Martin Slough Enhancement Project Monitoring Plan

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INTRODUCTION

The Martin Slough Enhancement Project (Project), is located in and along Martin Slough on private property recently acquired by the North Coast Regional Land Trust (NRLT) and public property owned by the City of Eureka (the City), leased and managed by CourseCo Inc. of Petaluma CA as the Eureka Municipal Golf Course. The NRLT property was owned by Mr. Gene Senestraro until December 2011 and he was the owner during the development of a feasibility study prepared for the project as well as through the development of the 30% design plans. Mr. Senestraro, the City, CourseCo, and the Redwood Community Action Agency (RCAA) have worked cooperatively since 2001 to develop an enhancement plan for Martin Slough. In 2006, the Martin Slough Enhancement Feasibility Study was produced by consulting engineers Winzler & Kelly and sub-consultants Michael Love & Associates and Coastal Analysis under contract to RCAA with funding from the State Coastal Conservancy, the Department of Water Resources, and the City. The Feasibility Study looked at 3 options as well as a no project alternative and led to the selection of a preferred option by the project team, a technical advisory committee (TAC) comprised of representatives from regulatory agencies and local jurisdictions, and the City of Eureka.

The Project site is diked-former-tideland that provides critical habitat for two endangered species (coho salmon [*Oncorhynchus kisutch*] and tidewater goy [*Eucyclogobius* newberryi]). The habitat has been degraded by past management practices that included draining the former tidal wetland by excavating straight-line channels, removing the riparian vegetation, and installing dikes and tide gates at the confluence of Martin Slough and Swain Slough. The exclusion of the tide resulted in losing the sediment transport benefits and natural fluvial geomorphic process that maintained the tidal wetlands and the channel capacity. The loss in channel capacity was offset by mechanical dredging to remove the accumulated sediment. With the endangered species listing of coho and tidewater goby, the cost of obtaining permits to conduct maintenance dredging became prohibitive for the landowners and resulted in the loss of channel capacity and an increase in the duration of flooding on their properties. The landowners sought assistance from RCAA in seeking grant funding to explore the feasibility of developing a project design that would assist them with their flood management problems, understanding that the project would also have to include enhancement of habitat for fish and wildlife to be attractive to funders. The landowners' cooperation led to the development of the feasibility study and to securing additional grant funding to design and implement the project.

The preferred alternative includes replacing the existing tide gates, introducing a muted tidal prism, excavating ponds to provide fish and wildlife habitat as well as flood water detention, excavating the channel to increase flow capacity and provide brackish marsh habitat along the channel margins, and restoring riparian and wetland vegetation within the constraints imposed by the land management objectives of a cattle raising operation and a public golf course.

The Martin Slough Enhancement Project Monitoring Plan (Monitoring Plan or Plan) sets forth simple, cost effective methods for evaluating the degree to which the Martin Slough project progressively meets its intended physical, hydrologic, and biological goals during the initial five years of the project. While this Monitoring Plan incorporates ongoing *pre-construction* monitoring activities and summarizes the *construction monitoring* that will occur during the project's build phase, the primary focus of this Monitoring Plan is *post-construction* monitoring. This monitoring plan outlines a methodology for "time-zero" monitoring initiating at the as-built project condition out to project Year 5. The Monitoring Plan includes both quantitative and qualitative measures to evaluate both structural and functional components of the project.

The essential purpose of 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. Conversely, good monitoring can also demonstrate that the current design and management approaches are working and provide evidence for the continuation of current management. In addition, implementation of the Monitoring Plan will demonstrate ongoing permit compliance and, it is anticipated, a trajectory of incremental project success as the project meets various annual performance criteria described in the plan which cumulatively lead to attaining final success criteria. Finally, the results of thorough project evaluation through implementation of this Plan will help this project to provide information about sound design or fatal flaws, effective or ineffective management techniques to other projects, land managers, restoration designers, and practitioners conducting similar estuarine restoration efforts in and around Humboldt Bay.

This Monitoring Plan complements pre-implementation monitoring, including physical, hydrologic, and biotic baseline evaluations that established initial conditions and defined background variability. Please note that the project's Pollution Prevention and Monitoring Plan (PPMP) will separately detail stormwater pollution prevention practices and water quality monitoring methods that will be conducted on the project primarily during and immediately following construction activities.

PLAN ORGANIZATION

This Monitoring Plan is for fish utilization only and is an excerpt from the Martin Slough Monitoring Plan, developed to meet the minimum monitoring requirements of the NOAA Restoration Center. The Plan is divided into six sections as follows:

Introduction – Summarizes the Monitoring Plan's purpose, organization, and responsible parties.

Project Summary – Lists the goals and objectives defined for this project and summarizes the project design

Monitoring Goals – Describes the goals of monitoring, lists the functions to be

monitored, sets forth the performance and success criteria, and elucidates the link between various monitoring efforts.

Monitoring Components – Details the sampling techniques, data analysis methods and schedule for each characteristic, function, or parameter to be monitored.

Reporting – Delineates the monitoring report format, schedule, and responsible parties.

Contingencies and Remedial Actions – Discusses provisions to ensure that enhancement sites that do not meet the goals or performance standards identified in the approved final monitoring plan will be remediated and/or adaptively managed

Guidance Documents

In addition to the Project's aforementioned project planning documents, the secondary monitoring guidance documents utilized in developing this monitoring plan include:

- Science-Based Restoration Monitoring of Coastal Habitats, Volume One: A Framework for Monitoring Plans under the Estuaries and Clean Waters Act of 2000; NOAA and National Ocean Service, October 2003

- NOAA Restoration Center Minimum Scientific Monitoring Requirements, NOAA, November 2003

- Measuring and Monitoring Plant Populations, BLM Technical Reference1730-01, May 2005

PROJECT SUMMARY

SITE DESCRIPTION

The Martin Slough Enhancement Project (Project) is located within 120 acres straddling two ownerships. The downstream 40 acres is owned by the North Coast Regional Land Trust and leased for raising yearling dairy cattle. The upstream 80 acres is owned by the City of Eureka and contains the Eureka Municipal Golf Course, leased and managed by CourseCo Inc. of Petaluma CA. The Project site is bound by a dike along the east bank of Swain Slough on its western boundary and Fairway Drive on its eastern boundary. The City boundary is the property boundary between the Senestraro Property and the Golf Course (Figure 1).

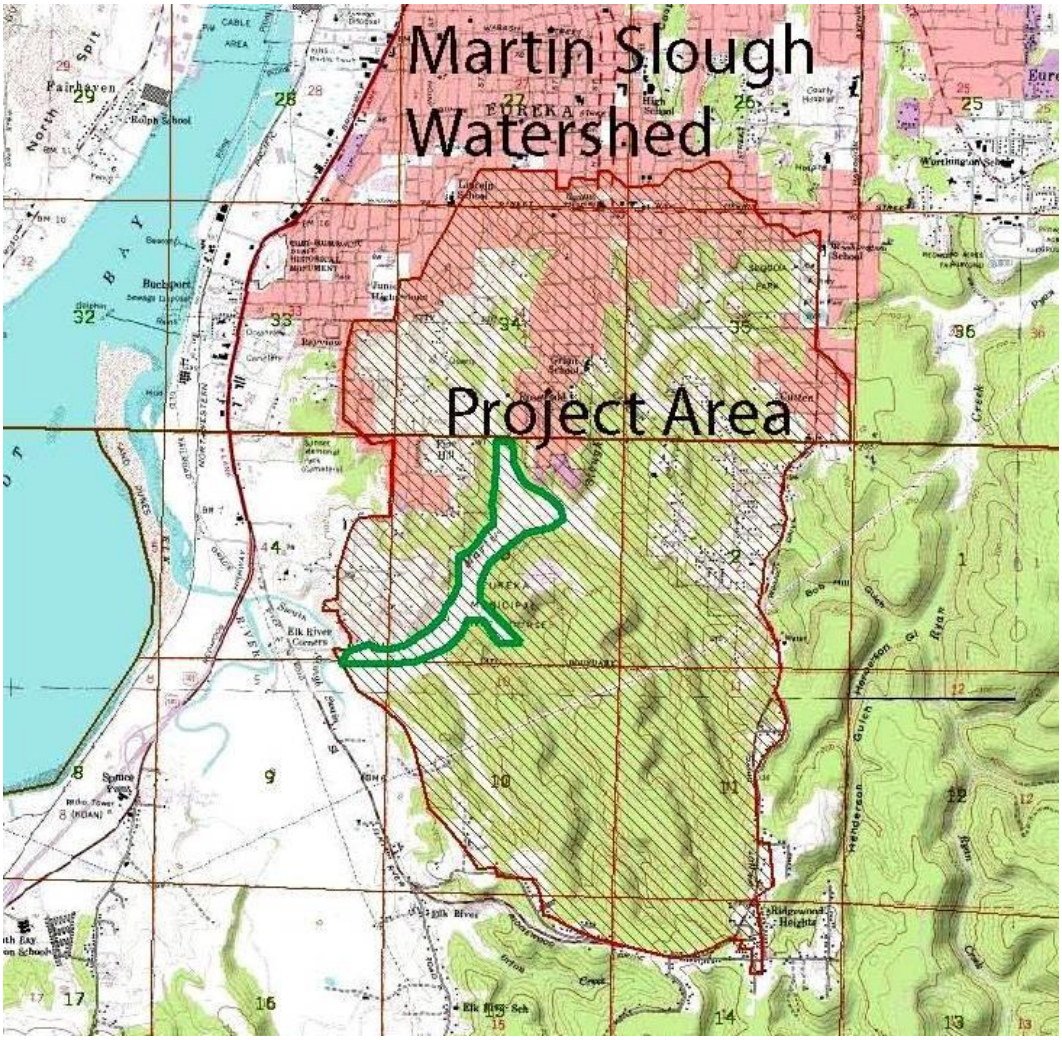

Figure 1. Location of the Martin Slough Enhancement Project, Humboldt County, CA.

The Martin Slough watershed is approximately 5.5 square miles and empties into Swain Slough through three tide gates on the Senestraro property. The tide gates allow the creek to drain, but prevent all but a small volume of leakage water from Swain Slough from entering Martin Slough. The inverts of two culverts are perched at an average elevation of 1.0 ft. NAVD88, approximately 2.0 ft. above the adjacent Swain Slough thalweg, with the invert of the third culvert at approximately 2.75 ft. Most sediment delivered from the Martin Slough watershed is likely trapped in the channel upstream of the tide-gated culverts.
The lower 40 acres of the Project site is currently wet meadow pasture created around 1900 by constructing dikes and installing tide gates to convert former tidelands to grazing lands. Mapping conducted in 1870 by the US Coast and Geodetic Survey did not include Martin Slough, but based on elevations of the channel and adjacent fields, the upper extremes of the project area likely transitioned to lower salinities characteristic of tidally influenced freshwater marshes. Tidal influence extended to approximately 7,000 feet upstream of the tide gates. The upper extend of the project is approximately 7,200 feet from the tide gates.

