Biological Assessment

Martin Slough Enhancement Project

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1. Introduction

1.1 Project Area Description

The Martin Slough Enhancement Project is located in and adjacent to the southern portion of the City of Eureka and terminates at its confluence with Swain Slough as shown below in Figure 1. Martin Slough is the last (most downstream) tributary to Elk River via Swain Slough. The mouth of Martin Slough is separated from Swain Slough by a berm and tide gates. The Martin Slough watershed includes both City and County jurisdictions, with the Project area owned by the City of Eureka (approximately 120 acres) and two private landowners (approximately 40 acres and 110 acres) whose ownerships are comprised of multiple assessor's parcels. The Project area is partially within the coastal zone.

The Martin Slough watershed land use includes a mix of residential, agricultural, timberlands, and municipal infrastructure. Humboldt County's Eureka Community Plan includes future residential development of the southeastern portion of the Martin Slough watershed in the Ridgewood Heights area. This currently forested area has been phased out of timber production zone (TPZ) status to allow for residential or mixed-use development. This conversion could modify the watershed hydrology and potentially result in increased storm water runoff. Its actual effect on peak flows within Martin Slough will be dependent on the measures taken by future development to address storm water runoff, currently set for no net increase by the County. Hydraulic modeling conducted during the development of the Martin Slough Feasibility Study (Winzler & Kelly et al. 2006) took into account future build-out and its effects on stream hydrology.

The Project area is currently zoned Agriculture Exclusive (60 acre minimum) and Public Facility. Municipal infrastructure directly within the Project area includes the City maintained Fairway Drive, three natural gas lines, sewer lines and a pump station, and the Eureka Municipal Golf Course. The Humboldt Community Services District also has existing sewer infrastructure and water lines near Pine Hill Road.

Martin Slough has a watershed area of approximately 5.4 square miles and natural channel length of over 10 miles, with approximately 7.5 miles of potential fish habitat. This habitat supports the federally listed southern Oregon/northern California (SONCC) coho salmon (*Oncorhynchus kisutch*) and tidewater goby (*Eucyclogobius newberryi*), as well as California coastal Chinook (*Oncorhynchus tshawytscha)*, northern California steelhead (*Oncorhynchus mykiss*), coastal cutthroat trout (*Oncorhynchus clarkii*), and numerous other non-listed estuarine species. New tide gates were installed in 2014 (described below). The lower portion of the watershed flows through low gradient bottomland containing the golf course and pastureland. Many of the stream channels flow from gulches that contain mature second-growth redwood forests. The upper portions of the watershed are either in urban settings, or are recently harvested timber lands slated for future residential and commercial development.

The Martin Slough Enhancement Feasibility study area consists of the Martin Slough flood plain between Swain Slough and the upper (second) Fairway Drive stream crossing in the lower Martin Slough watershed (Figure 1). Existing problems that have been identified in the Martin Slough study area include limited fish access, simplified fish habitat lacking diversity and habitat niches, large sediment loads, poor sediment routing, lack of riparian habitat, and frequent prolonged flooding. Prolonged flooding in particular has a negative economic impact on current land use and can cause fish stranding and predation as floodwaters recede and leave pools of water on pastures and fairways that become disconnected from the stream channel.

1.2 Project Area History

The Martin Slough and Elk River estuary are part of the larger Humboldt Bay ecosystem that accommodates a variety of waterfowl, wading birds, shorebirds, numerous species of fish and other aquatic organisms, passerines, and raptors. Not much is known about the historic composition of the lower portions of Martin Slough. However, it is apparent from its elevation relative to tidewater and its geomorphic features that the lower portions of Martin Slough consisted of estuarine habitat, likely composed of salt marsh and slough channels in the lower Project area along with other more brackish water habitats, transitioning to tidally-influenced-freshwater wetlands near the upstream end of the Project area.

Although much of the historic estuary has been converted to other land use, some estuarine habitat still exists. That habitat has been severely degraded by the installation of tide gates at the confluence of Martin Slough with Swain Slough and other land management practices. These modifications also have had a pronounced effect on flood routing and sedimentation in the lower channel.

Explicit documentation of historic conditions within the Project area of lower Martin Slough is lacking, but the basic geomorphic context as well as analysis of historic photos and current Lidar of the valley bottom reveals evidence of a historically complex, multi-threaded channel network. Regular high flow events (~ 2yr return interval) coupled with a high natural sediment supply would have likely maintained a dynamic, multi-threaded channel network with high rates of lateral adjustment, channel avulsion, and overbank flow. The valley bottom was likely wet and densely vegetated with Sitka spruce *(Picea sitchensis)*, alder (*Alnus spp.*), and willow (*Salix spp.*) as the dominant tree species. A mix of salt tolerant shrubs, forbs, and grasses were also likely present and reflective of a complex salinity profile throughout the lower watershed. Specifically, the pre-development vegetation of the Martin Slough valley bottom is presumed to have been a mixed Sitka Spruce (*Picea sitchensis*)/willow (*Salix spp.)* forest transitioning to tidal salt marsh. Extreme upper limits of the Project area were likely forested by coast redwood (*Sequoia sempervirens*). Transition areas between forest and tidal salt marsh would likely have been comprised of brackish to fresh water and high groundwater tolerant willows, sedges (*Carex spp.*), bulrush (*Scirpus ssp*.), and rush (*Juncus spp*.). Salt marsh vegetation probably dominated much of the study area prior to the construction of the berm along Swain Slough. The tidal areas were likely vegetated by pickleweed (*Sarcicornia virginica*) and salt grass (*Distichlis spicata*). In the non-forested transitional areas, brackish vegetation would have probably included soft rush (*Juncus effusus*), silverweed (*Potentilla anserina*), small-headed bulrush (*Scirpus microcarpus*), and tufted hairgrass (*Deschampsia cespitosa*).

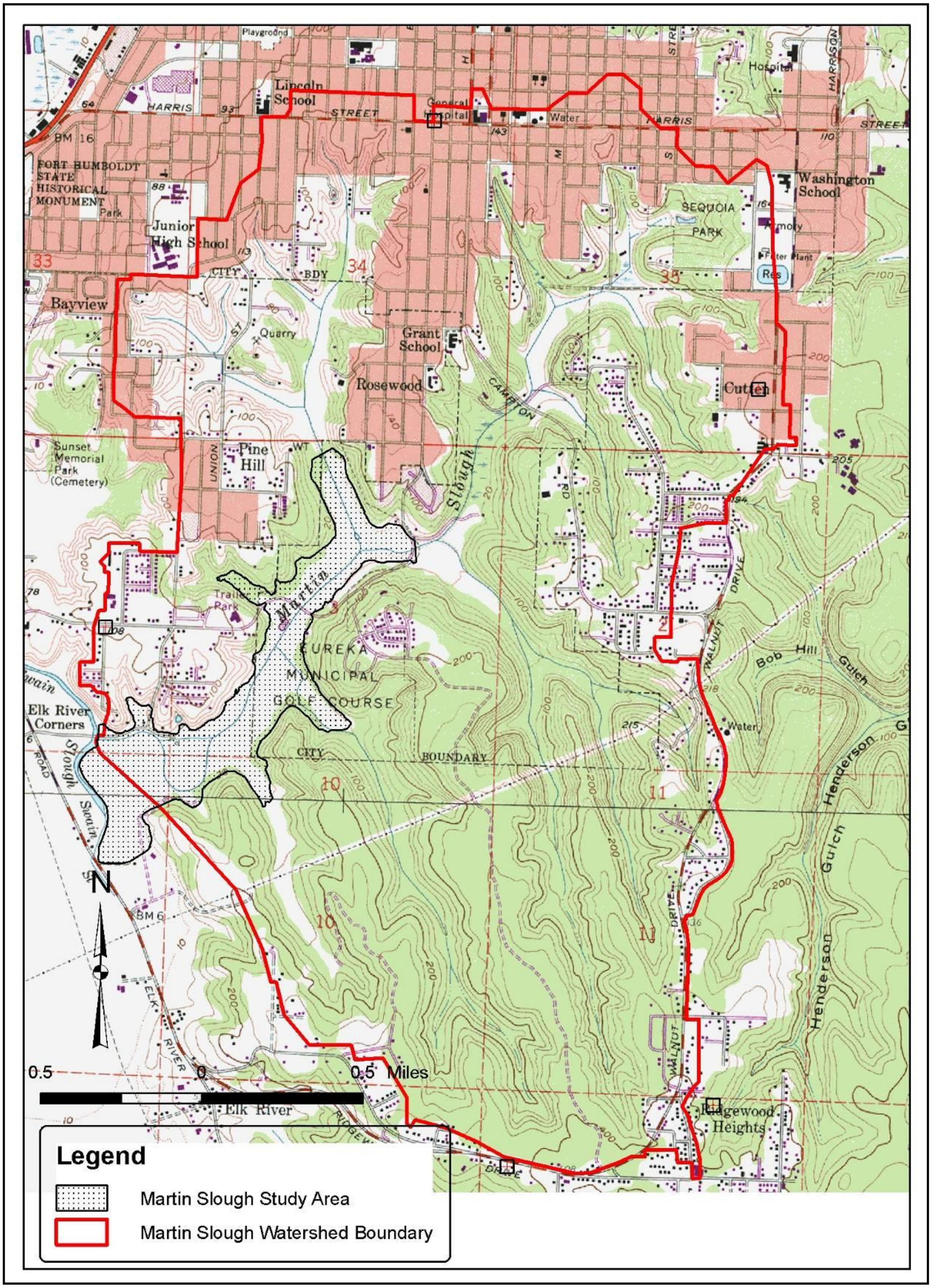

Figure 1. Martin Slough Enhancement Project Site and Watershed Boundary

1.3 Project Purpose and Goals

The purpose of the Martin Slough Enhancement Project is to improve aquatic and riparian habitat and reduce flooding throughout the Project area. Specific goals of the Project include the following:

1. Increase the resiliency of the coastal ecosystem by restoring a muted tidal inundation, supporting restored tidal wetlands and aquatic biota
2. Decrease the vulnerability of the coastal community to the effects of extreme weather by increasing channel network capacity and floodplain function to reduce flood impacts
3. Use fill material from Martin Slough channel enhancement and pond creation for tidal marsh restoration and sea level rise adaptation in the White Slough Unit of the Humboldt Bay National Wildlife Refuge. The White Slough Project is fully permitted (independent of this Project) to accept clean fill from suitable borrow locations.
4. Provide habitat and benefits to multiple species by improving and increasing the diversity and amount of fresh and saltwater wetland/estuarine habitat, particularly off-channel and side channel juvenile salmonid rearing and overwintering habitat
5. Increase sediment transport capacity from upstream and tidally transported sediment sources
6. Improve fish access from Swain Slough into Martin Slough
7. Increase the amount and quality of riparian corridor and riparian canopy
8. Improve water quality (decrease nutrient impacts, decrease sedimentation, increase salinity)
9. Reduce financial losses caused by flooding to the ranching interest and City of Eureka

1.4 Project Development

In 2001, the Natural Resources Division of Redwood Community Action Agency (RCAA) hired Winzler & Kelly (W&K), now called GHD, to conduct a feasibility study for an enhancement plan to improve fish access, expand and enhance aquatic habitat, improve sediment transport, and reduce flooding impacts on land use activities within Martin Slough. Michael Love & Associates (MLA), Graham Matthews & Associates (GMA), and Coastal Analysis, LLC (CAL) also participated in conducting early hydrologic and hydraulic assessments for the feasibility study. RCAA managed the study and was responsible for the Technical Advisory Committee (TAC) and landowner coordination. The TAC was comprised of agency representatives, landowners, and land managers, plus the team of consultants and representatives of RCAA. The TAC had the following entities represented at one or more meetings:

- City of Eureka
- CourseCo (golf course lessee)
- County of Humboldt (Planning and Public Works)
- CA Department of Fish & Wildlife (CDFW)
- State Coastal Conservancy
- CA Department of Water Resources
- US Army Corps of Engineers
- National Oceanic and Atmospheric Administration (NOAA) Fisheries
- US Fish & Wildlife Service (USFWS)
- GHD (formerly known as Winzler & Kelly)
- Michael Love & Associates
- Landowners (City of Eureka, Gene Senestraro, Bob Barnum, Northcoast Regional Land Trust)

The primary Project partners along with contacts include: Redwood Community Action Agency (Elijah Portugal, 707-269-2058), Northcoast Regional Land Trust (Mike Cipra, 707-822-2242), and the City of Eureka (Miles Slattery, 707-441-4184).

W&K , MLA, and CAL prepared a planning level report for the Project, entitled Martin Slough Enhancement Feasibility Study, Eureka California (Winzler & Kelly et al. 2006). The Feasibility Study characterized current conditions and limiting factors within Martin Slough, developed four alternative approaches that enhance aquatic and riparian habitat, and conducted hydrologic and hydraulic analyses of the proposed Project alternatives.

1.5 Project Alternatives Considered

The following four alternatives were identified and developed in the Feasibility Study:

Alternative 1: The No Action Alternative (Existing Conditions)

The No Action Alternative would leave the system as it exists today. This alternative is important for permitting considerations and also for comparing alternatives, allowing a familiar starting point for comparisons to be made.

Alternative 2: No Tide Gates or Levee (Full Tidal Influence)

Alternative 2 would result in removing the existing tide gates and the berm along Swain Slough. Based on land and tidal elevations, this alternative would open the majority of the Project area to full tidal influence, allowing the system to transform back towards its pre-development state.

Alternative 3: New Tide Gates and New Ponds (Muted Tide)

This alternative would consist of removing the existing tide gates, installing new tide gates with a habitat door designed to create a muted tidal prism and facilitate fish passage, increase the size of existing ponds, and create new ponds.

Alternative 4: New Tide Gates, New Ponds, and Modified Channel (Muted Tide)

This alternative is similar to Alternative 3, but includes improvements to the existing channel and a corresponding larger habitat door to accommodate the larger available tidal prism. This alternative consists of removing the existing tide gates, installing new three new 6’ x 6’ tide gates in addition to a 2’ x 2’ habitat door. The 2’ x 2’ habitat door will be controlled by a muted tide regulator (MTR) and one of the 6’ x 6’ side hinge doors will be controlled by a separate MTR. The MTRs are used to create a muted tide cycle and facilitate fish passage. Other Project actions include increasing the size of existing ponds, creating new ponds, making channel modifications, installing fish and wildlife habitat structures (woody debris), and re-vegetation throughout the Project area.

Alternative 4 was selected by the TAC, RCAA, Mr. Senestraro (then owner of the NRLT property), and the City of Eureka to move forward into design and environmental compliance and permitting.

Several different approaches were used to evaluate the alternatives. A simplified numerical model of tide gate hydraulics was created in a spreadsheet to allow for rapid analysis of the effectiveness of different tide gate designs in providing fish passage and flood routing within the Project area. Fish passage analysis of the tide gates was conducted for each alternative. Passage conditions were evaluated using the stream crossing design criteria developed by NOAA Fisheries (2001 and 2004).

The geomorphic stability of enlarging the Martin Slough channel within the Project area to increase conveyance area for both flood flows and a diurnal tidal exchange was analyzed using design guidelines developed for tidal channels. This was done because reintroducing a muted tide cycle into the Project area would result in large volumes of water flowing up and down the channel with each tide cycle, changing the fluvial processes that maintain the channel with the potential and likelihood of scouring the channel bed and banks, which could cause erosion that could affect existing infrastructure.

The new and expanded ponds would create additional habitat for rearing salmonids, waterfowl, and other aquatic and semi-aquatic species. The ponds would also provide additional storage capacity for storm flows, reducing the amount of time higher ground is inundated. This alternative would increase the size of three existing ponds on the golf course. Two new ponds would be added, one on the golf course and one on the NRLT property. It is anticipated that this alternative would provide a range of estuarine habitat with varying salinity values. The highest salinity values would be adjacent to the tide gates, and the lowest salinity would be found farther upstream. Salinity values would likely fluctuate from summer to winter months, being higher in the summer when less fresh water is entering the drainage. The golf course would likely need to use the upper irrigation pond as their primary irrigation source or use well water. The additional ponds with varying salinity values would be a large benefit for juvenile salmonids and other species. The ponds would be planted with a variety of wetland and riparian vegetation. The new riparian and marsh vegetation in the pasture would be protected by cattle exclusion fencing.

To assist in determining potential impacts and evaluate potential permitting issues for the different alternatives, a wetland and biological reconnaissance investigation was conducted to determine the extent and location of wetland as well as sensitive plant and animal habitats within the potential footprint of the alternatives developed (Winzler and Kelly 2011).

2. Description of the Action

2.1 Proposed Project

The proposed Project is comprised of multiple interrelated components summarized in the following text and listed below. Implementation will be phased over the summers of 2017 -2019. Please refer to Figures 2-5 for the location and description of the following restoration actions.

Actions include a new tide gate structure (completed in 2014, but since it is critical to the functionality of the rest of the Project, a description of it is included here), enlargement of the Martin Slough channel, relocation and decommissioning of buried PG&E gas lines, installation of scour protection over buried natural gas lines under channels or marsh plains, construction of several tidal ponds, raising of some local low areas on the golf course to elevation 7.0 feet (NAVD88), replacement of multiple agricultural-use and golf course stream crossings (including culverts in the pasture and bridges at the golf course), installation of large wood habitat structures throughout the Project, and extensive planting of wetland and riparian vegetation. Hydraulic, hydrologic, and geomorphic analysis were used to develop the interrelated Project components through an iterative design process. The total volume excavated and the disposition of the spoils from the expansion of the channel, ponds, and creation of new ponds is presented by phases in Table 1. Cut and Fill Volumes by Project Phase and Location. Additional detail is provided in Appendices F: 65% Basis of Design Report and G: 100% Design Plans.

Summary of Project Actions (the locations of the majority of the following restoration actions are shown in Figures 2-4:

- Installation of erosion control measures (as per Pollution Prevention and Monitoring Plan)
- Fish screen installation and fish relocation
- Cofferdam installation
- Stream flow bypass installation
- Construction area stream and pond dewatering
- Temporary construction access installation (including temporary bridges)
- Interior road hardening (installation of filter fabric, geo-grid, and road base)
- Removal of old culverts and installation of new culverts
- Installation of sheet piles along Martin Slough at the barn on NRLT property
- Replacement of the barn culvert with a bridge (including installation of bridge footings)
- Replacement of golf course bridges, including footings
- Installation of gas line scour protection
- Relocation of 130 feet of 6-inch natural gas line
- Decommission and abandonment of a 4-inch natural gas line
- Channel excavation
- New pond excavation
- Existing pond enlargement
- Installation of large wood habitat features in ponds and along channel margins and marsh plains
- Temporary stockpiling of spoils
- Hauling of spoils
- Placement of spoils to repair up to 50% of the berm separating Martin and Swain Slough

- Placement of spoils to fill low spots in the pasture and golf course to create positive drainage to prevent ponding on the floodplain and fish stranding during flood events
- Removal of temporary roads and access points and restoration of pasture areas and golf course fairways to pre-Project conditions
- Removal of cofferdams, stream bypass structures, and fish screens
- Installation of cattle exclusion fencing (NRLT property only)
- Installation of wetland & riparian plantings
- Salmonid and goby monitoring with the intent to observe new habitat and monitor fish utilization before introducing full muted tide (which will turn Pond E seasonally brackish) (Appendix D. Martin Slough Enhancement Project Monitoring Plan)

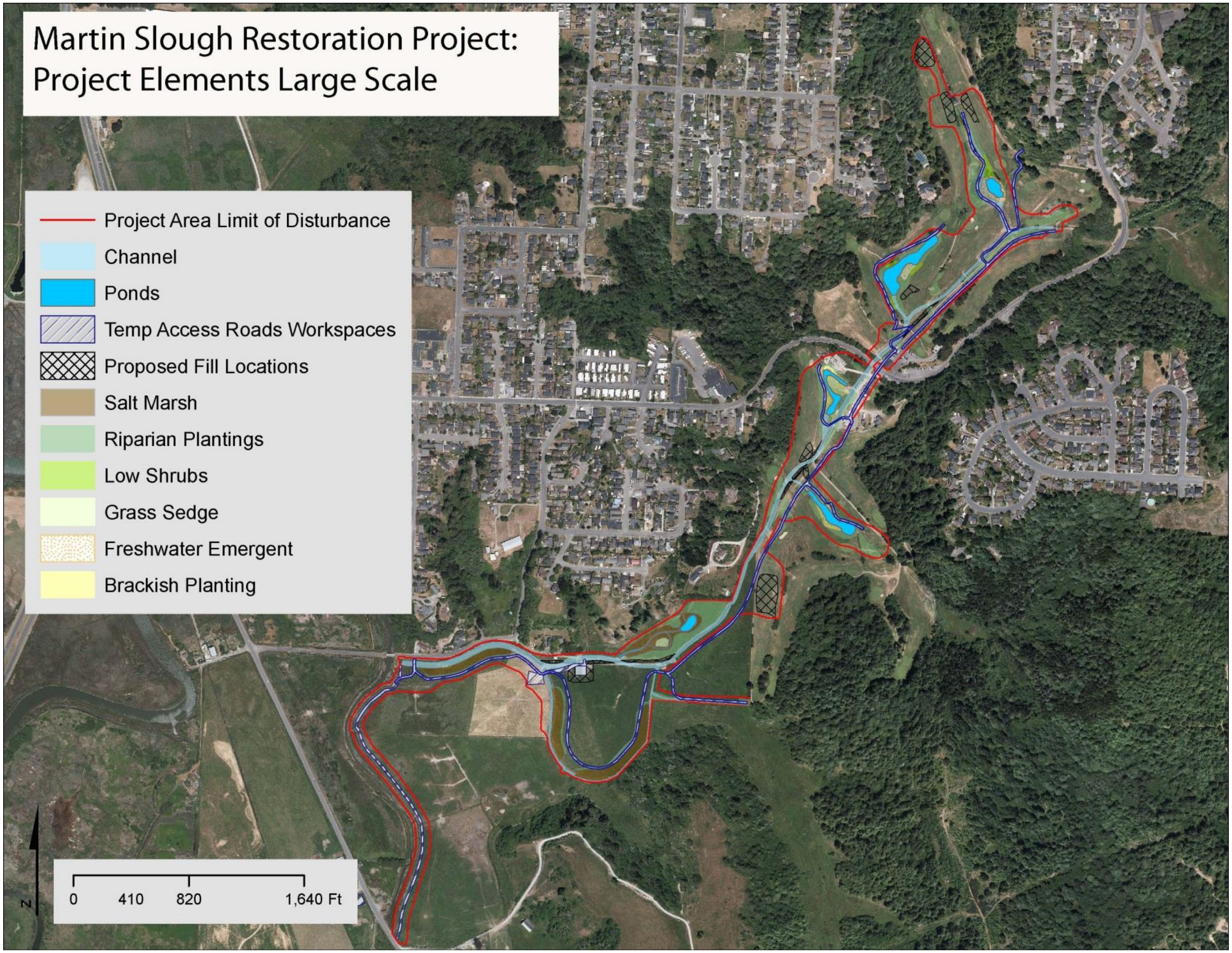

Figure 2. Martin Slough Restoration Project, Project Elements, Large Scale.

