# DRAFT
# SUPPLEMENTAL
# ENVIRONMENTAL ASSESSMENT

for the

Ni-les'tun Unit
of the
Bandon Marsh National Wildlife Refuge
Restoration Project

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# Executive Summary

In accordance with the National Environmental Policy Act (NEPA), this Supplemental Environmental Assessment (SEA) discloses the effects of alternatives for tidal wetland restoration in the Ni-les'tun Unit of the Bandon Marsh National Wildlife Refuge (NWR or Refuge). The Refuge is located along the Coquille River within and north of the city of Bandon in Coos County, Oregon.

This document adopts in part and supplements the Environmental Assessment (EA) for the Ni-les'tun Unit of the Bandon Marsh National Wildlife Refuge Restoration and North Bank Lane Improvement Project finalized by the U.S. Fish and Wildlife Service (USFWS or Service) and the Federal Highway Administration (FHWA) on June 10, 2009 (USFWS and FHWA 2009, USFWS 2009). The 2009 EA disclosed the potential environmental impacts associated with the following activities: (1) the restoration of more than 400 acres of tidal wetlands on the Ni-les'tun Unit, and (2) the improvement of North Bank Lane from its intersection with U.S. Highway 101 to Randolph Road. These activities were completed in 2011. The tidal wetland restoration component involved, in part, the obliteration of 15 miles of agricultural drainage ditches by discing and filling along with the construction of 5 miles of sinuous tidal channels. Seven thousand feet of the artificial dike adjacent to the Coquille River were lowered, and three water control structures were removed to allow full tidal flow across the historic and newly restored tidal marsh.

The purpose and scope of this SEA are limited to an assessment of the environmental impacts associated with additional activities related to the tidal wetland restoration portion of the project [item (1) above]. The proposal to improve tidal wetland function at the Ni-les'tun Unit has been modified in the following way since the completion of the 2009 EA: depressions that impound tidal waters where ditches were not adequately filled or where fill material settled, in the tracks of haul roads used by heavy equipment on the site, or on un-even terrain, would be drained via the excavation of approximately 40,000 linear feet of first- and second-order tidal channels, resulting in an expansion of the tidal channel network and increased tidal prism and water exchange.

The Preferred Alternative under this EA would have beneficial impacts to most resources (soil, air, water quality, vegetation, and wetlands). The Preferred Alternative would be expected to have less-than-significant adverse impacts to cultural resources and threatened and endangered species. Any impacts would be short-term, would occur during construction, and would be minimized through the implementation of project design criteria to protect aquatic species and their habitats. This project would be implemented in coordination with partners including Ducks Unlimited, Coos County, and others.

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# Chapter 1. Introduction

## 1.1 Background

Bandon Marsh National Wildlife Refuge (NWR or Refuge) is managed by the U.S. Fish and Wildlife Service (USFWS or Service) as part of the National Wildlife Refuge System (Refuge System). The 582-acre Ni-les'tun Unit is located on the east side of U.S. Highway 101 on the north bank of the Coquille River. This unit was established in 2000 to protect and restore intertidal marsh, freshwater marsh, and riparian areas; to provide a diversity of habitats for migratory birds including waterfowl, shorebirds, wading birds, and songbirds; and to restore intertidal marsh habitat for anadromous fish such as Chinook (*Oncorhynchus tshawytscha*) and chum salmon (*Oncorhynchus keta*), steelhead (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki clarki*), and the threatened Oregon Coast coho salmon (*Oncorhynchus kisutch*) (USFWS 2013a).

## 1.2 Need and Purpose for Action

The need for this project is generated from the overall USFWS mission and Refuge-specific goals and objectives. The USFWS is the primary federal agency responsible for migratory birds, endangered plants and animals, and certain marine mammals. National Marine Fisheries Service (NMFS) has jurisdiction over anadromous fish, which are present in the project area. The mission of the Refuge System is to administer a network of lands and waters for the conservation and management of fish, wildlife, and plant resources of the United States for the benefit of present and future generations. Refuge-specific goals include, but are not limited to, the following:

- Restore, protect, and maintain estuarine habitats characteristic of the North Pacific Coastal Ecosystem; and
- Enhance, protect, and maintain instream aquatic habitat for all dependent species including anadromous fish (USFWS 2013a).

In Oregon, the Coquille River estuary has suffered the largest percentage loss of tidal wetlands with a reduction of 94% of the historical total acreage (Good 2000). The loss of tidal wetlands, through agricultural dike construction and subsequent draining, has been identified as a major factor contributing to the decline of fishery resources and overall estuarine productivity throughout coastal Oregon. The completion of a restoration project at the Ni-les'tun Unit in summer 2011 resulted in a 400-acre net increase in tidal marsh habitat in the lower Coquille River estuary and an additional 4.3 percent within the state.

Prior to restoration, the Ni-les'tun Unit was primarily comprised of degraded, leveed pastureland that functioned as a seasonal freshwater wetland and supported a mixture of native and nonnative plants (Brophy 2005). Restoration activities included:

- lowering nearly 7,000 feet of artificial levees;
- disrupting by discing 11.2 miles of shallow, small internal channels and ditches;
- removing 3.8 miles of larger drainage channels by filling;
- removing 3 tide gates;
- constructing 5 miles of sinuous tidal channels;
- relocating electrical transmission lines;
- reconstructing and raising North Bank Lane including replacing existing under-sized culverts with fish-friendly oversized culverts;

- installing in-channel large wood;
- planting native vegetation and removing invasive, nonnative plants; and
- re-establishing tidal connectivity of small coastal streams (USFWS and FHWA 2009).

Post-restoration effectiveness monitoring indicates a shift in plant species communities towards more native-dominated tidal marsh communities, an increase in use by native fish and aquatic invertebrates, increase in use by migratory shorebirds and waterfowl, and changes in tidal hydrology and channel morphology (Brophy and van de Wetering 2012, Brophy and van de Wetering 2013, Silver et al. 2012, USFWS unpublished data). These monitoring results show that indicators of tidal marsh function at the restoration site are approaching or are already within the natural range of variation exhibited at reference sites.

During construction, depressions that impound tidal waters were inadvertently created where ditches were not adequately filled or where fill material settled, and in the tracks of haul roads used by heavy equipment on the site. These depressions, as well as additional depressions caused by un-even terrain not affected by the restoration actions, continue to strand shallow water as higher monthly tides recede, providing breeding sites for mosquitoes (Figure 1-1, primary mosquito source pools).

During summer 2013, the USFWS and Oregon State University, in coordination with the Multnomah and Benton County Public Health/Vector Control programs, conducted monitoring of mosquito larvae and adult abundance. Although initial sampling found five species of mosquitoes present, about 90% of the mosquitoes sampled on the Refuge were identified as the salt marsh mosquito (*Aedes dorsalis*). Shallow impounded pools or depressions of water, which developed within the marsh after the highest tides of each month, were found to be providing breeding habitat for salt marsh mosquitoes at extremely high levels. Late July mosquito sampling following the recent monthly high tide series found larvae in great abundance (over 20 larvae per dip sample on average) in nearly every impounded water body on the Ni-les'tun Unit south of North Bank Lane (USFWS 2013b). In addition, adult trapping data collected within the Ni-les'tun Unit indicated that large numbers of adult females were using the restored tidal marsh as a breeding site and dispersing to adjacent habitats on the Refuge and nearby private lands. This level of mosquito production far exceeded that of the natural tidal marsh of the Bandon Marsh Unit of the Refuge and other marshes of the region, and is clearly the result of site characteristics not normally present in tidal marshes. This infestation resulted in a Health Advisory issued by Coos County Public Health Department, and a subsequent Emergency Declaration by the Oregon Coast National Wildlife Refuge Complex Project Leader, which permitted an emergency application of mosquito larvicide to portions of the Ni-les'tun Unit in September 2013 (USFWS 2013b).

The purposes for the proposed project are to continue to increase tidal prism (the volume of water in a site between mean high tide and mean low tide) and water exchange, improve fish and wildlife habitat, and reduce mosquito breeding habitat at the Ni-les'tun Unit through the excavation of first- and second-order tidal channels. Tidal channels are hierarchically classified by "stream order" (Horton 1945, Strahler 1952). A first-order tidal channel has no tributaries; a second-order channel is formed when two first-order channels join, and so forth. Channel order is correlated with morphometry (e.g., width, depth, and sinuosity) and physical habitat characteristics, including the presence of vegetation, temperature, and salinity (Coats et al. 1995, Williams et al. 2002). For example, higher order channels are typically wider and deeper than lower order channels.

An enhanced and expanded tidal channel network would improve intertidal marsh, freshwater marsh, and riparian habitat values and functions by providing:

- foraging and loafing habitat for migratory and resident birds;
- foraging and nursery habitat for anadromous and other estuarine-dependent marine fishes;
- quality compatible wildlife-dependent recreational opportunities for the public; and
- a return to mosquito production levels typical of tidal marshes (e.g. the Bandon Marsh Unit) on the Refuge for the benefit of wildlife and the public.

## 1.3 Scope of Analysis

An Environmental Assessment (EA) finalized in 2009 (USFWS and FHWA 2009, USFWS 2009) analyzed a reasonable range of alternatives for (1) the tidal wetland restoration on the Ni-les'tun Unit and (2) the improvement of North Bank Lane from its intersection with U.S. Highway 101 to Randolph Road and disclosed the potential environmental impacts associated with each alternative. This Supplemental Environmental Assessment (SEA) adopts in part and supplements the 2009 EA. However, this SEA is limited to an assessment of the environmental impacts associated with additional activities related only to tidal wetland restoration [item (1) above]. No additional road improvements are proposed. Issues outside of the scope of this SEA include the pesticide treatment of mosquitoes on the Refuge, which is being analyzed through a separate, concurrent National Environmental Policy Act (NEPA) process (USFWS 2014).

## 1.4 Agencies with Jurisdiction and Coordination Requirements

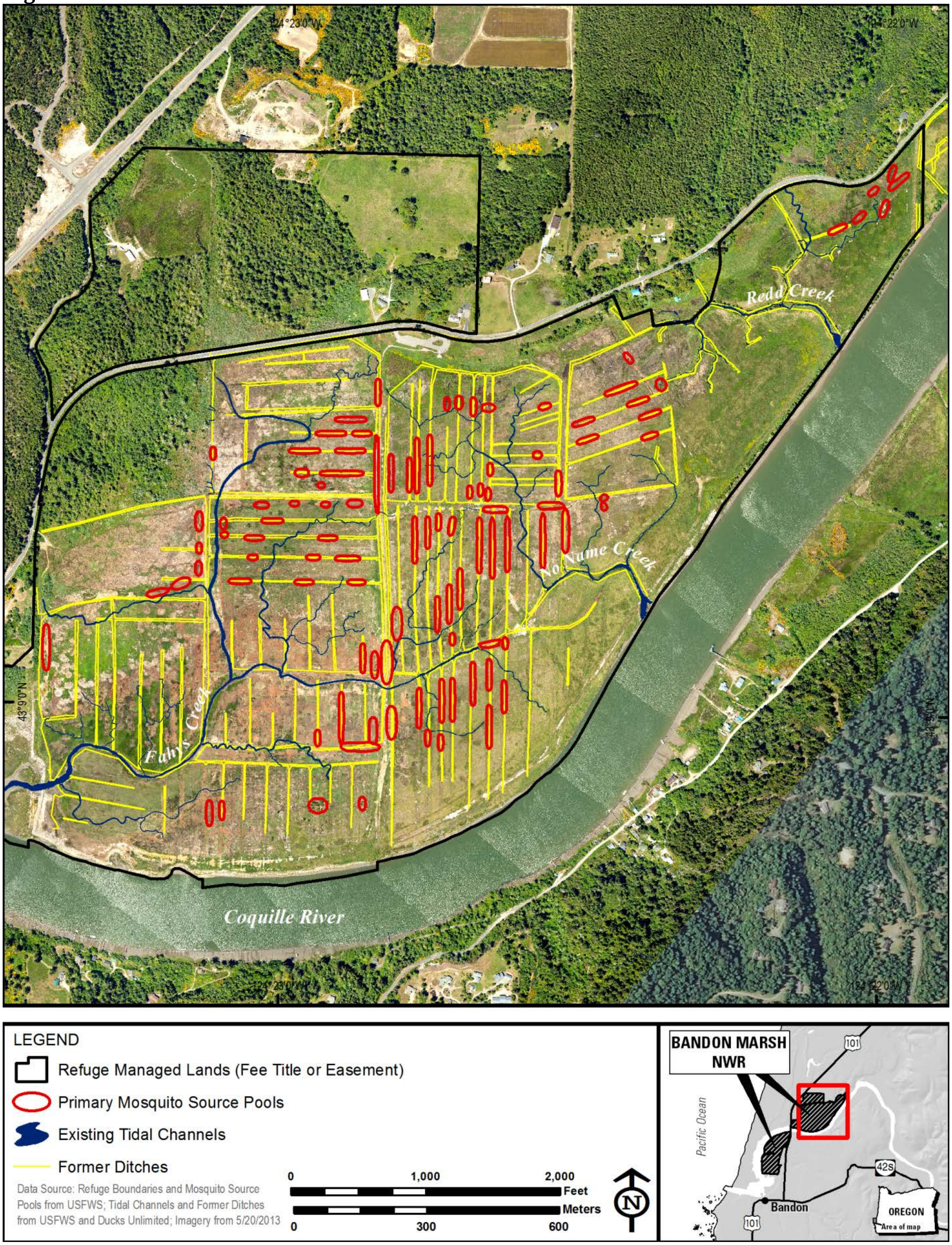
For the activities proposed in this SEA, the USFWS is required to coordinate and consult with a number of local, state, and federal agencies, and Tribes (Table 1-1). This coordination and consultation process is ongoing. There have been separate meetings, individual phone calls, and conference calls with the following agencies, Tribes, and organizations: the U.S. Army Corps of Engineers (Corps), Oregon Department of Environmental Quality (ODEQ), NMFS, Oregon Department of State Lands (DSL), Oregon State Office of Historic Preservation (SHPO), Oregon Department of Fish and Wildlife (ODFW), the Coquille Indian Tribe, the Confederated Tribes of the Siletz Indians, and Coos County Public Health Department and Commissioners.