A thin band of vegetation along Fairway Drive at the upstream project boundary where the land hasn't been cleared for the golf course or for grazing has the highest plant species diversity found across the site. The pasture is mostly monotypic grassland dominated by Velvet Grass (*Holcus lanatus*), Creeping Wildrye (*Leymus triticoides*), Creeping Bentgrass (*Agrostis stolonifera*), and Perennial Ryegrass (*Lolium perenne*) and the golf course is dominated by Bermuda grass (*Cynodon* spp.).

The dominant land use is grazing on the lower 40 acres and public recreation on the upper 80 acres.

GOALS and OBJECTIVES

The primary goal of the project is to restore and enhance estuarine function, improve fish access, and increase habitat diversity and native plant establishment to approximately 7,000 linear feet of channel and 15.5 acres of brackish marsh. In addition 2.5 acres of freshwater marsh and 262 feet of channel will be enhanced for freshwater tidal habitat. Another project goal is preserving working agricultural lands and the public recreational use of the golf course. A plan view of the enhancement plan is provided in Figure 2.

Specific project goals for each of these components include:

Goals: Estuarine Function

- restore tidal hydrology and enhance tidal and brackish marsh habitat to ~ 15.5 acres of former tidelands
- provide areas at an elevation and with access to the estuary that will accommodate a salt marsh plain

- provide areas at an elevation and with access to the estuary that will accommodate a salt marsh pond

Objectives: Estuarine Function

- replace the old tide gates with new tide gates fitted with a muted tide regulator to allow a muted tide
- excavate the channel margins to create the salt marsh plain
- expand existing ponds and create two new ponds at appropriate elevations and within reach of the tidal prism to create salt marsh

Goals: Habitat Diversity

- increase tidal and brackish marsh habitat diversity
- increase the extent of brackish marsh

Objectives: Habitat Diversity

- excavate a backwater channel
- construct inset floodplain benches within the main slough channel
- excavate portions of the pasture and golf course to increase the brackish marsh habitat from 0.2 acres to ~ 15.5 acres total with varying elevations to support the habitat diversity goals

Goals: Fish Access

- restore access, slough channel functions, and associated aquatic habitat in Martin Slough for native salmonid species, and for numerous other fish and wildlife species;
- expand habitat for listed fish species – salmonids (*Oncorhynchus kisutch*, *O. mykiss*, and *O. clarki clarki*) and tidewater goby (*Eucyclogobius newberryi*) – in portions of lower Martin Slough;
- increase the extent of rearing habitat for all fish species that utilize estuarine habitat

Objectives: Fish Access

- replace the existing tide gates with new tide gates designed to increase the amount of time fish can pass through the tide gates
- excavate off-channel ponds, expand existing ponds, and add large woody debris
- excavate the channel to provide marsh plains and estuarine habitat

Goals: Native Plan Revegetation/Recruitment

- facilitate re-conversion of non-native grasslands back to tidal and brackish marsh vegetation;
- restore native riparian vegetation;
- minimize surface erosion in areas disturbed by construction activities;
- minimize exotic invasive plant species on the marsh plain, including pasture grasses;

Objectives: Native Plan Revegetation/Recruitment

- through both active and passive revegetation convert 15.5 acres, including 8 acres of non-prime seasonal agricultural wetlands, to brackish and salt marsh plants;
- revegetate the off-channel pond perimeter and a portion of the riparian corridor with 1,000 plugs of small fruited bulrush (*Scirpus microcarpus*) and 1,000 willow (*Salix* spp.) sprigs
- applying temporary seeding with sterile erosion control grasses and forbs species

- use passive tidal inundation, in addition to manual removal of invasive dense-flowered cord grass (*Spartina densiflora*) that may colonize the restoration area after tidal prism re-introduction

Goals: Working Lands

- retain agricultural production;
- manage the property to facilitate marsh and riparian enhancement and fisheries restoration;

Objectives: Working Lands

- maintain cattle grazing on a 30-acre portion of the seasonal wetlands;
- keep cattle out of tidal marsh and channel restoration area via a cattle exclusion fence designed to permit small wildlife and amphibians to pass under and deer to jump over

Design

The project design will be detailed in the project's engineering construction plans and is summarized below and presented in Figure 2, as excerpted from the project's draft plans

The Martin Slough Enhancement Project is being proposed in order to restore tidal hydrology, expand brackish marsh habitat, and remove the primary barrier to fish migration into Martin Slough – the tide gates – in order to enhance salmonid and tidewater goby access. The project will replace the 3 existing 42-inch diameter culverts at the mouth of Martin Slough with three 6-ft. by 6ft. box culverts fitted with two side hinge and one top-hinge doors. One of the side hinge doors will include a habitat door and a muted tide regulator (MTR) that will allow brackish water to flow into Martin Slough up to a design elevation, allowing the re-establishment of a muted tidal prism. To expand aquatic habitat across the project area, approximately 7,000 linear ft. of channels will be expanded 14 acres of new brackish pond. Freshwater pond habitat will be expanded from the existing 0.5 acre to 2.5 acres (Figure 2). Some of the excavated spoils will be used to reinforce the levee between Martin Slough and Swain Slough, some will be spread on the pasture and golf course fairways, and the remainder will be hauled to a yet-to-be-determined spoils location.

Sections of Martin Slough will be dewatered during construction and fish will be relocated. Two existing culverts in the pasture will be replaced by bridges and the 24 bridges on the golf course will be consolidated into 10 bridges.

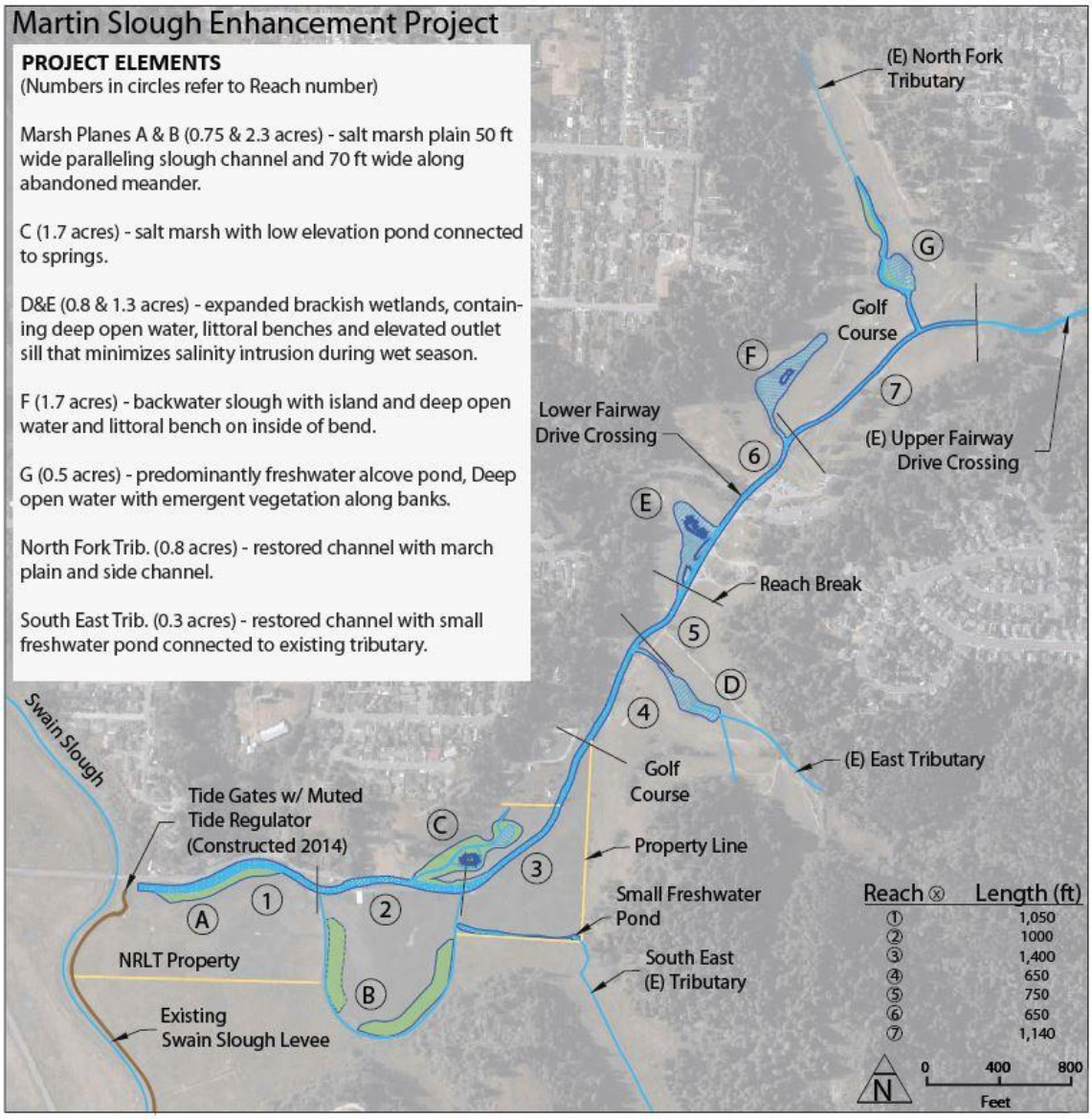

Figure 2. Proposed actions for the Martin Slough Enhancement Project.

Brackish and salt marsh areas will be revegetated with native marsh plant species following a revegetation design developed by the project botanist, and other disturbed areas will be seeded with pasture grass. Access and traffic on the site will be kept to a minimum, and the ground surface will be scarified as needed once the project is completed, to reverse any unwanted compaction.

Impacts

The Martin Slough Enhancement project is voluntary with the sole intent of habitat enhancement for its own intrinsic and biological value and reducing nuisance flooding to allow greater economic realization of the existing land uses. It does not fulfill an off-site mitigation obligation for a project elsewhere. The act of constructing functional wetlands and enhancing instream habitat does, however, generate some temporary and permanent impacts that are mitigated on site.

Temporary impacts will be mitigated at a 1:1 ratio (mitigation to impacts) by restoring the temporary impacts to pre-disturbance conditions. Permanent impacts will be mitigated on-site by creating new tidal salt marsh and brackish marsh habitat, as well as restoring and enhancing existing freshwater marsh habitat at a ratio that far exceeds projects impacts. Hence, the simple fact of constructing the project will result in a large net gain in estuarine functions and values, marsh habitat, and aquatic habitat accessible by fish.

The project's Biological Assessment and other environmental documents (under preparation) describe in detail the direct, indirect, and cumulative adverse impacts that are likely to occur to listed species, species of concern, and protected habitats that are present in the project area as a result of project actions. The mitigation measures that will be taken to avoid, reduce, and minimize those impacts will also be described in detail in the Biological Assessment, PPMP, and agency-specific permit conditions. It is important to note, however, that the pre-construction monitoring activities and assessments undertaken in the development of the project design and construction/post-construction monitoring activities described in this Monitoring Plan fulfill part of the mitigation for project impacts and will ensure that the project meets its short and long-term mitigation obligations.

