

Elk River Estuary and Tidal Wetlands Enhancement Project Constraints Analysis and Design Alternatives Summary

Prepared for:

The City of Eureka

Prepared by:

Trinity Associates
980 7th Street, Suite K
Arcata, CA 95521

Greenway Partners
1385 8th Street, #201
Arcata CA 95521

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EXECUTIVE SUMMARY

The goal of the City of Eureka's (City) Elk River Estuary and Tidal Wetlands Enhancement Project (project) is to expand and enhance tidal wetlands in the diked, former bay lands associated with the Elk River Slough/Estuary. Coho salmon and other aquatic species will benefit from this expansion of habitat quantity and quality. The project will also improve public access and recreation, extending from the City's Hikshari Trail south to South Bay at King Salmon along the Humboldt Bay Trail/Rail corridor and adding a non-motorized public boat ramp. The project will also construct a living shoreline to buffer a portion of Highway 101 from anticipated sea level rise.

The project is divided into two components 1) expand and enhance Elk River's estuary in Area 1 and Area 2 adjacent to the Elk River, and 2) expand and enhance tidal wetlands in Area 3 and Area 4 near King Salmon and Buhne Slough. All four areas are generally located between U.S. Highway 101 (Highway 101) and the North Coast Railroad Authority (NCRA) property and King Salmon Canal.

Within each of the four project areas (Area 1 through Area 4), constraints are identified and assessed relative to their potential impacts on the achievement of project goals. Constraints are evaluated in ten categories: regulatory requirements, property ownership, land use, hydrology, utilities, transportation infrastructure, physical constraints, biological constraints, cultural resources, and exotic invasive species. Identification of these constraints was used to evaluate a minimum of four design options for each of the four areas.

Across Areas 1-4, the preferred design alternative maximized ecological benefits within the limitations of existing constraints such as property ownership, physical topography and bathymetry, utilities, and flood control, among many others detailed in this report for each of the four areas. Additionally, the project will need to be compliant with all local, state, and federal land use and environmental regulations and ultimately obtain permits and permissions from numerous agencies.

The potential enhancement of the estuarine habitat uniquely available near the mouth of the Elk River is ecologically significant to the broader Elk River watershed and Humboldt Bay hydrologic unit. Increasing the quantity and quality of aquatic habitat in the Elk River estuary will have significant benefits to rearing coho salmon, Chinook salmon, and steelhead trout, all of which are listed as threatened or endangered under the Endangered Species Act. The project's resulting increase in aquatic habitat and ecosystem function will benefit many other species as well, including eelgrass.

The upper portion of the Elk River is presently listed as a 303(d) stream for sediment impairment under the Clean Water Act. Expanding the tidal prism on Elk River may have an added benefit of helping to flush sediments delivered from the upper watershed from the main channel.

Estuary habitat is incredibly valuable to wetland enhancement and species recovery. Expansion of this rare ecotone is a significant opportunity to pursue population recovery for numerous imperiled species in the Humboldt Bay and Elk River hydrologic units. Every possible opportunity must be taken to best realize this rare opportunity across more than 112 acres, restoring natural tidal function and ecosystem resiliency in a significantly altered landscape.

These proposed actions are taken in concert with participating landowners, who have generously donated their time to learn about the project's goal and conceptual design approach. The preferred design alternatives for each of the four areas were also developed considerate of comments received from public agencies, which generally expressed a preference toward pursuing restoration actions that would result in the most significant restoration gains.

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1 **PROJECT SUMMARY**

The City of Eureka's (City) Elk River Estuary and Tidal Wetlands Enhancement Project (project) is a multi-phase and multi-year project. The project goal is to expand and enhance tidal wetlands in the diked, former bay lands associated with the Elk River Slough/Estuary. Coho salmon and other aquatic species will benefit from this expansion of habitat quantity and quality.

There are two components to the City of Eureka's planning grant from the State Coastal Conservancy: 1) expand and enhance Elk River's estuary, and 2) expand and enhance tidal wetlands. The two components are hydrologically stratified. Areas 1 and 2 are connected to Elk River Slough, and Areas 3 and 4 are connected to Buhne Slough and South Bay (Figure 1). All four areas are generally located between U.S. Highway 101 (Highway 101) and the North Coast Railroad Authority (NCRA) property and King Salmon Canal. The project will also improve public access and recreation in Area 1, extending from the City's Hikshari Trail south to South Bay at King Salmon along the Humboldt Bay Trail/Rail corridor and adding a non-motorized public boat ramp.



Figure 1. Elk River estuary and tidal wetlands enhancement Areas 1-4.

The City is the project proponent of the Elk River estuary component approximately 112 acres (Areas 1 23.5 acres and Area 2 88.8 acres) of this planning grant, as most of this work would occur on City property in the City's jurisdiction. The tidal enhancement component of this grant is in Areas 3 and 4 on approximately 100 acres of public and private property. Project elements for Areas 3 and 4 include identifying constraints, developing potential conceptual designs, and having an advisory team review and select a preferred conceptual design. If affected property owners concur with the preferred project design, a project proponent would need to be identified to seek grants, develop engineering designs, secure regulatory authorization, and implement the project as a whole or in phases.

The project area has undergone substantial changes compared to conditions mapped in 1858 by the U.S. Coast Survey (Figure 2). Much of the original Humboldt Bay shoreline no longer exists near the Elk River estuary and Buhne Slough. The extensive tidal wetlands that once occupied the low-lying areas at the mouth of Elk River and on Buhne Slough were isolated from the Bay and converted to farmland. The Project area is traversed by the Northwestern Pacific Railroad (NPR), Highway 101, County roads, underground and above ground utilities, Humboldt Bay, and diked and rip-rapped shorelines.

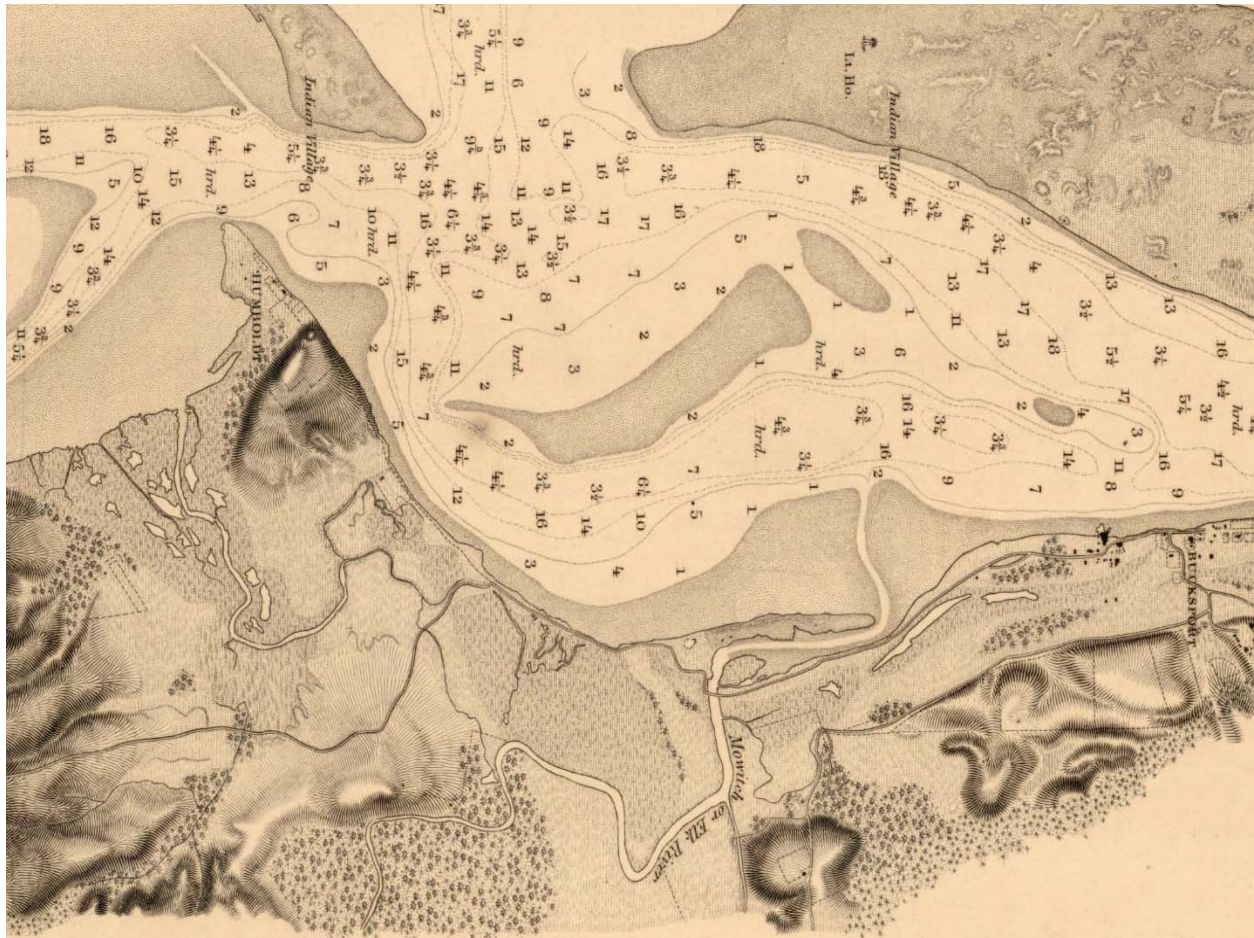


Figure 2. 1858 Coast Survey of the shoreline between Buhne Slough and Bucksport.

1.1 Constraints Analysis

Within each of the four project areas (Area 1 through Area 4), constraints are identified and assessed relative to their potential impacts on the achievement of project goals. Constraints are evaluated in ten categories:

1. **Regulatory Requirements:** permits and other regulatory permissions that must be sought and granted prior to commencing project implementation;
2. **Property ownership:** public (local and state) versus private interests-permission to place fill, excavate, replace or pull water controls structures, and alter saltwater intrusion/inundation;
3. **Land use:** conversion of agricultural lands and Aleutian goose grazing lands to natural resource uses;
4. **Hydrology:** existing tidal inundation, drainage pattern, and structures; potential project-related effects to stormwater runoff, flooding, and tidal inundation;
5. **Utilities:** the presence of above or below ground utilities that traverse the project area, which may affect excavation, placement of fill, or introducing tidal inundation;
6. **Transportation infrastructure:** consideration of public (local, state, and federal) and private roads and railroad, including the placement of fill or introduction of tidal inundation;
7. **Physical constraints:** existing surface and bathymetric elevations and need for fill or excavation.
8. **Biological constraints:** protected species, habitats, and species of concern such as tidewater goby, Humboldt Bay owl's clover, Point Reyes bird's beak, eelgrass, salt marsh, brackish wetlands, riparian and dune mat.
9. **Cultural resources:** identified through tribal consultation and formal cultural resources investigations; and
10. **Exotic invasive species:** removal and control of Spartina.

1.2 Conceptual and Preferred Design Alternatives

Conceptual Design Alternatives

At least four conceptual design alternatives have been prepared for each of Areas 1 – 4. Design alternatives have been developed considerate of identified constraints, ranging from property ownership, transportation, utilities, cultural resources, hydrology, land use, physical setting, and exotic invasive vegetation (i.e., Spartina).

Conceptual design alternatives considered the full range of enhancement actions possible in each of the four areas. While the four areas are described separately, design elements were developed comprehensively and linked between areas, establishing restored large-scale ecosystem functions, aquatic habitat connectivity, and enhanced tidal function at a landscape level.

During evaluation of project's constraint analysis and design alternatives, additional opportunities were identified for expansion and enhancement of tidal habitat on Buhne Slough (Areas 3C and 3D) and the estuary on Elk River (Area 5) (Figure 3). Area 5 is not addressed further in this report.

Preferred Design Alternatives

Conceptual design alternatives were shared with stakeholders and agency representatives. Based on known constraints identified in this document and input received from stakeholders and agency representatives, a preferred design alternative was selected for each of the four project areas. Thirty percent designs are being developed for Area 1 and 2 based on the preferred design alternatives. The City has pursued Phase II funding to develop 100% designs for Area 1 and Area 2 and implement the project.



Figure 3. Potential Elk River Estuary and Tidal Wetlands Project Areas 1-5.

2 **AREA 1 CONSTRAINTS**

2.1 Regulatory Requirements

All applicable local, state, and federal regulatory authorizations will need to be secured for the proposed project prior to commencing work. In addition, an encroachment permit from Caltrans will be required.

2.2 Property Ownership

Area 1 (Figure 4) is predominately owned by the City of Eureka. A portion of Caltrans' property extends west, into the proposed Project Area 1 from the Highway 101 on-ramp. The NCRA's railroad bed also extends east into Area 1. Proposed activities (placement of fill, channel excavation, placement of tide gate on culvert) involve Caltrans property, and the City will be required to secure an encroachment permit from Caltrans. The Waterfront trail extension will occur on property owned by NCRA under an easement currently held by the City to expand the Humboldt Trail/Rail corridor.