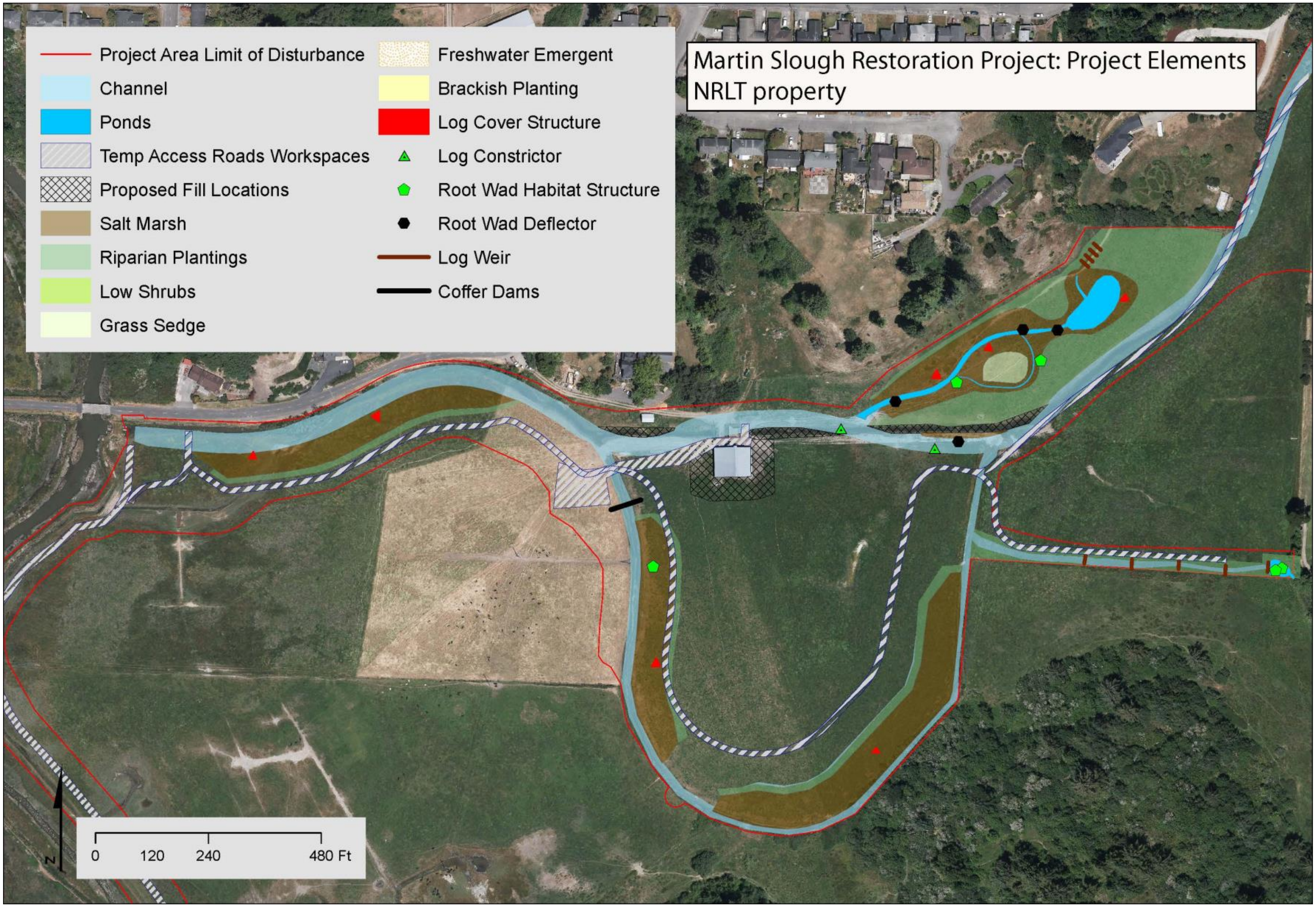

Figure 3. Martin Slough Restoration Project, NRLT Property.

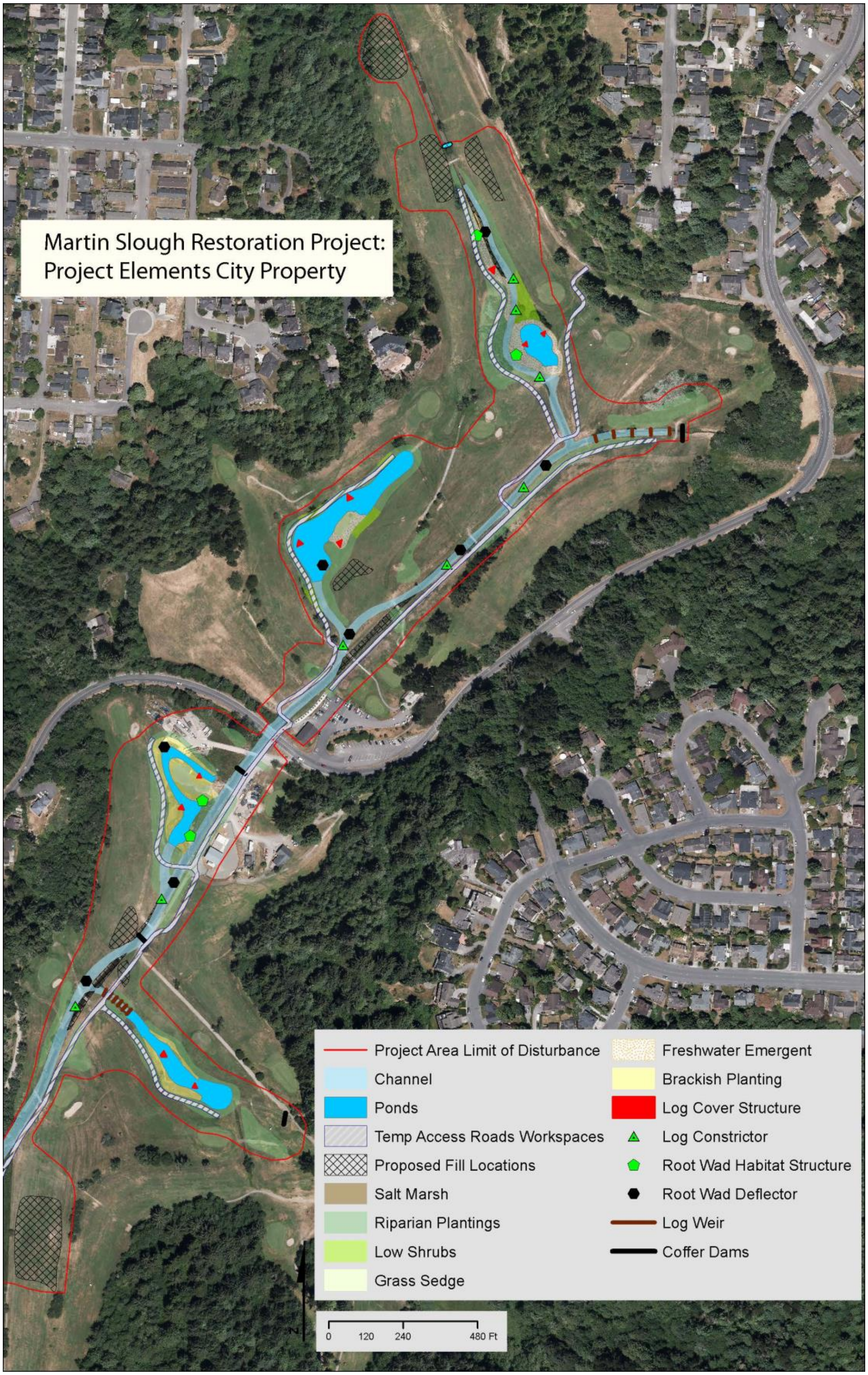

Figure 4. Martin Slough Restoration Project, City of Eureka Property

Table 1. Cut and Fill Volumes by Project Phase and Location. Station numbers (e.g., MS 0+00) refer t survey segments in the 100% Design Plans (Appendix G).

CUT VOLUMES				Fill Volumes		
			Phase 2			
Location	**Cut Vol. (CY)**	**Disposal Area**	**Phase**	**Location**	**Fill Vol. (CY)**	**Phase**
NRLT			**2**	**NRLT/Vroman Property**		**2**
Marsh Plain A + channel MS 0+00 to 9+50 (streambed)	5,000	White Slough, &/ or other permitted site*	2	Repairing Swain Slough Berm (wetland)	150	2
Southeast Trib. & Pond (wetland)	2,200	White Slough, around barn &/ or other permitted site	2	Around barn (wetland)	550	2
MS 9+80 6" gas line relocate (streambed)	350	Re-fill trench	2	MS 9+80 6" gas line relocate (streambed)	350	2
subtotal - Ph. 2 Exc.	**7,550**		2	**subtotal - Ph. 2 on-site fill**	**1,050**	2
				subtotal - Ph. 2 off-haul	**6,500**	2
			Phase 3			
City			**3**	**City**		**3**
North Fork & Pond G (streambed and wetland)	4,000	Old NF channel = 500 CY Fill low spots of Gold Course (3rd, 4th, 7th fairways) = 3,5000 CY	3	North Fork (streambed)	500	3
				GC 3rd Frwy (wetland)	2,500	3
				GC 4th Frwy (wetland)	1,000	3
				GC 7th Frwy (wetland)	500	3
subtotal - Ph 3 Exc.	**4,000**			**subtotal - Ph 3 on-site fill**	**4,500**	
			Phase 4			

NRLT			**4**	**NRLT**		**4**
MS 9+50 to 30+50 and meander channel (streambed)	7,500	MS 10+50 to 12+30 = 250 CY MS 13+80 to 15+80 = 550 CY MS 16+50 to 20+50 = 1,500 CY White Slough or other permitted location = 5,200 CY	4	MS 10+50 to 12+30 (streambed)	250	4
Marsh Plain B (wetland)	6,500	White Slough or other permitted location	4	MS 13+80 to 15+80 (streambed)	550	4
				MS 16+50 to 20+50 (streambed)	1,500	4
12" Gas Line Scour Protection (streambed)	10	Re-fill trench	4	12" Gas Line Scour Protection (streambed)	10	4
Pond C (wetland)	13,000	White Slough or other permitted location	4			
subtotal - Ph 4 Exc.	**27,010**		4	**subtotal - Ph 4 on-site fill**	**2,310**	
				subtotal - Ph 4 off-haul	**24,700**	
Total excavation volume for NRLT property (phases 2 and 4)	**34,560**		2,4	**Total on-site fill volume for NRLT property (phases 2 and 4)**	**3,360**	2,4
				Total Off-Haul for NRLT Property (phases 2 and 4)	**31,200**	
			Phase 5			
City			**5**	**City**		**5**

MS 30+50 to 46+00 (streambed)	3,500	GC 14th & 17th fairways = 2,000 CY White Slough or other permitted location = 1,500 CY	5	GC 14th Frwy (wetland)	1,500	5
East Trib & Pond D (wetland)	2,500	White Slough or other permitted location	5	GC 17th Frwy (wetland)	500	5
12" Gas Line Scour Protection (streambed)	10	Re-fill trench	5	12" Gas Line Scour Protection (NRLT) (streambed)	10	5
Pond E (wetland)	6,000	White Slough or other permitted location	5			
subtotal - Ph 5 exc.	**12,010**			**subtotal - Ph 5 on-site fill**	**2,010**	
				subtotal - Ph 5 off-haul	**10,000**	
			Phase 6			
City			**6**	**City**		**6**
Pond F (wetland)	13,000	Fill old channel MS 49+50 to MS 53 = 500 CY Fill low spot close to Pond F = 1,000 CY White Slough or other permitted location = 11,500 CY	6	Old channel MS 49+50 to MS 53 (streambed)	500	6
MS 46+00 to 62+80 (streambed)	3,500	White Slough or other permitted location	6	Low spot on GC close to Pond F	1000	6
subtotal - Ph 6 Exc.	**16,500**			**subtotal - Ph 6 on-site fill**	**1,500**	

				subtotal - Ph 6 off-haul	**15,000**	
Total excavation volume for City (phases 3,5,6)	**32,510**		3,5,6	**Total on-site fill volume for City (phases 3,5,6)**	**7,510**	3,5,6
				Total off-haul for City (phases 3,5,6)	**25,000**	3,5,6
				Total on-site fill volume for NRLT & City (all phases)	**11,370**	2-6
TOTAL EXCAVATION VOLUME NRLT + CITY (all phases)	**67,070**		2-6	**TOTAL OFF-HAUL NRLT & City (all phases)**	**56,200**	2-6

2.1.1 Project Phasing

Please refer to Figures 2-5 for the location of all project elements listed below

Project implementation will occur in phases due to three primary factors:

1. The large scale of the Project
2. Uncertainties around fundraising for phases on the City owned property
3. State and federal regulators have mandated that we provide replacement habitat for Pond E (see discussion below for more details on the concerns related to Pond E) before performing the pond and channel enhancements around the existing Pond E.

Phase 1, the replacement of the tide gates was completed in 2014. Phases 2 - 4 have been fully funded and will be constructed shortly after permits are obtained, hopefully in 2017. These phases include all of the actions on the NRLT property and the lowest downstream (DS) portion of the City of Eureka property. Phases 5 and 6, scheduled to take place on the City property, are not yet funded. Thus the timing of construction for those phases is currently uncertain. Funding sources from a mix of state and federal grant programs have been identified for Phases 5 and 6 and proposals will be submitted to these programs throughout 2017.

All phases include placement of large wood to enhance habitat, installation and removal of fish screens (locations shown on Figures 2-4), fish capture and relocation, installation and removal of cofferdams (locations shown on Figures 2-4), installation of stream bypass equipment (pumps and/or gravity flow pipes), installation of erosion control measures, and re-vegetation (location shown on Figures 2-4). Existing habitat will be enhanced and fish utilization of this new habitat will be monitored prior to introducing the full muted tide (see Section 2.1.14 and Appendix D. Martin Slough Enhancement Project Monitoring Plan for details).

Phase 1 was completed in 2014 and involved the replacement of three outdated tide gates at the confluence of Martin Slough and Swain Slough.

Phases 2-4 Implementation is proposed for the summer of 2017 (July 2017 – October 15, 2017) and will likely take approximately two months to complete. These phases will take place on the NRLT property and the lowest downstream DS portion of the City property. This includes excavating the Martin Slough channel starting from the tide gates moving upstream, including all of the NRLT property and additionally extending approximately 1,400 ft upstream from the boundary between the NRLT and City property (Reaches 1-4 on Figure 5). Additionally the Marsh Planes A and B (labelled A and B on Figure 5) will be excavated. Pond C (labelled C on Figure 5), a pond fringed by salt marsh and fed by a small freshwater spring, will also be excavated and replanted. The small freshwater pond fed by the southeast tributary (labelled E on Figure 5) and adjoining channel will be excavated in conjunction with excavating the meander bend adjacent to Marsh Plane B. On the lowest downstream portion of the City owned property, Pond D (Labelled as D on Figure 5) will also be enhanced with expanded brackish wetlands containing a variety of depths and an elevated outlet sill that minimizes salinity intrusion. Additionally, an existing, undersized culvert crossing leading to the agricultural bridge on the NRLT property will be removed, daylighting the channel for 40 ft. It will be replaced with a 20ft wide bridge, necessary for agricultural access. Sheet piles or other shoring will be installed on both banks to support this bridge and prevent erosion around the barn. Bridge footings and beams will be installed, with decking and railing on the bridge. Concrete curbs will also be installed around the edge of the bridge and the front of the barn to contain cow manure and prevent it from entering the channel.

(Additional actions on the City property include: installation of 3 new bridges and their associated footings, removal and disposal of 3 old bridges. The golf course bridges are critical for operation and maintenance of the golf course and need to be replaced due to the increased channel width after channel excavation.

These phases also include: installation of a variety of different types of large wood habitat structures (locations shown on Figures 2-4), grade control weirs on both the City property and NRLT (locations shown on Figures 2-4), riparian fencing, and re-vegetation (Locations shown on Figures 2-4). Additionally, this will include installation of scour protection on the 12-inch gas line that crosses the meander bend south of the barn

Phases 2-4 will also include gas line relocation (6-inch line) and decommissioning of the 4-inch line (collectively called the gas line project). The gas line project is described under section 2.1.3 below. The gas line project is being designed and implemented by PG&E in coordination with RCAA and will occur in 2017 and in conjunction with phases 2-4.

Funding for Phases 5 and 6 are not yet secured, so their implementation timeline is somewhat uncertain at this point. We are actively applying for grants this year to fund this work and have received some assurances on the part of funders that future funding will be forthcoming. We anticipate that at most, each phase will take one construction season (June 15 – October 15) with a duration of two to four months. Depending on the amount of secured funding, and the monitoring results of water quality and fish use of Ponds C and D (Figure 5) after implementation in 2017, we may be able to implement Phases 5 and 6 on the City property in conjunction with each other over one construction season, preferably in 2018.

Phases are shown below in Figure 5 and the anticipated schedule is summarized as follows:

- Phase 1 (NRLT): Funded, constructed in 2014
- Phase 2-4 (NRLT and lower City): Funded, construction expected summer/fall 2017
- Phases 5 and 6 (City): Not currently funded, funding sources identified and grant proposals are forthcoming in 2017 , anticipated implementation will occur in 2018 and possibly 2019

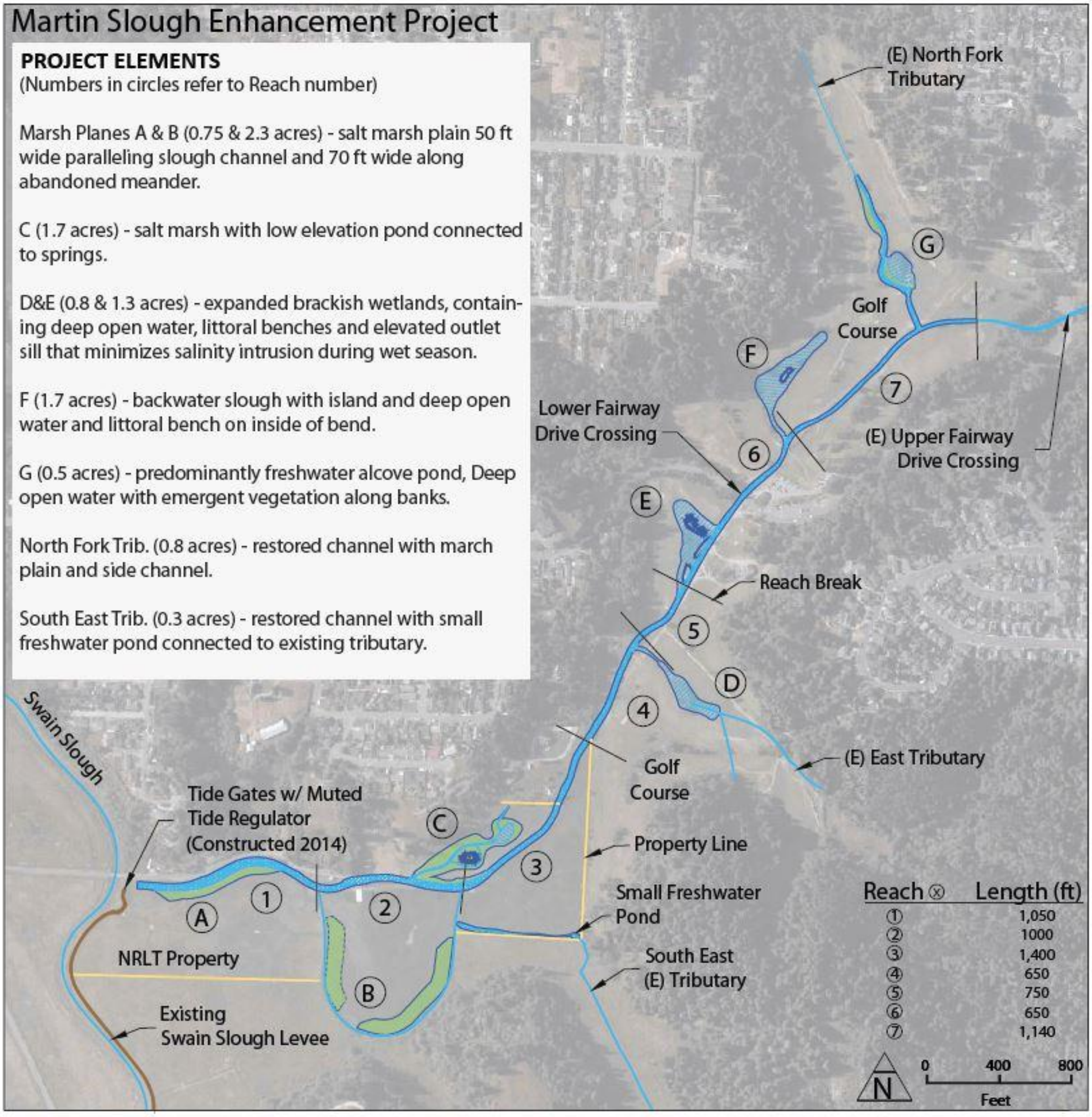

Figure 5. Summary of Martin Slough Enhancement Project Activities

Phases 5 and 6

If we secure funding in 2017 and the replacement habitat created in 2017 is adequate, we will implement phases 5 and 6 in 2018. Alternatively, if there are still concerns over replacement habitat, these phases will be split up with everything except Pond E implemented in 2018 and Pond E implement in 2019 (as described above).

Please refer to Figure 5 for the locations of the following actions:

- Excavation of the remaining Martin Slough channel on City of Eureka property from Pond D to the upstream limit of the project area (Reaches 5-7 on Figure 5)
- Enhancements of Pond E and creation of Pond F and Pond G (Figure 5).

- Excavation of a new channel for the North Fork tributary
- Fill in portions of the old channel
- Excavation of Pond G
- Placing fill to eliminate depressions on the floodplain adjacent to the channel that currently pond during floodplain inundation and present potential fish stranding opportunities.

This will create new freshwater-tidally-influenced habitat (Pond G) that California Department of Fish and Wildlife (CDFW) biologists have observed to provide ideal rearing conditions for juvenile coho salmon Pond G along with Pond F and the small freshwater pond on the NRLT property will be considered "replacement " freshwater habitat for habitat in Pond E that may become seasonally brackish upon implementation of all phases and operation of the muted tide regulator and tidal prism at full design level. Additionally, during these phases we will install a variety of large wood habitat structures; install 6 new bridges and their associated footings;, remove and dispose of 6 old bridges; install grade control weirs, and re-vegetate (locations shown in Figures 2-4).

Replacement Habitat for Pond E (17th hole pond)

As mentioned above, state and federal regulators are concerned about impacting Pond E before similar "replacement" habitat is provided. They fear that at full Project build-out, Pond E will become seasonally brackish due to the increased tidal volume when the tide regulator is opened to the full design level. CDFW biologists have observed that juvenile coho salmon have the highest abundance in winter months in tidally influenced reaches and off-channel ponds that have low levels of salinity (less than 5 parts per thousand – pers. comm. Michael Wallace). Currently, Pond E provides this type of habitat and CDFW fish sampling has revealed that the juvenile coho salmon from that pond have the highest growth rates of any of their sampling sites around Humboldt Bay. Because of the current high value of this habitat, we will provide similar replacement habitat before impacting Pond E.

We recently learned from Project engineers (Mike Love, personal communication) that we cannot reintroduce the tidal prism at the full build out level until we complete the channel enhancements to accommodate the additional volume from increased tidal inundation. This is due to concerns about increased channel bed and bank erosion and deposition if larger tides are allowed in the channel before the structure can accommodate it. Consequently, water quality (including salinity) in the ponds (including Pond E) and channel will not change drastically from the current conditions until full Project implementation is complete and we are able to open the tide regulator to the maximum design height. Essentially, the tide regulator will be operated at the same reduced level during Project implementation that it is currently operating at so salinity in Pond E (and elsewhere) is not predicted to change until Project completion when we increase the opening of the tide regulator to accommodate the full design build out tidal volumes. Our monitoring plan includes an adaptive management strategy for the tide gate operation that will enable incremental adjustments to the tide regulator as needed based on the continuous water quality monitoring results before, during, and after Project implementation.

The fact that water quality (specifically salinity) is not expected to change until after full Project implementation has altered the Project team's original planning around phasing on the City owned property. Previously, the Project team thought that the tide gate would be opened incrementally as the restoration actions occurred over time. Thus concerns about increasing Pond E salinity during the Project implementation and the need to provide replacement freshwater habitat was valid. Since the circumstances have changed and we will not be opening the tide gate until after full Project build-out, we have more leeway as to which ponds we implement first to provide the replacement habitat for Pond E. The Project team has discussed all of these matters related to Pond E with the appropriate state and federal regulators and they have expressed support for this phasing strategy (personal communication, Bob Pagliuco, NOAA; Steve Kramer, USFWS; Mike Wallace, CDFW).

However, even under operation of the full build-out design muted tide, Pond E will likely exhibit low salinity due to increased freshwater input from seasonal rains and groundwater inflow during the main time of the year when juvenile coho salmon have been documented using Martin Slough (December to June) (for a more thorough discussion about salinity see section 2.1.7). During the summer months, some juvenile coho salmon reside in Martin Slough, and it is expected that freshwater habitat in Ponds D, E, and F will be maintained in the upper layers as the water stratifies, as observed during fish sampling and water quality monitoring conducted between 2006 and 2016. Stratification causes a layering effect with the brackish water being heavier and occupying the bottom of the water column and fresh water being lighter and occupying the upper part of the water column. Pond E will provide low-salinity habitat during most of this period, even at full design operation of the MTR. Pond F is further upstream and it will have very low salinity or be primarily fresh water during the rainy season, with increasing salinity during low flow times of year but maintaining some freshwater habitat due to stratification. Pond G is expected to remain fresh throughout the year.