Time Frame

For a detailed description of the project phasing related to the timeframe see the Martin Slough Biological Assessment

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

Responsible Parties

The RCAA, in cooperation with the North Coast Regional Land Trust and the City of Eureka, is responsible for project implementation, including the design, construction, and monitoring phases, unless otherwise noted in this plan, e.g., ongoing fish monitoring by the California Department of Fish and Wildlife (CDFW).

The primary contact for this project is:

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Projects Coordinator Natural Resources Services,
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MONITORING GOALS

General Approach

This plan identifies the simplest and most cost-effective methods to be applied to fisheries use that when measured, using simple qualitative and quantitative tools, will yield the most information. In developing this fish monitoring plan, we also considered how to minimize the impact of monitoring activities on the habitat and plant and animal species themselves. Non-destructive or low-impact sampling methods were chosen.

We intentionally limited the geographic scope of monitoring to the immediate project site and subject properties, to ensure that all monitoring activities could be implemented without additional access permissions or complications. The project was designed with awareness that it is located in the Elk River watershed set within the larger Humboldt Bay basin and that there are watershed-scale and basin-scale inputs that may impact the success of estuary enhancement within the project site. This monitoring plan does not attempt to monitor the larger ecosystem but to monitor parameters, such as fish use within the site, that are directly and indirectly affected by the larger Elk River and Humboldt Bay ecosystems.

Internal to the project site, we similarly chose *critical areas* and *key areas* to monitor. Critical areas include aquatic habitats in the Martin Slough channel, tributary slough channels, and in- and off-channel ponds where endangered and listed fish species occur.

Monitoring Phases

Like many projects, monitoring for this project occurs in three general phases, including 1) pre-construction or pre-implementation monitoring, 2) construction monitoring, and 3) post-construction monitoring. These three phases of monitoring are linked and act in concert as described below.

Pre-construction monitoring conducted for this project included baseline fish utilization evaluations that established initial site conditions and define background variability. In the case of fish, pre-construction sampling occurred from the summer of 2006 through and will end in the late spring of 2017 (CDFW). In conjunction with the fish sampling, water quality samples were also taken and will be repeated pre- and post-construction. Early pre-construction monitoring has already fulfilled its principal goal of informing the design, implementation, and scheduling of the project. Moreover, pre-construction monitoring identified on-site and off-site reference conditions against which project success will be measured. The methods and results of pre-construction monitoring are detailed in individual reports and are incorporated into the approach and monitoring methods outlined in this plan.

Construction monitoring will be implemented during the construction phase to ensure that construction-related impacts, particularly to listed aquatic species, are avoided or minimized.

This plan will include only those construction monitoring activities that specifically fulfill project permit requirements or are germane to long-term monitoring. This plan will not discuss in detail those monitoring activities which do not define baseline conditions against which project performance and success criteria will be weighed.
Post-construction monitoring will be conducted according to this Monitoring Plan. This monitoring plan outlines a methodology for "time-zero" monitoring initiating at the as-built project condition out to project Year 5. The Monitoring Plan includes both quantitative and qualitative measures to evaluate the both structural and functional components of the project against the project's annual performance and final success criteria. Post-construction monitoring, particularly quantitative evaluations, will be performed in a visible and measurable manner that could be duplicated with some certainty. It will include collection and analysis of data utilizing widely accepted methods in a statistically valid manner where applicable. Similarly, qualitative measuring techniques will be utilized in a manner that reduces observer variability. Data will be made available to interested parties and reviewing agencies in a timely manner, as per the monitoring plan, to allow for course corrections and adaptive management.

The essential purpose of the construction and post-construction monitoring activities is to raise a warning flag if the project's tidal marsh enhancement design components or the current course of management actions are not working so that corrective actions and management may be applied while cost-effective and time sensitive solutions are still available. It is hoped that accurate monitoring can also demonstrate that the current design and management approaches are working and provide confidence in a trajectory of incremental project success as the project meets various annual performance criterion which cumulatively lead to attaining final success criteria.

Parameters

Five general post-construction parameters, including topography, hydrology, water quality, vegetation, and fisheries use will be monitored under this plan. Short-term construction monitoring is a category under this Plan but is not considered a stand-alone parameter for determining final project success. Topography, hydrology, water quality, vegetation, and fisheries use, however, are parameters directly linked to individual long-term goals established for the project and will provide a multi-parameter basis for evaluating the final success of the project. These five parameters were selected to ensure that overlapping structural and functional components assessing both physical and biological characteristics of the site will be measured to evaluate project success.

NOAA Restoration Center's *Minimum Scientific Monitoring Requirements* guidance document posits that at least three parameters must be measured including two *structural* parameters and one *functional* parameter. For the purpose of this plan, topography, hydrology, and water quality are classified as structural (physical or chemical) parameters, while vegetation and fisheries use are functional (biological) parameters. Clearly, there can be overlap between structural and functional, physical and biological parameters. Water fluctuation levels, for example, can both be a structural or functional

parameter. Vegetation can simultaneously be a structural/physical and a functional/biological parameter. Similarly, water quality is a physical/chemical component but also helps to evaluate estuarine function.

In most cases, this plan presents methods to measure multiple structural components within a single parameter. Topography, for example, will measure the length, width, and depth of new slough channels, the extent of sediment aggradation/degradation, the area of new ponds, and so on. Vegetation monitoring will measure multiple structural and functional components, including seedling survival, stem density, percent cover, natural recruitment of native plants, and invasive weed intrusion. Water quality will measure salinity, dissolved oxygen, and temperature: parameters critical to fish utilization of the site.

Qualitative and Quantitative Monitoring

In addition to monitoring structural and functional parameters, the monitoring implemented under this Plan will employ both *qualitative* (observational data) and *quantitative* (numerical data) measures to evaluate project performance and success.

Qualitative monitoring will implement presence/absence observations, estimates of population size, notes on population condition, mapping the boundary of the population, and site conditions assessment using photo-points, and field observations. Qualitative monitoring will be made more effective by observers articulating their qualitative assessments in as quantitative manner as possible. Observers will be prompted to do so by using field data sheets requiring that they make quantitative estimates of areas, plant size classes, relative cover values, depth of sediment deposition, level of high tide wrack lines relative to fixed features, and so forth.

Quantitative monitoring will involve the collection and analysis of numerical physical, chemical, and biological data along permanent fixed transects, channel cross-sections, and selected points. Additional numerical data will be collected at the site level (tidal stage data), macro-plot level (vegetation), and reach level (fish) rather than at fixed points. The location of the sampling unit within these larger sites will be selected at random in some cases and, at other times, will be permanent locations determined by access issues or safety concerns.
The specific monitoring methods, data analysis, and schedule are discussed in the Monitoring Components section of this document.

Reference Sites

One of the tenets of restoration is that it attempts to return an ecosystem to its historic trajectory. The identification of a site or combination of sites that remain unaltered from historic conditions is usually a key tool in developing a restoration project design. Appropriately selected reference sites allow for the evaluation of progress toward restoration endpoints and the accurate assessment of project performance. Two types of reference sites can be used: natural and disturbed.

Since the majority of Humboldt Bay's historic tidal wetlands have been diked and partially filled to create usable agricultural land, it is unlikely that most estuarine restoration sites around Humboldt Bay will recover to their historic pristine (pre-European settlement) state (structure, function, and representative species). Given the high level of disturbance around the Bay, the historic trajectory of a severely impacted ecosystem, like the Martin Slough system, is difficult to determine with complete accuracy. Certain ecosystem functions and values, however, can be restored resulting in substantial site enhancement beneficial to targeted species. Hence, this project is aptly titled the Martin *Enhancement* Project rather than the martin Slough *Restoration* Project. This distinction is not just semantics when it came to identifying reference sites upon which project goals and monitoring were developed.

As a result, two reference sites were selected and combined for this project: one reflecting the current disturbed conditions and the other reflecting as close to natural conditions as possible. The first reference site is the current disturbed project site itself. This disturbed Martin Slough site provides the baseline conditions against which the project will be compared and an indication of the rate of natural recovery had the project not been constructed. The second reference site is located in Fay Slough in an area subject to the tidal prism with representative brackish marsh species (see Figure 3). This site, while subject to a lesser degree of disturbance, provides insight into how the habitat functioned in Martin Slough prior to installation of the dikes, tide gate, and subsequent degradation.

Figure 3. Brackish marsh at the terminal end of Fay Slough at the confluence with Cochran Creek, used as a model of vegetation species composition and distribution for the Martin Slough Enhancement Project.

Using both the natural and disturbed sites as reference formed the basis to judge the progress the enhanced habitat makes in approaching the structural and functional status of a comparable adjacent ecosystem.

Coastal Development Permit Monitoring Parameters

In order to comply with the special conditions of the CDP permit, this Plan provides a program for monitoring the 15.5 acres of brackish marsh and 2.5 acres of juvenile salmonid rearing habitat sites. This Monitoring Plan includes, at the minimum, the following required provisions and components:

1) Performance standards that will assure achievement of the restoration goals and objectives;
2) Submittal of an "as-built" plan demonstrating the project has been constructed according to the approved plans and assessing the biological/ecological status of the "as-built" restoration/enhancements that will be monitored;
3) Assurances that the restoration and enhancement sites will be remediated within one year of a determination by the permittee or the responsible agency that monitoring results indicate that the sites do not meet the goals, objectives, and performance standards herein;
4) Implementation of the monitoring program for five (5) years;
5) Submission of annual reports by December 31 of each year.

This Monitoring Plan will exceed these minimum CDP requirements, as well as NOAA Restoration Center's minimum scientific requirements with the inclusion of the following in the Plan:

1) Several years of pre-construction monitoring to establish a wider understanding of variation in baseline hydrologic and biotic conditions;
2) Construction compliance monitoring as set forth in the Martin Slough Enhancement Project Compliance and Performance Monitoring Plan, and the project's Stormwater Pollution Prevention Plan.
3) Five parameter monitoring, including three structural parameters (topography, hydrology, and water quality) and two functional parameters (vegetation and fish) which exceeds the NOAA requirement for monitoring two structural parameters and monitoring a single functional parameter;
4) Inclusion of a sixth parameter, sediment, and a maximum sediment deposition goal, including measurement and observation of sediment aggradation and degradation within the site;
5) Comparison of the passive and active revegetation strategies to evaluate differences in establishment, cover values, species richness, and cost effectiveness
6) Qualitative monitoring of the compatibility between land uses, including agricultural use (grazing and native plant nursery), conservation, public access and education;

7) And, lastly, a commitment to the promulgation of results of performance monitoring to inform other land managers, designers, and practitioners engaged in estuarine restoration activities around Humboldt Bay.

Annual monitoring of the project by a qualified biologist will determine if the project is incrementally meeting the restoration and enhancement goals. Attainment of the performance and final success criteria will indicate that the project is well on its way towards meeting the long-term habitat goals with little chance of failure.