**Table 1-1. Agencies and organizations with permitting or consultation requirements.**

| Organization | Permit or Required Consultation |
|---|---|
| U.S. Army Corps of Engineers | Clean Water Act Section 404 Permit |
| Oregon Department of State Lands | Removal-Fill Permit |
| Oregon Department of Environmental Quality | Clean Water Act Section 401 Certification |
| Oregon Department of Fish and Wildlife | In-water work timing restrictions and fish salvage |
| Coquille Indian Tribe | Consultation on impacts to resources of interest to Tribe |
| Confederated Tribes of the Siletz Indians | Consultation on impacts to resources of interest to Tribe |
| State Historic Preservation Office | Consultation on potential impacts to cultural resources |
| National Marine Fisheries Service | Endangered Species Act Section 7 Consultation |
| Oregon Department of Land Conservation and Development | Coastal Zone Certification |

| Organization | Permit or Required Consultation |
|---|---|
| Coos County | Coastal Zone Certification |
| USFWS – Ecological Services Division | Endangered Species Act Section 7 Consultation |

**Figure 1-1. Aerial view of the Ni-les'tun Unit of Bandon Marsh NWR.**



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# Chapter 2. Alternatives

## 2.1 Alternatives Considered but Dismissed

Early in the alternatives development process, the planning team considered the following actions in one or more alternatives. These actions were ultimately eliminated from further consideration for the reasons provided.

Various other options were considered for eliminating the small depressions impounding water that develop on the marsh and provide mosquito breeding habitat after the highest tides of each month. Eliminating tidal influence through the construction of a levee and installation of tide gates would not assist the USFWS in meeting its publicly-mandated missions of assisting in the recovery of threatened and endangered species (e.g., coho salmon), preserving and enhancing fish and wildlife habitat, and providing opportunities for wildlife-oriented public uses (e.g., waterfowl hunting, wildlife observation). Consequently, this alternative was removed from consideration. Re-grading or leveling the site was eliminated as an alternative due to concerns over cultural resources disturbance, sediment discharge and other water quality issues, and prohibitive cost. Filling depressions using imported fill material was considered impractical due to potential water quality issues, prohibitively high cost, and logistical challenges. Fill material would need to be tested to ensure that it is not contaminated with pollutants or invasive plant propagules and would need to possess the chemical and structural properties of wetland soil, all of which would contribute to high cost. In addition, fill could not be distributed throughout the marsh without heavy equipment that would further disturb the ground. Unconsolidated fill material could easily erode and would likely lead to excessive sediment discharge.

Alternative configurations for excavated channels were considered. Re-excavation of former drainage ditches was dismissed since straight line tidal channels would not provide habitat complexity for fish or wildlife. Additionally, linear features would concentrate the limited erosive forces present and would perpetuate a rectilinear channel system. The construction of large open water ponds in the higher elevation marsh to increase hydraulic velocity and forcing was considered but dismissed due to the need for hauling spoils off site at high costs, potential creation of additional depressions with heavy equipment, and the potential for un-natural pools to provide habitat for invasive fish or aquatic plants.

## 2.2 Alternative A. No Action Alternative (Current Management)

Under Alternative A, the No Action alternative, USFWS would continue to enhance, protect, and maintain estuarine and instream habitat within the Ni-les'tun Unit per strategies articulated within the Refuge's Comprehensive Conservation Plan (USFWS 2013a). In addition to ecological monitoring, current activities include, but are not limited to, the following: using appropriate Integrated Pest Management techniques; installing and maintaining woody debris; reducing invasive species spread by cleaning and disinfecting clothing and boating equipment before and after entering the salt marsh; and conducting public outreach. Current management precludes further artificial manipulation of the site hydrology and active physical manipulation to reduce mosquito breeding habitat. Natural processes would be allowed to continue to modify the tidal channel network, and mosquito breeding habitat would continue to exist unmodified.

## 2.3 Alternative B. Preferred Alternative: Expansion of Tidal Channel Network

Under Alternative B, the Preferred Alternative, over 400 acres of tidal wetlands on the Ni-les'tun Unit would be enhanced through the excavation of an additional 40,000 linear feet of low-order tidal channels intended to expand the tidal channel network, increase tidal prism and water exchange, and reduce the number of shallow depressions that provide mosquito breeding habitat. During the original restoration, third- and fourth-order channels were installed. Under the Preferred Alternative, first- and second-order channels would be excavated. The additional channels would tie into the existing channel network.

Development of the Preferred Alternative was guided by Project Design Criteria (PDC; Appendix A) developed to protect federally-listed fish as described in the recently signed Programmatic Restoration Opinion for Joint Ecosystem Conservation by the Services (PROJECTS) by the USFWS and National Oceanic and Atmospheric Administration (NOAA) Restoration Center (NOAA 2013). The Preferred Alternative falls under the project category "Wetland Restoration" and all applicable PDC as detailed in the opinion would be followed.

The following paragraphs detail the specific work to be conducted.

*Tidal channel design and placement:* The tidal channel geometry and layout design would approximate the model developed for the original design which was based on a study of reference wetlands in four Oregon estuaries (So et al. 2009). Tidal channel design parameters modeled for first- through seventh-order channels included: channel length, width, depth, sinuosity, placement within the drainage network (or channel order), and drainage basin area. However, since a main design criterion for the new channel configurations is based on the capacity to drain existing primary mosquito source pools which are not distributed randomly (see Figure 1.1), channel distribution and sinuosity would not be entirely consistent with model parameters.

*Development of channel design criteria:* In the summer of 2013, an analysis of impounded shallow pools performed on two 10-acre sample areas by USFWS biologists showed that each of these 10-acre sample areas contained approximately 0.5 acres of shallow pools. The tidal channel model indicates that first-order tidal channels (1.0 feet wide and 0.8 feet deep) typically drain an area of 0.1 acres each and second-order channels (2 feet wide and 1.6 feet deep) drain an area of 0.2 acres each. Thus, the model indicates the need for roughly three second-order tidal channels to drain 0.5 acres of pools. To reduce mosquito habitat it was assumed that the pools should drain in one dropping tidal cycle or six hours. This is a very conservative assumption since salt marsh mosquito development from egg to adult requires at least seven days of constant ponding (Maffei 2000). In this case, the number and configuration of second-order channels needed would be based on the actual volume of water in the breeding pools at low tide, and the capacity of the channel, given its length and slope, to drain the water volume within one 12 hour tide cycle. Calculations indicate that the actual density (linear feet/acre) of second-order channels required would be substantially lower than that of a natural marsh.

Depressions or pools are generally 6–8 inches deep and most often located in the linear features remaining after the original ditch discing and filling. Some pools are located in other areas such as construction haul roads or in rough terrain areas. First-order channels would be installed to drain adjacent pools located within a former ditch outline (i.e., a "chain" of pools) to a second-order channel. First- and second-order channels would be constructed with a consistent slope to ensure pool drainage.

*Pre-construction:* Pre-construction activities would include mobilization of equipment and crews, establishment of erosion and traffic control measures, and removal or exclusion of fish from the active work area as necessary. Channel alignments and final construction staking would be laid out as designed.

*Construction of first- and second- order tidal channels:* Second-order tidal channels would be installed mechanically by low ground pressure equipment. The following construction scenarios were developed to minimize impacts to fish by taking into account tidal cycles:

1. <u>The channel construction will/may be completed in one low tide.</u> Excavate the channel at low tide when the channel is dry or on the incoming tide. Excavate from existing channel to ponded water or from ponded water to existing channel and complete. There would be full access both ways after construction and thus no stranding.
2. <u>Completing the channel will/may take more than one low tide</u>. Excavate the channel at low tide when the channel is dry or on the incoming tide. Excavate from existing channel to ponded water with no ditch plug to maintain fish passage during and after a high tide. Continue excavation on the next low tide. There would be full access both ways during high tides and after construction and thus no stranding.
3. <u>Completing the channel will/may take more than one low tide in high ground areas where the elevation of the surrounding marsh is sufficient to fully prevent high tides and fish from moving overland into the partially constructed channel</u>. Excavate from existing channel to ponded water leaving a ditch plug or from ponded water to existing channel, thereby leaving a de facto ditch plug. There would be no access for fish at low or high tide during construction and thus no stranding. The ditch plug would be removed at low or incoming tide after completion of the channel work providing full access both ways.
4. <u>Completing the channel will/may take more than one low tide in high ground areas where the elevation of the surrounding marsh are sufficient to fully prevent high tides and fish from moving overland into the partially constructed channel</u>. Excavate from existing channel to ponded water with a screen at the channel outlet rather than a ditch plug to exclude fish from the excavated channel. They cannot get in overland as the ground is high. There would be no access for fish at low or high tide during construction and thus no stranding. Screen would be removed when construction is completed providing full access both ways.
5. <u>The channel will/may take more than one low tide in high ground areas where the surrounding marsh will be inundated prior to completion.</u> Under this scenario, excavation would proceed from the channel to ponded water. Fish would have continuous access to tidally influenced channels.

First-order channels would be excavated by machine or by hand. Hand excavation would be used to manage and drain any equipment tracks where necessary and to connect small areas of ponded water into the tidal network. Machinery may be equipped with laser or GPS monitoring equipment for grade control. A field survey of each channel would be required to verify channel bottom slope and full drainage. Field surveys would verify that channels would intercept the lowest parts of each pool basin and that positive drainage existed throughout the channels.

*Demobilization:* Demobilization includes removal of temporary crossings, final grading, and site cleanup. Demobilization would also include removal of access sites and restoration of staging areas to pre-project conditions.

# Chapter 3. Affected Environment

## 3.1 Physical Environment

### 3.1.1 Climate

The climate at Bandon Marsh NWR is greatly influenced by the Pacific Ocean on the west and the Coast Range to the east. The Coast Range rises between 2,000 and 3,000 feet above sea level in the north and between 3,000 and 4,000 feet in the southwestern portion of the state with occasional mountain peaks rising an additional 1,000 to 1,500 feet. The southern Oregon coastal zone is characterized by wet winters, relatively dry summers, and mild temperatures throughout the year. Because of the moderating influence of the Pacific Ocean, extremely high or low temperatures are rare and the annual temperature range is lower here than in any other Oregon climate zone. Precipitation is heavier and more persistent during the winter but regular moisture occurs from rain and fog throughout the year (WRCC 2011). The area's heavy precipitation during winter results from moist air masses moving from the Pacific Ocean onto land. The lower elevations along the coast receive annual precipitation of 65 to 90 inches, which can cause flood events if abundant rainfall is consistent for several days. Occasional strong winds (50–70 miles per hour) occur along the coast, usually in advance of winter storms. Wind speeds have been recorded to exceed hurricane force and have caused substantial damage to structures and vegetation in exposed coastal locations (Taylor and Hannan 1999, Taylor 2008). Skies are usually cloudy in the winter during the frequent storms and clear to partly cloudy during summer, with localized fog along the coastline. As a result of persistent cloudiness, total solar radiation is lower along the coast than in any other region of the state.

### 3.1.2 Topography

The topography of the Ni-les'tun Unit is generally sloping from the north to the Coquille River on the south. The northeastern section of the Unit, encompassing the upland grassland, refuge headquarters, bunkhouse, shop, and Ni-les'tun overlook is located on a marine terrace. The southern extent and lowest elevations of the marine terrace are found at the Ni-les'tun overlook. Marsh plain elevation of the restored salt marsh ranges from seven feet North American Vertical Datum 1988 (NAVD88) at the eastern end to five feet NAVD88 at the western end. Eighty percent of the restoration site is below seven feet NAVD88 (Mean Higher High Water). The natural levee along the river ranges from nine feet NAVD88 at the east (upstream) end to six and a half feet NAVD88 at the west (downstream) end (Ducks Unlimited 2009).

### 3.1.3 Soils/Geology

The northeastern section of the Ni-les'tun Unit, encompassing the upland grassland, refuge headquarters, bunkhouse, shop, and Ni-les'tun overlook, is located on the Whisky Run terrace (McInelly and Kelsey 1990). This relatively thick marine terrace (10–66 feet) is made up of deposited marine and stream sediment. The marine terrace rests atop the Otter Point formation which is composed primarily of sheared sedimentary rocks with smaller amount of volcanic material (Baldwin et al. 1973a).

Excluding the areas of the Refuge on the Whisky Run marine terrace, the remainder was formed following a series of sea level rise, subsidence, and uplift events. The current location of the Coquille estuary was under tidal influence by 7,000 years ago, forming a "drowned river" estuary. Gradual uplift in the period between earthquakes may also reduce the size of the estuary, but this effect is temporary, being offset by episodic subsidence during earthquakes (Nelson 1992, Nelson et al. 1995, Witter 1999, Byram and Witter 2000, Witter et al. 2003).

Infilling of the estuary and marsh development occurs as runoff from precipitation washes sediments from slopes into streams or their floodplains. These sediments are then transported downstream to the estuary where they settle and become influenced by tides (Simenstad 1983). Most of the present-day Refuge is located on this alluvium (Baldwin et al. 1973b). Much of the coarser sediment settles out near the banks of the river, forming natural levees. The finer materials remain suspended longer and settle throughout the intertidal zone and flooded lowlands. Additionally, sediments are moved into the lower estuary from the ocean shore by tsunamis, storm surges, and dune building.

The entire Oregon coast is a tectonically active area that experiences massive earthquakes every 240 years, on average, when the land may subside 3.3 to 6.6 feet, and then subject the coast to large tsunami waves. The last such earthquake occurred in 1700 and with each passing year the odds of the next one happening increase (Atwater et al. 2005, Goldfinger et al. 2010). Obviously, the current landscape of the lower Coquille basin will change profoundly when the next large quake occurs.

### 3.1.4 Hydrology and Water Quality

The Ni-les'tun Unit is bounded on the south and east by the tidally influenced Coquille River. The Unit consists largely of restored tidal marsh with small acreages of forested wetlands, natural tidal marsh, and riparian corridors. Except for the higher elevation areas, the majority of the Ni-les'tun Unit lies within the boundary of the 100-year floodplain. The tidal marsh restoration project initiated in 2009 and completed in 2011 filled and removed 15 miles of interior drainage ditches and channels, constructed 5 miles of tidal channels, lowered all of the artificial river levees, and removed tide gates, and water control structures to facilitate full tidal function of the Unit. Typically, the highest tides that cover the entire marsh occur in the winter when they combine with elevated winter river flows. The National Ocean Survey tidal benchmark information for the Coquille River in Bandon for the 1983–2001 period is summarized in Table 3-1.

