7.0 RECOMMENDATIONS: THE SELECTED PLANS

Two plans, the NER and the LPP, have been selected as tentative plans for the Draft Feasibility Report. This chapter will fully describe the plans and what would be needed for implementation. After public review, one of the two plans will be selected for recommendation to the Headquarters office of the US Army Corps of Engineers; the final recommendation will be reflected in the final report.

7.1 Plan Description

Locally Preferred Plan

The LPP is the North, Central (Riparian), & South (No Seadrift) alternative plan. It includes the following restoration components: North Basin, Main Channel, Highway One Fills, Kent Island, Pine Gulch Creek Delta (Riparian), Bolinas Channel, South Lagoon Channel and Dipsea Road. A map of the LPP is shown in Figure 7.1. This plan would remove a total of 1,472,700 cy of material from the North, Central and South areas of Bolinas Lagoon. The footprint of this plan would cover a total of 429 acres out of 1,100 in the lagoon; about 39% of the total area would be affected. Of the sediment removed, 1,420,700 cy would go to SFDODS for disposal with 1900 barge loads, while 52,000 cy (plus trees and shrubs) would go to the Redwood Landfill with 4,750 truckloads.

NER Plan

The NER Plan is the North, Central (Estuarine), & South (No Seadrift) alternative plan. It includes the following restoration components: North Basin, Main Channel, Highway One Fills, Kent Island, Pine Gulch Creek Delta (Estuarine), Bolinas Channel, South Lagoon Channel and Dipsea Road. A map of the NER Plan is shown in Figure 7.2. This plan would remove a total of 1,504,800 cy of material from the North, Central and South areas of Bolinas Lagoon. The footprint of this plan would cover a total of 446 acres out of 1,100 in the lagoon; about 41% of the total area would be affected. Of the sediment removed, 1,427,500 cy would go to SFDODS for disposal with 1900 barge loads, while 77,300 cy (plus trees and shrubs) would go to the Redwood Landfill with 18,700 truckloads.

Full descriptions of both plans are presented in previous chapters of the Feasibility Report (Chapters 4, 5 and 6) and in the EIS/EIR. In addition, quantity estimates and detailed cost estimates are presented in the Cost Estimates Appendix, and design information is presented in the Engineering Appendix. There are no mitigation measures anticipated for either of the selected plans, with the exception of measures taken to minimize or avoid impact to sensitive habitat areas, including scheduling construction activities to avoid work during sensitive times (nesting and breeding periods, e.g.), using turbidity curtains around the dredge operations, and monitoring before, during and after construction. Many of these measures would be requirements imposed on the dredging contractor during construction.