From a logistical construction standpoint, and to minimize the impacts to the City-owned golf course during construction, we propose that Pond D and the small freshwater pond connected to the SE Tributary (proposed for construction in 2017), can provide suitable replacement habitat for Pond E. We will monitor fish use and water quality in all new and existing ponds (including Pond E) after phases 2-4 are implemented and we will verify that fish are using the new ponds and that water quality is similar to Pond E. We will share this data with state and federal regulators and, if all agree that these new ponds provide adequate replacement habitat during construction, we then propose to concurrently implement Phases 5 and 6 during the following construction season on the City property (anticipated to take place in 2018). Phases 5 and 6 (described in detail below) include the remaining channel enhancements on the City property and enhancements to Ponds E and G with a new pond created, Pond F. If water quality and fish use suggest that Pond E is still the most desirable habitat for endangered coho and that fish use or water quality is not sufficient in Pond D and the small freshwater pond on the SE Tributary, we will conduct the remaining restoration actions on the City property in two phases. Under these circumstances, we will enhance Pond E after all other actions are completed. This would allow for another full season of monitoring the new features before any impacts occur to Pond E. This option is not preferable because it will extend the construction period from 2 to 3 years on the City property, impacting the golf course for an additional construction season.

The following sections provide additional detail about the project components summarized above.

2.1.2 Tide Gate Replacement

New tide gates were installed in 2014 to replace the old, undersized tide gates where Martin Slough drains into Swain Slough to improve discharge capacity, improve aquatic organism passage, and introduce estuarine conditions into Martin Slough. The tide gate replacement project is described here because it is an integral part of the Project and without the new tide gates, the rest of the Project as described is not feasible. The replacement tide gates were designed to meet multiple objectives:

- Reduce the duration that floodwaters inundate the golf course and pasture
- Create a muted tide to enter Martin Slough to provide adequate volume of tidal water for sediment and nutrient flushing and enlargement of estuarine habitat
- Maintain the tidal water below elevation 6 feet (note: all elevations are in NAVD88) to protect adjacent pasture grasses and turf from salt-burn
- Mimic the natural variability of the tidal cycle within the muted tide range to support a variety of salt marsh and open water habitats
- Maximize the amount of time the tide gates are open to provide for upstream and downstream movement of aquatic organisms
- Maximize the amount of time water velocities through the gate openings meet passage criteria for adult and juvenile salmon and steelhead

A maximum allowable muted tide elevation of 6 feet within Martin Slough was established to avoid brackish waters in the channel affecting the root-zone of the golf course turf, which will have a minimum elevation of 7 feet after several low areas within the golf course are raised. In general, the muted high tide will only reach 6 feet for brief periods during spring (also called king) tides, which generally occur in late fall/ early winter (November-December).

The replacement tide gate structure is similar to the tide gate recommended in the Martin Slough Enhancement Feasibility Study (Winzler & Kelly et al. 2006). The new tide gate has three 6-foot by 6-foot gates that will drain outgoing flows. The three gates were constructed at an elevation of -1.0 foot to allow operation of the muted tide regulator (MTR) mechanism that controls the auxiliary door. The MTR mechanisms are essentially float valves installed on the upstream side of the tide gates, connected to the tide gates with an arm and cam system that closes the gate as the water level rises up to and above the design operation level. The invert of the separate auxiliary door was constructed at an elevation of -1.0 foot. The center gate is top-hinged and the outer two gates are side hinged so that outflow is centered, helping to prevent the potential for undermining of the Pine Hill Road bridge, which is adjacent to the new tide gates. The new tide gate structure was also placed 30 feet further upstream than the old tide gates to create more buffer between the tide gate discharge and the bridge. The auxiliary door is top hinged. The tide gate elevation was selected to balance the benefits of increasing the tidal prism into Martin Slough while at the same time minimizing the amount of potential scour that could occur under the foundation of the adjacent Pine Hill Road Bridge.

On an outgoing tide, all three of the 6-foot by 6-foot doors of the new tide gate open to allow drainage. On an incoming tide, two independently operated doors, one of the 6-foot by 6-foot doors and the 2-foot by 2-foot habitat door, each fitted with its own MTR, close when the water surface elevation within Martin Slough reaches specific elevations. This allows the muted tide within Martin Slough to follow the water surface elevation pattern of the natural tide within the elevation range of the muted tide. When the direction of the tide changes from outgoing to incoming, one of the 6-foot by 6-foot tide gate doors at an invert elevation of -1.0 feet remains open to allow tidal inflow into Martin Slough (MTR Gate). Once the tide reaches an elevation of 4.0 feet in Martin Slough, the MTR mechanism will close the gate. The MTR on the 6-foot by 6-foot door will not be put into operation until the channel and ponds have been excavated to accommodate the design tidal prism. After the single 6-foot by 6-foot MTR Gate closes, the auxiliary door will continue to allow a small portion of tidal water to flow into Martin Slough. The auxiliary door is necessary to prolong the duration of upstream fish passage and to create the diversity of tidal elevations necessary to achieve the zonation of salt marsh vegetation that is a Project objective. At full build out, once the tide in Martin Slough reaches an elevation of approximately 5.7 feet, (based on the results of water quality monitoring this level can be adjusted as needed) an MTR mechanism will close the auxiliary door, preventing saltwater intrusion into Martin Slough above an elevation of 6 feet. This, in turn, will prevent salt burn of the golf course turf and pasture grasses. The interim operation level of the auxiliary door is 5.0 feet, which will allow sufficient tide water to enter Martin Slough and sustain the salt marsh plants that have established along the channel due to the leakiness of the old tide gates. A tide gate operation plan that fully outlines operation protocols, including who has access and under what conditions adjustments would be allowed, is currently in development.

2.1.3 Pacific Gas & Electric Gas Line Protection, Relocation, and Decommissioning

Phase 2 will include relocation of 130 feet of a 6-inch natural gas line (line L 126A) and de-commissioning of a 4-inch gas line (Line L 126B) (the gas line project) to be carried out by PG&E. Phases 4 and 5 will also include installation of scour protection over a 12-inch gas line (line L 177) where it crosses the meander on NRLT property and the East Tributary on the Golf Course. The natural gas lines are owned and operated by Pacific Gas & Electric (PG&E).

Scour protection will be installed on the 12-inch gas line in three locations where it crosses the stream channel to prevent the loss of soil from channel scour, which would reduce the depth of soil cover over the gas line. The scour protection will include placement of woven geo-textile fabric and Armorflex™, or equivalent, over the gas line.

The gas line relocation project is necessary because the enhancement project will result in excavating soil from the channel and adjacent floodplain and thus reducing the soil cover over the gas lines to less than PG&E's required minimum depth of coverage. Currently the 6-inch gas line does not meet PG&E's standard of 5 feet of soil cover over the gas line, which also applies to gas lines under stream channels, meaning the gas line has to be 5 feet or more below the bottom of the channel. The 4-inch gas line currently meets the standard under the channel but if the marsh plain is extended to this location, the depth of soil cover would not meet PG&E's standards. The 4-inch gas line is a redundant line and PG&E has proposed to decommission it rather than relocate it. PG&E has approved of the plan to relocate the 6-inch gas line (L 126A) and decommission the 4-inch gas line (L 126B) and has agreed that the scour protection designed for the 12-inch gas line (L 177) will be acceptable and the 12-inch line won't need to be re-located. PG&E is currently developing the plans and specifications for the gas line relocation and decommissioning project, and will pay for the design work and project implementation. The enhancement Project proponents are including the gas line relocation and de-commissioning as part of the enhancement Project, CEQA document, and permit applications as it is an essential element for future Project phases.

The gas line relocation will involve temporarily shutting off the gas supply and venting the remaining gas in the line into the atmosphere. This is a common practice in conducting gas line maintenance and repairs and is not considered dangerous or harmful to the environment as long as standard safety practices are employed (i.e., no open flame or spark generating equipment is operated in the vicinity of the vent while venting is occurring). After the gas is evacuated from the 6-inch gas line, a pit will be excavated in order to expose it sufficiently to have access to all sides of the pipe. Installation of 130 feet of new 6-inch gas line will be implemented either using an open trench or directional drilling. Prior to installation of the new gas line, the old gas line will be removed from under the channel area proposed for excavation by the enhancement Project. Where the gas line crosses the channel, cofferdams will be installed upstream and downstream of the crossing and the work area will be dewatered by pumping. Stream flow will be routed around the work area by pumping. Energy dissipation will be employed at the stream bypass outlet to prevent an increase in turbidity downstream of the outlet.

Prior to installing the cofferdams, temporary fish screens will be installed upstream and downstream of the cofferdams. A licensed fish biologist approved by project partners at NOAA and NMFS will capture fish within the work area by seining. Fish will be identified to the species level and temporarily placed in aerated buckets. The biologist will be present during the de-watering of the work trench to ensure that any fish or amphibians that eluded capture during the seining are captured and relocated during the de-watering. The pump intake will be screened to prevent the intake of aquatic organisms. Once the site is de-watered and all fish and amphibians have been captured, they will be released back into the channel at least ¼ mile upstream of the de-watered section where they will have access to suitable habitat areas Basic water quality measurements (dissolved oxygen, temperature, salinity) will be taken prior to release to verify that conditions are suitable. The intake for the stream bypass will be placed between the upstream fish screen and cofferdam and it will have a screened intake with a mesh size opening no greater that 3/16 inch. The outlet of the stream bypass pipe will be discharged into an energy dissipater to prevent scour of the channel and creation of turbidity in excess of background levels.

If an open trench is used to install the new gas line, shoring will be installed according to OSHA-approved standards as the trench is excavated. The trench will be dug to a sufficient depth to accommodate the new gas line, including the minimum depth of soil cover (5 feet) over the pipe. The design channel depth at this location is -1.0 feet. The top of the new gas line will be at the depth recommended by PG&E engineers to provide allowance for unanticipated-future-channel scour in addition to the minimum depth of soil cover. The maximum elevation for the top of the gas line is anticipated to be -6.0 feet (after relocation).

If directional drilling is used, the station zero pit (on the south side of the channel) will be dug to sufficient size to facilitate the drilling machinery and operators and to sufficient depth to allow installation of the new gas line at a depth of -6.0 feet or greater. Shoring will be installed according to OSHA-approved standards. The gas line will be cut at station zero and at approximately station 130 on the north side of the channel. Sections of old pipe that interfere with the installation of the new gas line or stream flow within the channel will be removed and disposed of at a metal recycling facility upon enhancement Project completion. Sections of the old pipe under the pasture, where they will not interfere with the future channel or marsh plain, may be abandoned in place to minimize the disturbance to the pasture. A receiving pit will be excavated on the north side of the channel. Shoring will be installed according to OSHA-approved standards. After the bore hole is created, new 6-inch gas line will be pulled through the bore hole and re-attached to the existing gas line. After the line is pressure tested, the bore holes will be filled in, the cofferdams will be removed, the fish screens will be removed, and the gas line will be put back in service.

The 4-inch gas line will be decommissioned in place as PG&E has determined that it is a redundant line and its removal will not affect service to its customers. After venting, the gas line will be cut and capped. The gas line under the channel will not be removed. Based on pot-holing conducted by RCAA under the supervision of PG&E, the elevation of the 4-inch gas line was determined to be sufficiently deep under the channel that it will not interfere with stream flow, even after the channel is excavated to -1.0 feet as called for in the Project plans.

Phases 5 and 6 of the enhancement project will proceed only after the gas line relocation and decommissioning have been implemented. PG&E, the Coastal Commission, and RCAA have reached an agreement to have PG&E re-locate the 6-inch line and de-commission the 4-inch line to allow the upstream portions of the Project to proceed and to fulfill the wetland enhancement goal of the PG&E Humboldt Bay Generating Station. As part of that agreement, RCAA is including the gas line project in the CEQA document and permit applications for the enhancement Project. Phase 3 (Pond G and North Fork Martin Slough enhancement) may proceed prior to the gas line relocation as it involves enhancement of freshwater habitat that will not rely on the muted tide to maintain it.

2.1.4 Tidal Channel

The Project area of Martin Slough will be wholly within the limits of tidal influence after Project implementation, although full tidal variation will not be implemented until all construction is complete. The upper reaches of the Project (North Fork, Pond G, Reach 7 on Figure 5) are expected to remain tidally-influenced-freshwater habitat, meaning the water level will fluctuate with tide levels but the water will remain fresh, even at high tide. Though Martin Slough receives freshwater inflows, the hydraulic geometry of the tidal channel of Martin Slough is assumed to be governed by the daily tidal flux rather than less frequent high flow events from upstream. Therefore, the channel cross section and profile design was based primarily on established tidal channel design methodologies

The contributing tidal prism is defined as the total tidal flux between MHHW and MLLW from channel, pond and overbank storage flowing to a channel reach on an ebb tide. The tidal prism in Martin Slough will be controlled by tidal conditions in Swain Slough, tide gate opening geometry, water surface elevations within Martin Slough, and tidal prism storage within Martin Slough. The iterative process used in the channel design process yielded a channel cross section shape and size and a longitudinal profile in equilibrium with the contributing tidal prism.

A design tidal prism of approximately 20 acre-feet was identified to be feasible for the Project area. This volume was selected to achieve several project objectives. The design tidal prism is similar to the historical tidal prism determined from measurements of channel widths of the abandoned meander bend on the NRLT property. A tidal prism of this size will result in a stable channel that fits under the existing Lower Fairway Drive bridge crossing and also allow sufficient space for the golf cart path that crosses in that location.

Geomorphically stable tidal channels typically have a U-shape, with nearly vertical banks. Experience with tidal channel restoration projects throughout the West Coast has found that it is most effective to excavate new tidal channels to match the anticipated stable top width and depth, but not attempt to grade them in a U-shape. Rather, the channels are typically built in a trapezoidal shape and allowed to self-adjust. This process occurs relatively rapidly.

For ease of construction, the Martin Slough tidal channel will be constructed with a trapezoidal shape having side-slopes of 1.5H:1V. Steeper side-slopes can unnecessarily complicate construction. The resulting stable channel and marsh plain geometries will have top widths ranging from 60 feet wide at the mouth of Martin Slough (at the tide gates) and upstream along the lower portions of the Northcoast Regional Land Trust (NRLT) property to 20 feet wide at the confluence with the North Fork of Martin Slough. The constructed channel depths, as measured from the top of bank to bottom of channel, will range between 6.3 feet and 3.9 feet.

The new channel profile has a constantly decreasing slope. It matches the existing channel elevation at the upstream end of the Project and slopes downward at an average slope 0.25%

(0.0025 ft./ft.) until it reaches the confluence with Pond F. Downstream of Pond F, the channel slope averages 0.02% (0.0002 ft./ft.), ending at the replacement tide gates.

Channel segments will be dewatered during construction, as described below in Section 2.1.12.

2.1.5 New and Expanded Ponds

The Project will include construction of a new tidal marsh complex (Pond C), enlargement of the existing Pond D into an in-channel tidal pond in a tributary flowing into Martin Slough, enlargement of the existing off-channel Pond E, construction of new Pond F, and enlargement of the existing in-channel Pond G in the North Fork. A new channel will be constructed to route flow from the North Fork around Pond G, making Pond G an off-channel pond. This design feature is intended to route sediment down the North Fork channel around rather than through Pond G to avoid sedimentation of Pond G.

Tidal marshes and pond sizing is an integral process of the equilibrium tidal channel design. Tidally influenced ponds can be a substantial component of the contributing tidal prism in a receiving channel. Similar to the channel design, pond design was an iterative process between the tidal channel design equations and HEC-RAS model results to identify the optimal pond storage volume and outlet elevations to allow flow exchange and maintain the desired water quality.

Some existing vegetation will be removed during the construction of new ponds (Ponds C, F, and the small freshwater pond on the NRLT property) and the expansion of existing ponds (Ponds E and G). The existing vegetation that will be impacted is almost exclusively non-native pasture grass on the NRLT property and non-native golf course grasses on the City property. Please see section 2.1.13 Revegetation for a more complete description of the revegetation plan.

Pond Geometry

The ponds were designed to create side channel and off-channel rearing conditions preferred by juvenile coho salmonids. Circulation through the ponds will occur from stream through flow (Ponds D), periodic stream freshets, and tidal backwater effects (Ponds C, E, F, and G). The off-channel nature of the ponds and outlet designs are intended to minimize entry of sediments and control salinity entering from the main channel into the ponds.

All of the ponds were designed to provide a complex shoreline with a variety of water depths to create a range of wetland vegetation and habitat areas. The proposed pond side slopes range from 3H:1V to 10H:1V, depending on location. The more gentle side slopes are intended to simulate point bar geometry, and the steeper slopes to simulate meander channel banks. The side slopes of the ponds will create a shallow littoral area where emergent vegetation will grow. At and above the water line, zones of wetland vegetation will change to more upland vegetation. Below the permanent pool elevation established by the pond outlets, pond side slopes steepen to 1.5H:1V to create a permanent pool a minimum of 2 to 3-feet deep. Pond bottom elevations were set to the elevation of the adjacent stream channel so that differential draining will not occur.

Pond Outfalls/Earthen Sills

Ponds E, F, and G will be connected to Martin Slough, or the North Tributary in the case of Pond G, through an elevated pond inlet/outlet channel, referred to as the pond outfall. Martin Slough and the North Fork carry a substantial volume of fine sands and silts and the elevated outfalls will minimize entry of bedload sediment into the ponds, reducing the need for maintenance dredging to maintain pond capacity. Annual monitoring of the amount of infilling is anticipated.

Pond outfall elevations and locations were established to limit winter saltwater intrusion while maximizing the amount of time the pond is hydraulically connected to the channel. Pond outfall elevations were also established to ensure the ponds are flooded twice daily by the tidal cycle. This will allow aquatic organism ingress and egress, and ensure frequent water exchange and flushing between the pond and main channel. Additionally, each pond outfall was set at a different elevation to create a diversity of off-channel conditions and habitats.

The elevations of pond outfalls are intended to minimize entry of bedload sediments from the main channel into the ponds. Some accretion of fine material may occur from smaller grained sediments suspended within the water column during flood events. However, a large volume of the water in the ponds will be flushed twice daily by tidal action, minimizing the amount of time for settlement of smaller particles

Each of the pond outfalls is 20 feet wide. HEC-RAS modeling indicates peak velocities across the weirs do not exceed 0.5 fps. Therefore, grade controls on the pond outfalls are not proposed, but the outfalls should be composed of relatively resistant material, such as clays.

2.1.6 Tidal Marsh Plains A and B and Tidal Marsh Complex C Design

Approximately 1,970 feet of tidal marsh plain in 3 reaches will be constructed along alternating sides of the tidal channel (Marsh Plain A- 750 ft.) and meander reaches (Marsh Plains B1- 500 ft. and B2- 900 ft.) on the NRLT property. The marsh plains will have a top width of 50 to 75 feet with gentle side slopes of 3H:1V transitioning to existing ground. The width of the marsh plain will gently taper to the existing channel width of approximately 20 feet at the 12 inch gas line crossings in the meander (i.e., the marsh plain will end at the gas line crossing and stream flow will be carried by the channel only). Similarly, to facilitate flow into the new tide gate, the marsh plain width will taper to the channel width of approximately 35 feet immediately upstream of the tide gates.

The design marsh plain will range in elevation from 4.8 to 6 feet, with varying elevations both in cross section and along the channel length. This range in elevations is expected to support a range of salt marsh plant species. Elevations below 4.5 feet in Martin Slough are not expected to support salt marsh vegetation and will be open channel or mudflat. Elevations between 4.5 and 6 are expected to support a range of marsh communities including *Sarcocornia* Dominated Marsh and Mixed Marsh. It is expected that Mixed Marsh will extend a portion of the way up the 3H:1V side slopes, which will be partially inundated by higher tides.

Marsh Plains A and B and Tidal Marsh Complex C are expected to be brackish to saline most of the year and are expected to support tidal marsh vegetation, thus were designed specifically to support salt marsh plant communities. Ponds D through F are expected to experience brackish to freshwater conditions throughout the year and are expected to support more freshwater marsh species. Pond G is expected to remain fresh year-round but it will be tidally-influenced and pond-water elevations are expected to vary with the tides.

2.1.7 Salinity and Expanded Aquatic Habitats

The salinity modelling (Appendix F: 65% Basis of Design Report) indicated that for both current conditions and at full Project completion salinities fluctuate up and down with the tide and with freshwater inflows. Salinities increase in the downstream direction, with rising tides, and with drops in freshwater inflows. Conversely, salinities fall during freshwater inflow events and when the tide is falling.

After project completion with the tidegates operating at the full design level, the following describes the modeled or predicted salinities throughout the project area:

During the rainy season, salinities greater than 15 ppt will extend upstream in the Martin Slough Mainstem to Pond D. Tidal marsh Complex C (Pond C) will be brackish, but the upstream end of the pond, which receives freshwater input from springs, may have salinities less than 4 ppt. Similarly, Pond D will be brackish at the downstream end, with lower salinity upstream in the pond closer to the tributary inlet where salinities are approximatly 5 ppt. Pond E will have varying salinities of 0 ppt to approximately 6 ppt, similar to the mainstem at its outfall location. Ponds F and G, located in the upper reaches of the Martin Slough Mainstem, are expected to have salinities less than 1 ppt.

At the end of the dry season when stream baseflows are at their lowest, salinities up to 15 ppt are expected to extend from Swain Slough to the upstream head of Pond E. A similar situation may occur for Pond D. Pond E is located where channel salinites drop to a more brackish level. Pond E has salinities of approximately 6 ppt, similar to the mainstem at its outfall location. Ponds F and G are expected to maintain salinitnes less than 5 ppt. These predicted concentrations are depth averaged. Stratification is expected to occur during these low flow periods, with freshwater dominating the top portion of the water colunm and high salinities near the bottom. For additional information, see Salinity Model Geometry in Appendix F 65% Basis of Design Report.

The Project will increase the amount of tidal channel and bordering pond habitats in the Project area. This additional aquatic habitat will also improve hydraulic connectivity. The Project will re-establish a muted tidal prism, which will improve adult salmonid migration and spawning runs to upstream tributaries. Table 2 contains the existing and projected aquatic habitat for the expanded pond areas only. The table does not include the expanded Martin Slough channel width and depth which would also provide increased aquatic habitat.

Table 2. Existing and Projected Habitat for Expanded Pond and Marsh Plain Areas in the Martin Slough Project area

Expanded Ponds	Existing Habitat (Acres)	Projected Habitat (Acres)
Marsh Plain A	0	0.75
Marsh Plain B	0	2.3
Pond C (brackish)	0	1.7
Pond D (slightly brackish)	0.1	0.8
Pond E (Hole 17) (brackish)	0.2	1.3
Pond F (seasonally brackish)	0	1.7
Pond G (fresh)	0.10	0.5
North Fork (fresh)	0.12	0.8
Southeast tributary	0	0.2
SUBTOTAL	**0.52**	**10.05**
Riparian Habitat	**.50**	**9.23**
TOTAL HABITAT AREA	**1.02**	**19.28**

2.1.8 Golf Course Improvements

Currently, the golf course has numerous low areas on the floodplain that do not drain after storm events. Instead, the water ponds, increasing the potential for stranding of coho salmon and tidewater gobies as floodwaters recede and leave ponds that become isolated from the creek. As part of the Project design, the low areas within the golf course that pond will be filled to a minimum elevation of 7 feet so they drain towards the channel, reducing the likelihood of fish stranding and improving drainage.

The old tide gates had limited outflow capacity that increased the amount of time necessary for storm events to drain out of Martin Slough. The new tide gates have a much larger outflow capacity, reducing the amount of time it takes for flood flows to drain from Martin Slough. Channel excavation and replacement of the culvert at the barn on the NRLT property will improve conveyance of floodwaters and further reduce the duration of flooding. The added channel capacity and the enlarged ponds will also provide flood water detention, which will reduce the extent of flooding on adjacent pasture and golf course fairways. For additional information, see modelled post-implementation velocities in the Appendix F: 65% Basis of Design Report.