**Table 3-1. Tidal benchmark summary for Bandon, Oregon, at the Coquille River (NOAA 2011).**

| Station Information | Bandon, Coquille River Sta. ID 9419750 |
|---|---|
| Mean Higher High Water (MHHW) (feet) | 7.09 |
| Mean High Water (MHW) (feet) | 6.37 |
| Mean Tide Level (MTL) (feet) | 3.78 |
| Mean Sea Level (MSL) (feet) | 3.75 |
| Mean Low Water (MLW) (feet) | 1.19 |
| North American Vertical Datum 1988 (NAVD88) | 0.10 |
| Mean Lower Low Water (MLLW) | 0.00 |

Four small stream courses run through the Ni-les'tun Unit: Fahys Creek, Redd Creek, Blue Barn Creek (flowing into Redd), and No Name Creek. Prior to restoration, three of these creeks (Fahys, Redd, and No Name) were primarily tide-gated drainage ditches that dewatered the historic tidal and forested wetlands for agricultural purposes. Restoration, completed in 2011, re-connected the mouth of Fahys Creek to the Coquille River in its historical location and replaced the ditched and tide-gated portion of Redd Creek with a new excavated channel to connect the upland watershed drainage. No Name Creek was opened to tidal exchange through the removal of a tide gate. Now, No Name Creek is a tidally driven system without a continuous creek channel entering it. The freshwater input is primarily from subsurface discharge from the north marine terrace.

Mean salinities recorded for the Coquille River estuary at the location nearest to the Bandon Marsh Unit for January–March, April–June, and July–September are 8, 22, and 31 parts per thousand (ppt), respectively. At the mouth of Fahys Creek, adjacent to the Ni-les'tun Unit, mean salinities for January–March, April–June, and July–September are 1, 14, and 30 ppt (Hamilton 1984). These salinities can be considered the maximums along the gradients occurring through the respective marshes extending to the entirely fresh inputs in the upper marshes. These measurements indicate that during winter and spring, the freshwater flow down the Coquille River and its tributaries strongly limits the intrusion of marine water. Freshwater flow, measured at North, Middle, and South forks of the Coquille, is usually lowest in August and September and highest during January (Kraeg 1979).

No waters within the Bandon Marsh NWR boundary (i.e., Fahys, Redd, Blue Barn, and No Name creeks) were listed as impaired because these waters have not been assessed under the Section 303(d) of the Clean Water Act. However, the Coquille River adjacent to the Refuge was listed as impaired in the 2002 and 2004/2006 303(d) reporting cycles. The Coquille River was also listed as impaired in Oregon's 2010 Section 303(d) List of Category 5 Water Quality Limited Waters. Many parameters and beneficial uses are impaired on the Coquille River. Significant impairments include chlorophyll a, dissolved oxygen, fecal coliform, and temperature (ODEQ 2002, ODEQ 2006, ODEQ 2011).

### 3.1.5 Air Quality

The ODEQ does not have any ambient air quality monitoring stations located on the Oregon Coast. The majority of ODEQ's air quality monitoring stations is located within the interior valleys between the Coast and Cascade Mountain Ranges where the majority of Oregon's population resides. The lack of ambient air quality monitoring on the Oregon Coast makes it difficult to assess baseline air quality conditions.

Bandon Marsh NWR is located within the Oregon Coast Airshed which is generally well mixed year-round due to the influence of the Pacific Ocean. Low pressure systems move through the airshed throughout the year and usually bring wind, clouds, and rain. The intensity and frequency of these low pressure systems increases during the fall through winter resulting in sometimes very rainy and windy conditions. In between these low pressure systems, high pressure systems move in, resulting in drying trends. High pressure systems generally dominate the airshed during late spring, summer, and early fall. Coastal fog due to inland heating is common during the summer months. In general, the Oregon Coast Airshed remains relatively unstable resulting in a well-mixed atmosphere with suspected good air quality.

## 3.2 Biological Environment

Bandon Marsh NWR provides a variety of environments, each with its own characteristic set of flora and fauna. Environments throughout the lower Coquille estuary have been altered by past and current human actions including diking, draining, dredging, and agriculture. Today, land managers are working with interested partners towards enhancement and restoration of historic wetland environments of the Coquille River. These efforts provide opportunities to enhance or expand existing habitats for the benefit of wildlife, plants, and people. An important consideration moving forward is to ensure that the Refuge's actions do not enhance or create conditions in which mosquito populations increase above levels that create a health threat to the visiting public, adjacent landowners, and local communities.

### 3.2.1 Environments, Vegetation, and Associated Resources

Environments of the Refuge may be grouped into three types: (1) tidally-influenced habitats (Temperate Pacific Tidal Salt and Brackish Marsh, Temperate Pacific Intertidal Mudflat, and North Pacific Intertidal Freshwater Wetland), (2) non-tidal wetland and riparian habitat (North Pacific Hardwood-Conifer Swamp and North Pacific Lowland Riparian Forest and Shrubland), and (3) upland forests (North Pacific Hypermaritime Sitka Spruce Forest) (USFWS 2013a). Vegetation type descriptions according to the International Terrestrial Ecological System Classification under development by NatureServe and its natural heritage program members (Comer et al. 2003, NatureServe 2012) are listed in parentheses above. This plan's proposed action area is composed of tidally-influenced habitats. Tidally influenced habitats are of high ecological importance and are considered essential habitat for many marine and anadromous fish, crabs and other shellfish, and migratory birds (ODFW 2006, Seliskar and Gallagher 1983).

Salt marshes and estuaries occur where freshwater rivers meet the salty waters of the ocean. This dynamic habitat is greatly influenced by twice daily tidal flooding that affects the water levels, salinity, temperature, and the amounts of sunlight penetration, which in turn relates to oxygen levels. Salt marshes provide food and nursery areas for numerous young fish, crabs, shrimp, clams, and other invertebrates when flooded. Natural (un-diked) marshes provide numerous benefits including shoreline stability against wave and wind erosion; reduced flood peaks; trapping of nutrients, sediment, and pollutants; and sequestration of carbon. As one of the most productive ecosystems on earth, tidally influenced salt marshes are highly important to fish, wildlife, and society.

The only remaining large natural salt marshes in the lower Coquille watershed are located within Bandon Marsh NWR. The Refuge contains 650 acres of salt marsh. Plant species common in refuge salt marsh include Lyngby's sedge (*Carex lyngbyei*), seashore saltgrass (*Distichlis spicata*), pickleweed (*Salicornia virginica*), Pacific silverweed (*Argentina pacifica*), and tufted hairgrass (*Deschampsia cespitosa*). These plants are associated with unaltered estuarine tidal wetlands in Oregon (USFWS 2006). Within the Ni-les'tun Unit there is a mixture of nonnative species including creeping bentgrass (*Agrostis stolonifera*), tall fescue (*Festuca arundinacea*), and reed canarygrass (*Phalaris arundinacea*) and the native plant species also found within the unaltered Bandon Marsh Unit. As the marsh adjusts to post-restoration conditions, the proportion of nonnative plant species has been declining (USFWS unpublished data).

Intertidal mudflats are largely unvegetated substrates flooded and exposed by tidal action. Each type of mudflat (sand, mud, gravel or combination of these) supports slightly different plant and animal communities. Algae and diatoms are the principal plant types; vascular plants are rare or absent. Species such as native eelgrass (*Zostera marina*) are rare within the lower Coquille estuary's mudflats, but bands of widgeon grass (*Ruppia maritima*) are common along the margins of the flats and bottoms of the channels. These native intertidal grasses and algae are important habitat components of mudflats for a multitude of native fishes; smaller forms of gastropods, bivalves and crustaceans (Swayne 2004); shorebirds; and waterfowl.

### 3.2.2 Threatened and Endangered Species

One goal of the Refuge System is "To conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered." In the policy clarifying the mission of the Refuge System, it is stated, "We protect and manage candidate and proposed species to enhance their status and help preclude the need for listing." In accordance with this policy, the Service considered all species with federal or state status. Tables 3-2 and 3-3 list federal or state endangered and threatened species that are known or have the potential to occur on the Refuge. There are no listed reptiles, amphibians, invertebrates, or plants known or likely to occur on the Refuge.

**Table 3-2. Federal or state listed bird species with the potential to occur within the project area.**

| Common Name | Scientific Name | Federal Status | State Status | Current Occurrence |
|---|---|---|---|---|
| Marbled murrelet | *Brachyramphus marmoratus* | Threatened | Threatened | Potential flyover |
| Western snowy plover | *Charadrius nivosus* | Threatened | Threatened | One recorded sighting on the Bandon Marsh Unit in 2002. |

**Table 3-3. Federal or state listed fish species known or with the potential to occur within the project area or in surrounding waters (Coquille River).**

| Common Name | Scientific Name | Federal Status | State Status | Current Occurrence on Refuge |
|---|---|---|---|---|
| Oregon Coast Coho salmon | *Oncorhynchus kisutch* | Threatened | | Bandon Marsh and Ni-les'tun Units/Coquille River/coastal streams |
| Pacific smelt (eulachon) | *Thaleichthys pacificus* | Threatened | | Coquille River (suspected) |
| Green sturgeon | *Acipenser medirostris* | Threatened | | Coquille River (suspected) |

### 3.2.3 Key Wildlife Species Supported

Bandon Marsh NWR provides habitat for a wide range of wildlife species. These environments provide feeding, resting, or breeding habitat for both resident and migratory species. The Refuge contains the largest remaining tracts of salt marsh in the Coquille River Estuary and is considered an important migratory stop-over site along the Pacific Coast for migrating shorebirds and waterfowl. The estuarine salt marsh and tidal flats of Bandon Marsh NWR contain rich beds of algae, marine invertebrates and plant life that support wading birds, thousands of migratory waterfowl and hundreds of thousands of shorebirds, which in turn provide an important prey base for numerous raptors (i.e., birds of prey) including the recently delisted bald eagle (*Haliaeetus leucocephalus*) and the peregrine falcon (*Falco peregrinus*) (Hodder and Graybill 1984, Castelein and Lauten 2007, USFWS unpublished data). Wading birds such as great blue heron (*Ardea herodias*) and great egret

(*Ardea alba*), and shorebirds such as black-bellied plover (*Pluvialis squatarola*), killdeer (*Charadrius vociferous*), least sandpiper (*Calidris minutilla*) and western sandpiper (*Calidris mauri*), dunlin (*Calidris alpina*), and long-billed (*Limnodromus scolopaceus*) and short-billed dowitcher (*Limnodromus griseus*) make extensive use of the mudflats for foraging on macro-invertebrates and in some cases biofilm (Mathot et al. 2010, Skagen and Oman 1996).

Invertebrates such as snails, shrimp, clams, worms, and crabs are locally common or abundant (Simenstad 1983). The most common and important invertebrate species occupying the Bandon Marsh NWR mudflats include Dungeness crab (*Metacarcinus magister*), softshell clams (*Mya arenaria*), ghost shrimp (*Callianassa californiensis*), mud shrimp (*Upogebia pugettensis*), and a variety of worms (Rudy and Rudy 1983, USFWS unpublished data).

*3.2.3.1 Birds*

Bird use of the Ni-les'tun Unit has been monitored on a regular basis along an established sampling transect from November 2009 until late August 2013 (USFWS unpublished data). Based on systematic observations made throughout this period, Table 3-4 lists the species of birds potentially present in the project area during project implementation. Species listed as likely have been directly observed in recent years. Those listed as unlikely could be present but are rarely seen. The majority of the birds listed are transitory migrants, such as shorebirds and some waterfowl, and summer residents, such as other waterfowl, raptors, waders, and passerines.

**Table 3-4. Birds known or likely to be present in tidal marsh habitat of the Ni-les'tun Unit (USFWS unpublished data).**

| Common Name | Scientific Name | Likely | Unlikely |
|---|---|---|---|
| Aleutian Canada goose | *Branta canadensis leucopareia* | X | |
| American coot | *Fulica americana* | X | |
| American crow | *Corvus brachyrhynchos* | X | |
| American goldfinch | *Carduelis tristis* | X | |
| American kestrel | *Galco sparverius* | X | |
| American pipit | *Anthus rubescens* | X | |
| American robin | *Turdus migratorius* | X | |
| American wigeon | *Anas americana* | X | |
| Bald eagle | *Haliaeetus leucocephalus* | X | |
| Barn swallow | *Hirundo rustica* | X | |
| Belted kingfisher | *Ceryle alcyon* | X | |
| Black phoebe | *Sayornis nigricans* | X | |
| Black-bellied plover | *Pluvialis squatarola* | X | |
| Black-capped chickadee | *Poecile atricapilla* | | X |
| Brewer's blackbird | *Euphagus cyanocephalus* | X | |
| California gull | *Larus californicus* | X | |
| Caspian tern | *Sterna caspia* | X | |
| Cliff swallow | *Petrochelidon pyrrhonota* | X | |
| Common raven | *Corvus corax* | X | |