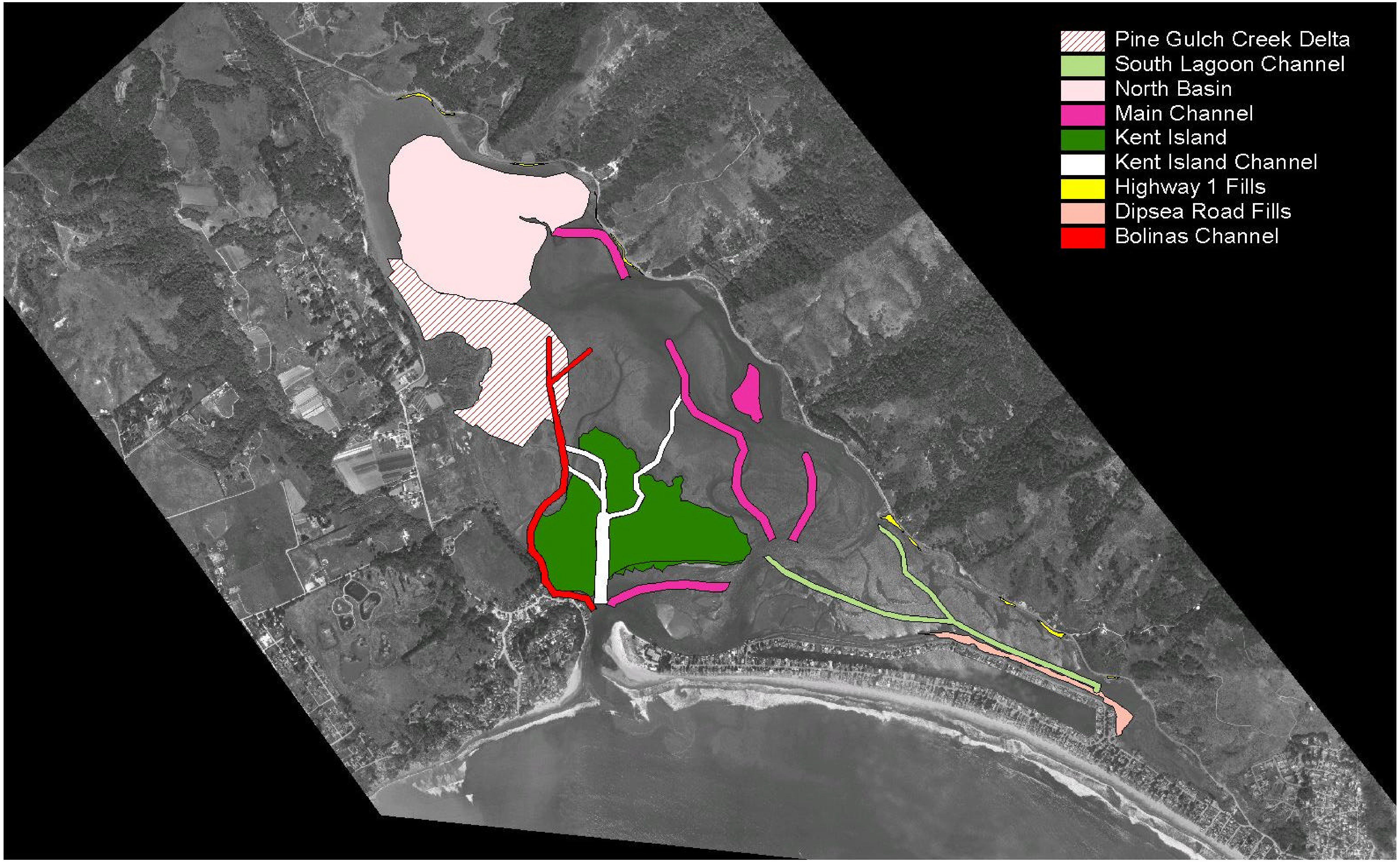

Figure 7.1 Layout of the Locally Preferred Plan

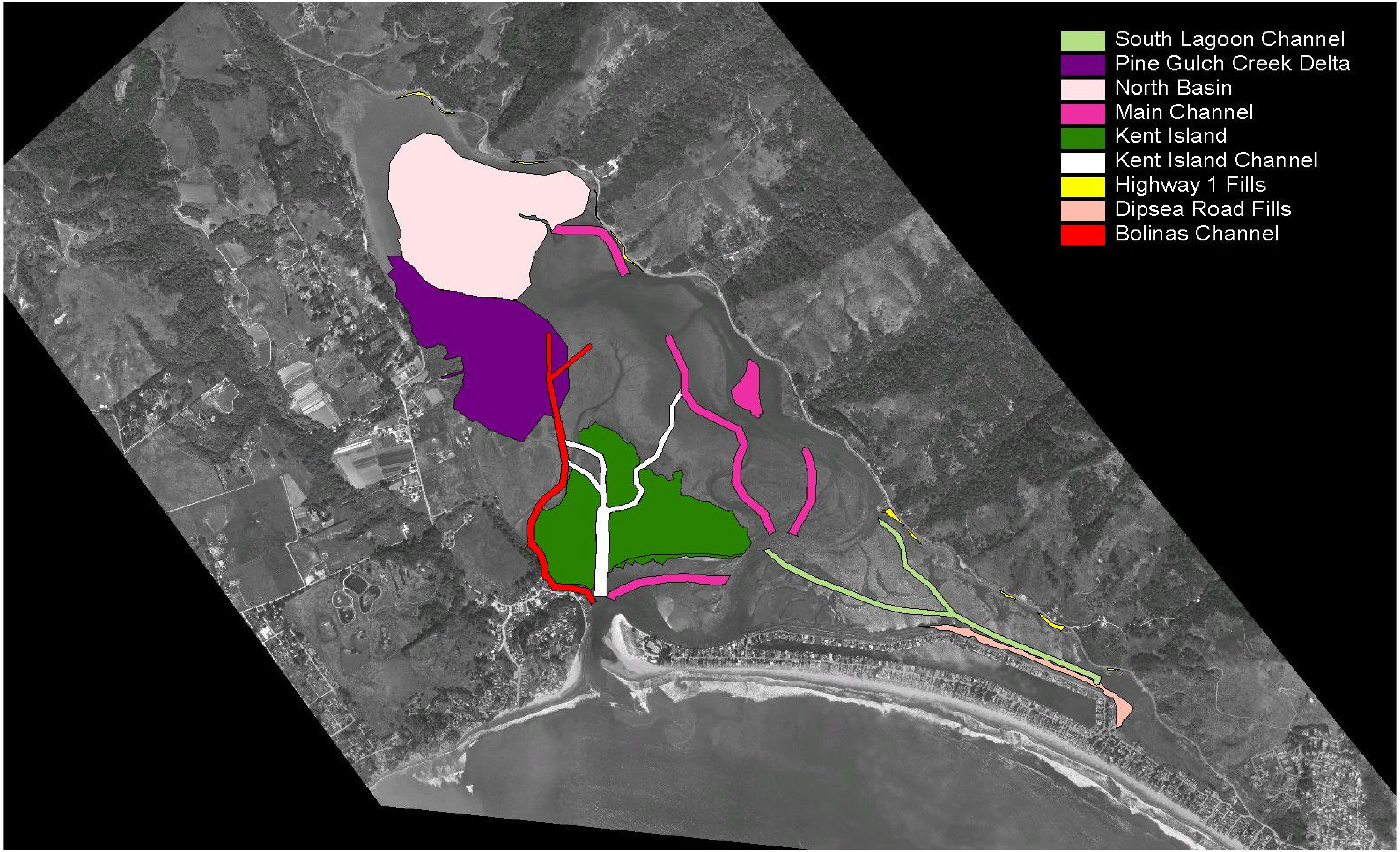

Figure 7.2 Layout of the National Ecosystem Restoration Plan

7.2 Construction Methods

7.2.1 Wet Sediment Excavation: Hydraulic Dredging

Wet sediment would be removed from the lagoon by a hydraulic cutterhead dredge (Figure 7.3), which would remove sediment in liquid slurry from the floor of the lagoon. For the purpose of this Feasibility Study, we have assumed that only one dredge would be used at a time in order to reduce short-term impacts, such as increased turbidity and noise levels, on sensitive habitats. The dredge itself floats, and can be moved by poling forward on walking spuds, by winching along anchor wires, or by using a propulsion system such as an outboard motor. It is a multi-functional unit that