2.1.9 Construction Phasing and Earthwork Volumes

Project construction will be phased over multiple construction field seasons as described in section 2.1.1. Each season may last up to 120 days, the duration to be determined by funding availability and construction logistics. Replacement of the tide gate structure was completed in the first construction season (Phase 1) in 2014. Phases 2-4 will be implemented in summer 2017 pending permit approval, with Phases 5 and 6 to occur during the following construction season depending on funding and the status of the replacement habitat constructed in 2017. Table 1 summarizes cut and fill volumes by Project Phase and Location. Sediment excavated from the channel and ponds will be primarily hauled offsite site to White Slough or another appropriate location for beneficial reuse for sea level rise adaptations. A small portion will be used onsite to raise adjoining ground elevations and to repair the Swain Slough berm.

Potential off-site reuse areas include spreading on nearby agricultural lands and re-use at White Slough in the Humboldt Bay National Wildlife Refuge (HBNWR), another wetlands enhancement project in the Humboldt Bay area, or another appropriate location. The USFWS has a failing dike around White Slough, which, if it fails, will expose the Highway 101 Hookton Overpass to wave action and erosion. HBNWR is seeking fill to help with sea level rise adaptation by raising the level of the subsided land behind the dike so it will be high salt marsh rather than open water, thus creating a buffer between the open water, wave action, and the overpass.

The White Slough project is fully permitted to accept clean fill from suitable borrow locations. Fill will be placed to raise marsh plain elevations and to eventually allow levee breaching and restoration of full tidal influence. The project is permitted by the U.S. Army Corps of Engineers, California Department of Fish and Wildlife, the North Coast Regional Water Quality Board, USFWS (Section 7 consultation), Humboldt Bay Harbor District, CALTRANS (access permit), and California Coastal Commission (via consistency determination). Construction at White Slough was initiated in 2015.

FIll placed at White Slough must come from borrow sites that are certified by the Northcoast Regional Water Quality Control Board (NRWQCB) as having soil contamination levels below or equivalent to soil contamination levels at White Slough. The North Coast Regional Water Quality Board has established a comprehensive testing protocol for sampling potential borrow soils. RCAA and GHD have developed plans for testing the soil and have coordinated with USFWS to ensure soils are tested in the approved manner. RCAA's sediment sampling plan has been accepted by the NRWQCB.

Construction Techniques and Temporary Disturbance

The primary excavation methods that will likely be utilized include track-mounted excavators, scrapers, and bulldozers. Additional details are included on the final design plans and in the 65% Basis of Design Report (Appendix F). Excavated material will be loaded into either belly- or end-dump trucks and hauled to the reuse areas. The contractor may choose to use track trucks to transport excavated material (spoils) to either an on-site re-use location or to a stockpile location from which larger street-legal trucks will be loaded for transport to its final destination. It will be the responsibility of the contractor to ensure the haul trucks are street legal and that local speed and weight limits are obeyed. The Contractor will also be responsible for developing and submitting for review by the Construction Manager a Traffic Control Plan prior to construction commencement. Hauling the excavated material from the Project area to reuse sites will require a fleet of dump trucks operating continuously during the excavation activities. Table 3 shows the range of Project construction equipment estimates for any given construction season.

Table 3. Estimates of Equipment Needed for Project Construction

Equipment Type	Estimated Quantity
Excavators	1-5
Scrapers	1-5
Dozers	1-5
Loaders	2-4
Dump Trucks	2-10
Small Tractors	1-3
Compactors	1-3
Graders	1-2

Water Trucks	1-3
Small Crane	1

Temporary construction areas will be needed to stage equipment, store material, and transport material. Temporary construction areas will be situated within locations already identified as permanent impacted areas such as excavation areas or areas within close proximity as depicted on the 100% Design Plans (Appendix G). Temporary construction activities outside permanent impact areas will be limited to temporary construction buffers, haul routes, material and equipment staging/stockpiling areas, and temporary egress/ingress areas adjoining City and County Roads and as shown on the 100% Design Plans (Appendix F). Areas identified as temporary construction areas will be restored to pre-construction conditions once construction is complete. Temporary haul roads and other high traffic areas will be de-compacted and restored back to pre-construction soil densities. Restoration of temporary construction disturbance areas will be detailed in the final specifications.

2.1.10 Temporary Haul Roads

The construction of temporary haul roads may be required to transport excavated materials from the channel corridor to City, County, and State Roads. Haul roads will also provide stable working and staging areas for excavation and loading activities. Haul road construction will depend on subgrade suitability, the size of the transport equipment to be used, the intensity of use, excavation/reuse locations, and identification of sensitive habitats and species. Temporary haul road construction could include proof-rolling native subgrade to provide a non-yielding surface or placement of crushed rock or river-run gravel over woven or non-woven geotextile fabric and geo-grid. Locations of anticipated temporary haul roads will be within the limits of temporary construction disturbance; approximate locations are depicted on Figures 2-4 and in Appendix G: 100% Design Plans, although exact locations will be determined by the contractor and may depend in part on soil conditions at the time of construction.

2.1.11 Construction Erosion and Sediment Control BMPs

Prior to Project construction, a Pollution Prevention and Monitoring Plan will be developed, submitted to, and approved by the North Coast Regional Water Quality Control Board (NCRWQCB) and implemented during construction. As part of this Plan, Best Management Practices (BMPs) for controlling soil erosion and the discharge of construction-related contaminants will be developed and monitored for successful implementation. BMPs that will be implemented as part of the Pollution Prevention and Monitoring Plan will include:

- Cofferdams or other temporary fish screens/water control structures will be placed in the channel during low tide, and will only be removed during low tide (if possible), after work is completed.
- Because cofferdams will be installed and the channel will be dewatered prior to excavation, equipment will not be operated directly within tidal waters or stream channels of flowing streams, after fish removal efforts have been completed.
- Silt fences and or silt curtains will be deployed in the vicinity of the cofferdams and at excavation of sloughs at culvert installation and removal areas to prevent any sediment from flowing into the creek or wetted channels. If the silt fences are not adequately containing sediment, construction activity will cease until remedial measures are implemented that prevent sediment from entering the waters below.
- Sediment sources will be controlled using fiber rolls, straw, filter fabric, sediment basins, and/or check dams that will be installed prior to or during grading activities and removed once the site has stabilized.
- Erosion control may include seeding, mulching, erosion control blankets, plastic coverings, and geotextiles that will be implemented after completion of construction activities.
- Excess water will be pumped into the surrounding fields to prevent sediment-laden water from entering the stream channel. If necessary, shallow, temporary receiving basins (settling

basins) will be excavated to receive and hold construction site water and allow it to percolate into the soil to avoid introduction of silty or turbid water into Martin Slough. Sod will be skimmed off the settling basin and temporarily stockpiled, as will soil from the basin, until the basin is no longer needed. At this time, the soil will be replaced into the basin and the sod will be re-planted. The MTRs will be taken out of operation during excavation to prevent tide water from entering Martin Slough and active work areas. This will reduce the amount of water in the work areas and the volume of water that will need to be evacuated from the construction site and discharged onto fields or into settling basins.

- Appropriate energy dissipation devices will be utilized to reduce or prevent erosion at discharge end of dewatering activity.
- Turbidity monitoring will be conducted in Martin Slough during the site stabilization period to ensure that water quality is not being degraded. Turbid water will be contained and prevented from being transported in amounts that are deleterious to fish, or in amounts that could violate state pollution laws. Silt fences or water diversion structures will be used to contain sediment. If sediment is not being contained adequately, as determined by visual observation, the activity will cease until remedial actions to correct the problem are implemented.
- Construction materials, debris, and waste will not be placed or stored where it can enter into or be washed by rainfall into waters of the U.S./State.
- Operators of heavy equipment, vehicles, and construction work will be instructed to avoid sensitive habitat areas. To ensure construction occurs in the designated areas and does not impact environmentally sensitive areas, the boundaries of the work area will be delineated with temporary fencing or marked with flagging.
- Equipment, when not in use, will be stored outside of the slough channel and above high tide elevations.
- All construction equipment will be maintained to prevent leaks of fuels, lubricants, or other fluids into the slough. Service and refuelling procedures will not be conducted where there is potential for fuel spills to seep or wash into the slough.
- Extreme caution will be used when handling and/or storing chemicals and hazardous wastes (e.g., fuel and hydraulic fluid) near waterways, and any and all applicable laws and regulations will be followed. Appropriate materials will be on site to prevent and manage spills.
- All trash and waste items generated by construction or crew activities will be properly contained and removed from the Project area.
- After work is completed, project staff will be on site to ensure that the area is re-contoured as per approved specifications. Restoration work (including revegetation and soil stabilization) will be performed in conformance with Appendix E Martin Slough Planting Plan and the Pollution Prevention and Monitoring Plan (at the time of writing this plan is still under development but will be complete before construction)

2.1.12 Construction Dewatering and Stream Diversion Sequencing

During excavation within the channel, management of the stream flow from Martin Slough tributaries will be required throughout the construction period. Preventing inflow into the active work zones (both tidal and freshwater) will be required to prevent aquatic and non-aquatic organisms from entering the construction site, to reduce the water to be managed in the active work area, and to reduce moisture content in the excavated soils. The muted tide regulators (MTRs) will be taken out of service during construction activities so no tidewater will enter the Martin Slough channel and ponds. This will reduce the amount of water the excavation contractor has to deal with when de-watering a work area. Inflow control practices include placement of temporary cofferdams to isolate the active work zone. The cofferdams may be comprised of native material, washed gravel encased with an impermeable geotextile or visqueen liner in combination with ecology blocks, and/ or water bladders. A combination of pumped and gravity diversion pipes will be used to route flow around the active work areas. Fish screens will be installed immediately upstream from the cofferdams to prevent aquatic organisms from being transported into the bypass pipe.

For all construction phases and areas, diversion of freshwater from the upstream cofferdam will be pumped or gravity piped and discharged onto pastures or fairways where it will be allowed to infiltrate into the ground. If needed, to prevent construction site water from returning directly to the stream through overland flow, shallow, temporary holding basins may be excavated in the pasture or fairways. Ponded storm or groundwater in construction areas will not be dewatered by Project Contractors directly into adjacent surface waters or to areas where they may flow to surface waters unless authorized by a permit from the North Coast Regional Water Quality Control Board (NCRWQCB). In the absence of a discharge permit, ponded water (or other water removed for construction purposes), will be pumped into adjoining fields to infiltrate if suitable, baker tanks, or other receptacles. If determined to be of suitable quality, some of this water may be used on-site for dust control purposes. The Contractor will be required to submit a Dewatering and Creek Diversion Plan for review and approval by the Construction Manager. This plan shall include the proposed dewatering and diversion techniques and schedule of operations. The following construction phases and associated dewatering and diversions activities are proposed to occur in the order presented below. For all construction within the channel or existing ponds, as water within the construction area is pumped out and the channel or pond is de-watered, a licensed fish biologist approved by project partners at NOAA and NMFS will observe and capture any fish as the water level is drawn down to ensure the fish are relocated to the suitable habitat conditions described above without harm. The fish biologist will also be onsite to check fish screens and cofferdams to ensure that they are free of debris and operating properly.

Lower Martin Slough Channel (MS 0+00 to MS 46+00), Including Ponds C and D

Cofferdams will be placed at the upstream and downstream end of the restoration area. Diverted flow will be pumped, gravity piped, or ditched and conveyed downstream of the active work zone. Prior to placement of temporary cofferdams, a qualified biologist will utilize seines to corral fish out of the construction limits and into adjoining waters.

Upper Martin Slough Channel Including Pond E and F

Prior to placement of temporary cofferdams, a licensed fish biologist approved by project partners at NOAA and NMFS will utilize seines to corral fish to areas out of the construction limits and into adjoining waters including the newly constructed Ponds C and D. Fish that cannot be corralled to areas outside of the construction limits will be captured and relocated as the water is drawn down during de-watering.

Pond G

During the instream channel excavation, a combination of pumped and/or gravity diversion pipes and or ditches will be used to route flow around the active work areas. Nuisance water (i.e., turbid water seeping into excavated areas from ground water) will be pumped to adjacent fields for infiltration or into settling basins. Clean water (e.g., water from Martin Slough and contributing tributaries) will be diverted using cofferdams that will prevent clean freshwater and clean tidal water from entering the excavation. Cofferdams will be placed in the Martin Slough channel immediately upstream and downstream from work sites, which will typically be 1,000 feet long or less. The cofferdams will preclude freshwater and tidal inflow into the work zone during construction. Diversion of freshwater from the upstream cofferdam will be pumped or gravity piped through a temporary culvert that will discharge onto pastures or fairways where it will be allowed to infiltrate into the ground. If needed, to prevent construction site water from returning directly to the stream through overland flow, shallow, temporary holding basins may be excavated in the pasture or fairways.

Golf Course Improvements

Currently, the golf course has numerous low areas on the floodplain that are slow to drain after storm events because the water does not have a flow path back to the channel. This increases the potential for stranding of coho salmon and tidewater gobies as floodwaters recede and leave shallow pools that are isolated from the creek. As part of the Project design, the low areas within the golf course that pond will be filled so they drain towards the channel, reducing the likelihood of fish stranding and improving drainage. Additionally, the new tide gates have a much larger outflow capacity, reducing the amount of time it takes for floodwaters to drain from Martin Slough. Eliminating shallow pools where fish can become stranded will also improve drainage.

2.1.13 Revegetation

The 100% Design Plans include the planting areas and species densities for the Project area (Appendix G). The goal is to create native, forested riparian, wetland, and tidal marsh habitats along the Martin Slough channel and expanded ponds. The excavated reaches of Martin Slough and expanded ponds will be revegetated with low growing brackish and freshwater wetland plants (sedges and rushes) and riparian forest (Sitka spruce, willow, wax myrtle, and alder). Plant material, to the extent feasible, will be salvaged from the Project impact footprint. All areas disturbed during grading and other construction activities will be treated with erosion control seeding (includes native grasses, forbs, and shrubs). A combination of active planting and passive revegetation with invasive plant control will be used. Active planting will include re-seeding of pasture and golf course fairways and planting of trees and shrubs within the riparian zone as identified in the planting plan (See Appendix E. Martin Slough Enhancement Project Planting Plan). Brackish wetlands will be re-vegetated with a combination of active planting and passive revegetation which will include monitoring and invasive plant removal. Fencing will be constructed around the perimeter of the riparian forest and along the channel through the pasture to protect the plantings from grazing and trampling by cattle. Fencing is not needed on the golf course (City) property as no cattle are allowed there. Revegetation activities will occur after each construction season during the winter/spring months and will continue until project completion.

Active vegetation maintenance will be regularly performed to ensure that the target riparian forest habitat develops along the riparian corridor areas. Options for limiting undesirable vegetation include intermittent, controlled, flash grazing (cattle, goat, or sheep), and manual removal. Special attention will be given to non-native invasive species such as dense-flowered cordgrass or reed canary grass, and periodic inspections will be conducted after completion of construction to provide early discovery of any invasive plants. Maintenance activities will be coordinated with regional eradication programs, including both timing and methods for removal of specific species. If grazing is employed, exclusion fencing will be placed to protect channel banks, newly establishing revegetation plantings, and areas of naturally recruiting desirable native plants. Flash grazing may be employed to control weed cover in active planting areas and natural recruitment areas but will be carefully managed to avoid damage to native plantings and recruits.

2.1.14 Fish Monitoring

As described in Appendix D: Martin Slough Enhancement Project Monitoring Plan, “the essential purpose of [the Project’s] monitoring activities is to raise a warning flag if the Project’s enhancement design components or the current course of management actions are not working so that corrective actions and adaptive management may be applied while cost-effective and time sensitive solutions are still available.” In developing the monitoring plan, the RCAA attempted to minimize the impact of monitoring efforts on fish species using non-destructive or low-impact sampling techniques. Monitoring for the Project includes three phases outlined below.

Pre-construction Monitoring

Pre-construction monitoring involved collecting baseline fish utilization data, establishing initial site conditions, and defining background variability. Sampling was conducted by the CDFW from the summer of 2006 through the late spring of 2017. Fish and water quality data were collected. These efforts informed the design process and phasing of the Project.

Construction Monitoring

During construction activities, monitoring efforts will be undertaken to avoid or minimize impacts to fish, with particular emphasis on listed species. Species and number of fish will be monitored during relocation prior to channel dewatering.

Post-construction Monitoring

Post-construction monitoring will occur during the 5 years following construction. Monitoring will encompass both quantitative and qualitative measures in order to evaluate the Project's annual performance. CDFW or other qualified fisheries biologists will conduct monthly fish monitoring at the Project site. Specifically, the presence/absence of target fish species will be monitored in aquatic habitat re-established or enhanced on the Project site. In addition, native salmonid and tidewater goby access to Martin Slough as well as terminal and off-channel ponds will be monitored. Methods are expected to include seine and minnow trap captures. Water quality samples will also be collected during fish monitoring. Temperature, salinity, water depth, dissolved oxygen, and conductivity will be recorded.

2.2 Federal Action

The Federal Actions are the issuance of a Section 404 permit by the U.S. Army Corps of Engineers and the funding of the project by the NOAA Restoration Center and the US Fish and Wildlife Service. The USFWS will be the lead agency for ESA consultations for this project.

2.3 Action Area

The Action Area (Figure 6) includes the Martin Slough floodplain extending beyond the limits of work slightly to the west and northwest to encompass the tide gates replaced in 2014 and a 500 foot buffer area around the site to account for any potential temporary increase in turbidity downstream of the work. It also accommodates the potential for noise, vibration, or other temporary disturbance during construction.Because the tide gates will be closed during construction, downstream influence is expected to be minimal.

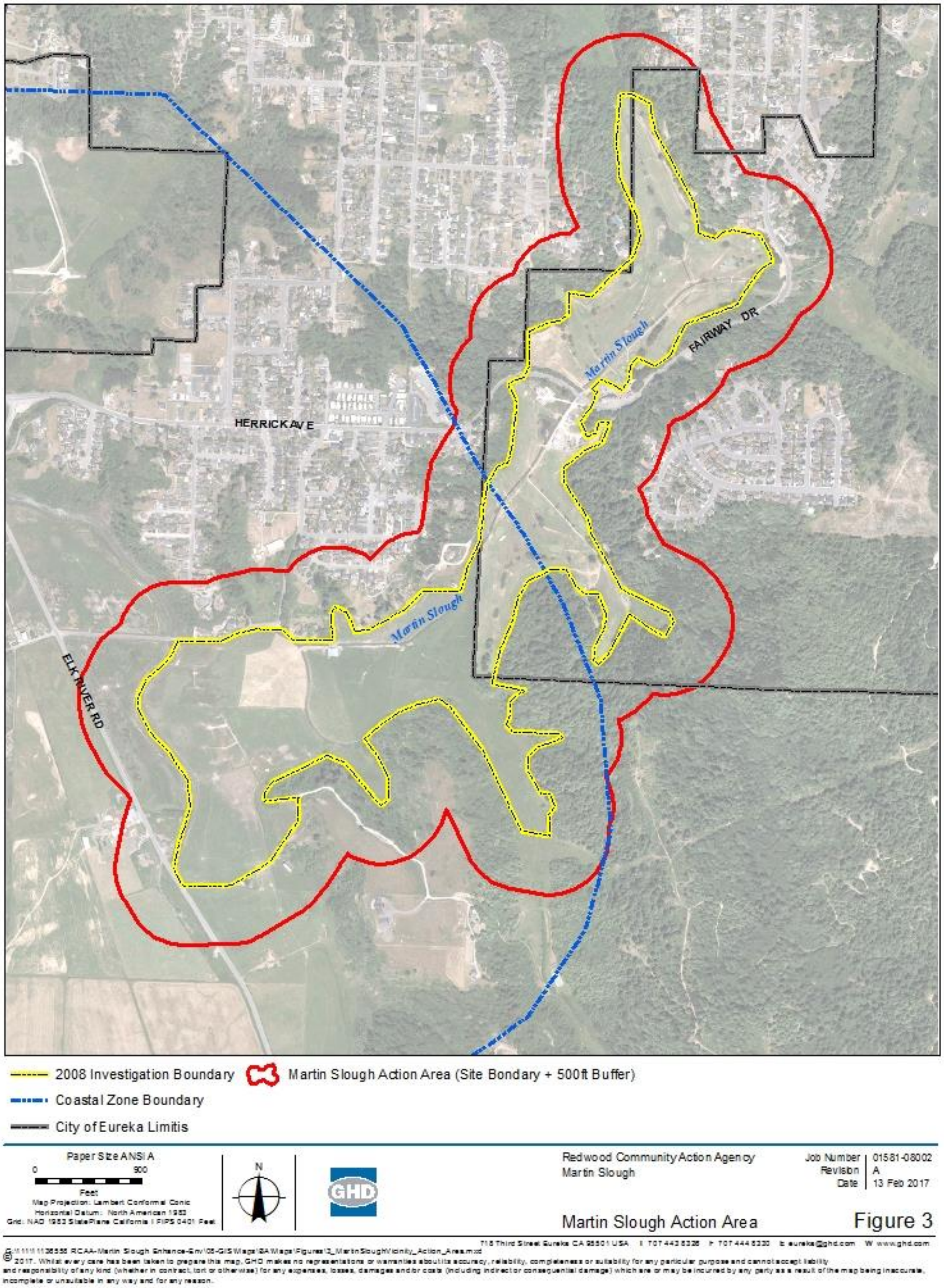

Figure 6. Martin Slough Action Area

2.4 Pre-consultation History

Tide gate replacement was covered under a NOAA Restoration Center programmatic biological opinion (Personal Communication, B. Pagliuco 2014 BO# 2011/06430) and based on an earlier version of this biological assessment completed in 2011.

2.5 Other Public Agencies Whose Approval is Required

Permits or approvals would be required from the following entities:

- U.S. Army Corps of Engineers, Section 404 permit
- North Coast Regional Water Quality Control Board, 401 Certification
- California Department of Fish and Wildlife, incidental take permit, CESA MOU, Scientific Collectors Permit, and 1600 streambed alteration agreement
- California Coastal Commission, coastal development permit
- Humboldt County grading permit

2.6 Proposed Conservation Measures

Conservation measures are intended to avoid, minimize, or compensate for environmental impacts to listed species or critical habitat. Various divisions and departments of the state and federal government may agree upon additional conservation measures.

The following proposed conservation measures are taken from the USFWS Biological Opinion for the Martin Slough Tide gate Replacement (phase 1 of the current restoration Project) which was constructed in 2014, with minor modifications to include additional species and account for differences between construction phases.

The proposed Project requires dewatering parts of the stream including salmonid and tidewater goby habitat. Prior to dewatering, the applicant proposes to implement the following measures to minimize potential Project effects to gobies:

1. Cofferdams and fish screens will be used to isolate the construction areas in the Martin Slough channel.
2. Salmonids and tidewater gobies will be translocated/removed by a licensed biologists under a scientific recovery permit pursuant to section 10(a)(l)(A) of the Act, or otherwise authorized by NMFS and USFWS, in order to minimize potentially adverse effects to salmonids and gobies. Fish will be relocated to an appropriate area within or adjacent to the Project area determined by the licensed fish biologist
3. Construction activities will only occur between June 15 and October 31 (and November 15 if there is no significant rain event) to avoid or minimize adverse impacts to sensitive fish, bird, and plant species and to minimize soil compaction and sediment transport.
4. Equipment will not be operated directly within tidal waters or stream channels of flowing streams and all BMPs outlined in section 2.1.11 will be followed.
5. To the extent feasible, work will be done during low tide when no water or fish are present, which will temporarily prevent sensitive fish species from gaining access to the vicinity of the work area. If water is present, the work area will be seined (3mm (1/16-in mesh)) and a fish screen installed (3mm (1/16-in mesh)) to isolate the work area. At this time, juvenile salmonids and gobies are susceptible to being injured or crushed by workers while they are entangled in, or being removed from netting In addition, water quality between the cofferdams will likely decline and may be unfavorable to salmonids.
6. Temporary fish screens will be removed after work is completed.
7. Silt fences will be deployed at construction areas to prevent any sediment from flowing into the creek or wetted channels. If the silt fences are not adequately containing sediment,

construction activity will cease until remedial measures are implemented that prevents sediment from entering the waters below

8. Excess water will be pumped into the surrounding fields to prevent sediment-laden water from entering any water courses. A maximum 1/16-in opening mesh screen will be used around pump inlets to prevent the potential entrainment of fish species during dewatering.