| Common Name | Scientific Name | Likely | Unlikely |
|---|---|---|---|
| Common yellowthroat | *Geothlypis trichas* | X | |
| Coopers hawk | *Accipiter cooperii* | | X |
| Double-crested cormorant | *Phalacrocorax auritus* | X | |
| Dunlin | *Calidris alpina* | X | |
| European starling | *Sturnus vulgaris* | | X |
| Gadwall | *Anas strepera* | | X |
| Great blue heron | *Ardea herodias* | X | |
| Great egret | *Ardea alba* | X | |
| Greater white-fronted goose | *Anser albifrons* | | X |
| Greater yellowlegs | *Tringa melanoleuca* | X | |
| Green-winged teal | *Anas crecca* | X | |
| Hooded merganser | *Lophodytes cucullatus* | | X |
| Killdeer | *Charadrius vociferus* | X | |
| Lapland longspur | *Calcarius lapponicus* | | X |
| Least sandpiper | *Calidris minutilla* | X | |
| Lesser yellowlegs | *Tringa flavipes* | | X |
| Lincoln's sparrow | *Melospiza lincolnii* | X | |
| Long-billed dowitcher | *Limnodromus scolopaceus* | X | |
| Mallard | *Anas platyrhynchos* | X | |
| Marsh wren | *Cistothorus palustris* | X | |
| Merlin | *Falco columbarius* | | X |
| Northern flicker | *Colaptes auratus* | X | |
| Northern harrier | *Circus cyaneus* | X | |
| Northern pintail | *Anas acuta* | X | |
| Pectoral sandpiper | *Calidris melanotos* | | X |
| Peregrine falcon | *Falco peregrinus* | X | |
| Purple martin | *Progne subis* | X | |
| Red-shouldered hawk | *Buteo lineatus* | X | |
| Red-tailed hawk | *Buteo jamaicensis* | X | |
| Red-winged blackbird | *Agelaius phoeniceus* | | X |
| Savannah sparrow | *Passerculus sandwichensis* | X | |
| Scaup sp. | *Aythya* sp. | | X |
| Semipalmated plover | *Charadrius semipalmatus* | X | |
| Sharp-shinned hawk | *Accipiter striatus* | | X |
| Short-billed dowitcher | *Limnodromus griseus* | X | |
| Short-eared owl | *Asio flammeus* | | X |
| Solitary sandpiper | *Tringa solitaria* | | X |
| Song sparrow | *Melospiza melodia* | X | |
| Spotted sandpiper | *Actitis macularia* | X | |
| Tree swallow | *Tachycineta bicolor* | X | |

| Common Name | Scientific Name | Likely | Unlikely |
|---|---|---|---|
| Turkey vulture | *Cathartes aura* | X | |
| Violet-green swallow | *Tachycineta thalassina* | X | |
| Virginia rail | *Rallus limicola* | X | |
| Western Canada goose | *Branta canadensis moffitti* | X | |
| Western gull | *Larus occidentalis* | X | |
| Western meadowlark | *Sturnella neglecta* | X | |
| Western sandpiper | *Calidris mauri* | X | |
| White-crowned sparrow | *Zonotrichia leucophrys* | X | |
| White-tailed kite | *Elanus leucurus* | X | |
| Wilson's snipe | *Gallinago delicata* | X | |
| Wood duck | *Aix sponsa* | | X |

*3.2.3.2 Mammals*

No formal survey of mammal use of the Ni-les'tun Unit has been conducted, but species that have been observed using the tidal marsh by refuge personnel are listed in Table 3-5. Probably the most abundant and widespread mammal is Townsend's vole (*Microtus townsendii),* which uses the dense vegetation in the higher parts of the marsh. Raccoon (*Procyon lotor* ) and mink (*Mustela vison)* are common medium-sized mammals based on the frequency with which their tracks are seen. Beaver (*Castor canadensis)*, muskrat (*Ondatra zibethicus*), and nutria (*Myocastor coypus*) are present but rarely observed, and probably occur in very low numbers, likewise for black-tailed deer (*Odocoileus hemionus columbianus*) and coyote (*Canis latrans*). Harbor seals (*Phoca vitulina* ) forage within the waters that are present over the marsh/mudflats when they are inundated at high tide.

**Table 3-5. Mammals observed in tidal marsh habitat of the Ni-les'tun Unit (USFWS unpublished data).**

| Common Name | Scientific Name |
|---|---|
| Black-tailed deer | *Odocoileus hemionus columbianus* |
| Beaver | *Castor canadensis* |
| Big brown bat | *Eptesicus fuscus* |
| Black rat | *Rattus rattus* |
| Brush rabbit | *Sylvilagus bachmani* |
| California myotis | *Myotis californicus* |
| Coyote | *Canis latrans* |
| Harbor seal | *Phoca vitulina* |
| Little brown bat | *Myotis lucifugus* |
| Long-eared myotis | *Myotis evotis* |
| Mink | *Mustela vison* |
| Muskrat | *Ondatra zibethicus* |
| Norway rat | *Rattus norvegicus* |
| Nutria | *Myocaster coypus* |

| Common Name | Scientific Name |
|---|---|
| Opossum | *Didelphis virginiana* |
| Raccoon | *Procyon lotor* |
| River otter | *Lontra canadensis* |
| Short-tailed weasel | *Mustela erminea* |
| Silver-haired bat | *Lasionycteris noctivagans* |
| Spotted skunk | *Spilogale gracilis* |
| Striped skunk | *Mephitis mephitis* |
| Townsend's mole | *Scapanus townsendii* |
| Townsend's vole | *Microtus townsendii* |
| Yuma myotis | *Myotis yumanensis* |

#### *3.2.3.3 Reptiles and Amphibians*

The few representatives of these taxa are generally restricted to the forested wetland fringes of the Bandon Marsh NWR where fresh water dominates. Species observed near tidal marsh habitat are listed in Table 3-6.

**Table 3-6. Reptiles and amphibians near tidal marsh habitat of the Ni-les'tun Unit (USFWS unpublished data).**

| Common Name | Scientific Name |
|---|---|
| Northwestern salamander | *Ambystoma gracile* |
| Northwestern garter snake | *Thamnophis ordinoides* |
| Pacific tree frog | *Pseudacris regilla* |
| Red-legged frog | *Rana aurora* |
| Rough-skinned newt | *Taricha granulose* |
| Southern alligator lizard | *Elgaria multcarinata* |

#### *3.2.3.4 Fish*

Fish use of waters within Bandon Marsh NWR has been monitored via regular sampling throughout the year by USFWS staff and a research cooperator as part of the restoration efficacy monitoring program that ended in late September 2013. This has included sampling along permanent streams flowing through the marsh, tidal channels, and the mainstem of the Coquille River. In general, these investigations show the return of many species and an increased use of the restored marsh channels by salmonids and other estuarine species such as surf smelt (*Hypomesus pretiosus)*, surf perch (*Cymatogaster aggregate)*, and starry flounder *(Platichthys stellatus)*. Within the Bandon Marsh NWR, juvenile coho and Chinook salmon have been observed in the tributaries and estuary waters of the lower Coquille River. No known salmon spawning habitat is within creeks on the Refuge. Surveys from 2005–2013 of Redd, No Name, and Fahys creeks in the Ni-les'tun Unit documented the year-round presence of juvenile coho and Chinook salmon (Hudson et al. 2010, Silver et al. 2012, van de Wetering unpublished data).

Bandon Marsh NWR provides spawning and rearing habitat for coastal cutthroat trout. Surveys from 2005–2013 of Redd, No Name, and Fahys creeks documented the year-round presence of adult and juvenile coastal cutthroat trout (Hudson et al. 2010, USFWS unpublished data). Cutthroat trout spawning redds were observed in 2012 in the recently restored (2011) portion of Fahys Creek both on and off -refuge (Chris Claire, ODFW, pers. comm.). In addition, spawning habitat is suspected to occur on off-refuge lands, including within Fahys and Redd creeks.

However, very low numbers of salmonids occur within the marsh during the summer season due to seasonally warm water temperatures. Table 3-7 lists all fish species known or likely to be present in the Ni-les'tun Unit of Bandon Marsh NWR.

**Table 3-7. Fish known or with the potential to occur within the Ni-les'tun Unit.**

| Common Name | Scientific Name | Known | Potential |
|---|---|---|---|
| American shad (nonnative) | *Alosa sapidissima* | X | |
| Black bullhead (nonnative) | *Ictalurus melas* | X | |
| Bluegill (nonnative) | *Lepomis macrochirus* | X | |
| Brown bullhead (nonnative) | *Ictalurus nebulosus* | X | |
| Chinook salmon | *Oncorhynchus tshawytsha* | X | |
| Coastal cutthroat trout | *Oncorhynchus clarki* | X | |
| Coho salmon | *Oncorhnchus kisutch* | X | |
| Common carp | *Cyprinus carpio* | X | |
| Eulachon | *Thaleichthys pacificus* | | X |
| Green sturgeon | *Acipenser medirostris* | | X |
| Largemouth bass (nonnative) | *Micropterus salmodes* | X | |
| Mosquitofish (nonnative) | *Gambusia affinis* | X | |
| Northern anchovy | *Engraulis mordax* | X | |
| Pacific staghorn sculpin | *Leptocottus armatus* | X | |
| Prickley sculpin | *Cottus asper* | X | |
| Saddleback gunnel | *Pholis ornata* | X | |
| Shiner surfperch | *Cymatogaster aggregate* | X | |
| Small mouth bass (nonnative) | *Micropterus dolomieu* | X | |
| Starry flounder | *Platichthys stellatus* | X | |
| Steelhead trout | *Oncorhynchus mykiss* | X | |
| Surf smelt | *Hypomesus pretiosus* | X | |
| Threespine stickleback | *Gasterosteus aculeatus* | X | |
| Whitebait smelt | *Allosmerus elongatus* | | X |

One introduced species, the mosquitofish (*Gambusia affinis*), is a commonly used biological control for mosquitoes. Historically, mosquitofish were introduced into the Coquille River watershed. Since then, the species has spread into streams throughout the watershed including Bandon Marsh NWR.

Due to this species' intolerance of saline conditions, it is restricted to more freshwater habitat of the Refuge found along the fringing forested wetland or marine terrace seepage areas.

*3.2.3.5 Invertebrates*

Invertebrates are considered an important component of any habitat, including tidal ecosystems. Despite their importance to ecosystems as a whole, little is known about the ecology and biology of invertebrates (excepting mosquitoes) within Bandon Marsh NWR. A detailed understanding of how terrestrial and aquatic invertebrates contribute to the success of other estuarine organisms (e.g., plants, wildlife) is lacking. However, some systematic sampling of aquatic invertebrates has occurred on the Refuge as part of fish use studies in recent years, and Table 3-8 lists those taxa that have been identified. These data show that tidal marsh provides habitat for a wide variety of invertebrates including crab, shrimp, mussels, clams, snails, amphipods, worms, spiders, and insects.

**Table 3-8. Estuarine invertebrates identified within the Ni-les'tun Unit (USFWS unpublished data).**

| Taxa | Common Name |
|---|---|
| Amphipoda | scuds |
| Brachyura | crab, Dungeness crab |
| Caridea | grass shrimp |
| Cnidaria | jellies |
| Gastropoda | snails |
| Insecta: | |
| Coleoptera | diving beetles |
| Diptera | mosquito, midge, other flies |
| Hemiptera | water boatmen |
| Megaloptera | fishflies |
| Odonata | damselflies and dragonflies |
| Isopoda | isopod |
| Nematode | round worms |
| Oligochaeta | marine worms |
| Polychaeta | bristle worms |
| Veneroida | clams |

Mosquitoes

Mosquitoes are typical nematoceran dipterans with aquatic immature stages and aerial adult stages. Eggs must come in contact with water in order to survive. Mosquitoes have four larval stages (instars) and one aquatic pupal stage. The aerial adult emerges from the pupal stage onto the surface of the water, expands its wings, hardens its exoskeleton, and flies off. In general, it takes from 4–30 days for a mosquito to complete its life cycle, depending on seasonal and environmental factors and the species of mosquito (Alameda Mosquito Abatement District 2014). The biology, vector and potential, and pest ability of each mosquito species is different and influences decisions concerning control strategies.

Five species of mosquito were identified on Bandon Marsh NWR during the summer of 2013 (USFWS 2013b). The species included: *Aedes dorsalis, Aedes sticticus, Aedes cinereus, Culiseta particeps*, and *Culex tarsalis*. The most common (approximately 90% of all mosquitoes sampled and identified) and problematic mosquito species breeding within Bandon Marsh NWR (Ni-les'tun Unit) is *Aedes dorsalis*, the summer salt marsh mosquito. A multivoltine (producing multiple broods in a single season) species, it can produce numerous generations from flooding tides between April and October. Shallow pools of water filled by the highest tides of each month were found to be providing breeding habitat for salt marsh mosquitoes at extremely high levels in 2013. Dispersal paths are random, but the adult mosquitoes favor grassy areas for resting. These aggressive biters are capable of flying 15 or more miles from their natal marsh. In Utah, this species is known to harbor California encephalitis, and is a possible vector of western equine encephalitis and St. Louis encephalitis (Alameda Mosquito Abatement District 2014). *Aedes* species of mosquito are considered to be low to moderately efficient vectors for West Nile Virus. Salt marsh mosquitoes feed primarily on mammals and could play a secondary role in transmission of this disease (Goddard et al. 2002).

### 3.2.4 Noxious Plants and Exotic Animals

Historic use of the Coquille River and southern Oregon estuaries for the maritime industries and aquaculture has introduced and been a vector for the transport of marine invasive species which threaten the biological diversity of Bandon Marsh (Bax et al. 2003). Invasive plants and invertebrates such as Japanese eelgrass (*Zostera japonica*), smooth cordgrass (*Spartina alterniflora*), Asian tunicate (*Styela clava*), lacy crust bryozoan (*Conopeum tenuissimum*), Japanese orange-striped sea anemone (*Diadumene lineata*), Harris mud crab (*Rhithropanopeus harrisii*), European green crab (*Carcinus maenas*), Chinese mitten crab (*Eriocheir sinensis*), New Zealand burrowing isopod (*Sphaeroma quoianum*), New Zealand mud snail (*Potamopyrgus antipodarum*), Griffen's isopod (*Orthione griffenis*), and a variety of Asian and eastern United States clams have been recorded within the southern Oregon estuaries and within the lower Coquille River watershed and may occur on the Refuge (Dudoit 2006, Bilderback and Bilderback personal communication, Davidson et al. 2007, USGS 2009).

Nonnative mammals that occur or have the potential to occur include feral cats (*Felis catus*) and dogs (*Canis lupus familiaris*), Norway (*Rattus norvegicus*) and black rats (*Rattus rattus*), house mouse (*Mus musculus*), nutria, and opossum (*Didelphis virginiana*) (Table 3-5; USFWS unpublished data). Nonnative fish known or likely on the Refuge include mosquitofish, brown (*Ictalurus nebulosus*) and black bullhead (*Ictalurus melas*), largemouth (*Micropterus salmodes*) and smallmouth bass (*Micropterus dolomieu*), common carp (*Cyprinus carpio*), American shad (*Alosa sapidissima*), and bluegill (*Lepomis macrochirus*) (Table 3-7).