The Hikshari Trail is located along the northern boundary of Area 1 along with three parcels. Two of the parcels are privately owned, and one is owned by the City. To the east is Pound Road under Humboldt County's jurisdiction and a Highway 101 inter-change owned by Caltrans. To the south is Elk River

Slough, which is state sovereign lands under the Humboldt Bay Harbor Recreation and Conservation District (HBHRCD) jurisdiction. To the west is the NCRA railroad property. On the City's property and parallel to the railroad is a 30-foot right-of-way easement that Humboldt Community Services District (HCSD) holds for their sewer line.

The only direct property ownership constraints to restoring and enhancing tidal wetlands opportunities in Area 1 is Caltrans' property on the eastern border of the project and cooperation with NCRA on the proposed trail extension on their property via an extension of the City's license agreement. The proposed project design will require an encroachment permit from Caltrans. Indirectly, protecting adjacent properties not owned by the City will require design considerations and cooperation related to maintaining or modifying drainage structures and accommodating stormwater runoff.

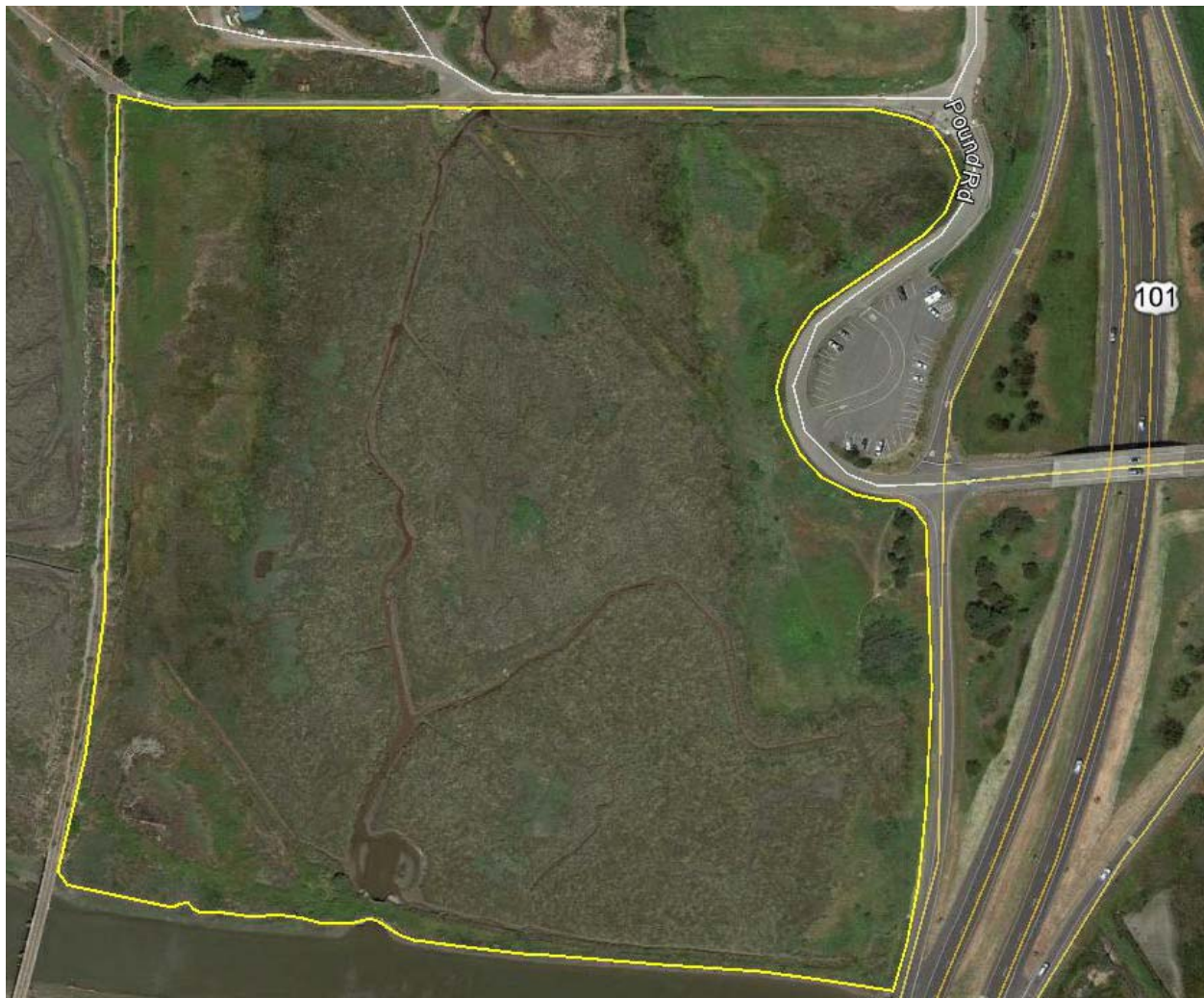


Figure 4. Existing conditions in Area 1, north of the Elk River Slough.

2.3 Land Use

Area 1 is in the City's land use jurisdiction and is zoned Natural Resource (NR). Restoration and enhancement of coastal wetlands are allowable uses on NR zoned property. However, pursuant to the

Coastal Act, Area 1 is in the State's retained jurisdiction, therefore proposed project activities, which are considered developments, will be subject to Coastal Commission authorization. The policies in Chapter 3 of the Coastal Act will apply to the proposed project activities. Existing zoning and regulatory policies are deemed to be compatible with the goal of the proposed project of expanding and enhancing the estuary and tidal wetlands on Elk River. All applicable local, state, and federal regulatory authorizations will be secured for the proposed project prior to commencing work.

2.4 Hydrology

There are five culverts draining adjacent properties to Area 1 (Figure 5). Restoring Area 1 to being fully tidal by removing the tide gates and dike on Elk River Slough could tidally inundate upstream properties, during mean higher high water (MHHW) and mean annual maximum water MAMW tides, if protection measures are not implemented (Figure 5). Tidal channels will need to be excavated or expanded to five existing water control structures to accommodate stormwater runoff and control backwater flooding. Tide gates on these culverts will limit saltwater inundation of adjacent properties. Three of these culverts already have tide gates. Two culverts will need to be retrofitted with tide gates. Tidal channels will be excavated or expanded to these five culverts to accommodate stormwater runoff and control backwater flooding. There is very little stormwater runoff or associated drainage area above the culverts draining to Area 1. Backwater flooding is not anticipated to become a problem with the installation and maintenance of tide gates. The main tidal channel from Elk River to the proposed boat launch ramp will need to be deepened to become a submerged channel and provide non-motorized watercraft access during low tides.

2.5 Utilities

There are both above and below ground utilities in Area 1. Pacific Gas & Electric (PG&E) has 9 electrical distribution poles located in Area 1 (six on City and three on Caltrans' property). Two poles are in an area designated for placement of fill, and one is in an area that is tidally inundated now and will remain inundated. Underground utilities in Area 1 include two sewer lines, one that parallels the western boundary near the toe of the NCRA railroad bed prism and the other along the eastern boundary of Highway 101. There are also buried optical fiber lines parallel to the eastern boundary along Highway 101, on Caltrans' property. Impacts to the underground utilities (sewer line and optical fibers) can and will be avoided through appropriate design and implementation. The two electrical distribution poles in areas where fill will be placed may need to be modified by PG&E to accommodate increased surface elevations.

2.6 Transportation Infrastructure

Restoring Area 1 to a fully tidal condition is not likely to adversely affect the road prism of the Highway 101 inter-change or the NCRA railroad bed prism, as they are tidally inundated now. Fill will be placed on the low-lying area fronting the Highway 101 road prism to form a living shoreline salt marsh plain/riparian slope (6' to 10' elevation NAVD 88) that will buffer the road prism from tidal inundation. An outlet channel will be left to convey stormwater discharge from an existing culvert in this area.

2.7 Physical Constraints

The depth of the proposed channels in Area 1 will match the thalweg elevation of Elk River Slough adjacent to Area 1. The existing tide gates and dike separating Area 1 from Elk River Slough will be removed. The width of the new channels will be modeled to accommodate the projected tidal prism volume and to optimize the creation of new eelgrass habitat. A Class 1 pedestrian trail will be constructed within the railroad property and a causeway and viewing platform will be constructed out into the salt marsh. There are several physical constraints (construction logistics) that will affect the proposed project design and construction sequencing.

The design of the trail and the causeway/viewing platform must consider the bearing capacity of the underlying soils and slopes of the terrain. The grading work and stockpiling sequence will also be affected by the soft (muddy) conditions that will develop when heavy equipment starts moving materials. Access roads and/or plank walkways may have to be installed and then removed. Much of the newly formed channels will be below seasonal groundwater elevations. The materials removed from the excavation will likely be saturated, heavy and sticky.



Figure 5. Location of water controls structures discharging to Area 1, and potential tidal inundation areas by MHHW (dark blue shading) and MAMW (light blue).

2.8 Biological Constraints

Vegetation survey and mapping have occurred in Area 1 to support project planning and design. A nine quadrangle U.S. Geological Survey (USGS) was also conducted to identify all potential vegetation, bird, animal, amphibian, and fish species that may be found in the project area and affected by project implementation.

There are no protected plant species in Area 1, but there are several populations of plant species of concern (Humboldt Bay owl's clover, Point Reyes bird's beak, and Lyngbye sedge). Best Management Practices (BMPs) will be necessary during project implementation to protect these species.

The U.S. Fish and Wildlife Service (USFWS) and Humboldt State University (HSU) collaborated to collect water samples to run eDNA test to determine the presence of any protected aquatic species such as tidewater goby in Area 1; none were found. Filling of in-board ditches will occur during low tide when they are de-watered to avoid impacts to tidewater goby should they be present.

Use of BMPs during project implementation will be needed to help ensure that Endangered Coho Salmon and Threatened Chinook Salmon and Steelhead trout are not negatively impacted, along with any sensitive bird species that may use the project area as identified in the nine quadrangle USGS search.

2.9 Cultural Resources

A cultural resource survey and investigation has been performed in Area 1. All observed historic resources were recorded and an evaluation of historical significance was conducted. The investigation recommended that these features no longer retain the requisite integrity to qualify for inclusion in the National Register of Historic Places. Additionally, historic Wiyot villages referenced in available ethnographic accounts and maps were determined to have been located outside the boundaries of Area 1 and Area 2. The investigation further concluded the proposed project will not result in significant impacts to historic resources, as defined by CEQA.

2.10 Exotic Invasive Species

Spartina, an invasive cordgrass species presently exists in Area 1. Restoring Area 1 to a fully tidal condition will require *Spartina* control to reduce the dispersal of *Spartina* to other areas on Elk River Slough and Humboldt Bay.

3 AREA 1 DESIGN ALTERNATIVES

The Goal for Area 1 is to expand and enhance tidal wetlands in Elk River Slough and public access to the coast and recreational opportunities. Proposed ecological benefits of design alternatives will focus on restoring hydrologic connectivity, expanding tidal channel habitat, managing *Spartina* and other invasive exotic species, and increasing eelgrass habitat. The project will also enhance Area 1's resiliency to sea level rise and improve the ecological integrity of its current condition. Five conceptual design alternatives are summarized below (Figure 6).

3.1 Option 1

This is the minimal conceptual design for Area 1 and includes the removal of existing tide gates and a length of dike sufficient to restore full tidal connectivity. Existing in-board ditches will be blocked off to focus the tidal prism in the main channels. Tide gates will be placed on three existing water control structures discharging to this area to prevent saltwater intrusion off-site. Once tide gates are removed, channel expansion and propagation would be expected to occur passively, in response to restoring full tidal connectivity. Option 1 does not include *Spartina* eradication or control.