9. All exposed soil surfaces will be mulched and seeded with appropriate native seed, when the work has been completed.

10. Construction materials, debris, or waste, will not be placed or stored where it may be allowed to enter into or be placed where it may be washed by rainfall into waters of the U.S./State.

11. Turbid water will be contained and prevented from being transported in amounts that are deleterious to fish, or in amounts that could violate state pollution laws. Silt fences or water diversion structures will be used to contain sediment. If sediment is not being contained adequately, as determined by visual observation, the activity will cease.

12. Exposed soil will be mulched and seeded with appropriate grass seed once fill removal is completed.

13. Upland areas will be used for equipment refueling. If equipment must be washed, washing will occur where wash water cannot flow into wetlands or waters of the U.S./State.

14. Best Management Practices (BMPs) will be implemented to prevent entry of storm water runoff into the excavation site, the entrainment of excavated contaminated materials leaving the site, and to prevent the entry of polluted storm water runoff into coastal waters during the transportation and storage of excavated materials.

15. Disturbed, grazed, seasonal wetlands will be de-compacted and seeded as needed, with a commercially available seed mixture composed of the same grass species that currently dominate the area, following completion of work.

16. Salmonid and tidewater goby habitat will be expanded and improved.

2.7 Mitigation and Avoidance Measures

2.7.1 Mitigation Measures

The Project is expected to be self-mitigating. The components discussed below are included in the Project description.

Establishment of Habitat

The Project will increase the amount of tidal channel and bordering pond and riparian habitats and decrease the amount of agricultural grassland and developed lands in the Project area. This will provide additional overwintering and rearing habitat for salmonids and tidewater gobies and improve hydraulic connectivity and re-establish a muted tidal prism, which could allow for adult salmonid migration and spawning runs to upstream tributaries. Table 4 contains the existing and projected salmonid and tidewater goby habitat. The table does not include the expanded Martin Slough channel width and depth which would also provide increased habitat for salmonids and tidewater gobies.

Table 4. Existing and Projected Salmonid and Tidewater Goby Habitat in the Martin Slough Project Area

Salmonid and Tidewater Goby Habitat	Existing Habitat (Acres)	Projected Habitat (Acres)
Pond E (Hole 17)	0.2	1.1
Pond C	0	1.7

Pond D	0	0.8
Pond F	0	0.8
Pond G	0	0.4
TOTAL	**0.2**	**4.8**

2.7.2 Minimization Measures

Pollution Prevention and Monitoring Plan

The Project has sought exemption from the Construction General Permit through the 401 permit application and as such is not required to develop a Stormwater Pollution Prevention Plan, instead prior to Project construction, a Pollution Prevention and Monitoring Plan (PPMP) will be developed and approved by the North Coast Regional Water Quality Control Board (RWQCB) and implemented during construction. As part of the PPMP, Best Management Practices (BMPs) for controlling soil erosion and the discharge of construction-related contaminants will be developed and monitored for successful implementation.

Implement Contractor Training for Protection of Water Quality

All contractors that would be performing demolition, construction, grading, or other work that could cause increased water pollution conditions at the site (e.g., dispersal of soils) will receive training regarding the environmental sensitivity of the site and need to minimize impacts. Contractors also will be trained in implementation of stormwater BMPs for protection of water quality.

Minimize Potential Pollution Caused by Inundation

Sites will not be inundated (connected to tidal water or upstream freshwater sources) until surface soil conditions have been stabilized, all construction debris removed, and all surface soils have been removed from the site.

Instream Erosion and Water Quality Control Measures During Channel Excavation

In instances where excavation and/or dredging occurs in an effort to widen/deepen the existing channel, in-stream erosion and turbidity control measures will be implemented. These measures include installation and maintenance of in-stream turbidity curtains and silt-fence along channel banks as specified in project designs, specifications, and erosion control plans.

Minimize Removal of and Damage to Native Vegetation

During excavation of the main channel, some native vegetation will be removed. Where possible, the contractor will use heavy equipment to excavate plants and shrubs with root wads and replant these at areas designated by the re-vegetation plan. Native vegetation that is removed or damaged at access ways and within the construction areas will be replaced at a 3:1 ratio.

Fish Relocation

Before any de-watering activities begin in any creeks or channels within the Project area, cofferdams will be erected and all native aquatic vertebrates and larger invertebrates will be relocated out of the construction area into a flowing channel segment by a licensed fisheries biologist approved by project partners with NMFS and NOAA. In deeper or larger areas, water levels shall first be lowered to manageable levels using methods to ensure no impacts to fish and other special status aquatic species. A qualified fisheries biologist or aquatic ecologist will then perform appropriate seining, dip netting, or other trapping procedures to a point at which the biologist is assured that almost all individuals within the construction area have been caught. These individuals will be kept in buckets or insulated coolers equipped with battery operated aerators to ensure survival, and will be relocated to an appropriate flowing channel segment or other appropriate habitat as identified by the National Marine Fisheries Service (NMFS), CDFW, and/ or the USFWS. If fish mortalities occur, individuals will be collected and frozen for delivery to NMFS (for salmonids) or USFWS (for tidewater goby). Construction activities shall be prohibited from unnecessarily disturbing aquatic habitat. Introduced species, particularly Sacramento pikeminnow, shall be documented and reported to the CDFW. Pikeminnow will be euthanized. Cofferdams will not be removed or tide gates opened until most sediment has settled, which will minimize water quality degradation from suspended sediment and turbidity in the estuary.

Implement Dewatering and Diversions Restrictions

Ponded storm or groundwater in construction areas will not be dewatered by Project contractors directly into adjacent surface waters or to areas where they may flow to surface waters unless authorized by a permit from the North Coast RWQCB. In the absence of a discharge permit, ponded water (or other water removed for construction purposes), will be pumped into baker tanks or other receptacles, characterized by water quality analysis, and remediated (e.g., filtered) and/or disposed of appropriately based on results of analysis. If determined to be of suitable quality, some of this water may be used on-site for dust control purposes. The Contractor will be required to submit for review and approval by the Construction Manager a Dewatering and Creek Diversion Plan that shall include the proposed dewatering and diversion techniques and schedule of operations.

Construction Sequencing

The construction phase sequence detailed in section 2.1.1. was developed in order to minimize impacts to wildlife and natural resources.

2.8 Known Ongoing and Previous Projects in the Action Area

Tidegate replacement took place in 2014 as an earlier phase of this Project.

The recently constructed Martin Slough Interceptor project consists of a wastewater interceptor system located within the Action Area. This includes the installation of a new buried sewer transmission pipeline that is located outside the aquatic habitat of the Action Area.

The City of Eureka has proposed construction of an irrigation supply pond and associated well within the Action Area located in close proximity to Pond G at the upper end of the project area. The Project is currently at 65% design. Grant funds for final design have been applied for but not yet allocated.

3. Environmental Baseline

3.1 Baseline Conditions

Historic conditions within Martin Slough are summarized in Section 1.2. Currently, much of Martin Slough within the Project area is a relatively small stream flowing through a golf course. The lower portions of the stream are within agricultural areas. There is presently relatively little overhanging vegetation or shade. Upper portions of the watershed, above the Project area, include residential neighborhoods within the City of Eureka, and former timberlands.

Existing environmental conditions are summarized below by category. Topic headings are from the NOAA Fisheries “Matrix Paper” (1996) to assess conditions.

Water Quality

Martin Slough within the Project area is thought to be at risk, because of seasonally low dissolved oxygen readings and a lack of buffer between the stream and adjacent golf course. Water quality monitoring, in conjunction with monthly fisheries sampling, was conducted by the CDFW from 2007 to 2010. After the replacement of the old tide gate in 2014, these surveys and sampling events were reinitiated and are currently ongoing through 2017.

Table 5. Summary of Water Temperature (°C), Salinity (ppt), and Dissolved Oxygen (DO; mg/l) Measurements in Various Locations at Surface (S) and Bottom (B) Elevations in Martin Slough Sampling Area from June 2016 to January 2017 (Wallace 2017).

Sample Type	June	July	August	September	October	November	December	January
				Swain Slough and Tide Gate				
Temp.	19.5-21.1	19.6-20.3	20.5-21.1	15.7-15.8	15.2-16.0	14.7-14.8	8.9-9.4	6.6-6.9
Salinity (S)	4.1-12.5	8.6-18.0	16.9-21.3	23.3-31.0	25.4-26.3	11.8-12.2	3.6-9.3	0.6-2.1
Salinity(B)	12.2-22.9	22.1-26.2	21.4-28.2	26.2-32.8	28.1-34.7	14.2-24.3	15.7-16.4	4.0-6.1
DO	6.09-7.35	4.64-5.41	6.67-7.13	4.74-5.27	5.31-5.55	4.85-5.70	8.17-9.17	8.36-9.27
				Martin Slough				
Temp.	15.6-15.8	17.5-20.8	19.8-22.3	14.2-14.4	14.4-14.5	13.5-13.7	8.0	6.3-6.4
Salinity	0.1	1.2-2.1	3.2-22.8	0.3-0.4	0.2	0.2	0.1	0.1
DO	8.48-9.42	2.82-3.00	0.63-5.18	3.91-5.00	3.61-6.15	2.93-4.57	6.59-6.90	8.88-9.54
				East Tributary				
Temp	14.4-15.7	16.4-17.4	22.8-23.2	15.3-15.7	15.4-15.6	13.2	7.9-8.2	6.6-6.7
Salinity	0.2	0.2	16.2-24.1	14.3-14.4	14.0-14.2	0.1	0.1	0.1
DO	5.89-10.07	2.95-4.01	0.71-1.63	3.92-4.44	5.20-5.84	6.92-7.08	9.07-9.61	11.16-11.23
				17th Pond				
Temp (S)	15.6-16.6	17.5-17.7	18.2-18.6	14.8-15.5	14.5-15.6	13.9-14.1	7.9-8.0	6.3-6.5
Temp (B)	14.0-17.0	15.7-16.3	22.9-23.0	21.6-25.3	17.1-22.6	13.9-14.9	8.5-10.5	5.9-6.8
Salinity (S)	0.1-0.2	0.2	0.6-1.4	0.3-0.5	0.2-0.3	0.2	0.1	0.1
Salinity	0.1-2.0	0.2	19.3-22.3	7.6-18.5	0.9-7.0	0.2-1.7	0.1-0.7	0.1-0.2

(B)								
DO (S)	6.01-6.74	4.75-5.44	4.00-4.76	7.41-10.16	4.65-10.16	1.76-2.14	5.68-5.74	7.06-8.16
DO(B)	4.92-7.06	3.67-5.15	0.94-2.06	8.45-13.94	1.78-8.45	1.10-2.14	0.34-0.52	1.12-7.12
				Fairway Drive				
Temp.	14.0-14.1	14.7-14.8	15.1	12.4	13.4	13.6	8.3	6.6
Salinity	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
DO	6.35-6.61	5.36-5.65	5.59-5.84	5.85-5.94	5.18-5.20	4.57-5.23	8.19-8.37	9.82-10.14
				North Fork				
Temp.	13.1-14.7	14.8-16.7	15.9-17.0	12.0-13.5	13.3-14.6	13.5-15.2	7.9-8.6	5.9-6.7
Salinity	0.1	0.1-0.2	0.1	0.1-0.2	0.1-0.2	0.2	0.1-0.2	0.1
DO	1.35-4.55	1.00-5.45	1.02-6.15	1.39-5.59	1.00-6.67	0.74-1.80	2.48-5.42	4.27-7.14

Habitat Access

In 2007, the existing tide gates at the lower end of the Project area had significantly deteriorated and had the potential to block future fish access to Martin Slough. Installation of the new tide gates in 2014 greatly improved fish passage into the Project area.

Habitat Elements

Habitat elements are not properly functioning. No information is currently available on substrate type or condition. Since the tide gate mutes (and until recently blocked) tidal scour and sediment outflow, the bottom is assumed to be silt or covered by a layer of silt. No large woody debris was noted in visual inspections. Deep pools and backwaters are uncommon, although golf course ponds provide refugia and rearing habitat for juvenile coho salmon. There is essentially no riparian buffer in much of the Project area.

Channel Condition and Dynamics

Channel condition and dynamics are not properly functioning. Although banks appear to be stable, there is little functioning floodplain and little or no wetland or riparian habitat is present.

Flow/Hydrology

Flow/hydrology is not properly functioning. The historic tidal prism has until recently been eliminated by tide gates at the lower end of the Project area. The upper watershed is less affected, but past logging activity and some residential construction have likely increased runoff rates.

Watershed Conditions

The upper watershed is at risk and the lower watershed is not properly functioning. Portions of the watershed are at the edge of urban areas and future growth is expected. Paved roads are present in low to moderate density in the lower watershed and unpaved logging roads are present in the upper watershed. Riparian areas are scarce in parts of the lower watershed.

4. Status of Species and Critical Habitat

4.1 Federally Listed Species

The U.S. Fish and Wildlife Service list of endangered (E) and threatened (T) species for the project vicinity (Arcata North, Arcata South, Cannibal Island, Eureka, Fields Landing, McWhinney Creek, and Tyee City) were reviewed and updated on December 19, 2016. This list (Appendix A) includes 18 species (seven birds, six fish, and four plants). One bird species is delisted (D). The USFWS list also includes species under the jurisdiction of National Marine Fisheries Service (NMFS).

Table 6. Federally Listed Species that Could Occur Within the Project area

Common Name	Scientific Name	Category	Critical Habitat	Potential to Occur in Project area
		Birds		
Marbled Murrelet	*Brachyramphus marmoratus*	T	Y	Low
Northern Spotted-Owl	*Strix occidentalis caurina*	T	Y	Moderate
Short-tailed Albatross	*Phoebastria albatrus*	E	N	None
Bald Eagle	*Haliaeetus leucocephalus*	D	N	Low
Western Snowy Plover	*Charadrius nivosus nivosus*	T	Y	Low
Yellow-billed Cuckoo (western DPS)	*Coccyzus americanus*	T	P	Low
California Ridgway's Rail	*Rallus obsoletus obsoletus*	E	N	None
		Fish		
*eulachon (southern DPS)	*Thaleichthys pacificus*	T	Y	Low
*green sturgeon (southern DPS)	*Acipenser medirostris*	T	Y	Low
*coho salmon, southern Oregon/northern California ESU	*Oncorhynchus kisutch*	T	Y	Present
*steelhead, northern California DPS	*Oncorhynchus mykiss*	T	Y	Present
*Chinook salmon, California Coast ESU	*Oncorhynchus tshawytscha*	T	Y	Moderate
tidewater goby	*Eucyclogobius newberryi*	E	Y	Present
		Plants		
Western Lily	*Lilium occidentale*	E	N	None
Beach Layia	*Layia carnosa*	E	N	None
Kneeland Prairie Penny-cress	*Noccaea fendleri californica*	E	Y	None
Menzies' Wallflower	*Erysimum menziesii*	E	N	None

Key:

(E) Endangered - Listed in the Federal Register as being in danger of extinction

(T) Threatened - Listed as likely to become endangered within the foreseeable future

(D) Delisted- Delisted as a recovered species or population

Critical Habitat - Y = Designated, P = Proposed, N = None Designated

* Denotes a species Listed by the National Marine Fisheries Service

4.2 Listed Species Excluded From Further Consideration

4.2.1 Marbled Murrelet (*Brachyramphus marmoratus*)

The federally threatened Marbled Murrelet is a small seabird that nests in coastal, old-growth forests of North America. The species is a year-round resident along the coast from the Alaskan Aleutian islands to Big Sur in California. The northernmost populations of Marbled Murrelets are migratory, while more southern populations likely only engage in small-scale migration movements (Nelson 1997).

Marbled Murrelets spend the majority of their lives in the near-shore marine environments and prefer to forage along rocky coastal areas within 1.2 miles of shore (USFWS 1997). They feed by diving for small fish and invertebrates in coastal waters and bays, but may also forage on rivers and lakes. Murrelets favor old-growth conifer forests <50 miles from the coast with decadence features such as remnant trees or large branch platforms from normal tree growth, disease, damage, or mistletoe for nesting. Nest site and nest tree fidelity is common (Nelson 1997). Proximity of nesting habitat to foraging habitat is an important factor in determining murrelet distribution (USFWS 1997).

Nest-building is typically initiated around early March with the breeding season spanning from March through September. Murrelets have a slow reproductive rate and produce only one egg per year (Nelson and Peck 1995, USFWS 1997).

Loss of habitat due to timber harvesting is a major contributor to the decline of the species. Further, edge effects resulting from clear-cuts adjacent to nest sites may contribute to increased predation rates, as forest edges are preferred by many murrelet predators including jays, crows, ravens, accipiters, squirrels, marten, and fisher. Marbled Murrelet populations are considered to be highly sensitive to forest fragmentation, and are nearly absent from much of their historic range. Other threats include gill-net fishing, marine pollution, and disease (USFWS 1997).

The Marbled Murrelet has low potential to occur in the Project area. There is no suitable nesting habitat in or near the Project area, but critical habitat does exist approximately six miles to the southeast. Similarly, Marbled Murrelets have been observed frequently foraging around the North and South spits and King Salmon. Thus, the possibility of murrelets flying over the Project area to/from nesting and foraging sites cannot be completely ruled out. However, since no suitable habitat exists for the Marbled Murrelet in the immediate Project area and the murrelet is highly mobile, no impacts are expected to occur to this species.

4.2.2 Short-tailed Albatross (*Phoebastria albatrus*)

The Short-tailed Albatross is the largest pelagic seabird in the North Pacific. The albatrosses nest colonially on two small islands off the coast of Japan (Torishima and Minami-kojima) and range throughout the North Pacific during the non-breeding season (Hasegawa and DeGange 1982). Individual breeding pairs have also been documented on Easter Island and Sand Island in Midway Atoll in recent years, with at least one successful nest in 2011 (BirdLife International 2016). The breeding season is extremely lengthy with egg-laying occurring in October and chick fledging in June of the following year. Short-tailed Albatross nests consist of large scoops lined with grass in open, grassy areas (Hasegawa and DeGange 1982). The birds frequently associate with upwellings along shelf-edge habitats. These upwelling areas are highly productive and bring prey closer to the surface of the water as a result of vertical mixing (Piatt et al. 2006).

Although the Short-tailed Albatross was historically abundant throughout its range, excessive hunting for the plume trade drove the species to near-extinction in the early 1900s. In addition, volcanic eruptions on Torishima in the 1930s destroyed some of the species’ breeding grounds.

After Japan designated Torishima as a no-hunting area in 1933, populations slowly started to increase. However, as a long lived species with a low reproductive rate, populations are rebounding slowly (Hasegawa and DeGange 1982).

The Short-tailed Albatross was originally listed as endangered outside of its U.S. range by the USFWS in 1970. The USFWS then proposed the species for listing as endangered within its U.S. range in 1998. It was finally listed as endangered on July 31, 2000 within the U.S. (65 FR 46643 46654).

Since no breeding or foraging habitat exists for the Short-tailed Albatross in the immediate Project area and the albatross is highly mobile, no impacts are expected to occur to this species.

4.2.3 Bald Eagle (*Haliaeetus leucocephalus*)

As the national bird, the Bald Eagle is perhaps one of the most well-known raptors in the U.S. It is also one of the most well-studied species on the continent. The Bald Eagle is the second largest birds of prey in North America with a wing span surpassed only by that of the California Condor (Palmer et al. 1988). Bald Eagles are found throughout North America, with year-round residents along both coasts and near large bodies of water such as rivers and lakes. Seasonal breeding populations occur throughout most of Canada and Alaska, with these populations wintering through the continuous U.S. and Central America. In California, Bald Eagle breeding is restricted primarily to the northern portion of the state, with a few breeding populations along the coast south of San Luis Obispo and on the Channel Islands (Buehler 2000, NatureServe 2015).

Bald Eagles nest in large trees, on cliffs, or on the ground in treeless regions adjacent to lakes, rivers, estuaries, and dams. Platform nests are constructed out of large sticks and lined with grass, moss, down feathers, and other soft vegetation. Bald Eagles are opportunistic feeders, taking fish, waterfowl, mammals, and even carrion during the winter (Buehler 2000).

Southern Bald Eagle populations were first protected under the Bald Eagle Protection Act in 1940 (now the Bald and Golden Eagle Protection Act, 16 USC 668-668d) and the Endangered Species Act in 1967 (32 FR 4001). The entire species was listed as endangered by the USFWS in 1976 in all states except Washington, Oregon, Minnesota, Wisconsin, and Michigan (where it was listed as threatened) (41 FR 28525 28527). Widespread population recovery led the USFWS to down-list the species from endangered to threatened in 1995 (60 FR 36001 36010). The species was finally de-listed in 2007 (72 FR 37346 37372).

The site does not contain suitable nesting or foraging habitat for Bald Eagles. Based on available data, the presence of any established breeders at the site is unlikely and the species has a low potential to be present in the Project area.

Since the species is de-listed, no breeding habitat exists for the Bald Eagle in the immediate Project area, and the bird is highly mobile, no impacts are expected to occur to this species.

4.2.4 Western Snowy Plover (*Charadrius nivosus nivosus*)

The Western Snowy Plover is listed as a threatened species, effective April 5, 1993 (58 FR 12864). The Snowy Plover is a small, six inch long shorebird, distinguishable from other shorebirds by its black legs, dark bars on either side of its breast, a dark fore-crown, dark eye patch, and brown to gray back (Page et al. 2009). Two distinct breeding populations of Western Snowy Plovers are known: the Pacific coast population and an interior population that breeds in Oregon, California, Nevada, Utah, New Mexico, Colorado, Kansas, Oklahoma, and Texas (USFWS 2007).

Snowy Plovers are year-round residents in pockets along the California coast as well as the San Joaquin Valley and Salton Sea. There are also seasonal breeding populations in northeastern California and the eastern edge of the San Joaquin Valley (Page et al. 2009). The Pacific coast population nests on beaches from the central Washington coast to the Baja peninsula. The breeding season of the Pacific coast Western Snowy Plover lasts from early March through mid-September. Pair bonds are formed in mid-February. Plovers prefer to nest above the high tide line on sand spits, dune-backed beaches, lagoon and estuary salt pans, and beaches near river and estuary mouths. They also may nest on sparsely vegetated dunes, salt pond levees, and river bars (Colwell 2005, USFWS 2007). In Humboldt County, plovers preferentially select for gentle slopes of

0-4% on wide stretches of beach (220 ± 98m) when choosing nest sites (Leja 2015). Nesting microhabitat within these larger landscape features include: open ground adjacent to driftwood, beached kelp, small plants, cow patties, or other conspicuous items in an otherwise barren landscape (Page et al. 2009, Leja 2015). Nest scrapes are also constructed in areas relatively free of *Ammophila* cover (Muir and Colwell 2010). Clutches tend to be three eggs and are laid in scrapes or depressions in the sand. These scrapes are lined with debris such as shell fragments, fish bones, pebbles, and bits of vegetation. Wintering areas are usually similar to those used for nesting and include tidal flats, dune-backed beaches, salt-evaporation ponds, and agricultural waste-water ponds (Shuford et al. 1995, USFWS 2007). Pacific coast plovers commonly forage amongst piles of beached kelp and in the wet sand of the intertidal zone. Above the high tide line, they feed in dry sandy areas, saltpans, spoil sites, and along the edges of salt marshes and ponds (USFWS 2007).

Small invertebrates comprise the bulk of the Western Snowy Plover's diet and include but are not limited to crabs, beetles, amphipods, insect larvae, flies, and caterpillars (Page et al. 2009). Important habitat components for plover foraging sites include open, sandy areas within the high-tide line that contain tide-cast wrack such as kelp and drift wood. These habitat components typically attract invertebrates (77 FR 36727 36869). Nesting and wintering habitat requirements include sparsely-vegetated beach areas in front of sand dunes, flat land between dunes, spits, washover areas, blowouts (a hole or cut in a dune caused by storm action), intertidal flats, salt flats, and gravel bars (USFWS 2007).

During the 20th century, the Snowy Plover breeding range along the California coast became extremely fragmented due to habitat loss (e.g., coastal development). Habitat loss is only one of numerous threats to the species. Other threats include but are not limited to human disturbance, predation by species associated with human development (e.g., corvids), and pesticides/inorganic contaminants (Page et al. 2009). Poor reproductive success is additionally responsible for the decline of Snowy Plovers along the Pacific coast. Further, the invasion of European beachgrass (*Ammophila spp*.) has led to declines in Western Snowy Plover wintering and nesting habitat along the Pacific coast (USFWS 2007). Predation by ravens may be the primary limiting factor for plovers in northern California. In addition off-highway vehicle use on Eel River gravel bars has crushed nests and disturbed nesting plovers (Colwell et al. 2005, Lau 2015).

