year from project completion during the spring and fall. Additional monitoring will occur during the spring and fall in years 1, 2, 3, and 5. A monitoring report will be prepared after each monitoring event, and will be submitted to USFWS, USACE, and Ecology no later than June 30th (spring) and December 31st (fall) of the monitoring year.

5.3 Monitoring Methods

Monitoring methods designed to evaluate the success of mitigation methods will be employed during each monitoring event. Specific monitoring methods are as follows:

- **Objective 1:** Allow native wetland vegetation to establish naturally under the new hydrologic regime, relying on the seed bank present at the site. No filling, excavation, or additional planting is proposed.

  Method: At least three photography stations will be established within the mitigation area during the first monitoring event and used thereafter to document wetland conditions over time. Pictures will be taken in each cardinal direction at each station. The radius of each station will be 11.8 feet, to provide coverage of 0.01 acres per station.

- **Objective 2:** Increase structural complexity of the wetland habitat by leaving trees that perish on-site as a result of inundation in the wetland either as standing snags or nurse trees, unless the trees pose a threat to human safety or QNFH operations.

  Method: The presence of large woody debris, including standing snags and nurse trees, will be documented via field notes and photographs during monitoring visits. The presence of plant and wildlife habitat, including nests and live vegetation on large woody debris, will also be documented.

- **Objective 3:** Promote native vegetation cover by controlling invasive species if the overall percent cover of invasive species exceeds 20% cover in any monitoring period.

  Method: Percent cover of invasive species will be estimated to ensure that total invasive species do not cover more than 20% of the mitigation area. If more than 20% cover of invasive species is documented during any monitoring visit, potential remedial actions will be proposed. Manual removal of invasive species, potentially combined with planting native species, will be the preferred method for addressing any issues with invasive species cover. Chemical treatments such as herbicide are not preferred for this site due to the proximity to Cook Creek and the QNFH.

- **Objective 4:** Retain species richness of at least 5–19 species that cover at least 10 square feet within the mitigation area, as Wetland E did at the time of formal wetland delineation (Appendix A).

  Method: Species richness documentation will be collected over the entirety of the mitigation area to ensure that the site retains a species richness of at least 5–19 species that cover at least 10 square feet each.

5.4 Contingency Plan

Information from monitoring efforts will be used to identify the need for corrective action at the site. If monitoring visits reveal that there is a significant problem with meeting any of the performance standards, issues will be documented in monitoring reports and specific corrective actions will be recommended at that time. Adaptive management techniques will be the preferred approach for solving problems and ensuring that performance standards are achieved at the mitigation site. If adaptive management actions are required, they will most likely include manual methods such as planting native species, hand removal of invasive species, or placing additional large woody debris.

6.0 References

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Appendix A

Quinault National Fish Hatchery Fish Exclusion Barrier Wetland and Waters of the U.S. Report