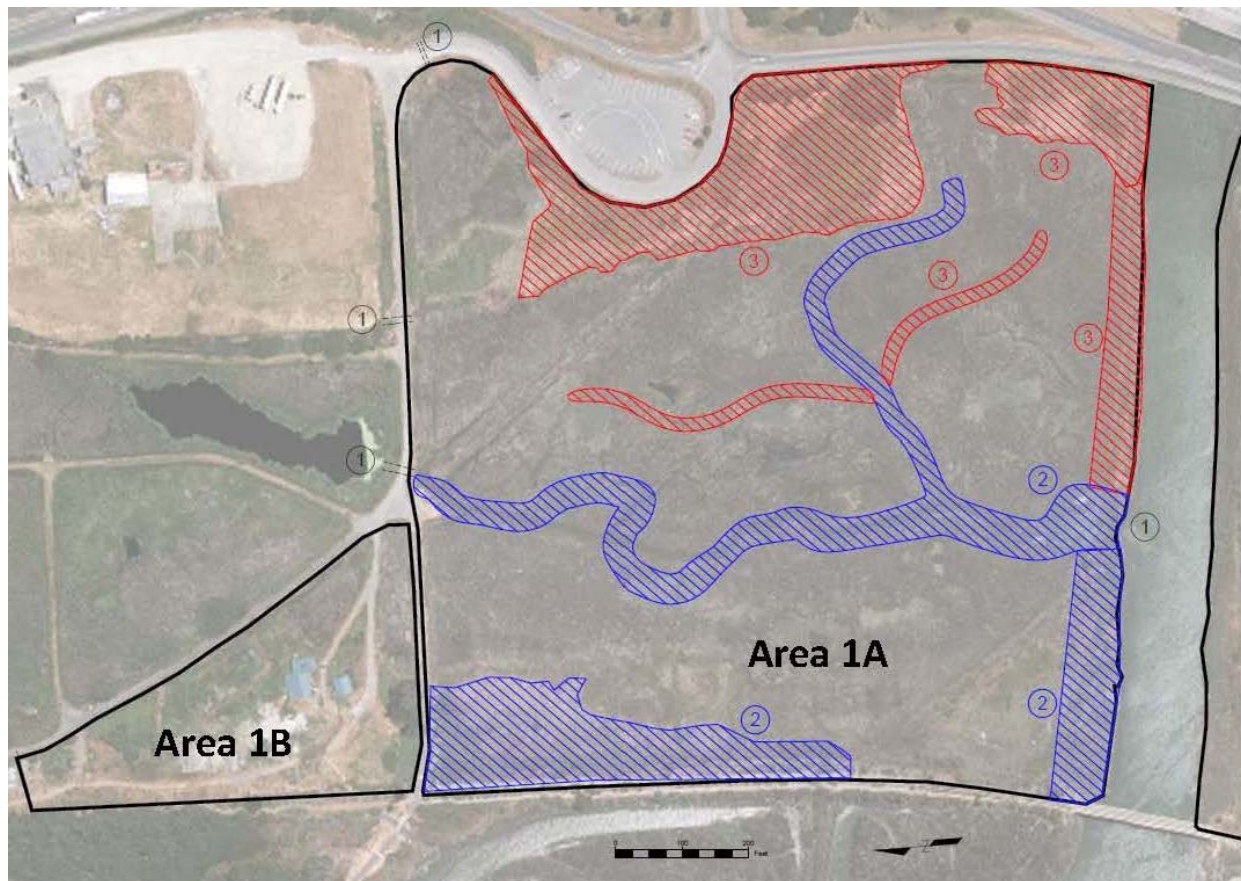


Figure 6. Conceptual design alternatives for Area 1A. Option 1 tide gate and limited dike removal only. Option 2 is shown in blue, and Option 3 is shown in red. Option 4 includes *Spartina* management in Area 1, and Option 5 includes public access and recreational opportunities. No design for area 1B.

3.1 Option 2

In addition to activities described under Option 1, heavy equipment would be utilized to excavate the dikes west of the tide gates to the rail road grade to restore greater tidal connectivity. The width and depth of existing channels would also be maximized for the benefit eelgrass and other aquatic species. Excavated material will be used on-site in upland areas, particularly in the proposed Humboldt Bay Trail corridor along the railroad grade and HCSD sewer right-of-way.

3.2 Option 3

Option 3 includes the full suite of possible actions for Area 1. In addition to the activities described in Options 1 and 2, the eastern dike would also be breached to further restore tidal functions and connectivity. The remnant railroad grade could be excavated to improve tidal connectivity. Additionally, new tidal estuary channels would be constructed with heavy equipment. Excavated material will be used on-site in upland areas along the Humboldt Bay Trail/Rail corridor and along Highway 101.

3.3 Option 4

Mechanical and manual *Spartina* removal would occur as well, to further reduce the spread of the

invasive exotic to other project areas.

3.4 Option 5

Option 5 would increase public access and recreational opportunities in Area 1. The private parcel in Area 1B would be acquired to be developed as a visitor center and parking as well as to expand tidal wetlands. The access gate at the end of the Pound Road would be removed. A non-motorized boat launch would be constructed at the entrance to Hikshari Trail at the juncture of Area 1A and 1B. Additionally, the City's Waterfront Trail would be extended south to the Elk River, expanding the Humboldt Bay Trail/Rail corridor.

3.5 Area 1 Preferred Design Alternative

Based on input received from stakeholders and consideration of constraints, the preferred design alternative for Area 1 includes the full suite of activities described in Options 1-5 (Figure 7). This will maximize the ecological benefits realized within existing constraints. Existing tide gates will be removed, and a length of dike sufficient to restore full tidal connectivity. Existing in-board ditches will be blocked off to focus the tidal prism in the main channels. Tide gates will be placed on three existing water control structures discharging to this area to prevent saltwater intrusion off-site. Once tide gates are removed, channel expansion and propagation would be expected to occur passively, in response to restoring full tidal connectivity.

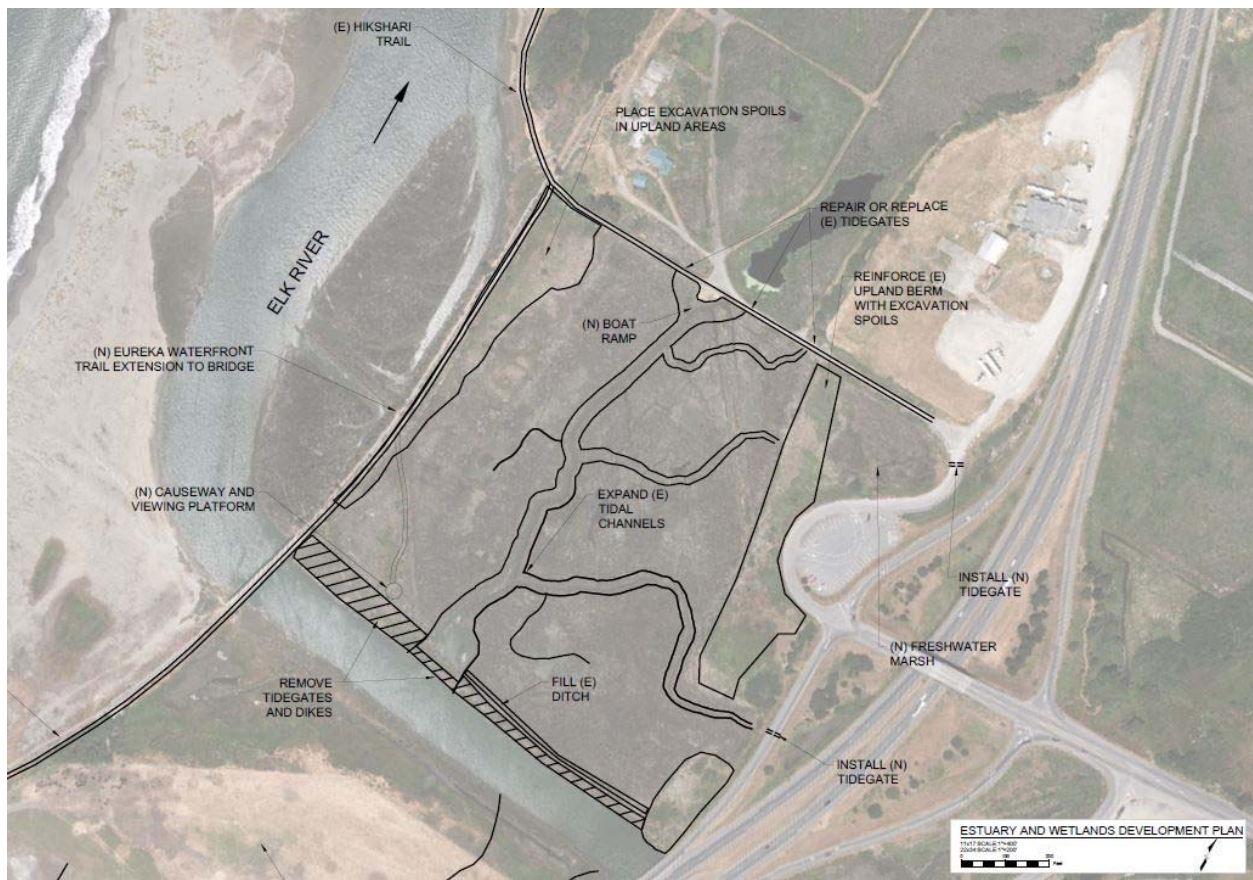


Figure 7. Area 1 preferred design alternative.

Heavy equipment would be utilized to excavate the dikes west of the tide gates to the rail road grade to restore greater tidal connectivity. The width and depth of existing channels would also be maximized for the benefit eelgrass and other aquatic species.

The eastern dike would also be breached to further restore tidal functions and connectivity. The former ERBS railroad grade could be excavated to improve tidal connectivity. Additionally, new tidal estuary channels would be constructed with heavy equipment. Excavated material will be used on-site in upland areas along the Humboldt Bay Trail/Rail corridor and along Highway 101.

Saltwater intrusion introduced to Area 1 through restoration actions (e.g., tide gate removal) would help treat Spartina. Remaining Spartina would be treated via mechanical and manual Spartina removal would occur as well, to further reduce the spread of the invasive exotic to other project areas.

Public access and recreational opportunities in Area 1 will be increased. The private parcel in Area 1B would be acquired to be developed as a visitor center and parking as well as to expand tidal wetlands. The access gate at the end of the Pound Road would be removed. A non-motorized boat launch would be constructed at the entrance to Hikshari Trail at the juncture of Area 1A and 1B. The Waterfront (Hikshari) Trail itself will also be extended southward to the Elk River.

4 AREA 2 CONSTRAINTS

4.1 Regulatory Requirements

All applicable local, state, and federal regulatory authorizations will need to be secured for the proposed project prior to commencing work. In addition, an encroachment permit from Caltrans will be required.

4.2 Property Ownership

Area 2 (Figure 8) is located south of Elk River Slough and is predominately owned by the City of Eureka. A 50-foot strip of land the length of the project area on the south bank of the Elk River is privately owned. Caltrans' Highway 101 property extends west into the project area, south to Tooby Road.

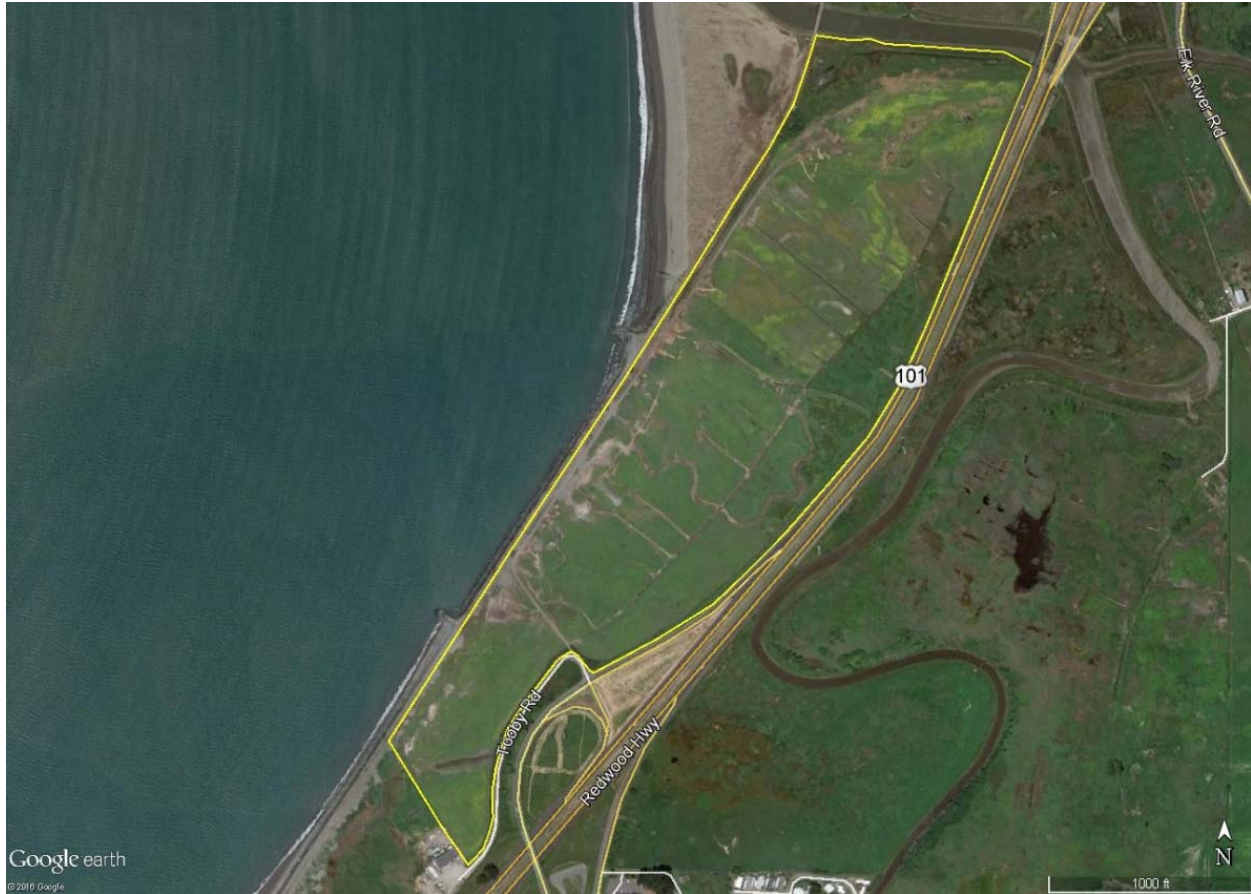


Figure 8. Project Area 2 (yellow outline), south of Elk River. Most the property is owned by the City of Eureka.