The Western Snowy Plover occurs at several locations around Humboldt Bay. The closest known record is from the Elk River spit in 1977 (CDFW 2016). The Elk River spit is located roughly 0.7 miles to the west of the Project area. The closest designated critical habitat is the South Spit, roughly two miles to the west of the Project location. However there are no reports of Western Snowy Plovers in the Martin Slough Project area, and the requisite habitat is not present.

No impacts are expected to occur to this species

4.2.5 Yellow-billed Cuckoo, Western DPS (*Coccyzus americanus*)

The Western Yellow-billed Cuckoo is listed as a threatened species, effective November 3, 2014 (79 FR 59991 60038). As a neotropical migrant, the Yellow-billed Cuckoo breeds in North America and winters in South America east of the Andes. In the U.S., the Western Yellow-Billed Cuckoo is a distinct population segment (DPS) of the species that is found west of the Rockies (79 FR 59991 60038). The Western Yellow-billed Cuckoo breeds in small riparian pockets in California, Arizona, Idaho, Colorado, Montana, Utah, New Mexico, and Wyoming. In California, the largest breeding populations are located in the Sacramento Valley and along the Kern and Colorado rivers (Gaines and Laymon 1984). Yellow-billed Cuckoos are a monomorphic species with males and females displaying almost identical physical features. The cuckoos are slender birds with olive brown to gray backs, white underbellies, white-tipped retrices, rufous wing patches, zygodactyl feet, and long, decurved black and yellow bills (Hughes 2015).

Western Yellow-billed Cuckoos typically arrive on their breeding grounds in June (NPS 2014). They breed and forage in low to moderate elevation riparian forests, such as cottonwood-willow forests, that are adjacent to water courses. They are also found in thickets, successional hardwood forests, abandoned agricultural land, and desert riparian woodland. Patch size is a major factor in nest site selection. Cuckoos generally prefer patches greater than 20 hectares. A multilayered canopy is also an important feature at nest sites (NPS 2014). Breeding is correlated with local food abundance. Cuckoos build their nests in trees such as willows or alders within 10 meters of the ground in dense riparian vegetation (Laymon 1980, Gaines and Laymon 1984). Nests are constructed out of twigs and lined with leaves, bark, and plant material (Hamilton III and Hamilton 1965). Yellow-billed cuckoos are interspecific brood parasites and may lay their eggs in the nests of passerines such as the American Robin. Cuckoos feed on insects (particularly caterpillars), amphibians, lizards, eggs, fruit, seeds, and young birds (Hughes 2015). Prey is captured via perch hunting or short flights (NPS 2014).

Important habitat needs for the cuckoo include large, un-fragmented riparian areas, a dense understory (often mature willows) for nesting, and cottonwood trees for foraging (Hughes 2015).

The species experienced precipitous population declines in the 20th century due to riparian habitat loss (e.g., agricultural and residential development) (NPS 2014, Hughes 2015). In addition, reproductive problems associated with pesticide use, such as eggshell thinning, have been documented in the species (Laymon and Halterman 1987). The spread of invasive plant species along riparian corridors has also resulted in the loss of cuckoo habitat (NPS 2014). Surveys in California in the 1980s revealed that only 33 breeding pairs were left in the state. This was a significant decline from the estimated 15,000 breeding pairs in California in the late 1800s (NPS 2014).

Until recently, the Western Yellow-billed Cuckoo was believed to be a casual summer visitor in riparian habitats along the Eel River (Gaines and Laymon 1984, eBird 2016). However, increased sightings of cuckoos over the last decade have indicated that the species is also a possible breeder in Humboldt County (CDFW 2016). However, no cuckoos have been reported at or near the Project site. The closest records in the area are from Cannibal Island in Loleta or the Arcata Marsh (CDFW 2016). In addition, there are no high quality habitat patches on the Project site. Based on available data, the presence of any established breeders at the site is currently unknown and would require protocol-level surveys to confirm. However, based on historical records and available habitat, the species has a low potential to be present, forage on, or nest within the Action Area.

No impacts are expected to occur to this species

4.2.6 California Ridgway’s Rail (*Rallus obsoletus obsoletus*)

The Ridgway's Rail (formerly Clapper Rail) was listed as an endangered species under the Endangered Species Preservation Act in 1970 (35 FR 16047). It is one of the largest rail species in North American, second in size only to the King Rail (Rush et al. 2012). It has a "hen-like" appearance, long de-curved orange bill, black and white barred flanks, rufous breast, and white-undertail coverts (USFWS 2013*d*, Rush et al. 2012). It is distinguishable from the physical similar and co-occurring Virginia Rail by brown dorsal feathers edged with gray, the lack of a gray cheek patch, and a duller bill color (USFWS 2013*d*, Rush et al. 2012). The species was formerly as a sub-species of the Clapper Rail of eastern North America, but recent genetic analysis split the Ridgway’s' Rail off taxonomically (Rush et al. 2012).

Ridgway's Rails are found year-round California's tidal salt and brackish marshes. The historical range of the species extended from Humboldt Bay to Morrow Bay (USFWS 2013*b*). Current populations are restricted to the San Francisco Bay area (USFWS 2013*d*). Ridgway's Rails are a monomorphic species with males and females displaying almost identical physical features. Males are typically larger in size and mass than females however (Rush et al. 2012).

Important nesting and foraging habitat features for these rails include tidal sloughs, abundant invertebrate populations, extensive vegetation cover including pickleweed (*Sarcocornia pacifica)* and cordgrass (*Spartina spp.*) in the lower tidal zone, and gum plant (*Grindelia cuneifolia*) and taller pickleweed in the upper tidal zone (Harvey 1988). Ridgway's Rails prefer to nest in areas of dense cover and at somewhat higher elevations to avoid detection by predators and tidal flooding (Storey et al 1988). This typically involves nesting on raised ground under dense vegetation (pickleweed and or cordgrass) in low marsh areas near tidal sloughs (Harvey 1988). Cup-shaped nests are constructed out of a combination of cordgrass, bulrush (*Schoenoplectus spp*.), and or saltgrass (*Distichlis spicata*), and are roughly 20 inches in diameter (Harvey 1988). In addition, nests may have domes to aid in their concealment (USFWS 2013*b*).

Parents share incubation duties with females typically brooding during the night and males brooding during the day. Ridgway's rails may initiate second broods in late June-early July, and the nesting season may extend into August (Harvey 1988). Ridgway's Rails typically lay around 8 eggs (Rush et al. 2012). Chicks are born with jet-black natal down (Weatherbee and Meanley 1965). When chicks are ready to leave the nest, parents construct floating brood-platforms around the nest, which offer a high tide refuge for young (USFWS 2013*b*). Post-breeding dispersal occurs during the fall or early winter (Linsdale 1936).

The Ridgway's Rail is an omnivore and feeds via surface-gleaning and shallow probing along mudflats. Typical prey items include a variety of invertebrates including crabs, insects, and clams. They also may occasionally eat rodents, small birds, and cordgrass seeds (Moffitt 1941). Due to large salt glands, Ridgway's Rails are capable of drinking seawater (Hammons et al. 1988).

The Ridgway's Rail has declined throughout it range primarily due to a loss in tidal marsh habitat. The current area occupied by the rail in the S.F. Bay Area constitutes less than 10% of the species' former range (USFWS 2013*b*). Historically, populations were also decimated by over-hunting for food and commerce (Rush et al. 2012). Current threats to the species include predation by native and non-native carnivores and sea level rise as a result of climate change (USFWS 2013*b*).

The last Ridgway's Rail breeding population documented in Humboldt County was in 1932 at the mouth of the Mad River (CDFW 2016). No records of the species have been documented since then. The species was extirpated from this area most likely as the result of tidal marsh habitat loss (USFWS 2013*b*). This being the case, no impacts will occur to the Ridgeway's Rail as a result of Project activities.

4.2.7 Western Lily (*Lilium occidentale*)

The Western Lily is a federally endangered herbaceous perennial monocot from the Liliaceae family (59 FR 42171). The flower blooming period is in June and July (Calflora 2012). The plant dies back every-year and overwinters as a bulbous rhizome (bulbiferous herb). This species is also capable of reproducing via seeds which are wind dispersed in close proximity to the parent plant, predominantly inside a 13-foot radius. Depending on seasonal and site specific factors, the plant generally emerges between mid- March and mid- May (USFWS 2009). The stem is un-branched and its leaves are up to three centimeters wide and 26 cm long. The leaves are composed of a single leaf or more commonly whorls (up to nine) that are elliptic, linear, or lanceolate in shape. The pistil is slightly shorter than the stamen; anthers are red, orange, or magenta in color (USFWS 2009). The flower appears as a bell shaped pendant, with 1-13 flowers per stem, and sometimes upwards of 35 flowers (Skinner 2016). Petals are curved in a backward direction and have a deep red to deep orange color peppered with dark dots, while the inner margin displays a yellow or green shaped star (USFWS 2009). This plant will show its flowers after three years and may live as long as 25 years or more. The flower is not fragrant.

The Western Lily is a wetland adapted plant (FACW) and is often found within a variety of habitats including freshwater bogs, fens, coastal scrub, coastal prairie, and along the ecotone of different vegetation types. It occurs in a coastal cool season Mediterranean climate, where summers are dry and windy and winters are wet and relatively warm. The preferred habitat for the species is characterized by a seasonally perched water table which may temporarily inundate the bulbs, but which drops below the level of the bulbs by mid to late spring (Imper 2010). Light requirements also play a critical role as too much shade may ultimately cause a populations decline from lack of light, while a lack of canopy cover can expose the plants to adverse browsing impacts (USFWS 2009).

For all principal occurrences, the species occupies either decomposed peat/muck substrate, or poorly drained soils as a result of a shallow iron pan or clay layer. The soil preference is considered to be high quality native soils, slightly acidic and high in organics (USFWS 2009, Center for Plant Conservation 2010). While the habitats for the Western Lily appear to be variable across its range, habitats are consistently in the early stages of succession. Plants commonly associated with the species in Del Norte Recovery Zone 5 include shore pine (*Pinus contorta ssp. contorta*) and Port Orford cedar (*Chamaecyparis lawsonia*), Labrador tea (*Ledum glandulosum*), western azalea (*Rhododendron occidentale*), Pacific rhododendron (*Rhododendron macrophyllum*),western tofieldia (*Tofieldia glutinosa*), Arctic starflower (*Trientalis arctica*), great burnett (*Sanguisorba officinalis*), peat moss (*Sphagnum spp.*), and marsh violet (*Viola palustris*). This species is also associated with Sitka Spruce (*Picea sitchensis*) forest. However, the plants in this setting generally are stunted non-flowering/reproducible plants (USWFS 2009).

Fragmentation of habitat, land clearing for agriculture, and development of utilities infrastructure are the leading documented causes described for the species decline. In Recovery Zone 5 (Del Norte County, California) threats include residential and commercial development, logging, increased flooding, predation, and the loss of early successional habitats from tree and shrub encroachment as a result of altered grazing and fire management (USFWS 2009).

The nearest known extant populations are of Western Lily occur on Table Bluff, roughly 6 miles to the southwest, and the requisite habitat is not present within the Project area.

No impacts are expected to occur to this species.

4.2.8 Beach Layia (*Layia carnosa*)

Beach Layia is a federally listed endangered herbaceous species endemic to California (NatureServe 2015). It has been documented from approximately 20 occurrences in eight dune systems between Freshwater Lagoon in Humboldt County and Vandenberg Air Force Base in Santa Barbara County (USFWS 2011). The largest extant occurrences are currently known from dunes in Humboldt County (USFWS 2013*a*).

Beach Layia is a succulent, annual herb ranging from a single stem to a many branched individual up to six inches tall and 16 inches in breadth, in part depending on site moisture. It is a member of the sunflower family and has small white ray flowers and yellow disk flowers (USFWS 1998). Populations tend to be patchy and subject to large annual fluctuations in size due to shifts in wind erosion patterns, remobilization, factors affecting dune stabilization, and moisture. The wind dispersed seeds often establish in sparsely vegetated areas. It does not survive for long in areas where there is high cover of native or non-native plants.

Beach Layia is found on semi-stabilized dunes from sea level up to 100 feet in elevation. As a winter annual, it germinates during the fall and mid-winter rains and blooms in spring (USFWS 2011, NatureServe 2015). Colonies of Beach Layia often occur where sparse vegetation can act to trap wind-dispersed seeds but also allow for minimal shading and competition (USFWS 2011).

The Beach Layia is threatened by coastal development, invasive plant species, off-road vehicles, trampling, and mowing within its range (NatureServe 2015).

Beach Layia occurs on coastal sand dunes, and is present at several locations around Humboldt Bay including the Elk River spit, which begins approximately 0.7 miles below the Project area. The requisite sand dune habitat does not occur within the Project site, and is segregated by Hwy 101 and railroad tracks. There will be no project related impacts in proximity to this population.

No impacts are expected to occur to this species.

4.2.9 Kneeland Prairie Penny-cress (*Noccaea fendleri californica*)

Kneeland Prairie penny-cress is a low-lying perennial herbaceous plant in the Brassicaceae (mustard family). The plant is generally less than 6 inches tall, with striking white flowers in an open inflorescence (USFWS 2011). Kneeland penny-cress blooms in March with seed set in April or May (USFWS 2011). It has a basal rosette of hairless leaves that are entire to dentate. The basal leaves have petioles. Cauline leaves are sessile with bases lobed or clasping.

Kneeland Prairie penny-cress is a California endemic species known from only one occurrence near the Kneeland airport approximately 15 miles from the Pacific Ocean in central Humboldt County. The occurrence is located on serpentine outcrops within a coastal prairie on a ridge, surrounded by broadleaved upland forest (USFWS 2011). The climate at the known occurrence is maritime-influenced, with frequent summer fog. The elevational range for the species is 760-815 meters (CNPS Inventory 2017).

4.2.10 The Project area does not contain suitable habitat for this species. No impacts are expected to occur to this species.Menzies' Wallflower (*Erysimum menziesii*)

Menzies' wallflower is a low-lying succulent biennial to short-lived perennial herbaceous plant species. It produces dense clusters of bright yellow flowers in the winter and early spring. The spatulate rosette of leaves distinguish the three subspecies of Menzies' Wallflower from other native wallflowers and can persist for up to eight years prior to fruiting (USFWS 2013*c*). Seeds are persistent on the plant and appear to only disperse during winter storm events (Pickart and Sawyer 1998). Although fecundity is high, the seeds do not persist in the seed bank and seedling survival rates are low, with 98.3% mortality shown to occur in the first year (Pickart and Sawyer 1998).

The Menzies' Wallflower occurs in semi-stable nearshore dunes and swales containing other low-lying native vegetation such as coast buckwheat, sand verbena, beach pea, and sand-dune bluegrass.

Survival of the species is threatened by several factors including: a white rust disease (*Albugo canadensis*) that decreases fecundity in the Humboldt Bay area, the encroachment of non-native plant species, deer predation, and recreational impacts.

Menzies' Wallflower is present at several locations around Humboldt Bay including the Elk River spit which begins approximately 0.7 miles below the Project area. The requisite sand dune habitat does not occur within the Project site, and is segregated by Hwy 101 and railroad tracks. There will be no project related impacts in proximity to this population. No impacts are expected to occur to this species.

4.3 Critical Habitat

4.3.1 Critical Habitat Designated Within the Action Area

Critical habitat was designated for the **green sturgeon** (Southern DPS), effective November 9, 2009 (74 FR 52300). Critical habitat for the green sturgeon includes coastal waters north of Monterey Bay, California and certain coastal bays and estuaries including Humboldt Bay. This designation also encompasses areas upstream of the tide endpoint in the Elk River. This includes Swain Slough. Martin Slough is the lowest tributary to the Elk River via Swain Slough.

Critical habitat was designated for the **coho salmon** Southern Oregon/Northern California Coasts ESU effective June 4, 1999 (64 FR 24049). All accessible areas of Humboldt Bay, including Martin Slough, are included in the areas designated as Critical Habitat for this ESU.

Critical habitat was designated for the Northern California **steelhead** DPS effective March 17, 2000 (65 FR 7764). All accessible estuaries, rivers, and tributaries within this ESU's range, including Humboldt Bay and Martin Slough, are included within the area designated as critical habitat for this ESU.

Critical habitat was designated for the California coastal **Chinook** salmon ESU effective March 17, 2000 (65 FR 7764). All accessible estuaries, rivers, and tributaries within this ESU's range, including Humboldt Bay, are included in the areas designated as Critical Habitat for this ESU, including Martin Slough.

Critical habitat was originally designated for the **tidewater goby** on November 20, 2000 (65 FR 69693 69717). This designation was revised multiple times, with the most recent iteration published on February 6, 2013 (78 FR 8745 8819). This critical habitat includes Pond E and a segment of the Martin Slough channel adjacent to and just downstream of the pond.

4.3.2 Critical Habitat Designated Outside the Action Area

Critical habitat was designated for the **Marbled Murrelet**, effective on June 24, 1996 (61 FR 26257 26320). This rule was revised effective as of November 4, 2011 (76 FR 61599 61621). The nearest area designated as critical habitat is approximately six miles to the southeast of the Project site.

Critical habitat was designated for the **Northern Spotted Owl**, effective February 14, 1992 (57 FR 1796 1838). There are no areas in the vicinity of the Project site that are designated as critical habitat. The closest designated critical habitat is roughly 14 miles to the southeast of the Project area.

Critical habitat was proposed for the **Western Yellow-billed Cuckoo** on August 15, 2014 (79 FR 48547 48652). The public comment period is over for this proposed habitat designation and the final rule is yet to be published by the USFWS. Proposed critical habitat includes habitat roughly 0.25-0.5 miles to the north and south of the Eel River from Cock Robin Island in Loleta, This proposed critical habitat falls outside the Project area.

Critical habitat was designated for the **Western Snowy Plover** in 2005 (70 FR 56970-57119) and updated effective July 19, 2012 (77 FR 36727 36869). The areas designated as critical habitat include roughly five miles of gravel bars within the Eel River (gravel bars between Fernbridge and the confluence of the Van Duzen River), as well as the coastal spits and beach north and south of the mouth of the Eel River. This critical habitat falls outside the Project area.

Critical habitat was designated for the **eulachon** (Southern DPS), effective December 19, 2011 (76 FR 65323). There are no areas in the vicinity of the Project site that are designated as Critical Habitat.

Critical habitat was designated from the **Kneeland Prairie Penny-cress** in 2002 (67 FR62897-62910). There are no areas in the vicinity of the project site that are designated as critical habitat.

4.4 Species Descriptions

4.4.1 Northern Spotted Owl (*Strix occidentalis caurina*)

Federal Status

Threatened in California (55 FR 26114 26194)

Critical Habitat

Critical habitat was designated for the Northern Spotted Owl, effective February 14, 1992 (57 FR 1796 1838).

Overview

The Northern Spotted Owl is the northwestern most dwelling subspecies of the Spotted Owl (*Strix occidentalis*) in North America. The range of the Northern Spotted Owl comprises mixed conifer forests from southern British Columbia to Marin County in northern California, with populations as far East as the Cascades (Gutierrez 1994).

Life History

As a non-migratory subspecies, the owls reside in mixed conifer forest habitat year-round (Allen and Brewer 1986). The Northern Spotted Owl is somewhat of a specialist species, primarily feeding on small to medium-sized rodents. However, the owls occasionally will also feed upon birds and invertebrates (Thomas et al. 1990). Northern Spotted Owls typically lay up to three eggs per breeding season. The breeding season spans from March through September (Forsman et al. 1984).

Biological Requirements

The preferred habitat type of the Northern Spotted Owl consists of old growth forests with moderate to high canopy closure, a multi-species canopy with large over-story trees, large trees with numerous decadence features (i.e. broken tops, cavities, and snags), and a significant amount of open space beneath the canopy (Allen and Brewer 1986).

Factors of Decline

Historically, threats to the Northern Spotted Owl included a loss of suitable habitat from logging as well as wildfires and disease. Current threats include timber harvesting and wildfires, as well as competition from Barred Owls and predation. Clear-cutting and even-aged stand forestry management practices in this region also have contributed to a decline in habitat (Thomas et al. 1990). New potential threats may come from West Nile virus, sudden oak death, and loss of genetic variation due to a recent genetic bottleneck (USFWS 2008).

Local Abundance and Distribution

Northern Spotted Owls have been document directly to the southeast of the Project site. Specifically, Spotted Owls have been detected eleven times within 1km of the project site as recently as 2002. However, nesting status was not confirmed at any of these locations since 1994. The closest documented Spotted Owl in the area was recorded in 1994 and located 528 meters to the southeast of the Project Site. There have been no documented records of Spotted Owls closer than 1km since 2002 (location was 753 meters to the southeast of the Project area). Considering the lack of suitable Spotted Owl habitat at the Project site, Spotted Owls are not likely to occur or nest onsite (CDFW 2016).

4.4.2 Coho Salmon, Southern Oregon/Northern California Coasts ESU (*Oncorhynchus kisutch*)

Federal Status

Threatened (62 FR 33038)

Critical Habitat

Designated within the Project area (64 FR 24049)

Overview

The southern Oregon/northern California coast coho salmon Evolutionary Significant Unit (ESU) was federally listed as a threatened species by NOAA Fisheries (62 FR 33038; dated June 18, 1997). This ESU is defined as all coho salmon naturally produced in streams between Punta Gorda in northern California, Humboldt County and Cape Blanco in southern Oregon. This listing was reaffirmed on June 28, 2005 (70 FR 37160).

Life History

Adult coho salmon enter rivers from late summer to mid-winter with most spawning occurring in early-to mid-winter. Eggs incubate for 1 to 1 ½ months during winter. Fry emerge and occupy shallow areas with vegetative cover. In Humboldt Bay tributaries, young of the year and yearling coho salmon rear in freshwater or tidal freshwater habitat areas, defined as the stream-estuary ecotone (SEE). Juveniles and yearlings spend various amounts of time in freshwater/estuary transition zones. In Martin Slough, little to no coho salmon spawning occurs. Instead, young of the year primarily use the area during the summer and fall, while yearlings use the slough year-round, with the greatest numbers recorded in the winter and spring. Mean residence rearing time for yearlings in the slough varies from a few weeks to nine months (Wallace et al. 2015). Adults typically spend the next two years in the ocean before returning to their home streams to spawn (Wallace 2010).

Biological Requirements

Marine invertebrates, such as copepods, euphausids, amphipods, and crab larvae, are the primary food when coho salmon first enter salt water. Fish represent an increasing proportion of the diet as coho salmon grow and mature (Moyle 2002).

Freshwater habitat requirements for juvenile coho salmon include cool water temperatures (12-14 ºC is optimal, but will survive at maximum weekly maximum temperatures <18 ºC), clear water, riparian vegetation that provides shade, clean silt-free gravel for spawning, in-stream large woody debris, availability of food (invertebrates), and overwintering habitat consisting of large off-channel pools with complex cover or small spring-fed tributary streams (Moyle 2002). Coho salmon from Humboldt Bay tributaries that reared in the estuary grew larger than their cohorts that reared farther upstream, which suggested that the stream/estuary ecotone is important overwintering and rearing habitat for juvenile coho salmon (Wallace and Allen 2009).

Factors of Decline

Population declines and extirpations in individual streams and tributaries occurred due to widespread degradation of freshwater habitats from activities such as timber harvest, road building, grazing and mining activities, urbanization, stream channelization, dam construction, wetland filling or draining, beaver trapping, and water withdrawals and diversions for irrigation (NOAA 2011). These activities resulted in changes in channel morphology and substrate, loss and degradation of estuaries, wetlands, and riparian areas, declines in water quality (e.g., elevated pH and water temperatures, reduced dissolved oxygen, altered stream fertility and biological communities, and toxics), altered stream flows, and fish passage impediments such as dams and road crossings (NOAA 2011).

Local Abundance and Distribution

Juvenile coho salmon are regularly observed in Martin Slough as evidenced by repeated captures during surveys from 2014 to 2016 (Table 8). Yearlings and young of year coho salmon may be present at any season. Adult coho salmon could potentially be present only during the early winter spawning period, and may be present only in small numbers.