## 3.3 Human Environment

### 3.3.1 Cultural Resources

The Coquille River native people (the Nasomah) hunted, fished, and created river shoreline settlements for thousands of years (Byram and Shindruk 2010, Tveskov and Cohen 2007). The Coquille River provided native people a convenient transportation route to inland resources and access to the sea. Tributary streams and river side marshes were ideal locations for the use of fish traps or weirs (Byram 2002). Marsh and estuarine habitats have abundant waterfowl and adjacent dry uplands were suitable for constructing living quarters, hunting of land mammals and birds, and gathering of roots and berries. The banks of the lower Coquille River provided prime locations for prehistoric Native American villages and food procurement locations (Byram and Witter 2000).

The earliest Euro-American inhabitants of the Coquille River watershed were believed to be fur trappers, traders, and explorers. The first settlers established the present town site of Bandon in 1853. As the Euro-American population increased, it moved away from fur trading and diversified into fishing, forestry, and agriculture. In the early 1880s, the first cranberry bogs were planted in the area. Riparian timber was logged and the lowland areas were diked, drained, and then cleared for pasture and crop production. Upland forested areas were harvested and logs were transported by water using splash damming of streams, and by roads. The hydrology of the riverine and tidally influenced portion of the Coquille River was altered by dredging and maintenance for commerce and travel. Historic commerce activities in the lower Coquille River in the proximity of the town of Prosper, south of Bandon Marsh NWR's Ni-les'tun Unit, consisted of shipyards, lumber mills, salmon canneries, schools, and residential buildings (Byram and Shindruk 2010, Reid and Stroud 2003).

Within the approved boundary of the Bandon Marsh NWR, there are several recorded archaeological sites. Two of the sites are documented long-term occupation locations. Three sites have major midden components that may indicate occupation or food processing locations. The rest are single fish weirs or a complex of weirs in a discrete location. This pattern and density of sites extends both up and down river from the Refuge (Byram and Shindruk 2010, Byram et al. 2014).

### 3.3.2 Socioeconomics and Environmental Justice

The proposed project area is located along the southern Oregon coast in Coos County, approximately two miles north of the city of Bandon. Based on 2009 population data, Coos County has an estimated population of approximately 62,800 people (U.S. Department of Commerce 2011). From 1999 to 2009, the county population decreased by 0.3 percent, compared with an 11 percent increase for the entire state, and a 10 percent increase for the U.S. overall. County employment increased by two percent from 1999 to 2009, compared to an eight percent increase for the state, and an eight percent increase for the U.S. From 1999 to 2009, per capita income in Coos County increased by 13 percent, while Oregon and the U.S. increased by 4 and 9 percent respectively (U.S. Department of Commerce 2011). The population of Bandon decreased from 3,066 residents in 2010 to an estimated 3,046 residents in 2012 (U.S. Census Bureau 2013).

The largest industry sectors of Coos County include Local Government, Health Care and Social Assistance, and Retail Trade. The Coos County economy is also dependent on forestry products, fishing, agriculture, and tourism. As the economy shifts away from manufacturing forestry products, it is moving toward the service industry in support of its tourism industry. The largest employer is the combined state and local government. Natural resource-based industries (logging, sawmills, and support activities for agriculture and logging) totaled 1,890 jobs. Food services, retail stores, and hotels, which are impacted by refuge visitation, are also important contributors to the economy (3,899 jobs) (Minnesota IMPLAN Group, Inc. 2008).

Approximately 144,077 acres of Coos County was classified as farmland in 2007, a 13 percent decrease from 1997 (USDA 2007). In accordance with provisions of the Refuge Revenue Sharing Act, the USFWS makes annual payments to Coos County based on the appraised value of refuge lands and facilities. The 2012 refuge payment to Coos County for Bandon Marsh Refuge was $3,669. In 2010 there were roughly 4,800 visits to the Refuge (including both the Ni-les'tun and Bandon

Marsh units) and it was estimated that these users spent about $73,600 in the local community (USFWS 2013a).

### 3.3.3 Land Use

The Refuge was established "for the preservation and enhancement of the highly significant wildlife habitat of area known as Bandon Marsh, in the estuary of the Coquille River in the state of Oregon, for the protection of migratory waterfowl, numerous species of shorebirds and fish, including Chinook and silver salmon, and to provide opportunity for wildlife-oriented recreation and nature study on the marsh." The Refuge consists of 889 acres of lands managed to provide habitat for a variety of estuary-dependent and migratory wildlife species. The Service manages the Refuge consistent with the refuge missions and policies described in Section 1.2. Other than refuge approved recreational activities and operation and maintenance activities, no other land use exists on the Refuge. Management of this refuge has centered on protecting, improving, and increasing the amount of wetland habitat available for the residential wildlife species, estuarine-dependent fish, threatened and endangered species, and the thousands of waterfowl and tens of thousands of shorebirds that migrate and winter in the lower Coquille estuary.

*Public Use of the Refuge:* Several levels of public use occur on the Refuge, ranging from no activity in closed areas to seasonal waterfowl hunting, wildlife observation, photography, and interpretation. Over 4,700 people visit the Bandon Marsh NWR annually for the purposes of the annual shorebird festival, environmental education, waterfowl hunting, clamming and bird watching, and to hike the marsh trail at the Ni-les'tun overlook (USFWS 2013a). A large percentage of the Refuge is open to public access by foot or boat seasonally throughout most of the year.

*Surrounding Land Uses:* Bandon Marsh NWR is located within the long and narrow Coquille River estuary in Coos County along the southern Oregon Coast. Two cities are located on the shores of this estuary: Bandon (population about 3,000) is at the mouth, and Coquille (population about 3,800) about 19 miles upstream. The Bandon Marsh Unit is bordered by the Coquille River to the north and west, Riverside Drive to the east, and by tidal marsh and mudflats to the south. The North Spit of the Coquille River, including Bullards Beach State Park, is directly across the river from the Bandon Marsh Unit. The southernmost portions of the Bandon Marsh Unit are also within Bandon city limits. The Ni-les'tun Unit is on the north bank of the Coquille River and bounded by U.S. Highway 101 to the west; North Bank Lane, East Fahy Road, and a quarry, small tracts of rural residential, or forestland to the north; and private muted tidal marsh to the east. There are numerous homes, farms, and businesses immediately adjacent to the Refuge that would be affected by refuge management, with respect to habitat enhancement that would affect on-refuge mosquito production.

The estuary has historically been the hub of agriculture, navigation, commerce, recreation, and fisheries in the Coquille River Valley. Forest products, tourism, fishing and agriculture dominate the Coos County economy. Consequently, the forested uplands have historically been utilized for timber production and cranberry operations, while the alluvial valleys support agricultural operations, including beef, sheep, and dairy production.

### 3.3.4 Human Health and Safety Concerns

Coos County does not have a mosquito abatement district that is funded through taxes and fees to provide a service to the residents of the Bandon area. The control of mosquitoes has not been conducted by the county in the past because health threats (e.g., nuisance, mosquito-borne diseases) have not been a major concern in this area. Due to this lack of need, little to no background data is available on mosquito-borne diseases in Coos County (Rick Hallmark, Coos County Public Health Department, personal communication 2012). The Coos County Public Health Department staff received numerous requests for mosquito relief in the summer of 2013 and responded to documented allergic reactions from bites and public distress by issuing a health advisory and subsequently working with the Service to treat larval mosquitoes on the Ni-les'tun Unit of Bandon Marsh NWR (USFWS 2013b).

Below is a summary of the types of mosquito-borne diseases that have occurred in western Oregon in the past and have the potential to occur in the future.

*West Nile Virus (WNV):* Despite the number of human infections, WNV is primarily a wildlife disease. The virus is spread by mosquitoes from bird to bird. Mammals, including humans, are only incidentally infected. This may change as new mosquito vectors are identified. The transmission cycle initially involves only birds and is infectious for only three to five days. WNV is especially virulent in elderly and those with a compromised immune system. Although the potential to carry WNV is being detected in additional species of mosquitoes, the freshwater *Culex tarsalis* is still the primary transmission vector. WNV is the only documented primary mosquito-borne diseases known to occur in Coos County (Rick Hallmark, Coos County Public Health, personal communication 2012). One human case of WNV was documented in the city of Bandon in 2012; however, the location of where the individual contracted the disease is unclear (Rick Hallmark, Coos County Health Department, personal communication 2014). In addition, statewide surveys are conducted in order to detect the presence of WNV in mosquito and bird populations. In recent years, WNV has become more prevalent within the eastern portion of the state of Oregon. As Oregon moves to a more global economy and lifestyle, the potential for outbreaks of mosquito-borne diseases imported from other countries is likely to increase.

*Malaria*: Historic documents concerning mosquitoes and mosquito-borne diseases in Oregon focus on the presence of malaria and large nuisance populations of mosquitoes affecting the first immigrants and settlers. The most severe mosquito disease and pest outbreaks of the 1800s occurred in the Columbia River region and Willamette Valley of Oregon (Kohn 2008). In the mid-1920s mosquito control focused around problem areas of the Columbia and Willamette Rivers adjacent to the City of Portland (USDA 1972). Malaria was most likely never a major issue along the coastal areas probably because the climate was not sufficiently warm for a continuous period of time.

Malaria is caused by a blood parasite (*Plasmodium*) that is transmitted by mosquitoes. Immigrants and visitors from countries where malaria is endemic may act as parasite reservoirs and import the disease. In the Coos County area, mosquitoes are not monitored for the presence of malaria. Instead, the counties rely on state health departments to notify them of apparent malaria cases.

### 3.3.5 Aesthetics

#### *3.3.5.1 Scenery*

Numerous studies have attempted to assign economic benefits to wetlands and open space, but it is extremely difficult to quantify the value of scenery for aesthetic purposes. The draw and attachment that residents and visitors have for the southern Oregon coast area is largely due to the beauty of the remote beaches and the large amounts of open space created by local estuaries. Bandon Marsh NWR contributes to the aesthetic value of the city of Bandon with its large tracts of wetlands and undeveloped open space. Refuge wetlands support fish important to sport and commercial fisheries, improve water and air quality, help mitigate floods, support wildlife, and provide outdoor recreation opportunities. In addition, people enjoy wetlands for their beauty, wildness and solitude, and the constantly changing appearance due to the rise and fall of the tides.

*3.3.5.1 Noise*

Noise levels vary throughout the Refuge depending on proximity to roads and U.S. Highway 101 and adjacent land uses. The Refuge area is rural in nature and is generally outside of the Urban Growth Boundary of the city of Bandon. Human sources of sound include traffic on U.S. Highway 101, Riverside Drive, and North Bank Lane, motorized boat traffic on the Coquille River, aircraft overflights, and occasional target shooting or waterfowl hunting.

# Chapter 4. Environmental Effects Analysis

## 4.1 Overview of Effects Analysis

This chapter provides an analysis of the environmental consequences of implementing the alternatives described in Chapter 2. Impacts are described for the main aspects of the environments described in Chapter 3, including physical, biological, cultural, and socioeconomic resources. Refuge staff experience, existing databases and inventories, relevant plans, results of past and current research, and consultations with other professionals were used for this analysis.

For the most part, boundaries for analysis of potential direct, indirect, and cumulative effects were at the project area level. Cumulative impacts, including impacts to refuge resources from reasonably foreseeable events and impacts resulting from interaction of refuge actions with actions taking place outside the Refuge, are addressed in the final section of this chapter.

The terms below were used to describe the scope, scale, and intensity of effects on natural, cultural, social (including recreational), and economic resources. Effects may be identified further as beneficial or negative.

***Neutral or Negligible.*** Resources would not be affected (neutral effect) or the effects would be at or near the lowest level of detection (negligible effect). Resource conditions would not change or would be so slight there would not be any measurable or perceptible consequence to a population; fish, wildlife, or plant community, or other natural resources; recreation opportunity; visitor experience; or cultural resource. If a resource is not discussed, impacts to that resource are considered to be neutral.

***Minor.*** Effects would be detectable within the Refuge, but localized, small, and of little consequence to a population; fish, wildlife, or plant community, or other natural resources; social and economic values, including recreational opportunity and visitor experience; or cultural resources. Mitigation, if needed to offset adverse effects, would be easily implemented and likely successful, based on knowledge and experience.

***Moderate.*** Effects would be readily detectable and localized, with measurable consequences to a population; fish, wildlife or plant community, or other natural resources; social and economic values, including recreational opportunity and visitor experience; or cultural resources within the Refuge, but not readily detectable or measurable beyond the Refuge. Mitigation measures would likely be needed to offset adverse effects and could be extensive, moderately complicated to implement, and probably successful based on knowledge and experience.

***Major.*** Region-wide effects would be obvious and would result in substantial consequences to a population; fish, wildlife, or plant community, or other natural resources; social and economic values including recreation opportunity and visitor experience; or cultural resources. Extensive mitigating measures may be needed to offset adverse effects and would be large-scale in nature, possibly complicated to implement, and may not have a high degree of probability for success. In some instances, major effects would include the irretrievable loss of the resource.

Time and duration of effects have been defined as:

***Short-term or Temporary.*** An effect that generally would last less than a year or season.

***Long-term.*** A change in a resource or its condition that would last longer than a single year or season.

## 4.2 Summary of Effects

The alternatives are compared side by side under each topic, and both the positive and negative effects of implementing each alternative are described. Table 4-1 provides an overview of the effects under each alternative by indicator. The effects related to implementing each alternative are described in terms of the change from current conditions (i.e., the environmental baseline). Alternative A, the No Action alternative would continue present management actions. However, the consequences of implementing Alternative A may have beneficial, negligible, or negative effects.