Specific Monitoring Goals

As elucidated in the *Monitoring Phases* section of this document, the project has monitoring goals and activities before, during, and after construction. With the exception of an additional round of pre-construction water quality monitoring, all pre-construction monitoring activities have already been concluded. Construction monitoring goals are briefly summarized in this Plan and will be included in the project's Pollution Prevention and Monitoring Plan (PPMP). Construction monitoring will ensure that the project has been built according to the approved project plans and specifications.

This Plan focused on and provides specific **post-construction** monitoring goals from the "as-built" condition out to Monitoring Year 5. Post-construction monitoring goals for the five parameters are presented in Table 1 below:

Table 1. Martin Slough Enhancement: Post-construction Monitoring Goals

Parameter	Monitoring Goal
Construction Compliance	Affirm that the project has been built according to the approved project plans and specifications
	Document that the temporary project impacts have been fully mitigated
	Document the post-construction "as-built" condition of the project upon which attainment of the long-term performance and success criteria will be based
Topography (NOAA Tier 1 Hydrologic Reconnection, Implementation, and Permit Monitoring)	Evaluate persistence of post-construction topographic conditions which increase areas subject to tidal inundation to ~15 acres
	Assess changes in width and depth of newly expanded first and second order tidal channels (7,000 linear feet)
	Assess changes in area and depth of off-channel freshwater rearing ponds upstream of the salinity sill
	Monitor marsh elevations and channel cross sections to evaluate rates of channel incision, scour, and sediment aggradation
Hydrology (Adaptive Management)	Measure MHHW and MLLW to evaluate the extent to which the as-built tidal range restores a muted tidal cycle
	Measure Mean of Maximum Monthly tidal elevation to

	assess extent of tidal effects, if any, on upland habitats
Water Quality (Adaptive Management Monitoring for Tide gate Operation)	Measure salinity, dissolved oxygen and water temperature to assess sufficiency of water quality for target habitats and species
Vegetation (Permit Monitoring)	Evaluate conversion of 8 acres of non-native grasslands back to tidal and brackish marsh
	Evaluate establishment of desired vegetative habitats, e.g., tidal marsh, brackish marsh, coastal prairie, freshwater marsh, and riparian habitats, as well as target brackish vegetation associations, i.e., Lyngbye's sedge/hairgrass
	Evaluate active vs. passive revegetation methods
	Evaluate exotic invasive weed establishment in active and passive revegetation areas
Fish Use (NOAA Tier 1 Fish Passage and Use Monitoring and Adaptive Management for Tide gate Operation)	Monitor access to Martin Slough, terminal and off-channel ponds for targeted fish species, i.e., native salmonids and tidewater goby
	Monitor presence/absence and use of targeted fish species in the various aquatic habitats created or enhanced by the project
Working Lands	Monitor use of 30-acres of dedicated agricultural area and effectiveness of exclusionary fencing to keep cattle out of enhancement areas

Performance and Success Criteria

The general monitoring goals above are further subdivided into performance and success criteria in the Monitoring Components section of this document. As previously stated, the performance and success criteria are based on physical, chemical, and biotic conditions and trends observed at reference sites and comparable estuarine enhancement projects. Performance criteria are annual qualitative and quantitative benchmarks against which project progress will be tracked. The final success criteria will be used to determine if the project has substantially met its individual and overall goals within the five (5) year monitoring period. Attainment of the final success criteria will indicate that the project is trending toward meeting the long-term habitat goals with little chance of failure. While overall monitoring will continue for a five year period, if final success criteria are reached for a particular parameter in less than five years, monitoring of that parameter may be discontinued or reduced in scope and frequency.

Vegetative trend characteristics, such as plant vigor/health, natural reproduction, recruitment, and invasive weed establishment are site characteristics to be monitored over time but, unlike simple plant survival which does have a quantitative goal under this Plan; these other characteristics have no fixed performance or success criteria. We cannot predict the rate of natural recruitment of desirable plant species into the passive

revegetation area. Similarly, monitoring of certain water quality parameters (temperature, dissolved oxygen, and salinity) and fish use will inform land managers of trends but do not have fixed performance criteria since these parameters are influenced by multiple off-site factors. For example, construction monitoring will confirm that fish access to the project site has been re-established through replacement of the tide gates and performance monitoring will evaluate if fish are entering the project area. We cannot, however, posit that there will be a certain number of salmonids present or even a percent increase in fish utilization of the project area. Hence, trend characteristics will provide valuable supplementary information concerning site development and use and will help guide maintenance activities and remedial action for some but not all parameters.

There are separate annual performance and final success criteria for each parameter and a correlating monitoring method and schedule. Specific performance and final success criteria are listed for each parameter in the next section of this Plan.

MONITORING COMPONENTS

This section is the heart of the monitoring plan and details the sampling techniques, data analysis methods, and schedule for each characteristic, function, or parameter to be monitored. Monitoring will occur in both *critical* and *key* areas. Critical areas are those aquatic habitats in the Wood Creek channel, tributary slough channels, off-channel and terminal ponds where endangered and listed fish species are most likely to occur. Key areas refer to the seven vegetative habitats to be established. Monitoring will include both large areas, herein referred to as macro-plots, as well as at discrete monitoring sites. Macro-plots are relatively large areas in which a single, or several, sampling units (e.g., line transects) are located, along which point data will be collected that should reflect what is happening within the larger macro-plot area.

Monitoring will include *permanent fixed* photo-points, channel cross-sections, and vegetation transects. Photo-points will show the direction of the photograph with an arrow. Photo-points are not in themselves considered sampling units since they will not be combined and analyzed as an aggregate sample.

Other monitoring activities, such as fish sampling will not be taken in permanent fixed locations but will be *temporary revolving* sites alternating among stream reaches as determined in the field by California Department of Fish and Game (DFG) monitoring biologists. Similarly, mapping of high tide wrack lines and other features that cover large portions of site will be visually determined in the field.

Monitoring activities are described below for each of the six parameters, including construction compliance, topography, hydrology, water quality, vegetation, and fish use. Each section is divided into three subsections as follows: 1) Methods, 2) Data Analysis, and 3) Schedule. Each section has a summary table a may include other figures and tables.

CONSTRUCTION MONITORING

The goal of construction monitoring is to ensure that the project has been built according the approved project plans and has complied with the temporary impact mitigations set forth in the project's Biological Assessment, Mitigated Negative Declaration, and project permits. Construction compliance monitoring will be implemented during the active construction period in accordance with the Martin Slough Enhancement Project Compliance Monitoring Plan, the project PPMP, and regulatory agency permit conditions which have been incorporated into the project's mitigation measures.

The end-product of construction monitoring is the "as-built" plan set which sets the "time zero" baseline conditions upon which fulfillment of mitigations for permanent impacts and all other project goals will be weighed.

Methods

Table 2. Martin Slough Enhancement: Construction Compliance Monitoring

Parameter	Goal	Method	Schedule	Performance Criteria	Success Criteria	Responsible Party
Design Compliance	Affirm that the project has been built according to the approved project plans and specifications	Inspections and checklist	Weekly	All design elements built/installed within engineering tolerances	Channel bottom elevations within 1.0 ft. of design elevations Channel widths within 10% of design width Pond area within 10% of design area, bottom elevation within 1.0 ft. of design elevation	RCAA
PPMP Compliance	Document that the temporary storm-	Inspections and BMP checklist	Pre-, during, and post-cons-truction as	All BMPs installed and maintained	No discharge of pollutants into waters	RCAA

	water impacts have been fully mitigated		per PPMP schedule			
As-built Plan (structural)	Compare historic topography to post-construction topo. Document the post-construction "time-zero" condition of the project	Produce as-built plan set (plan view, X-sec, profile drawings)	Within 120 days of completion of hard construction	As-built plan set complete	Plan made available to agencies and monitors	RCAA
As-built Plan (Revegetation)	Document the post-planting Year 1 condition	Final reveg plan (species, # plants, location, areas)	Within 30 days of vegetation installation	As-built plan set complete	Plan made available to agencies and monitors	RCAA

Construction monitoring will also document information collected during construction relevant to long-term monitoring which may include but not be limited to the following:

- Any construction-related pollutant contamination or spills on site that could affect water quality, soils, or revegetation.
- Turbidity readings in excess of PPMP allowances
- Native plants salvaged or transplanted during construction
- Fish (species and number) captured and relocated during channel dewatering activities
- A map of construction photo-point locations if different from those in this monitoring plan

Data Analysis

Construction compliance inspections will follow checklists developed from the all relevant construction plans, environmental documents, and permits. Completed checklists and photo-documentation of construction activities will provide the basis for determining that the construction phase of the project has been accurately completed and in compliance.

The as-built plan will not simply be a reprint of the project plans and specifications. The as-built plans will compare physical baseline and as-built conditions, in addition to

comparing historical topographic data to current topography. Moreover, the as-built plan will specifically document any changes or deviations from the approved plans, as well as provide additional details about project components, such as revegetation and water quality BMPs that are monitored in the long-term.

Schedule

Construction compliance monitoring will be phased based on the actual construction schedule but will generally be anticipated between October 31, (during the relevant year) and completion of revegetation activities in Spring of that year.

TOPOGRAPHIC MONITORING –NOAA Tier 1 Hydrologic reconnection, implementation monitoring, permit Monitoring

Topographic monitoring is focused on *critical* aquatic areas and *key* revegetation areas. Critical areas include aquatic habitats in the Martin Slough channel, tributary slough channels, and in- and off-channel ponds where the potential for occurrence of endangered and listed fish species is highest. Key areas refer to topographically sensitive vegetative habitats to be established on tidal marsh plains, pond margins, and riparian zones.

Methods

Topographic monitoring is a structural monitoring parameter and is intended to first compare historical topography to current topography to document the as-built condition and then to monitor time-zero topography against annual changes in topography. Quantitative comparison of baseline and as-built topographic conditions will help evaluate the numerous project goals including:

- estimate the increase in tidal range
- determine the number of acres subject to tidal inundation
- evaluate changes in channel geometry and pond bathymetry
- evaluate sedimentation rates

Qualitative changes in topography will be assessed annually while quantitative changes will numerically evaluated bi-annually per Table 3.