Table 7. Number of Juvenile Coho Salmon Captured by Month in Martin Slough, January 2007 to August 2011 (CDFG 2011*b*)

Date	Yearling Coho	YOY Coho
1/18/2007	3	0
2/23/2007	1	0
4/05/2007	39	0
5/10/2007	18	0
6/18/2007	14	0
8/16/2007	0	3
9/18/2007	0	14
10/18/2007	0	14
11/15/2007	0	10
12/11/2007	0	0
1/10/2008	28	0
2/05/2008	7	0
3/04/2008	33	0
4/08/2008	59	0
5/13/2008	11	0
6/12/2008	0	0
7/10/2008	0	4
8/07/2008	0	3
9/09/2008*	0	6
10/9/2008	0	0
11/6/2008	0	14
12/2/2008	0	7
12/11/08*	0	16
1/13/2009	30	0
2/10/2009	326	0
3/05/2009	79	0
4/07/2009	143	0
5/07/2009	88	1
6/04/2009	15	0
7/09/2009	8	12

8/06/2009*	7	18
9/10/2009	2	1
10/8/2009	1	0
11/12/2009	6	8
12/08/2009	1	0
1/12/2010	10	0
2/11/2010	128	0
3/10/2010	60	0
4/13/2010	51	0
5/24/2011	66	0
6/30/11	0	27
7/28/2011	0	33
8/25/11	0	64
Total	***1234***	***255***
* Much higher sampling effort occurred on this date		

Table 8. Number of Juvenile Coho Salmon Captured by Month in Martin Slough, October 2014 to January 2017 (Wallace 2017)

Date	Yearling Coho	YOY Coho
October 2014	0	0
November 2014	0	0
December 2014	1	2
January 2015	13	0
February 2015	9	0
March 2015	16	0
April 2015	37	0
May 2015	37	0
June 2015	1	0
July 2015	0	1
August 2015	0	0
September 2015	0	0
October 2015	0	0
November 2015	0	2
December 2015	0	4
January 2016	13	0
February 2016	113	0
March 2016*	10	0
April 2016	83	0
May 2016	52	0
June 2016	7	0
July 2016	2	1
August 2016	0	0
September 2016**	0	0
October 2016	0	0

November 2016	0	14
December 2016	1	121
January 2017	7	0
Total	***288***	***143***
*high water levels likely reduced catch ** no sampling in 17th hole pond due to large amounts of algae		

Table 9. Seasonal Presence of Coho Salmon in Coastal California Watersheds (CDFG 2004)

<table>
<tr><th rowspan="2">Life Stage</th><th colspan="12">Month</th></tr>
<tr><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sept</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>Adult migration into river</td><td bgcolor="#cccccc"></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td bgcolor="#cccccc"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td></tr>
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<tr><td>Rearing</td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td></tr>
<tr><td>Juvenile Outmigration</td><td></td><td></td><td bgcolor="#cccccc"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#808080"></td><td bgcolor="#cccccc"></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="13">NOTE: Dark shading indicates months of peak activity for a particular life stage; the lighter shading indicates months of lesser activity.</td></tr>
</table>

4.4.3 Steelhead, Northern California DPS (*Oncorhynchus mykiss*)

Federal Status

Threatened (65 FR 36074)

Critical Habitat

Designated within the Project area (65 FR 7764 7787)

Overview

The northern California steelhead (Northern California DPS) is listed as a threatened species (65 FR 36074; August 7, 2000). This coastal steelhead DPS occupies river basins from Redwood Creek in Humboldt County to the Gualala River (near the Mendocino/Sonoma County line).

Life History

Anadromous fish such as steelhead spend their adult lives in marine environments, returning to freshwater at the age of four or five to spawn, usually in their stream of origin. Steelhead is the anadromous form of rainbow trout, although steelhead are more similar to Pacific salmon than trout in their ecological requirements. Unlike salmon, steelhead do not necessarily die after spawning.

Eggs are deposited in redds constructed in gravel, and hatch after three to 14 weeks. The hatchlings, or alevins, emerge from the gravel after an additional two to five weeks. During the egg and alevin stages, survival depends in part on the presence of clean, well-oxygenated gravel. Excessive siltation contributes to mortality at these stages (Barnhart 1991, Stillwater Sciences 2006). Juveniles remain in fresh water for one or two years before returning to saltwater, with emigration typically occurring from March through June. A second year of growth is thought to contribute to a much higher probability of survival in the open ocean (Stillwater Sciences 2006).

Biological Requirements

Juvenile steelhead use a variety of in-stream habitats depending on age and size. Smaller fish inhabit shallow, slow moving margins of streams or other open situations. Larger juveniles move to deeper water with more cover and vegetation. Steelhead juveniles typically have a longer fresh water rearing requirement, and both adults and juveniles are much more variable in the amount of time spent in fresh and salt water. For upstream migration, steelhead require a minimum depth of at least seven inches and a maximum stream velocity of 8 ft/s (Smith 1973). Spawning requires a minimum of 1-3 ft/s velocity (Smith 1973), clean substrate and temperatures of 39 - 49° F.

Factors of Decline

In the Northern California ESU, the decline of steelhead has been attributed to factors such as watershed disturbances, including logging on steep slopes, grazing, road building; water diversions; and severe habitat degradation caused by timber harvest and intensive agricultural practices, resulting in decreased flows, loss of riparian habitat, channel widening, and increased siltation and water temperatures. Despite this decline, north coast rivers and streams have the greatest amount of steelhead habitat in California; the most abundant populations of steelhead are in the Klamath-Trinity River system (Barnhart 1991, Stillwater Sciences 2006).

Local Abundance and Distribution

Steelhead occur in many permanent streams in Humboldt County, including the Elk River system. Repeated sampling of Martin Slough within the Project area from 2007 to 2011 resulted in the capture of only five steelhead or rainbow trout (Table 15). In addition, sampling efforts from July 2015 to May 2016 yielded only three juvenile steelhead trout (Table 10).

Table 10. Number of Juvenile Steelhead or Rainbow Trout Captured by Month in Martin Slough, January 2007 to 2011 (CDFG 2011*b*)

Date	Steelhead/RT
1/18/2007	0
2/23/2007	0
4/05/2007	0
5/10/2007	0
6/18/2007	0
8/16/2007	0
9/18/2007	1
10/18/2007	1
11/15/2007	0
12/11/2007	0
1/10/2008	0
2/05/2008	0
3/04/2008	0
4/08/2008	0
5/13/2008	0
6/12/2008	0
7/10/2008	0
8/07/2008	0
9/09/2008*	0
10/9/2008	0

11/6/2008	0
12/2/2008	1
12/11/08*	1
1/13/2009	0
2/10/2009	0
3/05/2009	0
4/07/2009	1
5/07/2009	0
6/04/2009	0
7/09/2009	0
8/06/2009*	0
9/10/2009	0
10/8/2009	0
11/12/2009	0
12/8/2009	0
1/12/2010	0
2/11/2010	0
3/10/2010	0
4/13/2010	0
5/24/2011	0
6/30/11	0
7/28/2011	0
8/25/11	0
Total	***5***
* Much higher sampling effort occurred on this date	

Table 11. Number of Steelhead/Rainbow Trout Captured by Month in Martin Slough, October 2014 to January 2017 (Wallace 2017)

Date	Steelhead/RT
October 2014	0
November 2014	0
December 2014	0
January 2015	0
February 2015	0
March 2015	0
April 2015	0
May 2015	1
June 2015	0
July 2015	0
August 2015	0
September 2015	0
October 2015	0
November 2015	2
December 2015	0

January 2016	0
February 2016	0
March 2016	0
April 2016	0
May 2016	0
June 2016	0
July 2016	1
August 2016	0
September 2016	0
October 2016	0
November 2016	0
December 2016	1
January 2017	0
Total	***4***

4.4.4 Chinook Salmon, California Coast ESU (*Oncorhynchus tshawytscha*)

Federal Status

Threatened (64 FR 50394)

Critical Habitat

Designated within the Project area (65 FR 7764)

Overview

The California coastal Chinook salmon (California coastal ESU) was listed by the Federal Government as a threatened species on September 16, 1999 (64 FR 50394) and reaffirmed on June 28, 2005 (70 FR 37160). California coastal Chinook salmon are a distinct population of Chinook salmon that reside from Redwood Creek in Humboldt County, south through the Russian River in Sonoma County.

Life History

California coastal Chinook salmon spawn and rear in coastal and interior rivers in Northern California. Ocean-type chinook (fall run) rear for less than one year in freshwater, while stream-type Chinook (spring run) remain in freshwater for one year or more before emigrating to forage in coastal and marine zones of California for two to five years (Healey 1991). Currently, only fall-run Chinook appear to be extant in the DPS (NOAA Fisheries 2007), and typically migrate to the ocean within their first year from April through July, but have been observed in fall.

Biological Requirements

The ideal temperature range for rearing, smolting, and migrating (seaward) Chinook appears to be 50° to 55° F (Rich 1997).

Factors of Decline

The destruction and modification of historic spawning habitat, fish passage barriers, over-harvesting, floodplain connectivity and function, as well as stream flow and predation are considered moderate to very high threats to this ESU. Land use activities (logging, road construction, streambank alterations, etc.), water diversions and overutilization for recreational purposes are also major factors of decline. Main factors limiting this chinook ESU are low abundance, low distribution and negative trends. Predation by pikeminnow in the Eel River and genetic integrity are considered important. Uncertainty of the data is also considered a risk factor (NOAA Fisheries 2007).

Local Abundance and Distribution

Nehlsen et al. (1991) and Higgins et al. (1992) considered Chinook in Humboldt Bay tributaries to be at high risk of extinction. Numbers in Freshwater Creek increased in 2000 – 2001 although hatchery fish are thought to have contributed to part of the increase (Good et al. 2005). Chinook salmon have been consistently reported from the Elk River system and one sub-yearling was captured in Martin Slough in May of 2011 (Wallace 2017).

4.4.5 Tidewater Goby (*Eucyclogobius newberryi*)

Federal Status

Endangered (59 FR 5494 5499)

Critical Habitat

Designated within Project area (78 FR 8745 8819)

Overview

The tidewater goby was listed as endangered in 1994 (USFWS 1994). The species occurs in coastal lagoons, estuaries, and marshes (USFWS 2005).

Life History

Males excavate breeding burrows on unconsolidated coarse sand, usually beginning in April or May (Swift et al. 1989). Spawning peaks in late spring and late summer, but may occur at any time of year (USFWS 2005). Females deposit 6 to 12 clutches of 300-500 eggs, which are guarded by the males (Swift et al. 1989). Hatchlings remain in the burrow for 9 to 11 days before dispersing. Larvae are pelagic for several days, later becoming benthic (USFWS 2005, Chamberlain 2006). Few individual tidewater gobies live for more than one year.

Biological Requirements

Tidewater gobies generally inhabit saltwater-freshwater transition zones in coastal lagoons or estuaries, sometimes venturing upstream a short distance into freshwater. Populations may be most common above the frequent tidal exchange zone, including in muted tide areas inside levees and in perched areas inundated only during the highest tides (Chamberlain 2006).

Tidewater gobies are adapted to and occur in a broad range of water quality parameters, which likely reflects an underlying distribution of these variables in waters that have infrequent, occasional connectivity to tidal fluctuations (Chamberlain 2006). Along the northern California coast, tidewater gobies are typically found in water temperatures of 12-24ºC (54-75°F) within a range of 5.8-25ºC (42-77°F), salinities of ≤15 parts per thousand (ppt) (range 0-51 ppt), and water depths of 20-100 cm, although depth preferences are likely biased due to sampling methods (e.g., beach seine) (Stillwater Sciences 2005).

Factors of Decline

Little information is available on tidewater goby population trends. A number of new populations have been discovered in recent years, and for a time there was a proposal to split northern and southern populations into Distinct Population Segments and delist the northern populations. However, this proposal was later withdrawn (USFWS 2002).

The greatest threats are believed to include habitat loss (including bridging of coastal lagoon barrier sand bars, and channelization or relocation of streams); disease and parasitism; alteration of water flow; and introduction of exotic competitors or predators (USFWS 2005).

Local Distribution and Abundance

The project site is within the NC-3 population subunit, which extends from the Mad River to the Eel River and includes Humboldt Bay. The tidewater goby occurs in “multiple but small dispersed habitats” around Humboldt Bay (Chamberlain 2006); all currently known populations are in the northern part of the Bay (Arcata Bay). Until 2008, the species had not been reported from the Swain Slough/Elk River system (USFWS 2005, Chamberlain 2006) or in other nearby streams, and had not been taken in Martin Slough despite several years of frequent fish sampling associated with the current project. More recently, tidewater goby have been detected in Martin Slough. Deterioration of the culverts and increase in brackish water upstream of the tide gates have led tidewater goby to take up residence in the 17th hole pond (Wallace 2012). In November 2008, tidewater goby were captured in hole 17 pond and downstream of the pond by USFWS (Wallace 2010a). Tidewater goby were captured again in hole 17 pond during CDFG pikeminnow surveys in January 2010 and again in July and August 2011 (Table 11). During montly sampling efforts from October 2014 through May 2016, tidewater goby were detected on 19 of the 20 sampling days. During each of these sampling efforts, tidewater gobies were primarily collected at the hole 17 pond, However, gobies were collected several times at the tide gate location as well (Ojerholm and Wallace 2016). The occurrence of tidewater goby in Martin Slough appears to coincide with an increase in brackish water caused by the deterioration of the culverts upon which the tide gates are mounted and seepage of brackish water through the corroded culvert. The Eureka Municipal Golf Course measures salinity in the hole 17 pond and has detected an increase in salinity through the summer of 2011 to the point that the pond became unsuitable as a source of irrigation water for the golf course.

Table 12. CDFW Survey Results from Hole 17 Pond in Adjoining Martin Slough With 100ft x 5ft Seine Net (Wallace 2017)

Date	# Tidewater Gobies Captured
7/8/2015	11
8/13/2015	12
9/10/2015	16
10/8/2015	38
11/12/2015	27
12/10/2015	17
1/14/2016	0
2/16/2016	2
3/10/2016	2
4/11/2016	1
5/12/2016	5

5. Analysis of Effects

5.1 Northern Spotted Owl

5.1.1 Direct Effects

This species occurs to the south and southeast of the Project area. Although the mature mixed forest of some nearby lands provides suitable habitat, the Project area itself is outside suitable habitat and there will be no direct loss of habitat. Disturbance could occur as a result of construction noise from excavation equipment. This was assessed with the methods of USFWS (2006). Because a paved roadway with occasionally heavy and fast-moving traffic bisects the Project site, the background noise level is considered moderate. Project construction noise would be in the “high” range (backhoe, trucks, etc.) with the possibility of occasional brief instances of very high levels. At these levels, sound would reach the threshold of take at distances of up to 330 feet during worst-case scenario very high noise events, or 165 feet at more typical high noise levels. Since the nearest documented spotted owl territory is more than 500 feet away, there will be no direct effects related to noise.

The same report gives visual disturbance (direct line of sight) distances for spotted owls as 131 feet. Thus no direct visual effects are anticipated.

Since construction will be limited to the June 15th to October 15th period and will occur during normal daytime working hours, the potential for construction related impacts will be further reduced.

5.1.2 Indirect Effects

No indirect effects are expected.

5.1.3 Beneficial Effects

Although the project is intended to restore habitat, this will not extend into areas suitable for the spotted owl or include mature forested habitat.

5.1.4 Northern Spotted Owl Critical Habitat

No impacts are anticipated to occur to Northern Spotted Owl critical habitat since it does not fall in or directly adjacent to the Action Area. The closest designated critical habitat is roughly 14 miles to the southeast of the Project area.

5.2 Coho Salmon, Southern Oregon/Northern California ESU

5.2.1 Direct Effects

Juvenile coho salmon could be harmed during in-stream channel activities, especially when sections of the channel are dewatered or during channel excavation. For example, juvenile coho residing upstream of the Project area may be blocked from leaving Martin Slough during construction. However, coho salmon will be captured and then relocated during dewatering to prevent injury or mortality (see Section 2.6 Conservation Measures). Other life stages of coho salmon are not likely to occur between July 1st and October 15th in Martin Slough, so they would not be directly affected by in-stream channel activities. Only one Coho was captured during the July to October sampling events in 2015 (Ojerholm and Wallce, 2016).

Based on comments from the USFWS (Personal Communication, Steve Kramer, Feb 2017) regarding impacts to fish species, we have provided below the max, min, and mean number of both yearling coho salmon and young of the year coho salmon that have been captured during sampling events in Martin Slough. During the earliest years of the Project, fish numbers from the mainstem and east tributary were reported separately. Since the Action Area encompasses both of these portions of the slough, we summed the numbers from those sampling events to obtain Project site totals. In addition, we incorporated fish sampling numbers from Martin Slough pikeminnow surveys, which were reported separately from normal CDFW sampling events. This provides the most comprehensive max, min, and mean fish totals for the entire Martin Slough Project area. Numbers were round to the nearest whole digit.

The maximum, minimum, and mean number of yearling coho salmon captured during one sampling event at Martin slough from 2007-2017 was 647, 0, and 38 individuals respectively. The maximum, minimum, and mean number of young of the year coho salmon was 121, 0, and 7 respectively. Although 647 yearling coho and 121 young of the year could be in the slough during the spring/winter, the max, min, and mean number of yearling and young of the year coho during the summer months/construction season (June 15th-August 15th) is significantly lower. Specifically, during this period of time in 2007-2016, a max, min, and mean of 14, 0, and 2 yearling coho salmon were captured. Similarly, the max, min, and mean for young of the year coho during this same time period was 64, 0, and 8 respectively.

Considering a work period spanning from June 15th-August 15th (for up to three construction seasons), with an estimated single dewatering event for Phases 2-4 and two dewatering events for Phases 5 & 6, a maximum of 14 yearling coho and 64 young of the year coho could be affected by the Project work per year. There is an estimated 3% mortality for salmonids as a result of relocation projects (Collins 2004, NMFS 2012). This being the case, the dewatering aspect of the Project could negatively impact an estimated total of 42 yearling and 192 young of the year (234 total coho salmon) with up to 7 mortalities.

Monitoring would continue post-project, with some resulting handling and harassment of coho salmon. While the risk of monitoring-related mortality is low, it is possible. Since restoration efforts should increase habitat quality in Martin Slough, more coho salmon are expected to use the channel during the winter/spring and to be captured during sampling events. The pre project monitoring that has been conducted by CDFW sampled 6 sites throughout Martin Slough. The post project monitoring will include CDFW's original 6 sites and add an additional 6 sites for a total of 12 sites (see map of current and future sampling sites in Appendix D). According to CDFW's pre-project sampling efforts, the 2009 sampling year had the greatest number of coho yearling captures on Martin Slough with 504 in the winter, 8 in the fall, 23 in the summer and 254 in the spring for a total of 789 handled in 2009. Based on these numbers, the improved habitat conditions and the 6 additional monitoring sites that will be sampled post project, we anticipate handling and PIT tagging no more than 1600 coho yearlings each year. Based on a study looking at PIT tag mortality in juvenile Chinook salmon, PIT tag mortality in juvenile Chinook was less than 5% (Prentice et al 1987). Therefore we estimate that no more than 80 yearling coho will be killed each year, for 5 years post project. In addition, 135 coho young of the year (yoy) were captured during the winter of 2016, which was the greatest you capture event in 10 years. We will not be PIT tagging these individuals and mortality is expected to be <1% or no more than 14 individuals/year. We plan to conduct biological monitoring at these sites for up to 5 years after project completion.

5.2.2 Indirect Effects

Increased turbidity and suspended sediments in Martin Slough may occur as a result of channel excavation after the cofferdams are removed, or as a result of upland restoration activities such as riparian vegetation replanting. Increased turbidity and suspended sediments could cause mortality, illness, or injury of coho salmon due to re-suspended contaminants, clogging and abrasion of gill filaments, low-oxygen water, and interference with feeding due to poor visibility (LFR Levine-Fricke 2004). Sediment can also smother coho salmon eggs, which would affect future fish stocks (Hobbs 1937). However, no suitable spawning gravel has been observed in the Martin Slough Project area and being former tide land, the Project site does not contain suitable spawning habitat (i.e., pool-riffle morphology with suitable gravel). Therefore the Project is not anticipated to have any effect on spawning habitat. The introduction of sediments is expected to be short-term and insignificant, and background levels are already high in Martin Slough. In the long-term, turbidity and suspended sediment are expected to be reduced due to upland restoration activities and establishment of a riparian buffer.

Construction activities, as well as some of the future management and maintenance activities could accidentally introduce contaminants (fuel oils, grease) to Martin Slough and downstream of the Project area. These substances are known to be toxic to fish and prolonged exposure can cause morphological, behavioral, physiological, and biochemical abnormalities (Sindermann et al. 1982).

The risk of this disturbance would be highest during in-stream channel construction activities; the effect would be deleterious to coho salmon or their prey. However, these effects would be avoided through use of standard BMPs, and residual effects would be short-term and temporary if they did occur.

5.2.3 Beneficial Effects

Restoration activities will increase the availability of transition (salt/freshwater) habitat. This will increase the amount and quality of overwintering and rearing habitat for juvenile coho salmon, which grow larger in estuaries than farther upstream (Wallace and Allen 2009). In addition, excavation of additional ponds and widening of the lower channel will improve fish passage and increase aquatic habitat for coho salmon. The restoration of a riparian buffer will reduce water temperatures and increase protective cover and food sources for coho salmon. Turbidity and suspended sediment are expected to be reduced due to the new buffer zone, which may ultimately improve water quality and habitat for coho salmon. The project is expected to have a net beneficial effect to coho salmon.

5.2.4 Coho Salmon Critical Habitat

See section 5.4.5 for details.

5.3 Steelhead, Northern California DPS

5.3.1 Direct Effects

Steelhead occur in Martin Slough in small numbers, and it is possible that a few fish will need to be relocated during channel restoration activities. However no Steelhead were captured during July through October sampling events in 2015.

Based on comments from the USFWS regarding impacts to fish species (Personal Communication, Steve Kramer Feb 2016), we have provided below the max, min, and mean number of steelhead that have been captured during sampling events in Martin Slough. During the earliest years of the Project, fish numbers from the mainstem and east tributary were reported separately. Since the Action Area encompass both of these portions of the slough, we summed the numbers to from those sampling events to obtain Project site totals. In addition, we incorporated fish sampling numbers from Martin Slough pikeminnow surveys, which were reported separately from normal CDFW sampling events. This provides the most comprehensive max, min, and mean fish totals for the entire Martin Slough Project area. Numbers were round to the nearest whole digit.

The maximum, minimum, and mean number of steelhead captured during one sampling event at Martin Slough from 2007-2017 was 2, 0, and 0 individuals respectively.

Although, a maximum number of 2 steelhead could be in the slough during the spring/winter, the max, min, and mean number of steelhead during the summer months/construction season (June 15th-August 15th) is lower. Specifically, during this period of time in 2007-2016, a max, min, and mean of 1, 0, and 0 were captured.

Considering a work period spanning from June 15th-August 15th (for up to three construction seasons), with an estimated single dewatering event for Phases 2-4 and two dewatering events for Phases 5 & 6, a maximum of 1 steelhead could be affected from the Project work per year. There is an estimated 3% mortality for salmonids as a result of relocation projects (Collins 2004, NMFS 2012). This being the case, the dewatering aspect of the Project could negatively impact an estimated total of 3 steelhead with one mortality.

Monitoring would continue post-project, with some resulting handling, PIT tagging and harassment of steelhead While the risk of monitoring-related mortality is low, it is possible. Since restoration efforts should increase habitat quality in Martin Slough, more steelhead are expected to be in the channel during the winter/spring and captured during sampling events. We anticipate up to 300 steelhead 1+ to be handled and PIT tagged per year with a potential mortality of 5% or 15 individuals. We also expect to encounter up to 100 steelhead yoy during our monitoring efforts each year. We will not be PIT tagging these individuals and mortality is expected to be <1% or no more than 1 individual/year. We plan to conduct biological monitoring at these sites for up to 5 years after project completion.