**Table 4-1. Summary of effects.**

| | **Alternative A (No Action)** | **Alternative B (Preferred)** |
|---|---|---|
| EFFECTS TO PHYSICAL ENVIRONMENT | | |
| Soils and geology | Negligible short-term; minor to moderate positive long-term | Minor negative short-term; minor to moderate positive long-term |
| Hydrology and water quality | Minor negative to negligible short-term; minor positive long-term | Minor negative short-term; moderate positive long-term |
| Air quality | Negligible short- and long-term | Minor negative short-term; negligible long-term |
| EFFECTS TO BIOLOGICAL ENVIRONMENT | | |
| Vegetation | Negligible to minor positive short-term; minor to moderate positive long-term | Minor negative short-term; minor to moderate positive long-term |
| Threatened and endangered species | Coho salmon: minor negative to moderate positive short- and long-term<br>Marbled murrelet and western snowy plover: negligible short- and long-term<br>Eulachon and green sturgeon: neutral to negligibly positive short- and long-term | Coho salmon: minor negative impact short-term; moderate positive long-term<br>All other threatened and endangered species: same as Alternative A |

| | Alternative A (No Action) | Alternative B (Preferred) |
|---|---|---|
| Key fish and wildlife species | Negligible to minor positive short-term; minor to moderate positive long-term | Birds: Minor negative to negligible short-term; minor to moderate positive long-term<br>Mammals: Minor negative to negligible short-term; negligible long-term<br>Reptiles and amphibians: Negligible short- and long-term<br>Fish: Minor negative to negligible short-term; moderate positive long-term<br>Invertebrates: Negligible short-term; negligible to minor positive long-term |
| Noxious plants and exotic species | Minor negative to negligible short-term; moderate negative to negligible long-term | Negligible to minor positive short-term; moderate negative to negligible long-term |
| EFFECTS TO HUMAN ENVIRONMENT | | |
| Cultural and historic resources | Negligible short- and long-term | Negligible short- and long-term |
| Social and economic resources | Moderate to minor negative short- and long-term | Negligible to minor positive short-term; minor positive long-term |
| ADDITIONAL EFFECTS | | |
| Cumulative Effects | Negligible to minor positive short- and long-term | Moderate positive short- and long-term |

## 4.3 Effects to the Physical Environment

### 4.3.1 Effects to Soils and Geology

Alternative A – No Action

Under Alternative A, the No Action alternative, USFWS would allow natural processes including erosion, sediment deposition, and channel migration to occur, without any additional active physical manipulations. Prior to the restoration completed in 2011, soils within the Ni-les'tun Unit had about half the organic matter content compared to the reference site (Bandon Marsh Unit), and were much less saline (Brophy and van de Wetering 2012). The project area had also experienced subsidence (elevation loss). Subsidence is common at diked tidal wetlands in Oregon; it is caused by organic matter oxidation, buoyancy loss, and compaction associated with drainage, grazing, and other land use activities (Frenkel and Morlan 1991). Over the long term, implementing Alternative A would lead to minor to moderate positive effects as sediment deposition, organic matter accumulation, and plant succession would result in increased land elevations and soil characteristics (e.g., stored organic carbon, salinity, pH, texture) more similar to reference site conditions.

Alternative B – Preferred Alternative

Under the Preferred Alternative, the additional creation of low-order tidal channels would allow for increased conveyance of sediment within the project area. However, there would be short-term, localized soil disturbance during the construction period from excavation equipment. Low ground pressure equipment and/or construction pads would be used to minimize compaction and other surface disturbance. Many first-order channels would be excavated by hand, and resulting ground disturbance is expected to be negligible. Spoil from the new channels would be dispersed over the existing surface at shallow (under 6") depths which would temporarily disturb vegetation. Overall, short-term effects of the Preferred Alternative on soil resources are expected to be minor and negative. Long term, implementation of the Preferred Alternative would hasten the development of beneficial effects on the natural soils and soil processes described in Alternative A due to improved water circulation, resulting in a minor to moderate positive effect.

### 4.3.2 Effects to Hydrology and Water Quality

Alternative A – No Action

The primary geomorphic features of a tidal marsh include: (1) a gently-sloping mudflat, (2) a channel network, and (3) a marsh plain. The evolution and morphological characteristics of these features respond to: (1) the input of suspended sediment in tidal water, (2) the physical effects of dominant vegetation, (3) the input of wave and tidal energy, and (4) relative rise of sea level. Essentially, tidal marshes are the physical expression of the equilibrium between stress (wave and tidal) and strength (of cohesive sediments and vegetation). Tidal channel networks serve to distribute the dissipation of wave and tidal energy over space (Coats et al. 1995).

Under natural conditions, channels in tidal marshes generally evolve from channels developed initially on an unvegetated mudflat (Pestrong 1965). Channels within a newly-dissected mudflat are typically comprised of few widely-spaced and roughly parallel first- and second-order channels. Once vegetation has invaded the mudflat, it protects sediment on channel banks, as well as the developing marsh plain, from erosion. Channels become more stable; lateral migration proceeds by undercutting and bank caving. Head-cutting, or the erosion of the heads of channels into the marsh plain, may occur due to the increased hydraulic gradient between the vegetated marsh and the mudflat. Once the vegetated marsh plain has developed, the channels may incise, thus concentrating flow across the mudflat. Thus, in a mature marsh, vegetation plays a dominant role in processes of channel change.

One of the design goals for the Ni-les'tun Unit restoration phase completed in 2011 was to, as closely as possible, approximate natural systems in order to increase the long-term potential for effective tidal marsh functioning. Empirical tidal channel morphometric data were collected within the following unaltered emergent and shrub-dominated tidal wetlands within Oregon: wetlands between the Siletz River and Millport Slough [River Mile (RM) 0.9–1.8]; wetlands west of the confluence of the Alsea River and Drift Creek (RM 4.4–5.0); wetlands between the Siuslaw River and South Slough, east of Cox Island (RM 7.3–8.2); and wetlands along the east side of the Coquille River in the Bandon Marsh Unit of Bandon Marsh NWR (RM 2.3–3.5) (So et al. 2009). These data were used to inform tidal channel geometry and layout design. During the restoration phase completed in 2011, the approach was to design and build the third- and fourth-order channels to connect with larger slough/channels, and let natural sedimentation and erosion create the marsh plain with incised first- and second-order channels.

Under the No Action alternative, natural processes would continue to modify the tidal channel network and hydrology of the site, including the long-term development of first- and second-order channels, leading to a minor positive impact. The lack of active physical manipulation of the site would have a negligible effect on water quality. In the short term, however, the depressions or pools which formed subsequent to the completion of the prior restoration actions would continue to strand shallow water following the highest tides of each month (minor negative effect). While in the long term, these pools would naturally connect to the tidal channel system, the implementation of Alternative A would preclude any active physical manipulation of the site hydrology to advance the development of the channel network.

Alternative B – Preferred Alternative

Under Alternative B, the tidal channel network would be expanded via the excavation of small, sinuous first- and second-order channels. This would increase drainage density (i.e., the amount of tidal channels per area of marsh) and the volume of tidal water exchange, which would improve the drainage of currently disconnected depressions. Anticipated effects over the long term would be moderately positive. In the short term, construction activities requiring the use of heavy equipment to move earth and excavate the channels could lead to an increase in the contribution of sediment to the estuary. These activities also bring the risk of water contamination with petroleum products. However, the implementation of PDC associated with all construction activities would reduce the likelihood of excess sedimentation and contamination. Additionally, the use of low ground pressure equipment would reduce compaction and minimize the creation of unwanted depressions. Overall, implementation of Alternative B is expected to have moderate positive long-term impacts to hydrology and water quality.

### 4.3.3 Effects to Air Quality

Alternative A – No Action

Continuing the current management (Alternative A) would have negligible, if any, effects to air quality. With the lack of mosquito control via habitat modification, it can reasonably be expected that control would rely on the repeated use of pesticides by the Service, county, or others. The use of motorized land and air vehicles for pesticide application may contribute to air pollution, albeit negligibly.

Alternative B – Preferred Alternative

There would be limited, short-term impacts to air quality during restoration activities on the project area related to the use of heavy equipment. Most of the soil disturbing activities would occur in moist or wet soils and would therefore not generate much airborne dust. Heavy equipment operating on the project area would generate diesel fumes, but these impacts would dissipate quickly and would not occur after the conclusion of restoration activities. These short-term impacts are considered minor and localized. Long-term impacts would be negligible. To the degree that the proposed action would reduce the need for pesticide applications for mosquito control, air quality impacts of applicator equipment would be reduced.

## 4.4 Effects to the Biological Environment

### 4.4.1 Effects to Vegetation

Alternative A – No Action

Under the No Action alternative, plant communities indicative of Pacific Northwest tidal wetlands including Lyngby's sedge, seashore saltgrass, pickleweed, Pacific silverweed, and tufted hairgrass would, over the long term, continue to become established on the site while the proportion of nonnative plant species would continue to decline.

Alternative B – Preferred Alternative

Under Alternative B, restoration actions may temporarily disturb existing vegetation communities. PDC aimed at restoring areas impacted by construction would be applied (Appendix A). However, after new low-order tidal channels are excavated, native plant communities would colonize the disturbed areas and subsequently play an important role in the processes affecting channel morphology change. With an increase in the density of tidal channels, the effect on vegetation across the project area is expected to be minor to moderately positive in the long term. The differences between channel/creekside and marsh plain vegetation have been quantified by various wetland scientists (e.g., Bradley and Morris 1990). Channel/creek edges are extremely productive because of the circulation provided by flowing water. Sediments are more readily oxygenated, salinities are more stable at lower intertidal elevations, more nutrients are supplied, and toxic materials are washed away. Anoxia is less likely to develop, so sulfides do not build up and nitrogen may be taken up more readily (Coats et al. 1995).

Under this alternative, plant disturbance related to mosquito monitoring and control activities within the marsh would be minimized, as the need for and intensity of those activities would be reduced due to mosquito control via habitat modification. With an increase in the density of tidal channels throughout the site due to the proposed action, the effect on vegetation across the project area is expected to be minor to moderately positive in the long term.

No sensitive species of plants are known to occur within the restoration area. Therefore, there would be no effect on this resource by the Preferred Alternative. Plant disturbance related to mosquito monitoring and control activities within the marsh would be minimized as the need and intensity of those activities reduced due to mosquito control via habitat modification.

### 4.4.2 Effects to Threatened and Endangered Species

Alternative A – No Action

Marbled murrelet may occasionally fly over the Refuge during flights from inland forests to their foraging habitat of coastal ocean waters. Flyovers most likely would occur during the night. No murrelets have ever been documented on or over the Refuge due to these nocturnal life history parameters and the chances of observation are extremely rare. The effect of current management on marbled murrelet would be negligible.

Western snowy plovers are found on open sandy beaches along the Oregon coast. A small breeding population occurs on the beach approximately 2–3 miles south of Bandon. Because of their preference for sandy substrates on the Oregon coast they are rarely found within estuaries here. In the Coquille River estuary there is a single record of a bird observed in the Bandon Marsh Unit of the Refuge on August 14, 2002. There have been no observations of snowy plovers on the Ni-les'tun Unit pre- or post-restoration and suitable habitat is not present. The effect of current management on snowy plovers would be negligible.

Under current management, recent habitat modifications (e.g., estuary restoration, large wood placement) to provide cover and quality habitat for Oregon Coast coho salmon to improve health and survival would result in moderate positive impacts in the long term. However, the disconnected pools in depressions which form following high tides could lead to some fish entrapment and mortality, potentially leading to a minor negative impact.

Willson et al. (2006) listed the Coquille River drainage on the coast of Oregon as supporting eulachon spawning runs. Gaumer et al. (1973) recorded the taking of 28 eulachon in June 1971 by recreational fishers at the city docks of Bandon in the Coquille River estuary. Kreag (1979) also lists eulachon as occurring in the marine portion of the Coquille River estuary. Eulachon may occasionally swim within the estuary waters of the Refuge during runs within the Coquille River but have not been documented there during multiple surveys. Green sturgeon may also occasionally use the estuary waters of the Refuge within the lower Coquille River as habitat requirements of the species currently exist in this estuary. Overall, the effect of current management on eulachon and green sturgeon would be neutral to negligibly positive.

<u>Alternative B – Preferred Alternative</u>

The effects of implementing Alternative B on marbled murrelet, western snowy plover, eulachon, and green sturgeon are similar to Alternative A. There are two avenues through which coho salmon could be affected by the Preferred Alternative: minor temporary negative effects associated with construction and long-term positive effects associated with fish habitat restoration and function. Short-term construction activities that could affect coho salmon include in-water work, but would be mitigated by isolating active work areas and turbid water from fish-bearing waters. In addition to the potential for fish entrapment, these actions are all potential sources of sediment. However, because the site is a relatively low energy environment, erosion generated sedimentation issues and consequent adverse impacts to coho are expected to be minor. Other factors that could affect water quality include the accidental discharge of pollutants such as oil or grease from equipment. These effects would be localized and implementation of PDC (e.g., erosion control, fish salvage, use of biodegradable hydraulic oil and off-site refueling and maintenance; Appendix A) would essentially prevent or reduce adverse impacts. Even if fish rescue was not effective and construction of the Preferred Alternative were to result in the loss of a small number of rearing juvenile coho salmon this would be considered a less-than-significant impact because smolt production within the Coquille River is well over 100,000 individual smolts in most years (Nickelson 2001). Positive long-term impacts are associated with overall increases in habitat availability, quality, and access and improvements to water quality. While the Preferred Alternative would increase the overall quality of estuarine habitat available, this increase is not considered significant in the context of ongoing and historic degradation. Therefore, when all elements are combined, the Preferred Alternative is considered to have a minor negative impact on listed coho salmon during construction. The long-term operational effect of the Preferred Alternative is considered a moderately beneficial impact.

### 4.4.3 Effects to Key Wildlife and Fish

<u>Alternative A – No Action</u>

Under Alternative A, as the marsh continues to respond to the restoration, wildlife and fish habitats would gradually shift to favor estuarine-dependent species. No significant short- term effects are expected. In the longer term, ponded water at low tides would reduce due to sedimentation and the development of drainage channels, and use of this habitat would shift with the changing hydrology. For example, puddle dabbling duck use would likely decrease, and shorebird use may increase until the former ponds become fully vegetated.

Alternative A would likely result in reliance on pesticides for mosquito control for the multiple years it would take for the mosquito breeding habitat on the Refuge to degrade through natural processes. This increases the chance that pesticides would be used off-refuge by surrounding landowners, and the possibility that those pesticides are more harmful than those approved for use by the Refuge. Under this scenario, negative, but negligible long-term effects could occur, especially to non-target invertebrates and fish. These effects would be negligible because they would likely be localized and occur over relatively small areas.