Table 3. Martin Slough Enhancement Project: Topographic Monitoring

Parameter	Goal	Method	Schedule	Performance Criteria	Success Criteria	Responsible Party
As-built Plan	Survey "time-zero" topography	Install and survey channel and pond sections	Within 120 days of completion of hard construc-	As-built plan set complete and long-term x-sec transect	AutoCAD file made available to monitors	RCAA

			tion	monuments in place		
Tidal prism	Limit extent of tidal prism in main channel to channel downstream of Pond s G & H	Continuous salinity monitoring in channel with data sondes	Year 0, 1, 3, & 5	Salinity should be less than 1 PPT upstream of Station 62+50	Salinity is less than 1 PPT upstream of Station 62+50	RCAA
Sediment	Evaluate channel geometry and rates of scour and aggradation in channels	Survey fixed X-sections locations to be determined	Year 0, 1, 3, & 5	<20% net annual aggradation or degradation of channel and ponds	<25% net aggradation or degradation of channels and ponds within project site after 5 years	RCAA
Sediment	Evaluate bathymetry and rates of aggradation in terminal and off-channel ponds	Place permanent staff gauge in middle of pond and measure sediment at low tide or low water	Year 0, 1, 2, 3, 4, & 5	<20% net annual aggradation	<25% net aggradation of ponds within project site after 5 years	RCAA
Sediment	Evaluate rates of aggradation on the marsh plain, in channels and in ponds	Photo-points: take photo and estimate sedimenta-tion as N, L, M, or H	Year 0, 1, 2, 3, 4, & 5	Ocular estimation of aggradation is None or Low	Ocular estimation of aggradation is Low or Medium	RCAA

Data Analysis

Tidal Prism: The elevation of the salinity sill determines the extent of tidal influence in the main channel. If the salinity sill settles or scours saline waters will intrude into the upper reach of the channel and the off-channel pond intended to provide freshwater refugia for juvenile salmonid rearing. Hence, maintenance of the salinity sill at an elevation that inhibits saltwater intrusion up to Mean Higher High Water (MHHW) ~6.08 feet (NAVD88) into the upper channel is important. The elevation of the salinity sill will be compared with known tidal elevation data to determine if it is effective as salinity

barrier. Water quality grab samples (discussed later) will also be collected above the salinity sill to compare data sets.

Sediment: Comparison of sequential years of cross-sectional topography at cross-sections and/or staff gauge data will reveal relative rates of channel scour and/or aggradation, as well as overall physical site stability. Quantitative calculation of percent aggradation will be determined by dividing the depth of accumulated sediment by the channel or pond depth multiplied by 100.

Qualitative estimates of sedimentation of channels and pond will be made via annual photo-point documentation and qualitative ocular estimation of sediment rates from those points will be assessed as N=none, L=low, M=medium, or H=high. "None" or "Low" sedimentation rates will indicate that the marsh was excavated "at maturity" meaning no sediment aggradation is required to sustain the targeted hydrologic regime and marsh vegetation and the marsh is not recruiting sediment at a high rate.

High sediment rates approaching >20% bi-annually or >25% aggradation over 5 years have the potential of covering marsh plants with excessive sediment, clogging channels, reducing the extent of tidal inundation, and reducing the overall quality of habitat for fish.

Schedule

As-built topographical survey will be conducted within 120 days of the completion of construction. Pond staff gauge readings will be taken once annually at low tide at the terminal ponds and once annually at maximum draw down of the off-channel pond in September. Photographs of the main channel and pond will be taken annually at photo-points and qualitative estimates of sedimentation rates will be assessed at low tide or maximum pond draw down. Cross-sectional surveys will be shot at permanent fixed transects at Mean Lower Low Water (MLLW) or any low tide event which exposes the channel bottom in Years 0, 1, 3 & 5.

HYDROLOGIC MONITORING -Adaptive management for tide gate operation

Hydrology is a structural (physical) monitoring parameter. The hydrologic goals of the project include restoring a muted tide cycle, expanding brackish marsh habitat, and modifying the primary barrier to fish migration into martin Slough in order to enhance salmonid and tidewater goby access. Replacement of the tide gates and inclusion of a habitat door immediately achieves the latter goal of improved fish migration. Achieving and sustaining the targeted hydrologic regime, however, is critical to establishing a high-functioning muted-tidal marsh with representative brackish marsh vegetation. Vegetative conversion to brackish marsh is predicted to occur out to the blue line, the Mean of Maximum Monthly Tide elevation.

Methods

Tidal stages within the project site will be further monitored via deployment of data loggers (sondes) placed in the following locations:

1) Swain Slough – to assess the background condition
2) Martin Slough Tide gate – to evaluate the influence of Martin Slough
3) Upper Martin Slough channel – to evaluate Martin Slough above the salinity sill

Data sondes will provide continuous download of data, including tidal stage, for the month they are installed. Topographic monitoring alone is not sufficient in assessing the increase in tidal range and determining the acreage subject to tidal inundation. A combination of annual hydrologic mapping and annual photo-documentation, however, will provide quantitative and qualitative measures to evaluate the extent of the as-built tidal range. High tides rather than low tides will have a greater influence over the establishment of brackish marsh on the project site, so mapping the variation within Spring and Neap high tides is more important than mapping the range between MHHW and MLLW.

Table 4. Martin Slough Enhancement: Hydrologic Monitoring

Parameter	Goal	Method	Schedule	Performance Criteria	Success Criteria	Responsible Party
Tidal stage	To further evaluate tidal stages for adaptive manage-ment	Three data sondes collecting DO, salinity, stage and temp will be installed at 3 locations explained below	Four times annually in Nov., Feb., May. & Aug. for one year in Year 0	None – for research, design refinement, and adaptive management	None	RCAA
Mean high tidal range	Restoration of a muted tidal cycle to ~15 acres of slough channel	Walk tidal boundary (MHHW wrack line and lowest of the high tides)	Twice annually during a high Spring tide (full & new moon) and a high	No criteria	A minimum of 1 acre of new wetlands must be created to meet 1:1 mitigation	RCAA

		with GPS to map annual range of high tides; Take photos at photo points	Neap tide (first quarter/third quarter moon) in Years 0, 1, 3, & 5		obligations: restoration of over 15 acres is anticipated at a ratio of 15:1 mitigation: impacts	
Mean of maximum monthly	Predict the maximum extent of vegetation changes from tidal influence	Walk estimated mean maximum tide with GPS; Take photos at photo points	Once annually during high Spring tide ~7.63 ft. NAVD in Years 0, 1, 3, & 5	No criteria	Same as above	NRLT

Data Analysis

Data sonde data will be analyzed to develop tidal stage information and monitor water quality.

Multiple GPS point data will be utilized to map the extent of tidal inundation at selected high tide stages. Comparison of the existing MHHW and the as-built MHHW will provide an estimate of the increase in area of muted tidal marsh created by the project. The area of new wetlands created will be compared to the project's mitigation burden to calculate the acreage of new wetlands created above the required mitigation ratio.

Multiple point GPS data will be utilized to map the proposed Mean of Maximum Monthly tidal elevation in order to predict the maximum extent of vegetation changes resulting from muted tidal influence. This hydrologic mapping will be compared to the results of vegetation monitoring to analyze the qualitative correlation between ecological gradients, revegetation success, and invasive weed recruitment and selected tidal stages.

Photographs taken annually at fixed photo-points will provide additional qualitative information about tidal hydrology and vegetation establishment.

Schedule

Data sondes will be deployed at 3 locations longitudinally distributed throughout the project area (The exact locations are TBD) starting in Feb of 2017 and will be in place for

at least the first two years post construction (until 2019) measuring continuously with the goal to keep them in place as long as possible dependent on necessary funding. This will enable us to adaptively manage the operation of the tide gates to ensure that water quality objectives are met.

The MHHW tidal boundary will be walked with a GPS unit twice annually: once during a high Spring tide during a full or new moon and once during a high Neap tide in the first quarter or third quarter moon. Mapping of the tidal boundary will occur in Year 0 and then bi-annually in monitoring Years 1, 3, & 5. The estimated Mean of Maximum Monthly high tide will be mapped once annually during a high Spring tide ~7.63 ft. NAVD in Years 0, 1, 3, & 5.

Photographs will be taken from fixed photo-points annually.

WATER QUALITY MONITORING -Adaptive management for tide gate operation and fish use

Water quality is the third structural (chemical) monitoring parameter as defined by NOAA fisheries.

Methods

From 2006 – 2017, Michael Wallace collected grab samples of salinity, dissolved oxygen (DO), and temperature as part of his fish monitoring project.

One year of water quality (DO, PH, salinity) data was collected by RCAA in 2015 throughout the project area to provide a baseline data set that complements the water quality data collected by CDFW during their fish sampling from 2006- 2017. RCAA data was acquired using a YSI meter. 3 Data sondes collecting DO, PH, salinity, temp, and water stage will also be deployed when funds are available for their purchase, which is anticipated to occur in February of 2017 or earlier. They will collect continuous data for at least two years post construction with the goal to leave them in place as long as we are able to continue to fund this effort.

Table 5. Martin Slough Enhancement: Water Quality Monitoring

Parameter	Goal	Method	Schedule	Performance Criteria	Success Criteria	Responsible Party
Salinity Dissolved Oxygen Tempera-ture	Restore salt and brackish marsh to lower portion of project and maintain freshwater in upper project	Year 0-5 Data sondes Year 2-5 Grab samples	Salinity DO and Temp will be monitored continuously with data sondes over the course of the project starting in Feb of 2017 (see discussion above for baseline monitoring already completed	daily salinity mean $\leq$ 5 ppt above salinity sill and mean $\geq$ 5 ppt below salinity sill daily D.O. mean $\geq$ 6 mg/l Average daily temperature mean $\leq$ 20^{o}c,	Same as performance criteria	RCAA and DFG
Same as above	Assess WQ sufficiency for target fishes	Same as above	Same as above	Same as above	Same as above	Same as above

Data Analysis

Salinity, dissolved oxygen, and temperature will be measured using data loggers and data will be analyzed by RCAA with consultation from contractors over the course of the project. Numeric values for salinity, dissolved oxygen, and temperature will be compared to the threshold values in Table 5 to evaluate if the water quality is sufficient to sustain revegetation efforts and anticipated fish use. CDFW water quality grab samples include salinity, D.O., and temperature and will be analyzed using field kits by Mike Wallace and submitted in monthly reports.

Schedule

Year 0 - Pre-construction monitoring: Continuous monitoring starting in Feb of 2017 with data sondes by RCAA and NRLT which will include post construction monitoring for 2 years 2017-2019 funded through NOAA fisheries. It is our objective to provide the continuous monitoring beyond 2019 but will be dependent on necessary funds to continue the monitoring effort.

VEGETATION MONITORING –Permit monitoring

Vegetation is a functional (biological) monitoring parameter as defined by NOAA Fisheries. Of the three structural monitoring parameters (topography, hydrology, water quality) and two functional monitoring parameters (vegetation and fish use), vegetation is one of the most observable indicators of project success. Reconversion of pastoral grasslands back to brackish marsh can only occur if the topography, hydrology, and water quality support the vegetation to be established. Hence, vegetation establishment is an indicator that these structural parameters are sufficiently established for vegetation success. Therefore, vegetation monitoring under this Plan is somewhat more robust and detailed than is monitoring of the other parameters.

The principal revegetation goal of the project is to establish 10 acres of vegetative habitats, including tidal marsh, brackish marsh, freshwater marsh, riparian, and coastal prairie plant associations through both passive and active revegetation. Hydrologic and topographic design elements work in concert to diversify micro-habitats and discourage noxious weed establishment. Hence, vegetation monitoring includes the selection of macro-plots to assess vegetation trends and micro-plots to assess success of a given plant species.

Internal to the project site, we similarly chose *critical areas* and *key areas* to monitor. Critical areas include aquatic habitats in the Martin Slough channel, tributary slough channels, and on-channel pond where endangered and listed fish species occur. Key areas refer to the seven vegetative habitats to be established. The key vegetation habitats are relatively large areas in which a single, or several, sampling units (e.g., line transects) are located along which point data will be collected that should reflect what is happening within those larger area.
Vegetation monitoring will measure multiple structural and functional components, including seedling survival, stem density, percent cover, natural recruitment of native plants, and invasive weed intrusion.