Indirect Effects

Increased turbidity and suspended sediments in Martin Slough may occur as a result of channel excavation after the cofferdams are removed, or as a result of upland restoration activities such as riparian vegetation replanting. Increased turbidity and suspended sediments could cause mortality, illness, or injury of steelhead due to re-suspended contaminants, clogging and abrasion of gill filaments, low-oxygen water, and interference with feeding due to poor visibility (LFR Levine-Fricke 2004). Sediment can also smother steelhead eggs, which would affect future fish stocks (Hobbs 1937). However, no suitable spawning gravel has been observed in the Martin Slough Project area and being former tide land, the Project site does not contain suitable spawning habitat (i.e., pool-riffle morphology with suitable gravel). Therefore the Project is not anticipated to have any effect on spawning habitat. The introduction of sediments is expected to be short-term and insignificant, and background levels are already high in Martin Slough. In the long-term, turbidity and suspended sediment are expected to be reduced due to upland restoration activities and establishment of a riparian buffer.

Construction activities, as well as some of the future management and maintenance activities could accidentally introduce contaminants (fuel oils, grease) to Martin Slough and downstream of the Project area. These substances are known to be toxic to fish and prolonged exposure can cause morphological, behavioral, physiological, and biochemical abnormalities (Sindermann et al. 1982). The risk of this disturbance would be highest during in-stream channel construction activities; the effect would be deleterious to steelhead or their prey. However, these effects would be avoided through use of standard BMPs, and residual effects would be short-term and temporary if they did occur.

5.3.2 Beneficial Effects

The project will improve long-term habitat for steelhead by increasing channel diversity, providing riparian buffer, and expanding off-channel refugia. Earlier replacement of the tide gate with a more fish-friendly mechanism has already re-opened Martin Slough to anadromous steelhead.

5.3.3 Steelhead Critical Habitat

See section 5.4.5 for details.

5.4 Chinook Salmon, California Coast ESU

5.4.1 Direct Effects

Block nets will exclude Chinook salmon during channel construction areas, and if any are present, they would be relocated. Previous sampling suggests the species is infrequently present in most parts of the Project area, although the new tide gate has presumably improved access. Only one Chinook was captured in Martin Slough in recent sampling events (Ojerholm and Wallace, 2016). Post-project monitoring however will likely see increased numbers of Chinook salmon, In this case, fish sampling post-construction may have adverse impacts on individual Chinook.

Based on comments from the USFWS (Personal Communication, Steve Kramer, Feb, 2017) regarding impacts to fish species, we have provided below the max, min, and mean number of Chinook salmon that have been captured during sampling events in Martin Slough. During the earliest years of the Project, fish numbers from the mainstem and east tributary were reported separately. Since the Action Area encompass both of these portions of the slough, we summed the numbers to from those sampling events to obtain Project site totals. In addition, we incorporated fish sampling numbers from Martin Slough pikeminnow surveys, which were reported separately from normal CDFW sampling events. This provides the most comprehensive max, min, and mean fish totals for the entire Martin Slough Project area. Numbers were round to the nearest whole digit.

The maximum, minimum, and mean number of Chinook salmon captured during one sampling event at Martin slough from 2007-2017 was 1, 0, and 0 individuals respectively.

Although, a maximum number of 1 Chinook salmon could be in the slough during the spring/winter, no Chinook salmon have been recorded in Martin Slough during the summer months/construction season (June 15th-August 15th).

Considering a work period spanning from June 15th-August 15th for both Phases 2-4 and Phases 5-6, with an estimated single dewatering event per seasons, a maximum of 20 Chinook salmon could be affected via harassment and handling from the Project work per year.

Monitoring would continue post-project, with some resulting handling and harassment of Chinook salmon. While the risk of monitoring-related mortality is low, it is possible. Since restoration efforts should increase habitat quality in Martin Slough, more Chinook salmon are expected to be in the channel during the winter/spring and captured during sampling events. . We anticipate up to 100 Chinook 1+ to be handled and PIT tagged per year with a potential mortality of 5% or 5 individuals. We also expect to encounter up to 300 Chinook yoy during our monitoring efforts each year. We will not be PIT tagging these individuals and mortality is expected to be <1% or no more than 3 individuals/year. We plan to conduct biological monitoring at these sites for up to 5 years after project completion.

5.4.2 Indirect Effects

Increased turbidity and suspended sediments in Martin Slough may occur as a result of channel excavation after the cofferdams are removed, or as a result of upland restoration activities such as riparian vegetation replanting. Increased turbidity and suspended sediments could cause mortality, illness, or injury of Chinook salmon due to re-suspended contaminants, clogging and abrasion of gill filaments, low-oxygen water, and interference with feeding due to poor visibility (LFR Levine-Fricke 2004). Sediment can also smother Chinook salmon eggs, which would affect future fish stocks (Hobbs 1937). However, no suitable spawning gravel has been observed in the Martin Slough Project area and being former tide land, the Project site does not contain suitable spawning habitat (i.e., pool-riffle morphology with suitable gravel). Therefore the Project is not anticipated to have any effect on spawning habitat. The introduction of sediments is expected to be short-term and insignificant, and background levels are already high in Martin Slough. In the long-term, turbidity and suspended sediment are expected to be reduced due to upland restoration activities and establishment of a riparian buffer.

Construction activities, as well as some of the future management and maintenance activities could accidentally introduce contaminants (fuel oils, grease) to Martin Slough and downstream of the Project area. These substances are known to be toxic to fish and prolonged exposure can cause morphological, behavioral, physiological, and biochemical abnormalities (Sindermann et al. 1982). The risk of this disturbance would be highest during in-stream channel construction activities; the effect would be deleterious to Chinook salmon or their prey. However, these effects would be avoided through use of standard BMPs, and residual effects would be short-term and temporary if they did occur. .

5.4.3 Beneficial Effects

Chinook, if present in the future, would benefit from the restoration of in-channel spawning habitat, enhanced riparian buffer, and improved stream flow and habitat complexity in the long-term.

5.4.4 Chinook Salmon Critical Habitat

See section 5.4.5 for details.

5.4.5 Salmonid Critical Habitat

NMFS has identified the Primary Constituent Elements (PCEs) for salmon and steelhead in 70FR52630 as:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams, and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood. aquatic vegetation, large rocks and boulders, and side channels,
6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

5.5 Tidewater Goby

5.5.1 Direct and Indirect Effects

Tidewater gobies could be killed or injured during in-channel construction activities as a result of dewatering and channel excavation. In addition, channel and pond construction will also temporarily block movement of tidewater gobies between areas up and downstream of the cofferdams. This is most likely to occur during the expansion of Pond E at Hole 17 where tidewater gobies have been detected. The Project will be constructed in phases to minimize or otherwise avoid impacts to tidewater gobies. The construction phases will allow the most of the project to be constructed while keeping Hole 17 pond isolated from construction impacts. The construction sequencing and associated stream diversion techniques proposed to avoid impacts to tidewater gobies are described in the subsequent section. In-channel construction activities could also increase suspended sediment and turbidity and introduce contaminants to the channel, which could degrade water quality and result in injury or mortality to tidewater gobies. All in-stream construction and maintenance activities, including channel excavation, will be conducted between June 15th and October 15th. This construction window may coincide with the sensitive spawning and larval life stages of tidewater gobies. If larval, juvenile, or adult tidewater gobies are present during in-channel construction activities, it is anticipated that rescue and relocation efforts of tidewater gobies before dewatering the channel would reduce or eliminate injury or mortality. However, mortality of tidewater gobies could occur if they do not survive the capture and relocation process, and/or if the site they are moved to is unsuitable for their survival. This is unlikely to occur because tidewater gobies will be relocated to suitable habitat constructed in prior construction phases such as the expanded Ponds C and D and then returned to the site of capture (Pond E) if suitable conditions can be achieved in the same season. Thus, they could potentially recolonize the Martin Slough channel and Pond E after completion of construction activities. Restoration could also expand habitat for non-native fish species that prey on tidewater gobies, such as the Sacramento pikeminnow, which has been observed in Martin Slough, although it is unknown if this will occur.

The 0.52 acres of designated tidewater goby Critical Habitat that fall within the Project’s action area will be taken into account by the USFWS when calculating a take estimate for this species.

Based on comments from the USFWS (Personal Communication, Steve Kramer Feb 2016) regarding impacts to fish species, we have provided below the max, min, and mean number tidewater gobies that have been captured during sampling events in Martin Slough. During the earliest years of the Project, fish numbers from the mainstem and east tributary were reported separately. Since the Action Area encompass both of these portions of the slough, we summed the numbers to from those sampling events to obtain Project site totals. In addition, we incorporated fish sampling numbers from Martin Slough pikeminnow surveys, which were reported separately from normal CDFW sampling events. This provides the most comprehensive max, min, and mean fish totals for the entire Martin Slough Project area. Numbers were round to the nearest whole digit.

The maximum, minimum, and mean number of tidewater gobies captured during one sampling event at Martin slough from 2007-2017 was 308, 0, and 36 individuals respectively.

Although, a maximum number of 308 tidewater gobies could be in the slough year during the spring/winter, the max, min, and mean number of gobies captured during the summer months/construction season (June 15th-August 15th) is significantly lower. Specifically, during this period of time in 2007-2016, a max, min, and mean of 133, 0, and 73 gobies were captured.

Considering a work period spanning from June 15th-August 15th for both Phases 2-4 and Phases 5-6, with an estimated single dewatering event per seasons, a maximum of 133 tidewater gobies could be affected from the Project work per year. There is an estimated 3% mortality for salmonids as a result of relocation projects (Collins 2004, NMFS 2012). This being the case, the dewatering aspect of the Project could negatively impact an estimated total of 266 tidewater gobies with up to 8 mortalities.

Monitoring would continue post-project, with probable handling and harassment of tidewater gobies. While the risk of monitoring-related mortality is low, it is possible. Since restoration efforts should increase habitat quality in Martin Slough, more tidewater gobies are expected to be in Martin Slough and captured during sampling events. The pre project monitoring that has been conducted by CDFW sampled 6 sites throughout Martin Slough. The post project monitoring will include CDFW's original 6 sites and add an additional 6 sites for a total of 12 sites (see map of current and future sampling sites in Appendix D). According to CDFW's pre-project sampling efforts during the peak of goby detection, from May 2011 through April 2012, 605 gobies were captured after sampling 9 months. The monthly average is 67 gobies so we are assuming that an additional 200 gobies could have been encountered if CDFW was able to sample during the missing 3 months during that sampling period. Therefore, we estimate that 805 gobies could have been sampled per year during the peak of their detection on Martin Slough over the past 10 years of monitoring. Since our monitoring efforts (sites) will double post project, we anticipate that up to 1600 gobies could be handled and harassed each year. We will not be tagging these fish and mortality due to handling and trampling of burrows is expected to be <1%, so we anticipate less than 16 goby mortalities each year. . We plan to conduct biological monitoring at these sites for up to 5 years after project completion.Beneficial Effects

The muted tide cycle and brackish water will continue to support tidewater gobies. The proposed increase in brackish pond area will increase tidewater goby habitat and is expected to have a net beneficial effect to this species. Overall, the Project is expected to increase the amount of tidewater goby habitat compared to existing habitat by increasing the amount of available low-velocity tidal habitat in the form of off-channel ponds. The Project proposes to expand the pond habitat from an existing 0.2 acres to 4.8 acres (see subsequent section). Newly established ponds are expected to provide year-round habitat for tidewater gobies, similar to what has been observed at the Hole 17 pond.

Ultimately, the Project is expected to improve and enhance tidewater goby habitat by increasing the complexity, quality and quantity of available low-velocity tidal-freshwater and brackish habitat, reducing the potential for entrainment of tidewater gobies in areas disconnected from Swain Slough, and improving water quality by reducing turbidity and water temperatures. After completion of construction and restoration activities, Pond E should maintain the pre-existing tidal exchange at Hole 17; therefore, this site is expected to continue to provide suitable habitat for tidewater gobies.

5.5.2 Tidewater Goby Critical Habitat

Critical habitat was originally designated for the **tidewater goby** on November 20, 2000 (65 FR 69693 69717). This designation was revised multiple times, with the most recent iteration published on February 6, 2013 (78 FR 8745 8819). This Critical Habitat includes areas immediately adjacent to the project site.

5.6 Cumulative Effects

The cumulative effects analysis is confined to the Action Area defined for the proposed Project and assesses the effects of future non-federal (state, tribal, local, or private) actions that are reasonably certain to occur. This section of the biological assessment analyzes cumulative effects and assesses the risks to listed species and designated critical habitats that are associated with individual activities.

5.6.1 Cumulative Projects Near Action Area

Cumulative effects are those combined effects from private, past, present, and reasonably foreseeable future projects that occur in the vicinity of the Martin Slough Restoration Project.

The recently constructed Martin Slough Interceptor project consists of a wastewater interceptor system that will improve the water quality of the Martin Slough Watershed and Humboldt Bay by reducing incidents of Sanitary Sewer Overflows. This project is located within the Action Area and includes the installation of a new buried sewer transmission pipeline that is located outside the aquatic habitat of the Action Area. The Interceptor Project will benefit water quality in Martin Slough and in combination with the Martin Slough Enhancement Project is not anticipated to have any cumulatively impacts.

The City of Eureka has proposed construction of an irrigation supply pond and associated well within the Action Area. The pond would be lined and have a two to three day storage capacity. The well is expected to extend to a depth of 300 feet, with the upper 100 feet grouted to avoid drawing from near-surface groundwater supplies. The Project is currently at 65% design. Grant funds for final design have been applied for but not yet allocated.

5.6.2 Cumulative Effects to Sensitive Species

Hydrological Effects

The Project would improve habitat by widening the channel and increasing complexity. In the longer term, development in the upper watershed would have varying influences on flow depending on the effectiveness of mitigation measures incorporated in those projects.

Water Quality

There could be water quality constituents prevalent in the Project area that may be harmful to aquatic life either directly or indirectly. These include excessive nutrients and pathogens from agriculture operations and inputs from landscaping on surrounding developed lands (golf course, residential, commercial, etc.). These pollutants could cause harm to fish if they are found in high enough concentrations. The proposed Project will not increase background existing levels of these constituents although there may be localized short-term release from disturbing the substrate where they have adsorbed to buried soils. Revegetation zones along the riparian area will buffer future input of nutrients and pathogens to the stream channel.

During construction of projects, there could be increased sediment, which should be mitigated through project construction Best Management Practices and the Storm Water Pollution Prevention Plan(s). The effect of the Martin Slough project will be to improve water quality, while the effects of potential longer term development projects in the watershed are unknown at this time and will depend on mitigation measures included in other projects. Restoration of a muted tidal prism could reduce sediment blockage which might otherwise occur.

Construction of each project could result in short-term impacts to sensitive biological resources that could in turn affect listed species. However, these impacts will be mitigated through surveys, avoidance measures, and BMPs.

5.7 Effects on Tribal Resources or Interests

The project will have no known effect on tribal resources or interests.

5.8 Effects of Interdependent and Interrelated Actions

Interdependent and interrelated actions are those activities that depend on the project for their justification, or are associated with the proposed action. There are no proposed or known interdependent or interrelated effects.

6. Effects Determination

6.1 Species Determinations

Due to the absence of these species in the Action Area, and the distance to potentially occupied habitat, the Project is not likely to adversely affect the Northern Spotted Owl, green sturgeon, or Eulachon.

This project **may affect, and is likely to adversely affect** the following species:

- Coho salmon, southern Oregon/northern California ESU
- Chinook salmon
- Steelhead, northern California DPS
- Tidewater goby

Coho salmon, steelhead and tidewater gobies are likely to be affected during construction due to cofferdam construction and dewatering; however, fish will be relocated as described above. Increased suspended sediment and turbidity will also occur immediately post-project. However, these effects are considered short term and temporary. The project would ultimately restore or improve habitat and passage for coho salmon, steelhead, and tidewater Gobies in the Martin Slough watershed. Post-project monitoring may also result in handling of these species.

Chinook salmon are present in Humboldt Bay but are only rarely known to currently occupy any portion of Martin Slough or Swain Slough; when they are present, it is apparently on an occasional basis and in very low numbers. There would be no immediate adverse effect on these species, as they do not typically inhabit any of the areas that could be affected by the project construction activities. However, replacement of tide gates in 2014 may have reopened access, and they are included here to account for that increased possibility of future presence and sampling during monitoring efforts.

Ultimately, the project will restore channel complexity and open the lower reaches of Martin Slough to a muted tidal influence; thereby extending the useful spawning and rearing habitat for Coho Salmon, Steelhead and Tidewater Gobies.

The re-establishment of bordering riparian habitat will buffer runoff and improve water quality in lower Martin Slough and increase the amount and quality of overwintering and rearing habitat for juvenile Coho Salmon and other juvenile salmonids, which grow larger in estuaries than farther upstream (Wallace and Allen 2009).

6.2 Critical Habitat Determinations

The Project action area does not intersect with Critical Habitat designated for the following species and as suchh will have **no effect** to Critical Habitat for the following species:

- Marbled Murrelet
- Northern Spotted Owl
- Western Snowy Plover
- Western Yellow-billed Cuckoo
- Kneeland Prairie Penny-cress

This project **may affect, but is not likely to adversely affect** Critical Habitat for the following species:

- coho salmon, southern Oregon/northern California ESU
- steelhead, northern California DPS

- Chinook salmon, California coast ESU
- tidewater goby

Critical habitat for these species may be modified through construction and dewatering; however, short-term and temporary adverse effects will not appreciably diminish the value of Critical Habitat for the survival and recovery of the species. Temporal effects of construction will be offset by long-term beneficial effects of habitat restoration and re-establishment of a muted tidal prism.

7. Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act mandates inter-agency cooperation in achieving protection, conservation, and enhancement of Essential Fish Habitat (EFH). The Act defines EFH as "…those waters and substrate necessary to fish for spawning, breeding, feed, or growth to maturity." EFH designations serve to highlight the importance of habitat conservation for sustainable fisheries and sustaining valuable fish populations. EFH relates directly to the physical fish habitat and indirectly to factors that contribute to degradation of this habitat. Important features of EFH that deserve attention include water quality, water quantity, substrate, turbidity, temperature, food source, water depth, and cover/ vegetation.

Crucial interstate marine fisheries along the west coast of the contiguous United States (Washington, Oregon, California) are collaboratively managed through the Pacific Marine Fisheries Council. Council approved plans identify EFH. Federal agencies undertaking actions that may affect EFH have a duty to consult with NOAA Fisheries and seek their recommendations for avoiding or minimizing the effects of those actions. A search of NOAA's "species list tools" for the quad that includes Martin Slough yields the following list of plans that identify EFH that should be addressed in this section (Appendix A IPAC and CNDDB Search Results: Pacific Salmon (Coho and Chinook), Groundfish, and Coastal Pelagics.)

All historic spawning habitats except areas with access blocked by dams are designated as EFH for a number of species including salmonids. Coho salmon and steelhead trout are known to occur in the slough at this time and tidewater gobies although some species may enter Martin Slough when rare flood events overtop portions of levees.

NOAA Fisheries has approved plans to establish and protect more than 130,000 square miles of marine waters off the coasts of Washington, Oregon and California, as essential fish habitat for groundfish. The Coastal Pelagic Species Fishery Management Plan and the Pacific Coast Groundfish Fishery Management Plan includes designating various habitats such as kelp, sea grass and estuaries as "habitat areas of particular concern

Lower Martin Slough was historically an estuarine environment. Starry flounder and English sole have been collected from nearby estuaries and eelgrass habitat is widespread in Humboldt Bay and the estuarine regions of Humboldt Bay tributaries (Downie and Lucey 2005, USFWS 2010). These species are likely to use tidal channels, mudflats, and marsh edge habitats of the lowermost reaches of the Elk River Watershed as nursery and foraging habitat, occurring mostly in marine and brackish water habitats. Two small patches of eelgrass, each approximately one square foot in size, have been observed in Swain Slough approximately 15 feet from the existing tide gates (RCAA 2012). This observed eelgrass is outside the limits of construction disturbance and will be avoided during construction activities. Best Management Practices (as described in section 2.1.11) with regard to sediment management and turbidity will be employed to minimize any short duration effects from discharge from the slough.

Juvenile and adult salmonids (coho and Chinook salmon, and steelhead use the lower portions of a number of Humboldt Bay tributaries as migration corridors between estuarine habitats and upstream spawning and rearing habitat. Juvenile salmonids will use creeks and freshwater tidal marsh edges and protected tidal channels for foraging and growth; recent information from Humboldt Bay indicates that growth rates of juvenile coho salmon in freshwater tidal habitats can far exceed growth of juveniles in upstream creeks and may be important overwintering habitats (Wallace and Allen 2009). Brackish water habitats may be used for over-wintering or rearing, and are important transitional habitats for juvenile salmonids undergoing smoltification as they move into marine habitats.

Requirements for estuarine juvenile salmonids include well-oxygenated water (lethal at < 2mg/L) with temperatures of roughly 0-20^{o} C (optimum of 12-14^{o} C). Freshwater spawning and rearing habitat requirements include an abundance of cool (4.4 - 12.8^{o} C) and well-oxygenated water with spawning occurring in suitable gravels ranging from 6 to 100 mm. Breeding locations typically occur in streambed gravels just upstream from riffles. No spawning or breeding habitats exist at the project site for coho salmon, Chinook, or other salmonids due to the brackish nature, agricultural and developed land uses and river characteristics of the site, although limited coho salmon breeding apparently occurs somewhere in the upper watershed.

Riparian vegetation is an important habitat feature because it serves to stabilize banks (which reduces sedimentation), provide shade (which helps to maintain cool water), and provide a source of food supply (from falling invertebrates) for growth and survival of young fish. The aquatic insects that serve as the major sources of food inhabit the part of the streambed that requires a perennial flow of cool, highly oxygenated water. Limited riparian vegetation currently exists in the Project area due to the predominance of agricultural grasslands. The project is expected to improve salmonid rearing habitat by adding overhanging riparian vegetation along parts of the Martin Slough channel, providing cooler water and food sources.

Channel dredging operations can produce a suspended sediment plume that remains for varying durations of time. Resultant reduction in photosynthesis could indirectly affect EFH productivity. The reduced photosynthesis could result in a disruption to food source and feeding habits for fish that utilize the EFH. Turbidity issues would be addressed with the BMPs prescribed in this document. No lasting negative impacts to water quality (including temperature), food sources, water depths, or vegetation will occur as a result of the proposed project. No enduring negative effects on fish abundance, health, or long-term sustainability of groundfish, coastal pelagics, or salmon fisheries or EFH will result from the proposed project.

No marine EFH should be directly affected by the project; although, the marine habitat features will benefit in the long term from additional tidal exchange in lower Martin Slough and from creation of additional estuarine habitat with the restoration of a muted tidal prism. Turbidity issues will be addressed through our Pollution Prevention and Monitoring Plan and will be in compliance with permit obligations under the 401 Water Quality Certification from the RWQCB. BMPs identified in this assessment will be incorporated as enforceable terms and conditions as part of the federal grants and permits associated with this project.

Project activities may adversely affect EFH for pacific salmon by temporarily increasing turbidity and disturbing the benthos during sediment removal. However, given the net benefit of wetland and aquatic restoration and the general low quality of existing habitat for federally managed fishery species in Martin Slough, the adverse effects to EFH would be temporary and minimal. The long-term outcome of the Project will be enhanced estuarine and freshwater habitats serving fishes managed under NOAA approved Fishery Management Plans.

The large scale grading efforts will be conducted in 2-3 phases during the summer and early autumn of 2017 through 2019. Following the implementation of the large scale restoration project the doors on the tide gate will be opened to their design limits, thereby, reconnecting the restored habitat with the Swain Slough and restoring muted tidal connection to the expanded estuarine channel and freshwater channel network.

The proposed Project may temporarily affect, and is likely to adversely affect the Essential Fish Habitat for Pacific Coast Ground Fish within Martin Slough which is a HAPC. Once complete, the Project is likely to beneficially affect Essential Fish Habitat for Pacific Coast Ground Fishes, as estuarine habitat will be created and restored.

The proposed Project may temporarily affect, but is unlikely to adversely affect, Essential Fish Habitat for Pacific Salmon associated estuarine and freshwater rearing habitats in Martin Slough. Once complete, the Project is likely to beneficially affect Essential Fish Habitat for Pacific Coast Ground Fishes, as estuarine habitat will be created and restored.

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Appendices

Appendix A – IPaC and CNDDB Search Results

Appendix B – Martin Slough Sampling Memos

Appendix C – Water Quality Monitoring Results

Appendix D – Martin Slough Enhancement Project Monitoring Plan 2017

Appendix E – Martin Slough Planting Plan

Appendix F – Martin Slough 65% Basis of Design Report

Appendix G – Martin Slough 100% Design Plans

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