To the north of Area 2 is the Elk River Slough, which is state sovereign lands under the HBHRCD jurisdiction. Caltrans' Highway 101 Humboldt Hill off-ramp, and Tooby Road (maintained by Humboldt County) form the eastern border of Area 2. The NCRA railroad property forms the western border. HCSD's forced main sewer line runs parallel to the railroad grade in a 30-foot easement on the City's property. A private parcel forms the southern border of Area 2.

The only direct property ownership constraint to expanding and enhancing Elk River's estuary and tidal wetland opportunities in Area 2 is the private property between the Elk River and City's property and Caltrans' property. The City will need permission to excavate a new channel across the private parcel or to acquire the property. Proposed project activities that involve Caltrans property (placement of fill, channel excavation, and construction of public parking lot at Tooby Road) will require the City to secure an encroachment permit. Indirectly, protecting adjacent properties to the south not owned by the City will require design considerations such as increasing the elevation of slight topographic divide to 10+ ft. (NAVD 88) to limit salt water inundation of these properties.

4.3 Land Use

Area 2 is in the City's land use jurisdiction and is zoned coastal agriculture. Approximately 12.5 acres of Area 2 is in the State's retained jurisdiction pursuant to the Coastal Act, while the remainder of the area is in the City's Local Coastal Program (LCP) jurisdiction. Development will be subject to both the City's and Coastal Commission authorization. The City leases its property in Area 2, which has been used to

graze livestock. Converting land zoned coastal agricultural to non-agricultural uses could be a constraint. There is also a conflict between interest groups regarding the proposed conversion of seasonal Aleutian goose grazing habitat to estuary and tidal wetlands habitat for Coho salmon recovery and the benefit of pelagic fisheries. Former use of Area 2 for bio-solids disposal may require soil testing and possible approval by the North Coast Water Quality Control Board (NCRWQCB) for the conversion of this land to estuary and tidal wetlands, which will discharge to Elk River.

The policies in the City LCP and in Chapter 3 of the Coastal Act apply to the proposed project activities. Existing zoning and regulatory policies are deemed to be supportive of the goal of the proposed project of expanding and enhancing the estuary and tidal wetlands on Elk River, although there is an inherent conflict between policies to restore tidal wetlands whenever feasible and protect agricultural lands. As these are former tidelands, their restoration can only occur in this location, while agricultural uses are prevalent on non-former tide lands. Further, estuaries are valuable habitat for the recovery of protected Coho salmon and naturally occur in the lower-most reaches of rivers such as Elk River. On the balance, restoring former tidal wetlands and enhancing the estuary on Elk River are of greater priority in this unique coastal location than perpetuating agricultural uses on these public lands.

The Coastal Act does allow fill to be placed to protect existing structures, such as Highway 101. The construction of a living shoreline, which will support coastal wetland habitat will help protect Highway 101 from tidal inundation as result of the proposed Project restoring Area 2 to full tidality.

4.4 Hydrology

There are two water control structures with tide gates that drain Area 2 beneath Highway 101 and discharge to Elk River. The southern tide gate is proposed to be removed to increase connectivity with Elk River. There is a drop inlet structure associated with Caltrans' northern culvert; removing the tide gates could result in tidal inundation of the median area on Highway 101 that drains north to Elk River. The drainage channel from Area 2 to the northern culvert will be filled and the tide gate will remain. Stormwater and tidal drainage from Area 2 will be directed to Elk River. Salt water inundation from removing the southern tide gate will be limited to Area 2 and not affect properties to the south (Figure 9). Connecting Area 2 directly to Elk River will result in tidal inundation during MHHW and potentially of property to the south during MAMW tides (Figure 6). Preventing tidal flooding of private property to the south will need to be addressed and avoided by increasing the elevation of an existing topographic divide to 10+ ft. (NAVD 88). Opening Area 2 to a full tidal cycle during MHHW or MAMW (6.5 and 8.8 ft. [NAVD 88]) will not result in the NCRA property becoming tidally inundated.

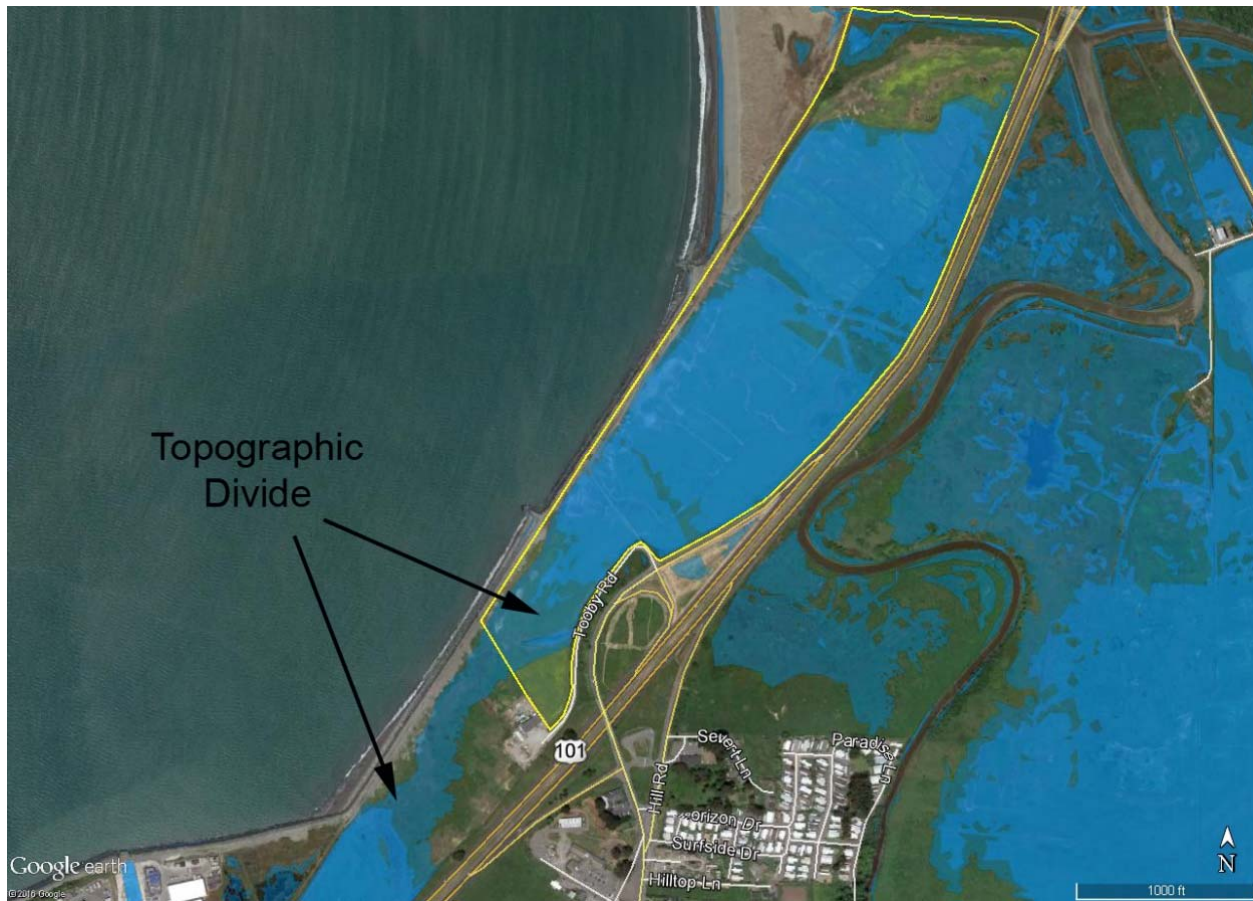


Figure 9. Potential tidal inundation of Area 2 during MHHW (dark blue shading), MAMW (light blue) tides, and an existing topographic divide between Areas 2 and 3.

Recent extreme tides and storm surges have severely eroded railroad grade ballast from NCRA property in numerous locations resulting in fill of seasonal wetlands in Area 2 and 3 (Figure 10). The condition of the seawall and NCRA property needs to be assessed and engineering designs developed to rehabilitate and enhance the structure to protect infrastructure and the estuary and intertidal wetland features proposed for Area 2.

4.5 Utilities

There are both above and below ground utilities in Area 2. PG&E has eleven electrical distribution poles located in Area 2 on City property. Nine poles are in an area designated for placement of fill, and one is in an area that is tidally inundated now and will remain inundated. Underground utilities in Area 2 include a HCSD force main pressure sewer line that parallels the western boundary of the City's property and is located approximately 10 ft. east of that property line. There are also buried optical fiber lines parallel to the eastern boundary along Highway 101 on Caltrans' property. These underground utilities (sewer line and optical fibers) can and will be avoided through appropriate design and implementation. The nine electrical distribution poles in areas where fill will be placed may need to be modified by PG&E to accommodate increased surface elevations.



Figure 10. NCRA railroad grade erosion and seasonal wetlands fill, post 2015- 2016 king tides and storm surge in Area 2.

4.6 Transportation Infrastructure

Restoring Area 2 to a fully tidal condition is likely to tidally inundate the road prism of Highway 101 and off-ramp as well as a portion of Tooby Road, during various high tide events. As described in Section 2.4 (Area 2 Hydrology), the NCRA railroad prism is not likely to be tidally inundated at MAMW or king tides. Fill can be placed along the Caltrans road prism to form a living shoreline salt marsh plain/riparian slope (6 ft. to 10 ft. elevation NAVD 88) that will buffer the road prism from tidal inundation. An outlet channel will be needed to convey stormwater discharge through the southern culvert under Highway 101.

An engineering assessment is needed of the Humboldt Bay Trail/Railroad corridor and protective shoreline rock sea wall. Recent extreme high tides and storm waves have caused extensive erosion of the railroad ballast, which have formed gravel deltas extending out into Area 2. Bay over-wash will only increase as the sea wall deteriorates as will erosion of Area 2, ultimately threatening HCSD forced sewer main and even Highway 101.

4.7 Physical Constraints

An existing windblown sand deposit forms an upland area parallel to Elk River and is a physical constraint to reconnecting Area 2 to Elk River. The proposed Project will need to excavate a new channel through this sand deposit from Elk River. The new channel will then meander south approximately 4,200 ft. The side slopes of the channel through the sand dune may have to be laid back further than the side slopes throughout the rest of the Area. The depth of the proposed main tidal channel into Area 2 will match the thalweg elevation of Elk River slough adjacent to Area 2. The width and depth of the tributary

tidal channels will be modeled to accommodate the projected tidal prism volume and to optimize the creation of new eelgrass habitat.

4.8 Biological Constraints

Vegetation survey and mapping have occurred in Area 2 to support project planning and design. A nine quadrangle USGS was also conducted to identify all potential vegetation, bird, animal, amphibian, and fish species that may be found in the project area and affected by project implementation.

There are no protected plant species in Area 2, but there are several populations of plant species of concern (Humboldt Bay owl's clover, Point Reyes bird's beak, and Lyngbye sedge). BMPs will be necessary during project implementation to protect these species.

USFWS and HSU collaborated to collect water samples to run eDNA test to determine the presence of any protected aquatic species such as tidewater goby in Area 2, and none were found. Filling of in-board ditches should occur during low tide when they are de-watered to avoid impacts to tidewater goby should they be present.

Use of BMPs during project implementation will be needed to help ensure that Endangered Coho Salmon and Threatened Chinook Salmon and Steelhead trout are not negatively impacted, along with any sensitive bird species that may use the project area, as identified in the nine quadrangle USGS search.

While there are no Aleutian goose roosting or nesting sites in Area 2 or in the vicinity, construction would occur during the dry season after Aleutian geese have finished their seasonal grazing.

4.9 Cultural Resources

As with Area 1, a cultural resource survey and investigation has been performed in Area 2. All observed historic resources were recorded and an evaluation of historical significance was conducted. The investigation recommended that these features no longer retain the requisite integrity to qualify for inclusion in the National Register of Historic Places. Additionally, historic Wiyot villages referenced in available ethnographic accounts and maps were determined to have been located outside the boundaries of Area 1 and Area 2. The investigation further concluded the proposed project will not result in significant impacts to historic resources, as defined by CEQA.

4.10 Exotic Invasive Species

Spartina presently exists in a limited (approximately an acre) reach of Area 2 parallel to Elk River. Restoring Area 2 to a fully tidal condition will require *Spartina* eradication where it exists and control to prevent its establishment in the new tidal wetlands areas.