Native Plan Revegetation/Recruitment:
facilitate re-conversion of 8 acres of non-native grasslands back to tidal and brackish marsh vegetation through both active and passive revegetation;
revegetate the off-channel pond perimeter and a portion of the riparian corridor with 1 small fruited bulrush (*Scirpus microcarpus*) and willow (*Salix* spp.) sprigs;
minimize surface erosion in areas disturbed by construction activities via temporary seeding with sterilized erosion control grasses and forbs species;

encourage passive revegetation of salt marsh, brackish marsh in the lower third of the Martin Slough and adjacent marsh plain;
minimize exotic invasive plant species on the marsh plain, including aforementioned pasture grasses, by passive tidal inundation, in addition to manual removal of invasive dense-flowered cord grass (*Spartina densiflora*) that may colonize the restoration area after tide gate removal.

Methods

Table 6. Martin Slough Enhancement: Vegetation Monitoring

Parameter	Monitoring Goal
Vegetation	Evaluate conversion of 8 acres of non-native grasslands back to tidal and brackish marsh
	Evaluate establishment of desired vegetative habitats, e.g., tidal marsh, brackish marsh, coastal prairie, freshwater marsh, and riparian habitats, as well as target brackish vegetation associations, i.e., Lyngbye's sedge/hairgrass
	Assess the success of passive revegetation
	Evaluate active vs. passive revegetation methods
	Evaluate exotic invasive weed establishment in active and passive revegetation areas

Sampling Site Selection

Vegetation data will be collected by means of permanent plot sampling. Twelve, 900 square foot plots will be located on the site using a random, stratified sampling method. Within each plot data will be collected on plant survival, percent cover, tree height, site maintenance, plant health and vigor, and natural recruitment. The location of each permanent plot will be established according to the following protocol:

A baseline will be established in four areas proposed for channel or pond expansion. In each of the sites, one transect will be randomly established perpendicular to the baseline at intervals that will vary with each site according to the site's acreage. A minimum of one plot will be randomly assigned to each transect. The northern boundary of each plot will be represented by the transect.

In addition to permanent plot sampling, a qualitative assessment of the entire site will be undertaken to assess the performance of areas outside the sampling plots. This visual reconnaissance could reveal aspects of site performance not exhibited in the sampling plots. Key indicators to be observed would be clusters of mortality, stunting, erosion, fire, vandalism, sedimentation, or changes in channel configuration.

Natural Reproduction/Recruitment

Natural reproduction and recruitment of woody plant species will be monitored in the sample plots. Native and non-native woody plants that become established will be counted and reported by species.

Plant Vigor and Health

A qualitative assessment of overall plant vigor and health will be made. Taken into consideration will be factors such as plant color, bud development, new growth, herbivory, drought stress, fungal/insect infestation, and physical damage. Overall health and vigor will be rated as high, medium, or low as follows:

High =	1-3 =	67-100% healthy foliage
Medium =	4-6 =	34-66% healthy foliage
Low =	7-9 =	0-33% healthy foliage

If a plant's foliage is abnormally sparse, then the health/vigor rating will be lowered accordingly, even if the foliage present is healthy.

A quantitative assessment of plant vigor and health will be made once per year for each woody species planted. A minimum of five percent or 5 individuals (whichever is greater) of each species installed at each site will be sampled. Individuals sampled will be selected at random. Selected individuals will be evaluated and given numerical ratings. These ratings will be compiled by species to provide an overall species health and vigor rating. Data will be used to determine temporal trends in vigor for each species at each site, to help determine the cause of poor survival and growth of certain species, and to assist with development of remedial action recommendations. Once monitoring has transitioned from survival counts to cover sampling, vigor assessments will be done only in monitoring years preceded by 2 sampling periods in which no increase in cover has occurred.
The foliage, wood, and root crown, will be given a separate vigor rating for each individual sampled. Factors such as color, bud development, new growth, herbivory, drought stress, fungal/insect infestation, and physical damage will be taken into consideration when rating the foliage, wood, and root crown. Non-lethal ailments typically associated seasonally with certain species (e.g. summer mildew on box elder, spring anthracnose on sycamore) shall not be cause for down-grading. Vigor ratings will be assigned on a scale of 0 to 4 (Table 7).

Table 7. Health and Vigor Rating Scale.

Health and Vigor Numerical Rating	General Condition	Specific Criteria
0	Dead	
1	Poor	> 75 % of plant affected by cumulative symptoms

2	Fair	25 - 75 % of plant affected by cumulative symptoms
3	Good	< 25 % of plant affected by cumulative symptoms
4	Excellent	< 5 % of plant affected by cumulative symptoms

An overall rating for each plant sampled will be calculated by averaging the ratings for foliage, wood, and root crown.

For example: Plant Sample # 133
Foliage Rating = 2; Wood Rating = 3; Root crown Rating = 2
Overall Rating = (2+3+2)/3 = 2.33

Photo-documentation

Photo-documentation of the site will be conducted from a number of fixed locations. Photographs also will be taken to record any events that may have a significant effect on the success of restoration, such as flood, fire, or vandalism. The locations for photo-documentation will be selected prior to construction.

Qualitative Measures/Methods. Photographs shall be taken of the existing wetlands from different vantage points both at mid-winter (hydrologic peak) and mid-summer (vegetative peak) to document the relative habitat quality of the site, including the obligate and facultative wetland plants occurring on site, the period of inundation/saturation, and evidence of wildlife use. A similar number of photo-points (3) will be established at each wetland pond and photos will be taken annually as described previously. Reference photographs from the impact wetland will be compared to the mitigation wetlands by a qualified biologist, botanist, or wetlands ecologist to determine the relative ecological and hydrological success of the replacement wetlands on a qualitative basis.

Quantitative Measures. Vegetative success shall be measured based on a minimum relative cover of 60% herbaceous hydrophytes (e.g. combined obligate wetland, facultative wetland, and wetland transition species) within the wetland ponds. *Coverage* is defined as the proportion of the ground occupied by a perpendicular projection to the ground from the outer or aerial parts of the members of a plant species, whereas *relative coverage* is the proportion of that coverage represented by hydrophytic plant species compared to that of all plant species in the wetlands area. It is not necessary to monitor plant density, frequency, species richness, and mortality to determine relative cover of hydrophytic species.
Both planted and naturally recruited hydrophytic plants may be included in the calculation of total cover. We include all hydrophytes in the evaluation of percent cover because the wetlands hydrology is expected to vary significantly from year to year and pond to pond favoring certain species above others. When ponds or parts of ponds are subject to longer periods of inundation they will likely be dominated by obligate wetland

plant species such as cattail, spike rush and beard grass. Shorter periods of inundation in the ponds (or parts of ponds) will likely favor facultative species such as sedge and dock. Ponds that experience soil saturation without inundation will probably be dominated by rushes and grasses.

Data Analysis

Data analysis will be conducted as soon as possible following collection of field data. Minimizing delays between data collection and data analysis provides an opportunity to return to the site to verify any discrepancies encountered in the original data set and to conduct further sampling as necessary before the site evolves significantly. Data analysis will be conducted using standard spreadsheet, data base, and statistical computer applications. Data input will be spot checked and results will be carefully reviewed by the project supervisor. All data will be presented separately for each mitigation site, as well as combined for an overall review of the project as a whole. The yearly monitoring results will be compared with results from previous years to evaluate site progress. The data will be analyzed using a standard spreadsheet, data base, and statistical package.

Plant Survival

The overall survival rate and survival rate of each species will be compared to survival rates in previous years and to the performance criteria. Survival rates will be based on the original number of plants installed.

Percent Cover

Total tree and shrub cover will be compared to values determined in previous years, as well as to cover goals and performance criteria. Each transect will be considered a replicate in the data analysis. Significant differences in total cover between years will be tested using Analysis of Variance (ANOVA). A Tukey's test will be used to test for significant differences between individual years.

Average percent cover by native woody species is expected to be relatively low during the first three years following plant installation, but should increase quickly thereafter. Table 8 provides the performance criteria for percent cover.

Table 8. Riparian Mitigation Site Percent Cover Performance Criteria.

Monitoring Year	Average Percent Cover of Native Trees	Average Percent Cover of Native Shrubs
Year 2	2 %	1 %
Year 3	4 %	3 %
Year 4	8 %	5 %

Year 5	15 %	7 %
Year 6	25 %	10 %
Year 8	35 %	15 %

Natural Reproduction/Recruitment

Natural recruitment rates will be recorded each monitoring year on the basis of recruit density and frequency for all woody species within the mitigation sites. Mean, range and variances for recruit densities and absolute and relative frequencies will be presented separately for native and non-native woody species. It should be noted, however, that the maintenance program calls for the removal of all non-native woody plants during the plant establishment period.

Natural recruitment of seedlings of woody plant species will be monitored in a five-foot wide band along each transect. Native and non-native woody plants that become established will be counted and reported by species.

Photo-documentation

Photographs taken of the site will provide valuable visual information as a compliment to the graphs, figures and narrative material which will be included in the monitoring reports.

Plant Health and Vigor

Plant vigor and health will be reported as the average health and vigor of each species. Health and vigor ratings will be evaluated over time.

Schedule

Vegetation and wildlife monitored will be conducted at the sites between April and October of each monitoring year. The USACE jurisdictional area delineation will be conducted in the spring of Year 3 to take advantage of the best opportunities to examine the site's soils and hydrology. Table 9 lists the years in which each site characteristic will be monitored. Monitoring reports will be prepared following data collection and will be submitted to the permitting agencies by December 31 of each monitoring year.

Table 9. Riparian Mitigation Site Monitoring Schedule

Years	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**10**
Survival	x	x	x	x	x			
Percent Cover	x	x	x	x	x	x	x	x
Tree Height	x				x			x

Site Maintenance	x	x	x	x	x			
Natural Recruitment	x	x	x	x	x	x	x	x
CDFG Delineation	x							
USACE Delineation			x					
Wildlife Use					x			x
Photo document	x	x	x	x	x	x	x	x

Vegetation Monitoring

- conduct vegetation transect surveys annually for 5 years
- evaluate exotics colonization on tidal hummocks
- map and evaluate extent of Lyngbye's sedge

The expected conversion of aquatic habitats and associated fish fauna, and conversion of marsh types from seasonal grazed wetland to higher quality brackish marsh is the primary goal of this project. The project proponents and design team are committed to working with the grant funding agencies to obtain additional project funds to monitor the specific biological responses to the implementation of this project.

- Seasonal Wetland Forbs Plantings—at least 15 percent cover by the plantings in Year 1, 30 percent in Year 3, and 50 percent in Year 5. Final success shall be determined by a formal wetland delineation certified by the USACE.
- Grass and Forbs Seeding—50 percent cover by the seeded species in Year 1, 60 percent in Year 2, 75 percent cover in Year 3.