<u>Alternative B – Preferred Alternative</u>

Consistent with restoration's goal of benefiting estuarine-dependent species, this alternative would substantially accelerate the transition to a fully functioning tidal marsh. However, as with any change of habitat characteristics, some species benefit at the expense of others. Each key fish and wildlife taxonomic group is considered below.

*4.4.3.1 Birds*

The restoration has resulted in a large increase in aquatic bird use of the Ni-les'tun Unit since tidal influence was re-established (USFWS unpublished data). Implementation of the Preferred Alternative is likely to have a long-term minor to moderate positive effect on bird use, similar to Alternative A, with a few possible exceptions:

1. During the channel construction, equipment traffic may damage or destroy nests of marsh wrens, savannah sparrows, and possibly other less common species' nests because construction is expected to overlap nesting season. Temporary disturbance of any birds in the vicinity of construction activity would occur. These effects to these species' local populations are expected to be negligible to minor negative in the short term.
2. Altering the hydrologic characteristics of the mosquito breeding pools so that they drain during low tides would shorten the length of time that such ponds are available to ducks that now use them as low tide refugia. To the extent that the depressions remain free of dense vegetation as they are now, draining them may increase foraging habitat for shorebirds. The associated creation of additional tidal channels would increase foraging habitat for shorebirds and waders within those channels. This effect would likely be minor.
3. The reduction of mosquitoes at all life stages, a goal of the project, would alter foraging patterns of birds that feed on the larval stage (e.g., shorebirds) and on the adults (e.g., swallows). Due to the availability of alternate prey for these birds and the short time the local

populations have had to adjust to the mosquito abundance, these effects would be negligible to minor.

*4.4.3.2 Mammals*

During the channel construction, equipment traffic may damage or destroy small mammal nests, runs, and burrows, especially those of Townsend's vole, the most abundant species on the marsh table. Such disturbance may result in mortality, but is considered negligible to minor to the local population. To the degree that inundation regimes determine small mammal distribution on the marsh, altering the hydrology may cause minor shifts in distribution as individuals move to higher ground to avoid tidal flooding. Carnivores such as weasels and coyotes may adjust their foraging patterns as their resources adjust to the new channels. These effects are expected to be negligible in the long term.

*4.4.3.3 Reptiles and Amphibians*

Representatives of these taxa are sensitive to aquatic salinity, and as the new channels improve circulation of tidal waters higher in the marsh, these species would be pushed closer to fresh water sources, resulting in a minor reduction of habitat available. Populations of all these species are dependent on upland and fresh water habitats located above the tidally influenced habitats, the total acreage of which would be only slightly changed. Therefore, effects on local populations of reptiles and amphibians are expected to be negligible.

*4.4.3.4 Fish*

The restoration has resulted in a dramatic increase of use by estuarine species of fish, including salmonids (Silver et al. 2012). Implementation of the Preferred Alternative is expected to moderately enhance that effect by increasing physical channel habitat, increasing availability of marsh table foraging habitat, and increasing nutrient exchange between the marsh primary producers and aquatic animals. Implementation of PDC (Appendix A) would keep short-term negative effects to minor to negligible levels.

*4.4.3.5 Invertebrates*

The Preferred Alternative would drastically reduce the amount of shallow pools with limited tidal interchange. Thus, any invertebrates that depend on this habitat, particularly salt marsh mosquitoes, would be reduced as well. It is reasonable to expect that the increase in channel habitat would benefit other invertebrate species, which may compensate for the loss of ecological function provided by the salt marsh mosquitoes (e.g., as a prey species). The net effect is expected to be negligible to minor positive in the long term.

### 4.4.4 Effects to Noxious Plants and Exotic Animals

<u>Alternative A – No Action</u>

The proportion of the plant community that is nonnative marsh plants would decline gradually as the marsh continues to adapt to salt water intrusion resulting from the restoration. A negligible effect to exotic animal populations such as mosquitofish and nutria is expected under this alternative.

<u>Alternative B – Preferred Alternative</u>

The disturbance to marsh soils and plants resulting from the construction process would likely promote establishment or spread of some noxious plants in the short term, but improved tidal function resulting from the new channels should hasten the re-establishment of native plants in the long term. Improved tidal circulation in the higher marsh elevations would also hasten the process of a general reduction in nonnative plants in the community. PDC that minimize the spread of noxious plants would be followed (Appendix A).

Implementation of the Preferred Alternative is expected to have negligible effects to exotic animal populations, with the possible exception of reducing the habitat of mosquitofish by increasing the salinity of some of their current habitat to levels above their tolerance.

## 4.5 Effects to Cultural and Historic Resources

Preserving the culture and history of the nation's past are the goals of regulations that include the National Historic Preservation Act (NHPA), Antiquities Act of 1906, Archeological Resource Protection Act of 1979, and Historic Sites Act of 1935. The NHPA regulations require that federal agencies seek information, as appropriate from the State Historic Preservation Officer (SHPO), Indian tribes, and other individuals and organizations likely to have knowledge of, or concerns with, historic properties in the potentially affected area. Cultural resources defined within the framework of these regulations include archeological sites, historic sites, and traditional cultural properties associated with the values of Native Americans and other cultural groups.

Actions that physically disturb a site, alter its setting, or introduce elements out of character with the site may constitute an adverse effect. If a site is eligible for inclusion in the National Register of Historic Places, any type of physical damage results in a permanent loss of information that reduces the understanding of the site's contribution to the past.

<u>Alternative A – No Action</u>

Under the No Action alternative, the current management of the Ni-les'tun Unit is not expected to impact cultural resources because no alteration to the character, setting, or use of cultural resources due to ground disturbing activities would occur.

<u>Alternative B – Preferred Alternative</u>

Under Alternative B, tidal channel construction activities including earthmoving, excavation, and the alteration of current erosion patterns has the potential to adversely affect historic cultural resources or archaeological sites. The USFWS would pursue compliance with the appropriate cultural resource laws, principally the NHPA. That effort would include implementation of a pre-construction survey and construction monitoring protocol. Implementation of these procedures would ensure that negative impacts to cultural resources from implementation of the Preferred Alternative are negligible.

Monitoring of all on-site work would be conducted by individuals with appropriate cultural and archaeological knowledge. Whenever possible, discovered resources would be avoided or protected through implementation of in situ site stabilization techniques. When sites cannot be avoided, documentation and data recovery efforts would be implemented. Monitoring and discovery plans would be developed by the USFWS with input from Tribes and SHPO prior to construction.

## 4.6 Effects to Social and Economic Resources

NEPA requires a discussion of a proposed action's potential social and economic effects.

Alternative A – No Action

Under the No Action alternative, the current management of the Ni-les'tun Unit would lead to minor to moderate negative impacts as the presence of small impounded depressions or pools of water, which develop on the marsh after the highest tides of each month, would continue to provide breeding habitat for salt marsh mosquitoes. As documented in the 2013 post-treatment NEPA compliance documentation for the "MetaLarv S-PT Treatment on the Ni-les'tun Unit of Bandon Marsh NWR," the high numbers of mosquitoes found in impounded water bodies on the Refuge created concerns within the community about the public health and safety of local residents and visitors to the Bandon area (USFWS 2013b). Under the No Action alternative, high mosquito densities and associated social and economic impacts would likely persist. These impacts would create public pressure to control mosquitoes with pesticides, either applied by a mosquito abatement district which currently does not exist, or piecemeal by private citizens poorly-equipped to effectively, broadly, and safely apply pesticides. The social and economic impacts of Alternative A may include lower quality of life for residents and visitors of mosquito-infested areas, reduced tourism and lower patronage of businesses and attractions located (or perceived to be) within mosquito-infested areas, increased public exposure to health risks associated with mosquito bites and mosquito pesticides, and societal tensions among stakeholders related to conflicting perspectives about how to deal with nuisance mosquitoes.

With the lack of mosquito control via habitat modification, it can reasonably be expected that mosquito control would rely on the repeated use of pesticides.

There would be no changes to the noise on the project area as a result of the No Action alternative. This alternative would have no effect on noise resources or sensitive receptors.

Alternative B – Preferred Alternative

Under the Preferred Alternative, the construction of low-order tidal channels would lead to an overall reduction in mosquito breeding habitat and constitute the primary salt marsh mosquito control method. Successful mosquito control via habitat reduction would preclude the negative social and economic effects listed above for the No Action alternative, leading to a net minor positive long-term effect.

Short-term local economic benefits of this alternative would primarily stem from construction expenditures that would bring business to local contractors, retail outlets, hospitality businesses, and other services needed to support the project. The total amount of this economic benefit would depend on many factors including; the cost of construction, whether the primary contractor would be local or from outside the region, and the duration of the project, none of which have yet been determined.

Construction activities associated with implementation of the Preferred Alternative would temporarily increase the amount of noise on the project area when those activities involved heavy equipment. Noise levels have not been determined, but would be considered to impact local sensitive noise receptors. Because work would occur for a limited period of time and during defined time periods, the Preferred Alternative is considered to have a minor negative short-term effect on noise levels and sensitive receptors.

## 4.7 Cumulative Effects

The Council on Environmental Quality (CEQ) regulations for implementing the provisions of NEPA defines several different types of effects that should be evaluated in an EA including direct, indirect, and cumulative. Direct and indirect effects are addressed above. This section addresses cumulative effects. The CEQ (40 CFR § 1508.7) provides the following definition of cumulative effects:
"The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions."

Cumulative impacts are the overall, net effects on a resource that arise from multiple actions. Impacts can "accumulate" spatially, when different actions affect different areas of the same resources. They can also accumulate over the course of time, from actions in the past, the present, and the future. Occasionally, different actions counterbalance one another, partially canceling out each other's effect on a resource. But more typically, multiple effects add up, with each additional action contributing an incremental impact on the resource. In addition, sometimes the overall effect is greater than merely the sum of the individual effects, such as when one more reduction in a population crosses a threshold of reproductive sustainability, and threatens to extinguish the population.

The Ni-les'tun restoration project is the largest, but not the sole example of past and proposed tidal marsh restoration within the Coquille River basin, which is the most salient ecological unit within which cumulative effects should be considered. Given the historical loss of tidal wetlands in the basin, restoring additional area would result in an incremental positive effect on tidally influenced marsh-dependent species due to an increase in habitat availability. For example, the Oregon Coast Coho Conservation Plan (ODFW 2007) identifies the lack of off-channel wintering habitat as a limiting factor for the Coquille River population. This means that as each additional acre of tidal marsh is made available to juvenile coho, there would be some incremental increase in fish survival to adulthood. In the case of the Preferred Alternative within this SEA, the physical area of the marsh would not be increased, however, the quality of the habitat would be improved such that each acre would support, on average, more individuals of estuarine-dependent species (e.g., adding approximately 40,000 linear feet of new tidal channels would increase fish access to the marsh). This benefit is cumulative to past and potential tidal marsh restoration projects in the Coquille River Basin.

A separate, concurrent NEPA process being conducted by the USFWS is analyzing the potential effects of pesticide treatment of mosquitoes on the Refuge (USFWS 2014). If approved and implemented, the cumulative impact of pesticide treatment and the restoration project described in this document would comprise the Service's integrated approach to mosquito management. This two-pronged approach would result in a moderately positive impact on the human environment within the Refuge's sphere of influence by reducing mosquito breeding habitat on the Refuge.

# Appendix A. Project Design Criteria - General Construction Measures (NOAA 2013)

**1. Project Design**

a. Use the best available scientific information regarding the likely effects of climate change on resources in the project area, including projections of local stream flow and water temperature, to ensure that the project will be adaptable to those changes.
b. Obtain all applicable regulatory permits and official project authorizations before beginning construction.
c. Minimize the extent and duration of earthwork, *e.g.*, compacting, dredging, drilling, excavation, and filling.
    i. Avoid use of heavy equipment, vehicles or power tools below bank-full elevation unless project specialists determine such work is necessary, or will result in less risk of sedimentation or other ecological damage than work above that elevation.
    ii. Complete earthwork in wetlands, riparian areas, and stream channels as quickly as possible.
d. Cease project operations when high flows may inundate the project area, except for efforts to avoid or minimize resource damage.

**2. Site Contamination Assessment**

a. The level of detail and resources committed to such an assessment will be commensurate with the level and type of past or current development at the site. Assessments may include the following:
    i. Review available records, such as former site use, building plans, and records of any prior contamination events.
    ii. If the project site was used for industrial processes (*i.e.*, mining or manufacturing with chemicals), inspect to determine the environmental condition of the property.
    iii. Interview people who are knowledgeable about the site, *e.g.*, site owners, operators, and occupants, neighbors, or local government officials.
b. Retain contaminant survey information in the project file. Consult with NMFS if ground disturbance to accomplish the proposed project will potentially release contaminants to aquatic habitat that supports listed fish species.

**3. Site Layout and Flagging**

a. Before any significant ground disturbance or entry of mechanized equipment or vehicles into the construction area, clearly mark with flagging or survey marking paint the following areas:
    i. Sensitive areas, *e.g.*, wetlands, water bodies, ordinary high water, spawning areas
    ii. Equipment entry and exit points
    iii. Road and stream crossing alignments
    iv. Staging, storage, and stockpile areas
b. Before the use of herbicides, clearly flag no-application buffer zones.