5 AREA 2 DESIGN ALTERNATIVES

The goal for Area 2 is to also expand and enhance the estuary of Elk River and increase public access and recreational opportunities. Proposed ecological benefits of design alternatives will focus on creating a tidal channel network and hydrologic connectivity with the estuary of Elk River. This expansion of the estuary will also increase tidal and brackish water wetland habitat and eelgrass habitat. The construction of a living shoreline buffer along the western and eastern boundaries of the Project area will benefit publicly owned transportation, utility corridors, public access, and recreational opportunities. Four conceptual design alternatives for Area 2 are summarized below (Figure 11).

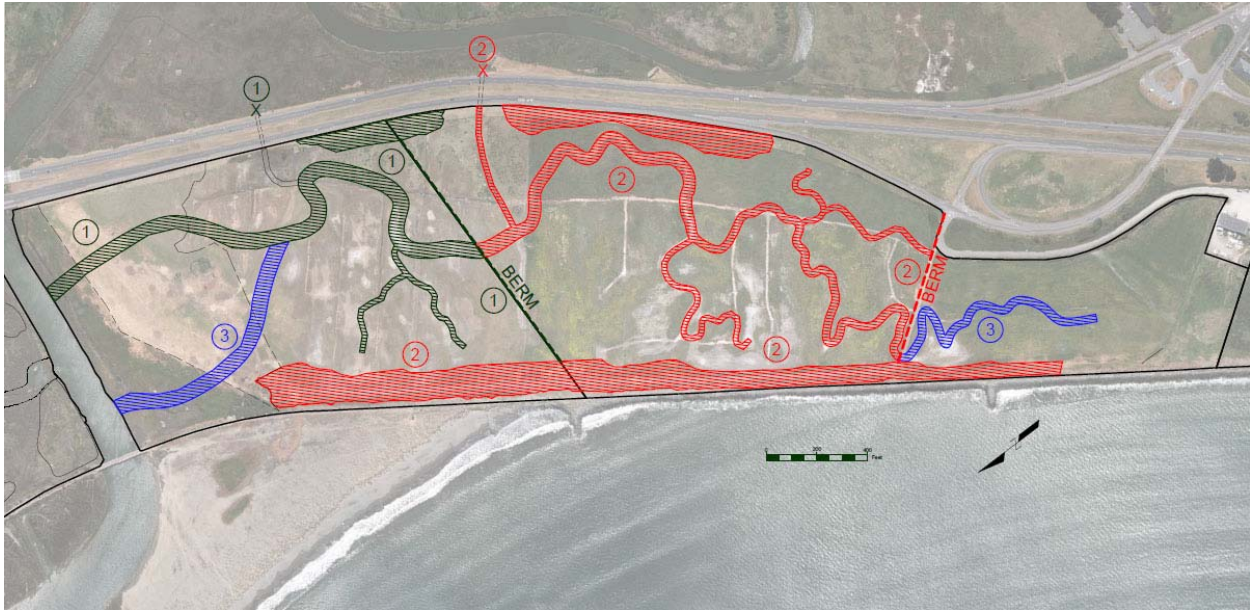


Figure 11. Conceptual design alternatives considered for Area 2. Option 1 shown in green; Option 2 shown in red; Option 3 shown in blue. Option 4 includes an access road and observation trail and deck.

5.1 Option 1

This is the minimal conceptual design alternative that includes the excavation of a tidal channel entrance and network to enhance tidal connectivity and tidal/estuarine habitats. The new channel entrance would connect directly to the Elk River. An existing in-board ditch will be blocked off to focus the tidal prism in the main channel. Note width and depth dimensions will ultimately be controlled by the depth of the Elk River channel itself. The width and depth of the new channels would be maximized for the benefit Eelgrass and other aquatic species. A tide gate on one culvert that drains to the east beneath Highway 101 to Elk River would be removed to increase tidal connectivity. Excavated material would be used on-site to construct a hydrologic berm/riparian habitat to retain grazing and Aleutian goose habitat on the southern half of Area 2. Construction of the new tidal channel entrance and network would enhance seasonal wetlands in a 50:50 balance between agricultural grazing use/Aleutian goose habitat and new estuary habitat.

5.2 Option 2

Option 2 expands the channel network proposed in Option 1 to enhance a larger amount of estuary habitat while retaining agricultural grazing use/Aleutian goose habitat at approximately a 66:33 ration. The new channel network would also be extended. A second tide gate on a culvert that drains to the east beneath Highway 101 to Elk River would be removed to increase tidal connectivity. Excavated material would be used to construct living shorelines that gradually increase in elevation to buffer the Humboldt Bay Trail/Railroad/HCSO right-of-way and Highway 101.

5.3 Option 3

Option 3 includes the excavation of a second new tidal entrance and maximizing tidal connectivity. The two new channel entrances would connect directly to the Elk River. Excavated material would be used to construct living shoreline that gradually increase in elevation to buffer the Humboldt Bay Trail/Railroad/HCSO right-of-way and Highway 101.

5.4 Option 4

Option 4 would increase public access and recreational opportunities in Area 2. The existing dirt road would be improved to provide public access from Tooby Road to the NCRA railroad and then parallel to railroad north to a crossing to allow the public to access Elk River Spit and Humboldt Bay. Public parking with pervious pavers would be developed adjacent to Tooby Road. A public trail would extend from the Humboldt Bay Trail corridor east to a viewing deck above the enhanced tidal wetlands area.

5.5 Area 2 Preferred Design Alternative

Based on input received from stakeholders, the preferred design alternative for Area 2 includes a modified version of Options 3 and 4 (Figure 12).

Excavation of a single tidal channel entrance and network will enhance tidal connectivity and tidal/estuarine habitats. The new channel entrance would connect directly to the Elk River. An existing in-board ditch will be blocked off to focus the tidal prism in the main channel. Note width and depth dimensions will ultimately be controlled by the depth of the Elk River channel itself. The width and depth of the new channels would be maximized for the benefit eelgrass and other aquatic species. A tide gate on one culvert that drains to the east beneath Highway 101 to Elk River would be removed to increase tidal connectivity.

A second tide gate on a culvert that drains to the east beneath Highway 101 to Elk River would be removed to increase tidal connectivity. Excavated material would be used to construct living shoreline that gradually increase in elevation to buffer Highway 101.

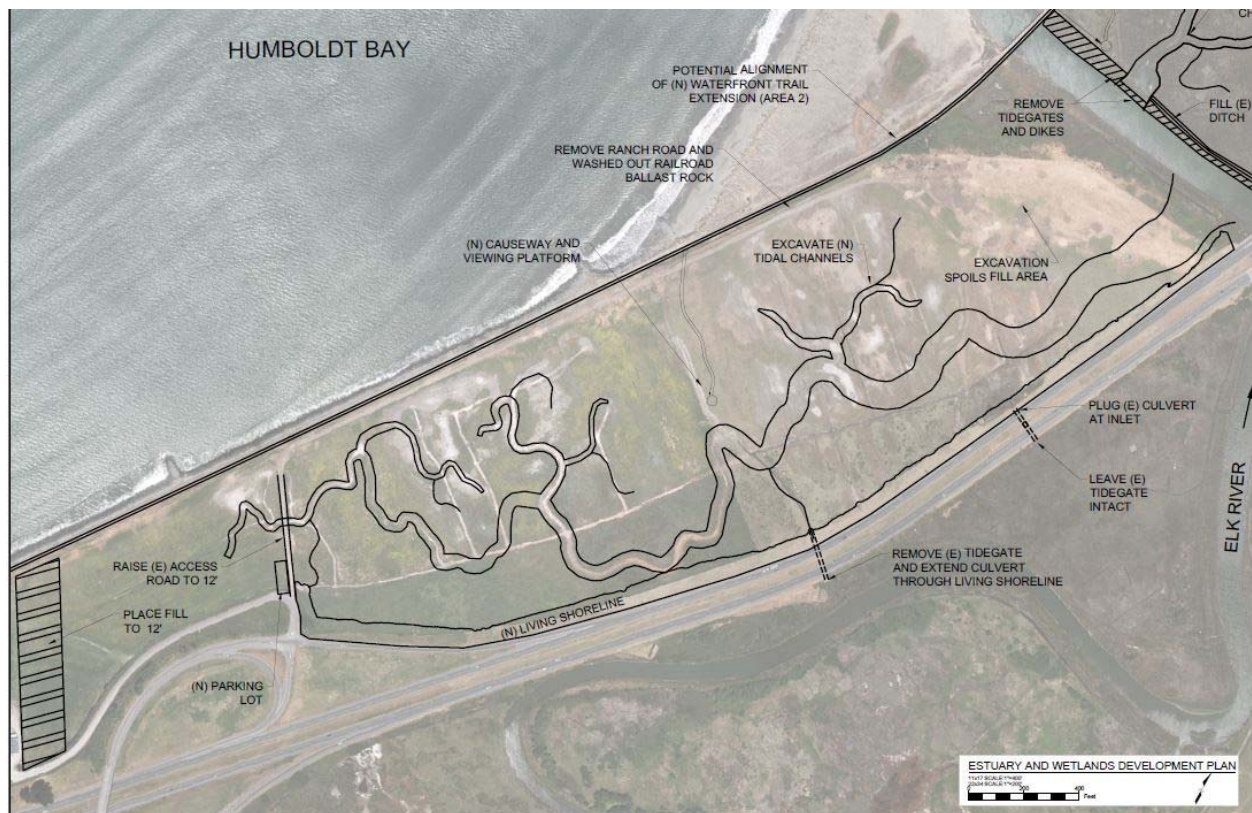


Figure 12. Area 2 preferred design alternative.

6 AREA 3 CONSTRAINTS

6.1 Regulatory Requirements

All applicable local, state, and federal regulatory authorizations will need to be secured for the proposed project prior to commencing work. In addition, an encroachment permit from Caltrans, Humboldt County, and NCRA will be required.

6.2 Property Ownership

Area 3 (Figure 13) has been divided into Area 3A and Area 3B based on property ownership and is located north of King Salmon Avenue and west of Highway 101. Area 3A includes two private parcels. One parcel has a wetlands conservation easement held by the National Resources Conservation Service (NRCS). NRCS staff and property owner have expressed support for enhancing connectivity of this parcel with Buhne Slough and the conversion of seasonal freshwater wetlands to tidal and brackish water wetlands. Area 3B is predominately privately owned by PG&E (three parcels in Area 3B). The NCRA owns the railroad corridor property, which forms the western boundary of Area 3A and traverses Area 3B. Caltrans' Highway 101 property also extends west into Area 3. The County owns King Salmon Avenue. The HCSD holds a right-of-way easement for its sewer line that crosses Area 3B east to west and then parallels the NCRA property north to the Elk River waste water treatment facility.

Permission and/or collaboration from/with PG&E and two private property owners and two easements will be necessary in Area 3. The direct property ownership constraints to restoring and enhancing tidal wetlands opportunities in Area 3 are (1) PG&E's property and their need to maintain access to their utility infrastructure and (2) Caltrans' property and water control structures on the eastern border of the project. The proposed project design will require PG&E permission and an encroachment permit from Caltrans. Indirectly, protecting adjacent properties that could be tidally inundated by the proposed project will require design considerations and cooperation related to maintaining or modifying drainage structures and accommodating stormwater runoff.



Figure 13. Project Area 3 (A&B), north of King Salmon Avenue. Area 3 was historically part of the Buhne Slough tidal complex.

6.3 Land Use

Most of Area 3 is in Humboldt County's land use jurisdiction. The City of Eureka's jurisdiction occupies a small portion of the northern most northern private parcel in Area 3A. All of the private properties east of the NCRA property in Area 3 are zoned Commercial Recreation with the following combining zone designations: Coastal Resource Dependent, Flood Hazard Areas, and Coastal Wetlands. PG&E's property west of the NCRA in Area 3B and north of King Salmon Avenue is zoned Coastal Dependent Industrial (MC) with the following combining zone designations: Coastal Resource Dependent, Flood Hazard Areas, and Coastal Wetlands.

Pursuant to the Coastal Act, a significant portion of Area 3 is in the State's retained jurisdiction, while the remainder of Area 3 is in the County LCP jurisdiction as described in the Humboldt Bay Area Plan (HBAP). Any proposed habitat enhancement activities are considered development and will be subject to both the County's and Coastal Commission coastal development authorization. There may be a conflict between interest groups regarding the proposed conversion of seasonal Aleutian goose grazing habitat in Area 3B to tidal wetlands habitat.

The policies in the County's HBAP and in Chapter 3 of the Coastal Act will apply to the proposed project activities. Normally converting CDI to other uses would be a constraint, but the portion of the CDI parcel in Area 3A is undeveloped and currently supports tidal wetlands and would not be developable as a CDI use. The Commercial Recreation designated properties in Area 3B are east of the NCRA property are

undeveloped and support tidal wetlands. In Area 3A, the low-lying properties are currently under agricultural use for grazing, and the upland portion is developed for commercial uses. Restoration of coastal wetlands is an allowable use in Commercial Recreation designated lands with a Coastal Wetlands overlay. Therefore, existing zoning and regulatory policies are deemed to be supportive of the goal of the proposed project of expanding and enhancing hydrologic connectivity and tidal wetlands on Buhne Slough. All applicable local, state, and federal regulatory authorizations will be secured for the proposed project prior to commencing work.