Herbaceous Wetland Plant Cover

Monitoring parameters for herbaceous wetland plants will include percent cover and health and vigor.

Percent cover will be monitored in Years 1, 3, and 5; longer if needed. Percent cover by species will be determined by the quadrat method (Bohnam 1989). This technique may be refined using a gridded quadrat (subdivided quadrat). Quadrats shall be $1m^2$ plots sampled at random locations along permanent transects in a stratified-random design. The percent cover of each species rooted within the plot will be visually estimated to the nearest 5%. The wetland indicator status (WIS) according to the United States Fish and Wildlife Service (USFWS) National List of Plant Species that Occur in Wetlands (1988) of each species will be determined, and the average percent cover attributable to the wetland indicator statuses shall be calculated. Those totals shall then be presented according the WIS classifications provided in the United States Army Corps of Engineers (USACE) Delineation Manual (Environmental Laboratory 1987).

Sampling shall continue until an adequate sample size is attained. Sufficiency shall be determined by running a cumulative percent cover average of the quadrats sampled until site variability is adequately sampled (Kershaw 1973). Thus, the sampling area will vary among years depending upon interannual plant cover variability. This is accomplished

by graphing the cumulative average percent cover on the Y-axis against the number of quadrats on the X-axis during sampling.

Seeded Grass Cover

Grasses will be monitored during each of the first three years after seeding using the quadrant method (Bonham, 1989) as described above. Seeded areas outside of the seasonal wetland mitigation area need not be summarized by WIS. The data will be averaged to determine the cover of seeded and naturally recruited grasses and forbs.

Plant Survival

All trees and shrubs shall show 80% survival during the 3-year plant establishment period. All dead plants will be replaced if survival falls below this performance criterion. In Year 5, two years after the completion of plant establishment and the cessation of artificial irrigation, survival shall not be lower than 70%. If survival falls below the Year 5 performance criterion, the causes of plant mortality will be assessed and remedial actions to increase plant survival will be implemented. Survival results following the cessation of irrigation will indicate whether plants' roots are sufficiently developed to support the plants under natural conditions.

Percent Cover

Table 10 lists the performance criteria for present cover.

Table 10. Riparian Mitigation Site Percent Cover Performance Criteria

Monitoring Year	Tree Cover	Shrub Cover
Year 2	2%	1%
Year 3	4%	3%
Year 4	8%	5%
Year 5	15%	7%

FISHERIES MONITORING – NOAA Tier 1 monitoring fish passage, adaptive management monitoring for tide gate operation

Methods

The pre project fish monitoring has been conducted by CDFW from 2006- 2017 at 6 sites throughout Martin Slough (Figure 4). The post project monitoring will include CDFW's original 6 sites and add an additional 6 sites for a total of 12 sites. CDFW fish monitoring was instigated to determine juvenile salmonid utilization of Martin Slough as a non-natal rearing area and to obtain water quality data. DFG was trying to ascertain if conditions Martin Slough allow juvenile salmonids to rear here in the summer or seek refuge out of the main channel of Elk River during high stream flows in the winter and spring. DFG was also collecting baseline information prior to and during planned habitat restoration and tide gate modification in Martin Slough.

DFG conducted fish sampling at selected sampling sites with minnow traps baited with small pieces of frozen salmon roe in Martin Slough. WQ measurements were gathered using a YSI Model 85 handheld water quality meter.

Tidewater goby will be monitored annually for 3 years in conjunction with salmonid monitoring.

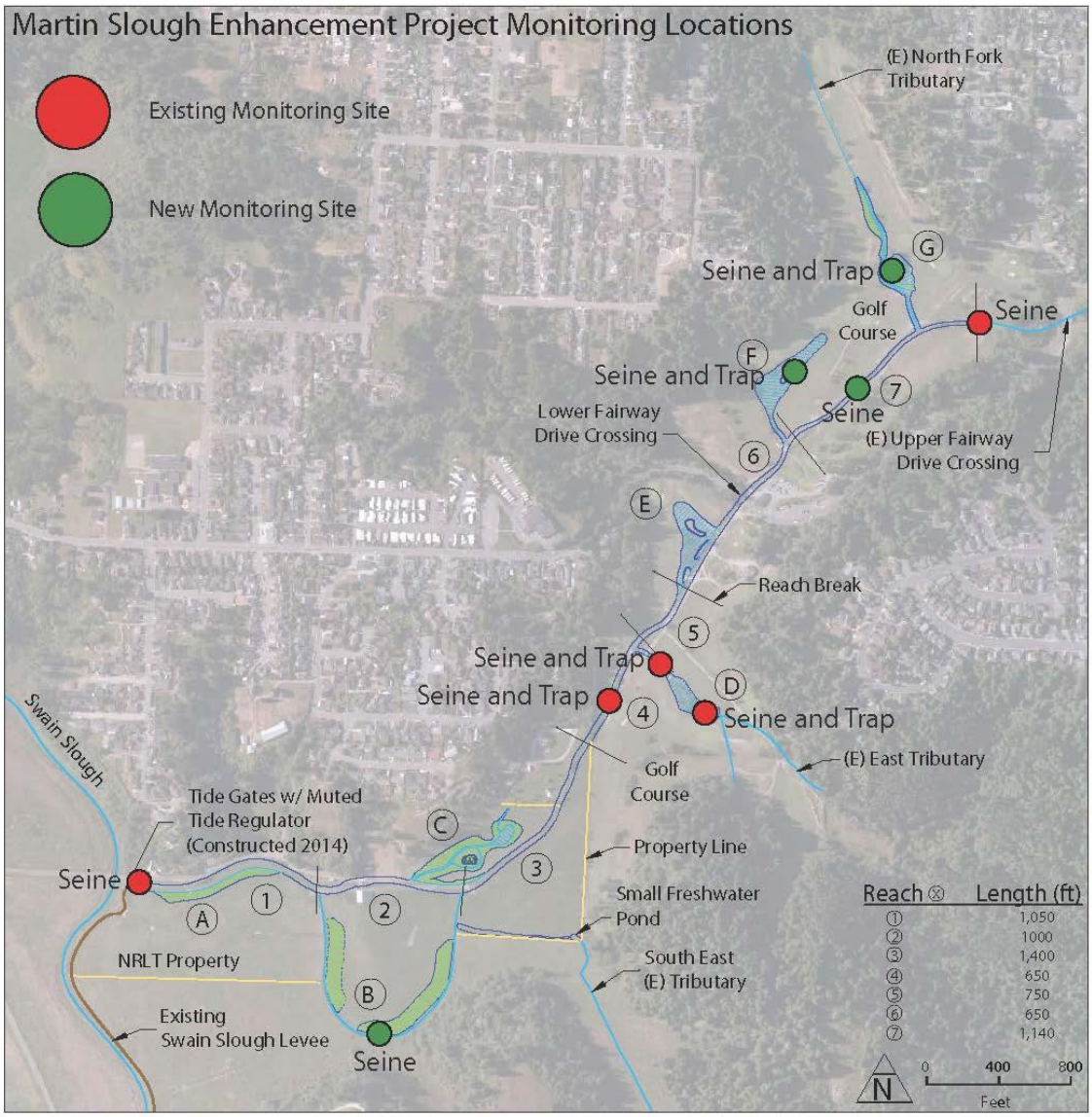

Figure 4: Fish sampling locations in Martin Slough showing the established CDFW monitoring locations in red and the new sites in green. Post project monitoring will include all the sites shown.

Table 11. Martin Slough Enhancement: Fish Monitoring Goals

Parameter	Monitoring Goal
Fish Use	Monitor access to the main stem of martin Slough, its tributary sloughs, terminal and off-channel ponds for targeted fish species, i.e., native salmonids and tidewater goby Sites and methods will mirror the monitoring effort from CDFW 2006-2017 (Figure 4).
	Monitor presence/absence and use of targeted fish species in the various aquatic habitats created or enhanced by the project

Data Analysis

Data analysis will consist of tabulating the results of fish monitoring surveys and calculating fish usage on a fish per area basis. Fish abundance is influenced by many factors, such as spawning run size, spawning success, survival from egg to fry, and successful downstream migration and re-distribution. Therefore data has to be considered in context of the annual spawning run for coho salmon, the main target species.

Analysis will also include a narrative assessment of the size of the spawning run as reported by California Department of Fish & Wildlife in order to obtain an order of magnitude assessment of the number of fish inhabiting off-channel rearing ponds and in-channel habitat in relationship to observations from other Humboldt Bay tributaries.

Schedule

Fish monitoring will be conducted on a monthly basis throughout the year for 2 years.

Fisheries

Monthly fisheries monitoring for juvenile salmonid use will be conducted by CDFW and/or licensed fisheries biologists, including monitoring for tidewater goby colonization into new slough channels. Continued monitoring will provide information to better understand their habitat needs and distribution. From the USFWS website: "The species, which is endemic to California, is typically found in coastal lagoons, estuaries, and marshes with relatively low salinities (approximately ten parts per thousand (ppt)). Its habitat is characterized by brackish shallow lagoons and lower stream reaches where the water is fairly still but not stagnant. However, tidewater gobies can withstand a range of habitat conditions: they have been documented in waters with salinity levels from 0 to 42 parts per thousand, temperatures from 8 to 25º Celsius, depths from 25 to 200 centimeters, and dissolved oxygen levels of less than one milligram per liter."

Water Quality Monitoring with Fish Sampling

Standard protocols will be used that have been established by CDFW for discrete water quality samples collected during fish monitoring and will record temperature, salinity, water depth, DO and conductivity.

Performance Monitoring

PARAMETER	TYPE OF MONITORING	FREQUENCY	SCHEDULE	SUCCESS CRITERIA	REMEDIAL ACTIONS
Topography	Longitudinal channel profile of Martin Slough , and cross section survey to replicate cross sections and profiles in Design Report; and plot	Collected in Years 1, 3 and 5	Once per year during summer	Less than twenty five percent net aggradation of channels and ponds within project site after 5 years (some deposition and scour is anticipated but no net volume decrease of ponds and channels	Excavate material to achieve as-built condition unless otherwise agreed by regulatory agencies
Tidal stage	Data logger for tidal stage	Continuous, download monthly	Continuous for one year and through the period where the MTR is being adjusted	Not Applicable (NA) – for research purposes to inform/ refine future designs	NA
Water quality	Temperature, salinity, dissolved oxygen (DO) at upstream of project	Continuous, download monthly for year one and through the period where the MTR is being adjusted; once per month years two through five	Continuous for year one and through the period where the MTR is being adjusted; monthly readings for years two though five	Avg. Max daily wa. temp. $\leq$ 22^{o}c, Avg. daily wa. temp $\leq$18 ^{o}c Avg. daily DO $\geq$ 4 ppm, Avg. daily salinity $\leq$ 1 ppt in pond G	Modify tide regulator; install shade cover (native willows, alders, spruce)
Vegetation	Plant survival and species composition	Once per year	Annually for 5 years	80% survival of woody plants; 70% cover by native brackish marsh plants on tidal hummocks above MHHW after 5 years	Replant, re-seed until criteria met; mechanically or manually remove invasive plants within re-constructed tidal channels and tidal hummocks
Fisheries - salmonids	Seining, minnow traps	Once per month	Monthly for 2 years post project	Annual average net increase of 50% over pre-project coho salmon numbers (combined total for juvenile young-of-the-year and one-year old fish) monitored by CDFW	None – uncontrollable variables (ocean conditions, run size) can affect numbers; this is a continuation of CDFW's monitoring
Fisheries – tidewater goby	Seining,	Once per year	Annually between May 1 to June 30 for 2-5 years	Presence in new terminal ponds at upper end of new slough channels B10 and B11 (Design Report, p. 56; and pond at sta.	None – uncontrollable variables affect tidewater goby distribution including

				18+00 Design Report, p. 53, Fig 3-1); continued presence in pond at auxiliary tide gate	predation by birds and fish.
Photographic Record for overall site evolution, visual aesthetics	Photo monitoring	Once/year during the same season	Annually for 5 years		

REPORTING

To be useful, monitoring data, results, and "lessons learned" have to be shared.