**4. Staging, Storage, and Stockpile Areas**

a. Designate and use staging areas to store hazardous materials, or to store, fuel, or service heavy equipment, vehicles and other power equipment with tanks larger than 5 gallons, that are at least 150 feet from any natural water body or wetland, or on an established paved area, such that sediment and other contaminants from the staging area cannot be deposited in the floodplain or stream.
b. Natural materials that are displaced by construction and reserved for restoration, *e.g.*, large wood (LW), gravel, and boulders, may be stockpiled within the 100-year floodplain.
c. Dispose of any material not used in restoration and not native to the floodplain outside of the functional floodplain.
d. After construction is complete, obliterate all staging, storage, or stockpile areas, stabilize the soil, and revegetate the area.[1]

**5. Erosion Control**

a. Use site planning and site erosion control measures commensurate with the scope of the project to prevent erosion and sediment discharge from the project site.
b. Before significant earthwork begins, install appropriate, temporary erosion controls downslope to prevent sediment deposition in the riparian area, wetlands, or water body.
c. During construction, if eroded sediment appears likely to be deposited in the stream during construction, install additional sediment barriers as necessary.
d. Temporary erosion control measures may include fiber wattles, silt fences, jute matting, wood fiber mulch and soil binder, or geotextiles and geosynthetic fabric.
e. Soil stabilization utilizing wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil if the materials are noxious weed free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.
f. Remove sediment from erosion controls if it reaches 1/3 of the exposed height of the control.
g. Whenever surface water is present, maintain a supply of sediment control materials and an oil-absorbing floating boom at the project site.
h. Stabilize all disturbed soils following any break in work unless construction will resume within four days.
i. Remove temporary erosion controls after construction is complete and the site is fully stabilized.

**6. Hazardous Material Spill Prevention and Control**

a. At the project site:
   i. Post written procedures for notifying environmental response agencies, including an inventory and description of all hazardous materials present, and the storage and handling procedures for their use.
   ii. Maintain a spill containment kit, with supplies and instructions for cleanup and disposal, adequate for the types and quantity of hazardous materials present.

[1] Road and path obliteration refers to the most comprehensive degree of decommissioning and involves decompacting the surface and ditch, pulling the fill material onto the running surface, and reshaping to match the original contour.

iii. Train workers in spill containment procedures, including the location and use of the spill containment kits.

b. Temporarily contain any waste liquids generated under an impervious cover, such as a tarpaulin, in the staging area until the wastes can be properly transported to, and disposed of, at an approved receiving facility.

**7. Equipment, Vehicles, and Power Tools**

a. Select, operate and maintain all heavy equipment, vehicles, and power tools to minimize adverse effects on the environment, *e.g.*, low pressure tires, minimal hard-turn paths for track vehicles, use of temporary mats or plates to protect wet soils.
b. Before entering wetlands or within 150 feet of a waterbody, replace all petroleum-based hydraulic fluids with biodegradable products.[2]
c. Invasive species prevention and control.
    i. Before entering the project site, power wash all heavy equipment, vehicles and power tools, allow them to fully dry, and inspect them to make certain no plants, soil, or other organic material adhering to the surface.
    ii. Before entering the water, inspect any watercraft, waders, boots, or other gear to be used in or near water and remove any plants, soil, or other organic material adhering to the surface.
d. Inspect all equipment, vehicles, and power tools for fluid leaks before they leave the staging area.
e. Before operation within 150 feet of any waterbody , and as often as necessary during operation, thoroughly clean all equipment, vehicles, and power tools to keep them free of external fluids and grease and to prevent leaks and spills from entering the water.
f. Generators, cranes or other stationary heavy equipment operated within 150 feet of any waterbody must be maintained and protected as necessary to prevent leaks and spills from entering the water.

**8. Temporary Access Roads and Paths**

a. Whenever reasonable, use existing access roads and paths preferentially.
b. Minimize the number and length of temporary access roads and paths through riparian areas and floodplains.
c. Minimize removal of riparian vegetation.
d. When it is necessary to remove vegetation, cut at ground level (no grubbing).
e. Do not build temporary access roads or paths where grade, soil, or other features suggest slope instability.
f. Any road on a slope steeper than 30% must be designed by a civil engineer with experience in steep road design.

[2] For additional information and suppliers of biodegradable hydraulic fluids, motor oil, lubricant, or grease. See, Environmentally Acceptable Lubricants by the U.S. EPA (2011); *e.g.*, mineral oil, polyglycol, vegetable oil, synthetic ester; Mobil® biodegradable hydraulic oils, Total® hydraulic fluid, Terresolve Technologies Ltd.® bio-based biodegradable lubricants, Cougar Lubrication® 2XT Bio engine oil, Series 4300 Synthetic Bio-degradable Hydraulic Oil, 8060-2 Synthetic Bio-Degradable Grease No. 2, *etc*. The use of trade, firm, or corporation names in this opinion is for the information and convenience of the action agency and applicants and does not constitute an official endorsement or approval by the U.S. Department of Commerce or NMFS of any product or service to the exclusion of others that may be suitable.

g. After construction is complete, obliterate all temporary access roads and paths, stabilize the soil, and revegetate the area.
h. Temporary roads and paths in wet areas or areas prone to flooding must be obliterated by the end of the in-water work window. Decompact road surfaces and drainage areas, pull fill material onto the running surface, and reshape to match the original contours.

**9. Temporary Stream Crossings**

a. No stream crossing may occur at active spawning sites, when holding adult listed fish are present, or when eggs or alevins are in the gravel.
b. Do not place temporary crossings in areas that may increase the risk of channel re-routing or avulsion, or in potential spawning habitat, *e.g.*, pools and pool tailouts.
c. Minimize the number of temporary stream crossings; use existing stream crossings whenever reasonable.
d. Install temporary bridges and culverts to allow for equipment and vehicle crossing over perennial streams during construction.
e. Wherever possible, vehicles and machinery must cross streams at right angles to the main channel.
f. Equipment and vehicles may cross the stream in the wet only where the streambed is bedrock, or where mats or off-site logs are placed in the stream and used as a crossing.
g. Obliterate all temporary stream crossings as soon as they are no longer needed, and restore any damage to affected stream banks or channel.

**10. Surface Water Withdrawal and Construction Discharge Water**

a. Surface water may be diverted to meet construction needs, but only if developed sources are unavailable or inadequate.
b. Diversions may not exceed 10% of the available flow and must have a juvenile fish exclusion device that is consistent with NMFS's criteria (NOAA 2011).
c. Treat all construction discharge water using best management practices to remove debris, sediment, petroleum products, and any other pollutants likely to be present (*e.g.,* green concrete, contaminated water, silt, welding slag, sandblasting abrasive, grout cured less than 24 hours, drilling fluids), to ensure that no pollutants are discharged to any perennial or intermittent waterbody.

**11. Fish Passage**

a. Provide fish passage for any adult or juvenile Endangered Species Act (ESA)-listed fish likely to be present in the action area during construction, unless passage did not exist before construction or the stream is naturally impassable at the time of construction.
b. After construction, provide fish passage for any adult or juvenile ESA-listed fish that meets NMFS's fish passage criteria (NOAA 2011), or the most recent version, for the life of the action.

**12. Timing of In-Water Work**

a. The inwater work window will be identified as the limit to inwater construction specified in the project notification form. The construction schedule will conform to the windows established in Oregon, Washington, and Idaho by the Oregon

Department of Fish and Wildlife (ODFW 2008), Washington Department of Fish and Wildlife (WDFW 2010), and Idaho Department of Fish and Game, respectively. Any exceptions to in-water work windows recommended by ODFW, WDFW, or IDFG must be approved by NMFS. In the Willamette River below Willamette Falls, the winter work window (December 1 – January 31) is not approved for actions under this opinion.

b. Hydraulic and topographic measurements and placement of LW, boulders, or gravel may be completed anytime, provided the affected area is not occupied by adult fish congregating for spawning, or in an area where redds are occupied by eggs or pre-emergent alevins.

**13. Work Area Isolation**

a. Isolate any work area within the wetted channel from the active stream whenever ESA-listed fish are reasonably certain to be present, or if the work area is less than 300 feet upstream from known spawning habitats. However, work area isolation may not always be necessary or practical in certain settings; *i.e.*, dry streambeds and tidal zones, respectfully.

b. Engineering design plans for work area isolation must include all isolation elements and fish release areas.

c. Dewater the shortest linear extent of work area practicable, unless wetted in-stream work is deemed to be minimally harmful to fish, and is beneficial to other aquatic species.[3]

   i. Use a coffer dam and a by-pass culvert or pipe, or a lined, non-erodible diversion ditch to divert flow around the dewatered area. Dissipate flow energy to prevent damage to riparian vegetation or stream channel and provide safe downstream reentry of fish, preferably into pool habitat with cover.

   ii. Where gravity feed is not possible, pump water from the work site to avoid rewatering. Maintain a fish screen on the pump intake to avoid juvenile fish entrainment (NOAA 2011).

   iii. Pump seepage water to a temporary storage and treatment site, or into upland areas, to allow water to percolate through soil or to filter through vegetation before reentering the stream channel with a treatment system comprised of either a hay bale basin or other sediment control device.

   iv. Monitor below the construction site to prevent stranding of aquatic organisms.

   v. When construction is complete, re-water the construction site slowly to prevent loss of surface flow downstream, and to prevent a release of suspended sediment.

d. Whenever a pump is used to dewater the isolation area and ESA-listed fish may be present, a fish screen must be used that meets the most current version of NMFS's fish screen criteria (NOAA 2011). NMFS approval is required for pumping that exceeds 3 cfs.

[3] For instructions on how to dewater areas occupied by lamprey, see *Best management practices to minimize adverse effects to Pacific lamprey* (*Entosphenus tridentatus*) (USFWS 2010).

**14. Fish Capture and Release**

a. If practicable, allow listed fish species to migrate out of the work area or remove fish before dewatering; otherwise remove fish from an exclusion area as it is slowly dewatered with methods such as hand or dip-nets, seining, and trapping with minnow traps (or gee-minnow traps).
b. Fish capture must be supervised by a qualified fisheries biologist, with experience in work area isolation and competent to ensure the safe handling of fish.
c. Conduct fish capture activities during periods of the day with the coolest air and water temperatures possible, normally early in the morning to minimize stress and injury of species present.
d. Monitor the nets need to isolate a site frequently enough to ensure they stay secured to the banks and free of organic accumulation.
e. Electrofish during the coolest time of day, only after other means of fish capture are determined to be not feasible or ineffective.
    i. Follow the most recent version of NOAA (2000) electrofishing guidelines.
    ii. Do not electrofish when the water appears turbid, *e.g.*, when objects are not visible at depth of 12 inches.
    iii. Do not intentionally contact fish with the anode.
    iv. Use direct current (DC) or pulsed direct current within the following ranges:
        1. If conductivity is less than 100 µs, use 900 to 1100 volts.
        2. If conductivity is between 100 and 300 µs, use 500 to 800 volts.
        3. If conductivity greater than 300 µs, use less than 400 volts.
    v. Begin electrofishing with a minimum pulse width and recommended voltage, then gradually increase to the point where fish are immobilized.
    vi. Immediately discontinue electrofishing if fish are killed or injured, *i.e.*, dark bands visible on the body, spinal deformations, significant de-scaling, torpid or inability to maintain upright attitude after sufficient recovery time. Recheck machine settings, water temperature and conductivity, and adjust or postpone procedures as necessary to reduce injuries.
f. If buckets are used to transport fish:
    i. Minimize the time fish are in a transport bucket.
    ii. Keep buckets in shaded areas or, if no shade is available, covered by a canopy.
    iii. Limit the number of fish within a bucket; fish will be of relatively comparable size to minimize predation.
    iv. Use aerators or replace the water in the buckets at least every 15 minutes with cold clear water.
    v. Release fish in an area upstream with adequate cover and flow refuge; downstream is acceptable provided the release site is below the influence of construction.
    vi. Be careful to avoid mortality counting errors.
g. Monitor and record fish presence, handling, and injury during all phases of fish capture and submit a fish salvage report to NMFS within 60 days of capture that documents, date, time of day, fish handling procedures, air and water temperatures, and total numbers of each salmon, steelhead and eulachon handled, and numbers of ESA-listed fish injured or killed.

**15. Site Restoration**

a. Restore any significant disturbance of riparian vegetation, soils, stream banks or stream channel.
b. Remove all project related waste; *e.g.*, pick up trash, sweep roadways in the project area to avoid runoff-containing sediment, *etc.*
c. Obliterate all temporary access roads, crossings, and staging areas.
d. Loosen soil in compacted areas when necessary for revegetation or infiltration.
e. Although no single criterion is sufficient to measure restoration success, the intent is that the following features should be present in the upland parts of the project area, within reasonable limits of natural and management variation:
    i. Human and livestock disturbance, if any, are confined to small areas necessary for access or other special management situations.
    ii. Areas with signs of significant past erosion are completely stabilized and healed, bare soil spaces are small and well-dispersed.
    iii. Soil movement, such as active rills and soil deposition around plants or in small basins, is absent or slight and local.
    iv. Native woody and herbaceous vegetation, and germination microsites, are present and well distributed across the site; invasive plants are minimal or absent.
    v. Plants have normal, vigorous growth form, and a high probability of remaining vigorous, healthy and dominant over undesired competing vegetation.
    vi. Plant litter is well distributed and effective in protecting the soil with little or no litter accumulated against vegetation as a result of active sheet erosion ("litter dams").
    vii. A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank.

**16. Revegetation**

a. Plant and seed disturbed areas before or at the beginning of the first growing season after construction.
b. Use species that will achieve shade and erosion control objectives, including forb, grass, shrub, or tree species that are appropriate for the site and native to the project area or region.
c. Short-term stabilization measures may include use of non-native sterile seed mix if native seeds are not available, weed-free certified straw, jute matting, and similar methods.
d. When feasible, use vegetation salvaged from local areas scheduled for clearing due to development.
e. Do not apply surface fertilizer within 50 feet of any wetland of water body.
f. Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
g. Do not use invasive or non-native species for site restoration.
h. Remove or control invasive plants until native plant species are well-established.

## Project Design Criteria – Types of Restoration Actions

**Wetland Restoration** to restore degraded wetland by (a) excavation and removal of fill materials; (b) contouring to reestablish more natural topography; (c) setting back existing dikes, berms and levees; (d) reconnecting historical tidal and fluvial channels; (d) planting native wetland species; or (e) a combination of the above methods. This action does not include installation of water control structures or fish passage structures.

a. Include applicable General Construction Measures (PDC 13-31) and PDC for specific types of actions as applicable (*e.g*., Off- and Side-Channel Habitat Restoration (PDC 26); Set-Back or Removal of Existing Berms, Dikes, and Levees for Wetland and Estuary Restoration (PDC 38); and Dam and Legacy Structure Removal (PDC 34)) to ensure that all adverse effects to fish and their designated critical habitats are within the range of effects considered in this opinion.

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