6.4 Hydrology

Area 3 occupies the historic Buhne Slough salt marsh complex that has been diked off from Humboldt Bay, channelized with construction of King Salmon Canal, and segmented hydrologically by several linear transportation structures (NCRA, Highway 101, Buhne Ranch Road, and King Salmon Avenue). Area 3 currently supports a muted tide cycle and tidal wetlands and brackish and freshwater wetlands fed by stormwater runoff from Humboldt Hill east of Highway 101. The lower portion of historic Buhne Slough in Area 3 is now referred to as King Salmon Canal and the former inlet to PG&E's Humboldt Bay Power Plant. In Area 3, there are several water controls structures in place where Highway 101, NCRA railroad, old Buhne Ranch Road, and King Salmon Avenue cross Buhne Slough.

In Area 4, Buhne Slough joins King Salmon Canal via a 2 ft. diameter culvert with a tide gate (currently staying open) and enters Area 3 through a 5 ft. diameter culvert, under King Salmon Avenue. Tidal waters proceed up Buhne Slough through a 2 ft. diameter culvert under the railroad, and then through two 3 ft. diameter culverts under the abandoned Buhne Ranch Road before entering a 4 ft. x 10 ft. box culvert under Highway 101 at the eastern edge of Area 3.

A small roadside ditch is present along western toe of Highway 101 that allows stormwater to drain from Area 3A south to Buhne Slough. The historic Buhne Slough channel in Area 3A has been cut-off from the lower Buhne Slough with the construction of Highway 101. Area 3A receives wave generated over wash from Humboldt Bay in the winter. Stormwater in Area 3A drains south to a remnant of Buhne Slough on PG&E's property, not east in its historic channel which was blocked by the construction of Highway 101. A small 1 ft. diameter culvert also allows tidal waters to be exchanged from Area 4 underneath King Salmon Avenue with Area 3.

The series of culverts between Highway 101 and King Salmon Avenue are grossly undersized, partially plugged and significantly restrict stormwater flows coming from the Humboldt Hill watershed that drains to the historic Buhne Slough salt marsh complex east of Highway 101.

If Area 3 became fully tidal, salt water inundation could extend north to Area 3A. Area 3B is predominately salt marsh now. MAMW or king tides could extend north to Area 2 if the slight topographic divide is not increased in elevation above 9 ft. (Figure 14). If Area 3 became fully tidal, stormwater runoff from the east could also become temporarily impounded behind Highway 101 and flood properties east of Highway 101 and east of Broadway Avenue.

Recent extreme tides and storm surges have severely eroded railroad grade ballast from NCRA property in numerous locations resulting in fill of seasonal wetlands in Area 2 and 3 (Figure 10). The condition of the seawall and NCRA property needs to be assessed and engineering designs developed to rehabilitate and enhance the structure to protect infrastructure and seasonal wetland features in Area 3A.

The low lying former Buhne Slough salt marsh and stormwater runoff from two drainages on Humboldt Hill to the east Highway 101 drain into Area 3. The area to the east of Highway 101 becomes flooded in the winter from precipitation and stormwater runoff. The former Buhne Slough salt marsh area is underlain with Bay mud and not very permeable. Buhne Slough has been diverted from its former channel (King Salmon Canal) and discharges to Area 4 via a 5 ft. culvert. The reduced drainage capacity of Buhne Slough and current water control structures likely contribute to flooding east of Highway 101.

Restoring connectivity between Buhne Slough and South Bay could tidally affect former salt marsh areas upstream and east of Highway 101. Restoring tidal connectivity could affect stormwater runoff and flooding east of Highway 101. Installing tide gates on Buhne Slough water control structures would likely increase flooding upstream during stormwater runoff. Preventing tidal inundation or flooding of private property to the east of Area 3 will need to be addressed. Caltrans is not supportive of placing tide gates on its water control structures (culverts) due to the increased maintenance responsibilities associated with tide gates.

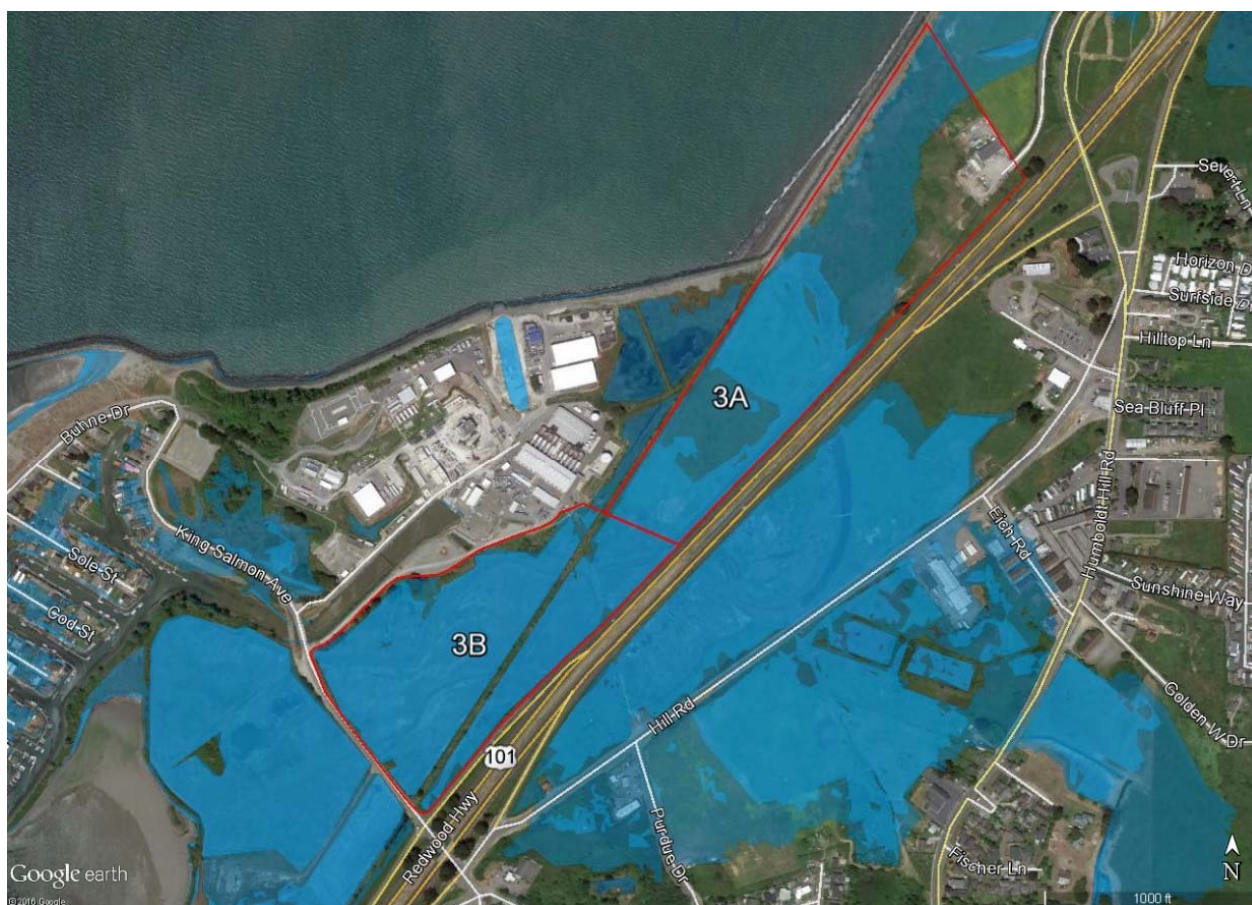


Figure 14. Potential tidal inundation of Area 3 during MHHW (dark blue shading) and MAMW (light blue) tides, and an existing topographic divide between Areas 3 and 2.

6.1 Utilities

There are both above and below ground utilities that traverse Area 3 in a very concentrated zone (Figure 15). The HCSO has a forced main pressure sewer line that crosses Area 3 and Buhne Slough from the east and then runs north parallel to the railroad grade in a 30-foot easement. PG&E has a main 12 in gas line entering Area 3 from the east that also crosses Buhne Slough and multiple electrical transmission lines and towers/poles crossing in the same zone. There are also buried optical fiber lines parallel to the eastern boundary along Highway 101 on Caltrans' property.

The underground utilities that cross Buhne Slough create major constraints to increasing the slough's channel capacity (width and depth). As long as the electrical transmission towers and poles can remain accessible, increasing tidal connectivity in Area 3B with Humboldt Bay should not be a limitation as this area is tidally inundated under existing conditions.

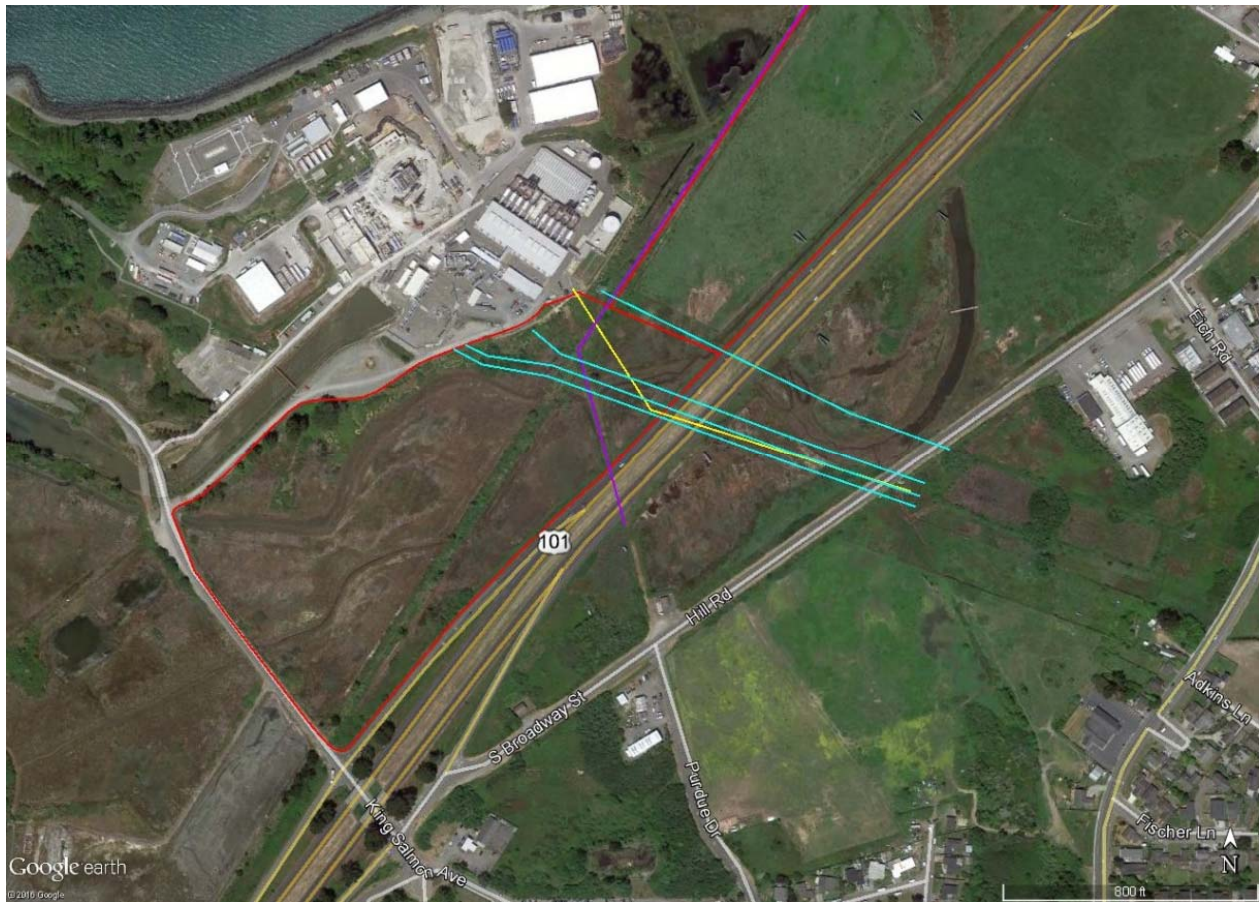


Figure 15. Utilities traversing Area 3: Humboldt Community Services District's sewer line (purple), PG&E's gas line (yellow) and overhead electrical transmission towers and poles (turquoise).

6.1 Transportation Infrastructure

Tidal inundation of Highway 101, King Salmon Avenue, PG&E road prisms, and the railroad base occurs under existing conditions in Area 3B but not in Area 3A. Restoring Area 3 to a fully tidal condition would likely inundate the road prism in Area 3A on the west-side of Highway 101 by MHHW. This is not considered a constraint under the current tidal regime. If Area 3 is restored to full tidal influences, no road, highway, or railroad surfaces would be tidally inundated by current MAMW tides.