As-built Plans

After project construction is complete, an as-built report will be prepared. This report will include a copy of the time-zero as-built plans and will provide a thorough description of the status of the site, with particular attention paid to any adjustments to the final restoration plan. This report will be completed within 4 months of the completion of site implementation and will be submitted to the permitting agencies.

Within 8 weeks of the completion of mitigation site construction, the monitoring biologist will prepare marked-up "time zero" landscaping plans. These plans will show all significant deviations from the planting plans including the number of plants installed, species installed, deviations from plant installation locations, unplanted areas, changes to floodplain construction, and any features added to the site that were not included in the landscape plans. Future analysis of the site will be based on these plans.

Annual Reports

Monitoring of vegetation, hydrology, and soil stability in the mitigation sites will take place in April-September of each monitoring year. Monitoring reports will be submitted to the regulatory permitting agencies by December 31 of each monitoring year. Hard copy reports will be provided to funding agencies, the Coastal Commission, the CA Department of Fish and Game, and other regulatory agencies who request a hard copy. Electronic copies in PDF format will be placed on the RCAA web site and will be provided to other interested parties who request a copy of the report. Copies of photo-documentation and maps showing monitoring areas will be included in the annual reports. Field data sheets will be available for review by the agencies upon request.
A final report summarizing the restoration project, evaluating the sites' overall performance and providing maintenance recommendations will be prepared and submitted 60 days prior to the end of monitoring. Monitoring will cease when the site has met all of the project goals or when the reviewing agencies agree that the site is expected to meet the goals with little chance of failure.
Reports will be prepared in the following format:

1. Introduction
2. Materials/Methods
3. Results
4. Discussion
5. Recommendations
6. References
7. Appendixes

Trend Characteristics

Trend characteristics to be monitored include natural recruitment, tree height and wildlife use. The results of the trend characteristics monitoring will aid in the assessment of the site's progress.

Final Report

A final monitoring report will be prepared at the end of the five-year monitoring period by a qualified wetlands biologist. The report will evaluate whether the enhancement site conforms to the goals, objectives, and performance standards set forth in the approved final restoration and enhancement plan. The report will address all of the monitoring data collected over the five- year period.

MAINTENANCE, CONTINGENCIES, AND REMEDIAL ACTIONS

Provisions will be included to ensure that the enhancement site will be remediated within one year of a determination that monitoring results indicate that the sites do no meet the goals, objectives, and performance standards in the approved final monitoring plan.

If annual performance criteria are not met for any portion of the restoration project in any year, or if any of the final success criteria are not met, the owners or owners' representative will work with the permitting agencies to prepare an analysis of the cause(s) of failure. If requested by the permitting agencies, a remedial action plan will be prepared in concert with the permitting agencies' action plan within 2 months of the initial request. Implementation of remedial actions will depend on the nature of the work; thus, a schedule will be presented to the agencies for review and approval as part of the remedial action plan. Alternative mitigation site planning will begin if it becomes apparent that the long-term success criteria for the sites will not be achieved in a timely fashion.

Monitoring protocols and results will be reviewed annually. Adjustments to monitoring procedures or schedule may need occasional adjustments to remain accurate, complete and feasible. Such adjustments will be developed by monitoring staff and project managers and presented to the permitting and resource agencies prior to application. After reviewing annual reports the agencies may also have suggestions for adjustments to the monitoring program. Agency suggestions will be reviewed, and if appropriate will be incorporated into the following year's monitoring program. The key is to anticipate that the monitoring program is flexible and adaptable to meet unanticipated or changing conditions.

Monitoring Procedure Adjustments

The protocol and results of the monitoring program will be reviewed annually by the monitoring biologists. Adjustments to monitoring procedures or schedule may be required as the site changes over time, or if logistical problems render a procedure unduly difficult to conduct. Such adjustments would be developed by the project biologist and reported to the permitting and resource agencies and proposed for approval prior to

application. After reviewing annual reports the agencies may also have suggestions for adjustments to the monitoring program. Agency suggestions will be reviewed, and if appropriate will be incorporated into the following year's monitoring program. The key is to anticipate that the monitoring program may need occasional adjustments to remain accurate, complete and feasible.

Monitoring results from Years 1 through 5 will be compared to the performance criteria to evaluate progress toward the goals and to provide a basis for remedial action recommendations. The results of the monitoring in Year 5 will be compared to the final success criteria to determine if these criteria have been met. If the final success criteria have not been met, remedial actions and monitoring will continue until they have been met.

Replanting

Replanting will be performed if plant mortality of any species exceeds the performance criteria. Monitoring will start anew if mortality exceeds 30% in a given year, or if at the end of Year 5, survival is less than 50%.

ADAPTIVE MANAGEMENT STRATEGIES

Analysis of monitoring results will be used as part of an adaptive management strategy to ensure that the goals and objectives of the project are met. There are four general areas that may require remedial action if goals and objectives are not met:

- Topography
- Tidal Stage
- Water Quality
- Vegetation

The other two areas are fisheries – salmonids and tidewater goby. Because there are so many factors that affect abundance of fish species the project cannot be expected to guarantee numbers of fish, but rather only providing the right kind of habitat and access to the habitat. The 4 parameters mentioned above will assess whether the habitat goals were met and if adaptive management needs to be employed.
The Performance Monitoring table on page 43-44 describes the remedial action required if success criteria are not met. These actions are described in more detail below.
<u>Topography:</u>
By surveying cross sections and longitudinal profiles annually the project team will determine whether or not the success criteria have been met. While specific sites are expected to experience varying degrees of scour and deposition there is an expectation that the hydraulic analysis and modeling have accurately predicted the ratio of the tidal volume to channel and pond dimensions so that the tidal prism will maintain the design conditions within reason. The success criteria have been set as less than 25% net aggradation of channels and ponds within 5 years when looking at average scour and deposition over all cross sections surveyed.

If the success criteria are not met, maintenance dredging will be implemented and adjustments will be made to the operation of the tide gate as recommended by the engineers.

Tidal Stage:

Tidal stage in Swain Slough is controlled by tide levels in the Elk River estuary, Humboldt Bay, and the Pacific Ocean. Tidal stage within Martin Slough will be controlled by the muted tide regulator on the tide gates. There is no success criteria set for tidal stage as the desired outcome is not the tidal stage itself, but the habitats that the tidal prism will maintain. The initial objective of the project is to maintain the tide gates open up to elevation 6.0 (NAVD 88) and then allow the tide gates to close, keeping the habitat door open via the muted tide regulator to simulate the natural hydrograph so that it peaks at around 6.5 feet. The tide gates and habitat door can be adjusted to attain the desired tidal stage inside Martin Slough. The muted tidal stage inside Martin Slough may need to be adjusted as determined by the results of the topographic surveys. However an analysis of the reasons for the changes in topography will have to be made to determine whether the cause of failure to meet topographic goals is a result of sediment emanating from the upper watershed or failure of the muted tidal prism to transport sediment as predicted by the model. If the failure is due to miscalculations on the sediment transport capabilities of the tidal prism, adjustments to the muted tide regulator will be made and the response of channel sediment will be measured and re-evaluated at the next monitoring. If the failure is due to excess sediment entering the project site from upstream, channel dredging may be performed to correct the immediate situation. However, such a scenario would also require investigation into the cause of the excess sediment and an analysis of what the appropriate treatment should be.

Water Quality:

Water quality goals include temperature, salinity, and dissolved oxygen. Water Temperature in Martin Slough under a muted tide regime will be largely controlled by water temperatures in Swain Slough, the source of the incoming tide. Water temperature can be positively influenced in Martin Slough by increasing shade cover and maintaining adequate depth of the channel. With the tidal marshes and the tidal plains in the lower channel, there will be ample areas of shallow water that will be subject to solar heating during the summer, even on cloudy days. Therefore the average daily temperature will be the criteria. If temperature goals are not met, an assessment of the factors causing the failure to meet the criteria will be made, including monitoring water temperatures in Swain Slough and in Martin Slough upstream of the project. If water temperature upstream and downstream does not meet the success criteria, it will be difficult if not impossible to make changes at the project site that will affect water temperature. If water temperature upstream and downstream does meet the success criteria but water temperature at the project site does not, additional plantings of riparian vegetation to create shade will be made. If topographic monitoring shows the channel has net aggradation greater than the success criteria, loss of depth will likely be a contributing factor to the failure to meet temperature objectives, in which case actions taken to restore the topographic objectives will also contribute to correcting the problem that is causing the failure to meet the temperature objectives.

Salinity objectives are set to maintain mostly fresh water conditions at Pond G, designated as tidally influenced freshwater habitat. If salinity objectives are not met, the

options will be to adjust the tide regulator to shut off at a lower elevation or to install a salinity sill downstream of Pond G. Because the channel grade through the project is so low, it may be necessary to install the salinity sill.

Dissolved oxygen objectives are set to maintain the minimum observed DO levels currently used by coho salmon juveniles. Failure to meet the DO objectives would likely be due to vegetation conditions in the pond or channel. If DO objectives are not met, an assessment of aquatic vegetation will be made to determine if that is the causative factor. If it is, the aquatic vegetation will be mechanically removed. If the low DO is caused by another factor, an assessment of contributing factors will be made and a remediation plan will be developed.

Vegetation:

Plant survival and species composition will be monitored annually for five years. Success criteria include 80% survival of woody plants and 70% cover by native brackish marsh plants on tidal hummocks above MHHW after 5 years. Adaptive management strategies if the criteria are not met include replanting or re-seeding until criteria met; and mechanically or manually remove invasive plants within re-constructed tidal channels and tidal hummocks. Due to the climate conditions at the project site (foggy summers, abundant rain from Fall through Spring), irrigation is not planned. Irrigation would also not be applicable to salt and brackish marsh plants. However if the freshwater plantings in the riparian zone do not meet the success criteria, an assessment of the causative factors will be made and the appropriate remedial action will be implemented. Remedial action could include installing irrigation or implementing a weed control program consisting of weed eradication and use of weed cloth to suppress weeds.

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