6.2 Physical Constraints

There are no natural physical constraints in Area 3, but artificial constraints from existing water control structures on Buhne Slough and utility and transportation infrastructure impose many physical constraints to increasing tidal connectivity and enhancing tidal wetlands in Area 3. Excavation to increase the capacity of Buhne Slough would be constrained by underground utilities that cross the channel. The private road on the left bank of King Salmon Canal may not be able to be breached to support full tidal restoration of Area 3 if it is designated as a haul route to be used in the removal of nuclear casks from PG&E's property. The removal of nuclear casks from PG&E's property may also prevent construction of

a full tidal channel under King Salmon Avenue to connect Area 3 to Humboldt Bay. Tidal inundation and backwater flooding of adjacent properties east of Highway 101 and south of King Salmon Avenue are fluvial constraints to restoring a full tidal cycle on Buhne Slough in Area 3.

6.3 Biological Constraints

Vegetation survey and mapping have not been prepared of Area 3 for this project but environmental assessments prepared for PG&E and NRCS do cover most of Area 3. Stillwater Sciences (2016) conducted vegetation surveys in Area 3 as part of PG&E's *Biological Mitigation and Monitoring Plan for the Humboldt Bay Power Plant* and identified the presence of special status Sea-watch (*Angelica lucida*), as well as Lyngbye's sedge and Point Reye's bird beak, also found in Area 1 and Area 2. Eelgrass was also observed in the PG&E Intake Canal (Stillwater Sciences 2016). Stillwater Sciences (2016) also noted that special-status northern red-legged frog (*Rana aurora*) amphibians have the potential to occur in Area 3.

USFWS and HSU collaborated to collect water samples to run eDNA test to determine the presence of any protected aquatic species such as tidewater goby in Area 3; none were detected.

6.4 Cultural Resources

A cultural resource survey and investigation has not been performed in the course of this project of Area 3. A cultural resources survey would need to precede any proposed excavation in Area 3.

6.5 Exotic Invasive Species

Spartina presently exists in Area 3B but not in 3A. Increasing Area 3's connectivity with Humboldt Bay will require *Spartina* eradication where it exists and control to prevent its establishment in the new tidal wetlands of Area 3A.

7 AREA 3 DESIGN ALTERNATIVES

The goal in Area 3 is to restore connectivity of Buhne Slough to Humboldt Bay and restore Buhne Slough's former tidal wetlands and eelgrass habitats. Hydrologically, Area 3 is part of the larger former salt marsh area associated with Buhne Slough that includes Area 4 too. As the goals for Area 3A and 3B are the same, these two areas could be combined into one Area 3. Five conceptual design alternatives for Area 3 are summarized below (Figure 16).

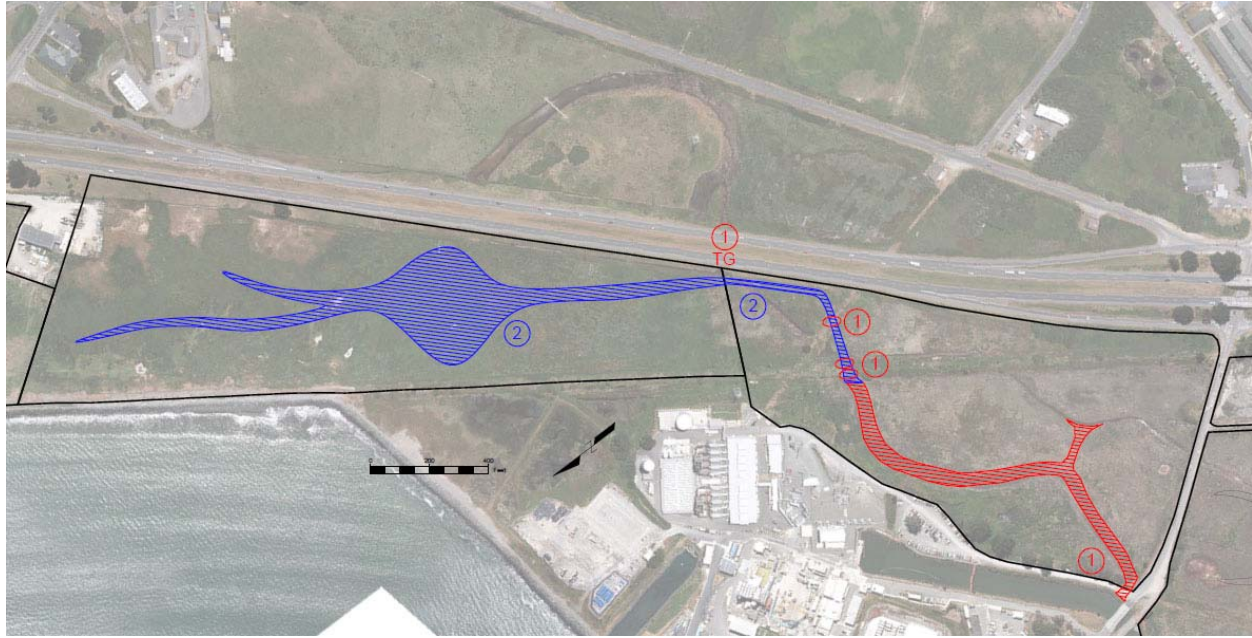


Figure 16. Conceptual design alternatives for Area 3. Option 1, shown in red, proposes to breach King Salmon Canal and install tide gates. Option 2 is shown in blue, and Option 3 in green.

7.1 Option 1

This is the minimal of the conceptual design alternatives, which focuses on restoring full tidal connectivity to Buhne Slough and South Bay via the King Salmon canal, and promoting passive tidal channel expansion. An existing in-board ditch will be blocked off to focus the tidal prism in the main channel. The two culverts under the NCRA Railroad grade and the one culvert under former Buhne Road will be either removed or expanded to accommodate full tidal capacity. Tide gates would need to be installed in Caltrans' box culvert on Buhne Slough and another culvert to the South beneath Highway 101 to prevent saltwater intrusion east of the highway. Backwater flooding during stormwater runoff is likely to occur east of Highway 101 and Broadway Avenue (Figure 14). Option 1 does not include Spartina control.

7.2 Option 2

Option 2 is essentially the same as Option 1, although tide gates will not be placed on Caltrans' culverts under Highway 101. Tidal inundation would occur east of Highway 101 and east of Broadway Avenue. A tide gate could be installed on the culvert under Broadway Avenue to prevent the area to the east from saltwater intrusion. Backwater flooding during stormwater runoff is likely to occur east of Highway 101 and Broadway Avenue.

7.3 Option 3

In addition to restoring full tidal connectivity to Buhne Slough to South Bay via the King Salmon canal, Option 3 will expand the channel capacity of Buhne Slough up to Highway 101 where an outlet pool will be excavated at the culvert. A new channel would be excavated north from Buhne Slough to reconnect the former upper reaches of Buhne Slough (Area 3a). A pond would also be excavated in the former Buhne Slough channel to the west of the Highway 101 in remnant reach of Buhne Slough. Option 3 also does not include Spartina control.

7.4 Option 4

Option 4 would expand the channel capacity of an existing tidal channel in Area 3B extending north from King Salmon Avenue through a culvert that would need to be replaced or removed under the NCRA Railroad grade up to Buhne Slough.

7.5 Option 5

Option 5 would add mechanical and manual Spartina control to Options 1-3 tidal connectivity activities.

7.6 Area 3 Preferred Design Alternative

Based on feedback received from stakeholders on conceptual design alternatives and existing constraints, the preferred design alternative for Area 3 includes all elements from Option 2 – Option 5. Full tidal connectivity to Buhne Slough and South Bay via the King Salmon canal will be restored, promoting passive tidal channel expansion. An existing in-board ditch will be blocked off to focus the tidal prism in the main channel. The two culverts under the NCRA Railroad grade and the one culvert under former Buhne Road will be either removed or expanded to accommodate full tidal capacity. Tidal inundation would occur east of Highway 101 and east of Broadway Avenue. A tide gate could be installed on the culvert under Broadway Avenue to prevent the area to the east from saltwater intrusion. Backwater flooding during stormwater runoff is likely to occur east of Highway 101 and Broadway Avenue (Figure 14).

The channel capacity of Buhne Slough will be expanded up to Highway 101 where an outlet pool will be excavated at the culvert. A new channel would be excavated north from Buhne Slough to reconnect the former upper reaches of Buhne Slough (Area 3A). A pond would also be excavated in the former Buhne Slough channel to the west of the Highway 101 in remnant reach of Buhne Slough.

The channel capacity of an existing tidal channel in Area 3B will also be expanded, extending north from King Salmon Avenue through a culvert that would need to be replaced or removed under the NCRA Railroad grade up to Buhne Slough.

Mechanical and manual Spartina control to all tidal connectivity activities in Area 3.

8 AREA 4 CONSTRAINTS

8.1 Regulatory Requirements

All applicable local, state, and federal regulatory authorizations will need to be secured for the proposed project prior to commencing work. In addition, an encroachment permit from Humboldt County may be required.

8.2 Property Ownership

Area 4 (Figure 17) is located south of King Salmon Avenue and west of Highway 101 and is a mix of public (HBHRCD and Humboldt County) and two privately owned properties. Area 4 has been divided into Area 4A and Area 4B based on property ownership and hydrological characteristics. In Area 4A, two public agencies own properties who are supportive of the project but it will not be feasible to enhance connectivity with South Bay and tidal wetlands or eelgrass habitat without the cooperation of adjacent private property owners. Area 4B is entirely privately owned, and the owner is interested in enhancing connectivity with South Bay and creating eelgrass habitat and tidal wetlands. Area 4B is hydrologically isolated from Area 4A through MHHW tides and can be made so from higher tides such as MAMW if

tidal enhancement is not pursued in 4A.

The NCRA owns the railroad corridor property, which forms the eastern boundary of Area 4. Caltrans' Highway 101 borders the NCRA property. The County owns King Salmon Avenue. Area 4 is bound by King Salmon Canal (Buhne Slough) and South Bay, separated by earthen dikes, except in Area 4B where the dikes have been breached.



Figure 17. Project Area 4 (A&B), south of King Salmon Avenue. Area 4 was historically part of the Buhne Slough tidal complex.

8.3 Land Use

All of Area 4 is in the County's land use jurisdiction and is zoned Coastal Recreation with the following combining zone designations: Coastal Resource Dependent, Flood Hazard Areas, and Coastal Wetlands. The State has retained coastal development jurisdiction in this area pursuant to the Coastal Act. The policies in the County's HBAP and in Chapter 3 of the Coastal Act will apply to the proposed Project activities. Nearly all the property in Area 4 is undeveloped and currently supporting tidal wetlands with a few upland areas and remnant concrete slabs and asphalt road from past commercial uses. The concrete in Area 4B may have supported former commercial uses. If soils associated with the concrete are contaminated their removal may be necessary. There is interest in both the public and private properties to seek mitigation credit for their properties. Restoration of coastal wetlands is an allowable use in Commercial Recreation designated lands with a Coastal Wetlands overlay. Therefore, existing zoning and

regulatory policies are deemed to be supportive of the goal of the proposed project of expanding and enhancing hydrologic connectivity and tidal wetlands on Buhne Slough.

8.4 Hydrology

There are two drainage structures (5 ft. and 1 ft. culverts) beneath King Salmon Avenue that convey stormwater runoff from Area 3 to Area 4. There is a 2 ft. culvert and tide gate on the drainage ditch (Buhne Slough) that is connected to King Salmon Canal. The tide gate is not operational, and is currently stuck open. An in-board ditch parallels the perimeter dike from King Salmon Avenue east to the NCRA. The ditch has been filled at the property boundary between Area 4A and B. A former agricultural ditch extends north from the perimeter dike ditch to Area 3 via a 1 ft. diameter culvert without a tide gate. Area 4B has become hydrologically reconnected with South Bay since its perimeter dikes were breached. Potential tidal inundation of Area 4 resulting from project implementation is shown in Figure 18.

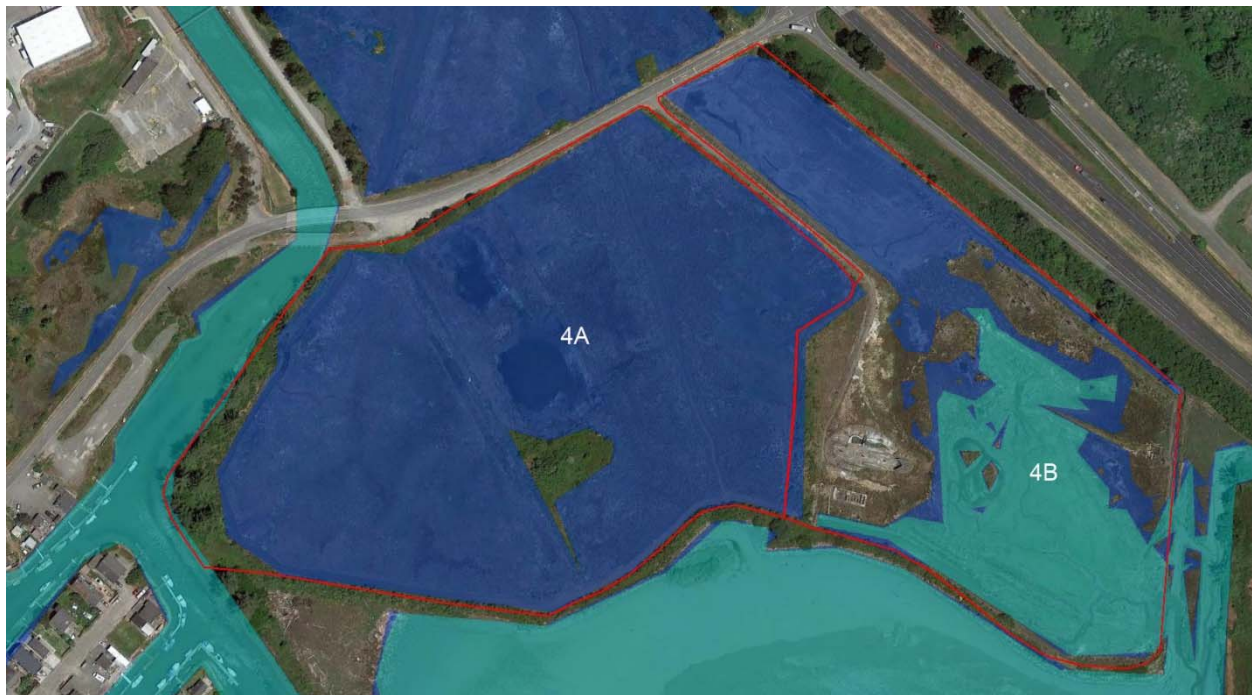


Figure 18. Tidal inundation of Area 4 during MHW (light blue) and MHHW (dark blue) tides. Area 4A and Area 4B are hydrologically separated.

Area 4A is a mix of public and private property. It is not possible to hydrologically isolate the private property from the public property, due to restrictions on placing fill in existing wetlands. Enhancement of tidal wetlands in Area 4A will require the cooperation of all property owners. If Area 4A were to be reconnected to King Salmon Canal and South Bay, it may be necessary to limit tidal inundation of Area 3 with the placement of tide gates on the 5 and 1 ft. diameter culverts under King Salmon Avenue to prevent backwater flooding of Area 3 and property east of Highway 101 during high tides. Area 4B is hydrologically isolated from Area 4A and is currently connected to South Bay (Figure 18).

8.5 Utilities

There are underground utilities in Area 4. HCSD has a sewer and possibly a water line parallel to King Salmon Avenue. Access to these underground utilities would not be impaired by re-connecting Area 4 to

King Salmon Canal and South Bay, as Area 4 is currently tidally inundated by a muted tide cycle.

8.6 Transportation Infrastructure

Tidal inundation of King Salmon Avenue and NCRA railroad base currently occurs in Area 4. If Area 4 is restored to full tidal influences, King Salmon Avenue road surface would not be tidally inundated by current MAMW tides.

8.7 Physical Constraints

The lack of a dike or upland topography separating the private property from publicly owned property in Area 4A is a constraint to increasing re-connectivity to King Salmon Canal and South Bay. The potential depth of tidal channels in Area 4 to create eelgrass habitat may be controlled by the depth of King Salmon Canal in Area 4A and the existing a South Bay channel adjacent to Area 4B.

8.8 Biological Constraints

Vegetation survey and mapping have not been prepared of Area 3 for this project but environmental assessments prepared for PG&E do cover most of Area 4A. Stillwater Sciences (2016) observed Seawatch in Area 4. Stillwater Sciences (2016) also noted that special-status northern red-legged frog (*Rana aurora*) amphibians have the potential to occur in Area 4.

USFWS and HSU collaborated on collecting water samples to run eDNA test to determine the presence of any protected aquatic species such as tidewater goby in Area 4; none were detected. Any filling of in-board ditches should occur during low tide when they are de-watered to avoid impacts to tidewater goby should they be present.

8.9 Cultural Resources

A cultural resource survey and investigation has not been performed in the course of this project of Area 4. A cultural resources survey would need to precede any proposed excavation in Area 4.

8.10 Exotic Invasive Species

Spartina presently exists in Area 4. Increasing Area 4's connectivity with Humboldt Bay will require *Spartina* eradication where it exists. *Spartina* control would be required to reduce seed dispersal to other areas on Buhne Slough and South Bay.

9 AREA 4 DESIGN ALTERNATIVES

The goal in Area 4 is to restore connectivity of tidal wetlands to Buhne Slough and South Bay, and enhance tidal wetlands and eelgrass habitats. As the goals for Area 3 and 4 are the same, these two areas could be combined into one Area 3, if all landowners were willing. Area 4 is predominately diked former tideland. Historically, Area 4 was hydrologically connected to Buhne Slough and South Bay. Five conceptual design options for Area 4 are summarized below (Figure 19).



Figure 19. Conceptual design alternatives for Area 4. Option 1, shown in red, replaces culvert under King Salmon Avenue on Buhne Slough, removes a tide gate and segment of an existing dike, indicated by a red X. Option 2 is shown in blue, and Option 3 is shown in green.

9.1 Option 1

This is the minimal of the four potential conceptual design options. Option 1 focuses on reconnecting Buhne Slough to King Salmon Canal by removing the tide gate and a length of dike sufficient to restore full tidal connectivity. An existing in-board ditch will be blocked off to focus the tidal prism in the main channel. This Option would require the participation of private property owners in Area 4A. Option 1 does not include Spartina control.

9.2 Option 2

In addition to the activities described for Option 1, Option 2 proposes to excavate another section of dike to accommodate a new channel entrance to South Bay and a network of tidal channels throughout Area 4A, connecting to two existing ponds, and expanding an existing tidal channel North to King Salmon Avenue. The culvert under King Salmon Avenue would be replaced to accommodate greater channel capacity. Option 2 would also require the participation of private property owners in Area 4A. Option 2 does not include Spartina control.

9.3 Option 3

Area 4B can be restored independent of Area 4A, as it has a single property owner who is willing to create eel grass habitat on their property. An existing roadway from King Salmon Avenue to the perimeter dike separates Area 4A from 4B from tidal inundation except during king tides. The asphalt on the road way could be removed and a dike constructed to keep the two areas hydrologically separated. Area 4B could be excavated to form a network of deep channels that connect to an existing channel draining to South Bay to provide eel grass habitat. The existing breaches in the perimeter dike could also be expanded to restore full tidal connectivity to South Bay.

9.4 Option 4

This is the most comprehensive of the conceptual design alternatives for Area 4, as it would implement Options 1 through Option 3.

9.5 Option 5

Option 5 includes mechanical and manual *Spartina* removal throughout Area 4.

9.6 Area 4 Preferred Design Alternative

Based on feedback received from stakeholders on conceptual design alternatives and existing constraints, the preferred design alternative for Area 4 includes all elements from Option 1 through Option 5. Buhne Slough will be reconnected to King Salmon Canal by expanding the culvert capacity under King Salmon Avenue and removing the tide gate and a length of dike sufficient to restore full tidal connectivity. An existing in-board ditch will be blocked off to focus the tidal prism in the main channel. A second segment of dike on South Bay would be removed to promote passive tidal channel development. However, this option would require the participation of private property owners in Area 4A.

10 CONCLUSIONS

As stated previously, there are two components to the City of Eureka's planning grant from the State Coastal Conservancy:

1. expand and enhance Elk River's estuary in Area 1 and Area 2, as well as the Humboldt Bay Trail/Rail corridor expansion; and
2. expand and enhance tidal wetlands and eelgrass habitat in Area 3 and Area 4.

The two components are hydrologically stratified. Area 1 and Area 2 are connected to Elk River Slough, and Area 3 and Area 4 are connected to Buhne Slough and South Bay. The City is the project proponent of the Elk River estuary component (Areas 1 and 2) of this planning grant, as most of this work would occur on City property in the City's jurisdiction. The City has applied for a grant to fund to complete engineering and permitting in Phase II of its Elk River Estuary Enhancement and Waterfront Trail Extension Project.

The tidal and eelgrass habitat enhancement component of this grant is in Area 3 and Area 4 on approximately 100 acres of public and private ownership. A project proponent(s) is/are needed to seek grants, develop engineering designs, secure regulatory authorization to implement a project or projects to expand and enhance tidal wetlands or eelgrass habitats in Area 3 or Area 4. Enhancement of Areas 3A and 3B would likely need to proceed together as they are hydrologically linked.

A significant constraint to enhancing connectivity with Buhne Slough (King Salmon Canal) and South Bay to restore a full tidal cycle is the potential to cause backwater flooding east of Highway 101 during

high tides and impairing access to high priority utility assets in Area 3.

In Area 4, enhancement of Area 4B is likely to proceed without Area 4A as the two areas are and can be kept hydrologically separated, except during king tides, and there is just one property owner in Area 4B who is interested in moving forward with creating eelgrass habitat. While Area 4A, a separate hydrologic area, it has a mix of public and private property owners who need to collectively support any enhancement of tidal wetlands or eelgrass habitat. A lack of permission to proceed with enhancement activities from the private property owners in Area 4A would be a substantial constraint that would prevent authorization of any enhancement activities.

10.1 Area 1 and 2 Constraints

The following is a list of the most significant constraints to restoring estuary habitat in Area 1 and Area 2:

1. acquisition of the 50 ft. wide private parcel or permission to construct will be necessary to proceed;
2. rehabilitation and enhancement of NCRA's seawall may be necessary to prevent storm surge and extreme tide over wash from eroding railroad ballast and filling proposed tidal wetlands;
3. a living shoreline is proposed, consisting of placing fill along the Caltrans road prism to form a salt marsh plain/riparian slope (6 to 10 ft. elevation NAVD 88) that will buffer the road prism from tidal inundation;
4. two existing Caltrans culverts will need to be installed with tide gates to prevent tidal inundation of adjacent properties and Highway 101;
5. preventing tidal flooding of private property to the South of Area 2 will need to be addressed and avoided by increasing the elevation of an existing topographic divide to 10+ ft. (NAVD 88);
6. eleven of PG&E's electrical distribution poles are in areas designated for placement of fill. PG&E will need to modify or replace these poles to accommodate increased surface elevation of the proposed living shoreline;
7. issues with the conversion of agricultural lands, Aleutian geese habitat and placement of fill to protect the shoreline and existing structures, including Highway 101, will need to be resolved with the Coastal Commission; and
8. Spartina control will be required to reduce seed dispersal to other areas on Elk River Slough and Humboldt Bay.

10.2 Areas 3 and 4 Constraints

The following is a list of the most significant potential constraints to enhancing tidal wetlands and eelgrass habitat in Areas 3 and Area 4:

1. permission/collaboration from/with PG&E and other private property owners (n=2) and easement holders (n=2) will be necessary in Area 3, and from one private property owner in Area 4A;
2. rehabilitation and enhancement of NCRA's seawall may be necessary to prevent storm surge and extreme tide over wash from eroding railroad ballast and filling proposed tidal wetlands;
3. encroachment permits from the NCRA, Caltrans, and County would be required for proposed modifications to their culverts;
4. underground utilities that cross Buhne Slough may prevent excavation of the channel to increase depth or width;
5. stormwater runoff may increase flooding during high tides of property north of King Salmon Avenue, and east of Highway 101 if Area 3 and 4A were to become fully tidal;

6. the HCSD would have concerns over access to its underground sewer line if all of Area 3 were to become tidally inundated;
7. Spartina control in Area 3 and Area 4A will be required to reduce seed dispersal to other areas on Elk River Slough and Humboldt Bay; and
8. potential depth of tidal channels in Area 3 and Area 4 to create eelgrass habitat will likely be controlled by the water control structures in Area 3 and the depth of King Salmon Canal in Area 4A and the existing a South Bay channel adjacent to Area 4B.

10.3 Preferred Design Alternatives

Across Areas 1-4, the preferred design alternative maximized ecological benefits within the limitations of existing constraints. The potential enhancement of the estuarine habitat uniquely available near the mouth of the Elk River is ecologically significant to the broader Elk River watershed and Humboldt Bay hydrologic unit. Expanding the tidal prism on Elk River may have an added benefit of helping to flush sediments delivered from the upper watershed from the main channel. Every possible opportunity must be taken to best realize this rare opportunity to enhance estuary and tidal marsh habitat for the benefit of numerous aquatic species and the restoration of natural tidal function in a significantly altered landscape.

These actions are taken in concert with participating landowners, who have generously donated their time to learn about the project's goal and conceptual design approach. The preferred design alternatives for each of the four areas were also developed considerate of comments received from public agencies, which generally expressed a preference toward pursuing restoration actions that would result in the most significant restoration gains.

11 REFERENCES

Stillwater Sciences. 2016. Biological Mitigation and Monitoring Plan for the Humboldt Bay Power Plant Final Site Restoration Project – Revised. Prepared by Stillwater Sciences, Arcata, California for Pacific Gas and Electric Company, Eureka, California.