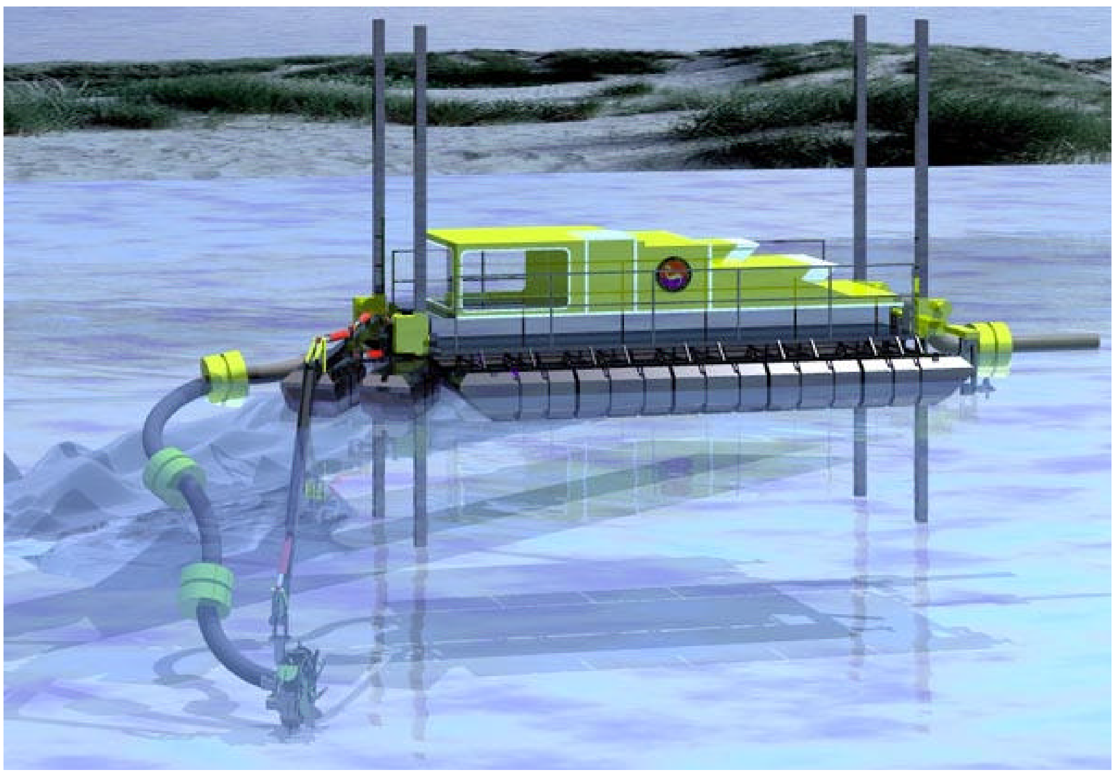

Figure 7.3 Hydraulic Cutterhead Dredge
(Illustration Courtesy of Keene Engineering)

can be transformed into an amphibious dredge, via the use of bolt-on tires. This amphibious conversion allows the dredge to traverse over land and shallow areas normally not accessible to conventional dredges (Figure 7.4). The dredge head is on an articulated pipe extending from the front of the dredge, and can be manipulated with some dexterity by the dredge operator. This articulated head gives the dredge a considerable range, and prevents the need to relocate the dredge frequently. A disposal pipeline will extend from the rear of the dredge, traverse the lagoon, and be inserted into the barge anchored in Bolinas Bay.

Figure 7.4 Amphibious Hydraulic Cutterhead Dredge (Illustration Courtesy of Keene Engineering)

The dredge head is circular, with sharp teeth designed to chew through packed sand and clay (Figure 7.5). In addition, this particular dredge has optional work implements whereby vegetation "harvesting," raking and solid material grappling is possible, when required. The "underwater trimmer," for example, can be used to cut through existing vegetation, as needed (Figure 7.6). As the dredge head spins, the dredge pump sucks the dislodged sediment in through the dredge head along with a large amount of water to form a slurry. Because the slurry would be pumped some distance prior to disposal, the sediment would be mixed with sufficient water with a ratio of 25 percent solids to 75 percent water. A suction dredge would pull disturbed water and soil into the pipe, so no noticeable long term water quality impacts should result from the dredging activities.

Figure 7.5 Dredge Head on a Hydraulic Cutterhead Dredge (Illustration Courtesy of Keene Engineering)

The slurry would be pumped from the dredge through a flexible pipeline over the end of Stinson Beach sand spit to one of two transport barges, or scows, anchored in Bolinas Bay (Figure 7.7). The scow would be anchored far enough out in the bay to be past the surf zone, and the anchor would be a buoy left in place during the entire project period. The pipe would be up to 16,300 feet long, made of steel or polyvinyl chloride (PVC), and would be kept afloat by buoys while in Bolinas Lagoon. The pipeline would be 10 or 12 inches in diameter, and would be protected from human disturbance by fences and flags. A walkway would be built to enable passersby to cross the pipeline, either by running the pipe underground at that point or by building a bridge over it. For most of the upland crossing, the pipeline would rest on top of the beach sands, but may be covered by blowing sand as the season progresses. From the beach to the disposal scow, the pipeline would run along the bottom of the bay in order to avoid the force of the surf crashing on the shore. The pipeline would be designed to keep up with the capacity of the dredge as it excavates, so there would be no backlog of dredged material waiting to be pumped out to the scow. The pipeline is designed for removal after the end of each dredging season, and re-installation the following summer.

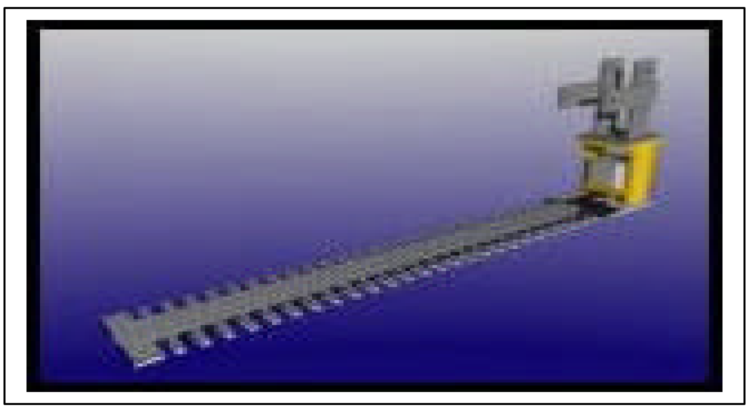

Figure 7.6 "Underwater Trimmer" Attachment to Hydraulic Cutterhead Dredge (Illustration Courtesy of Keene Engineering)

The barge, or scow, anchored in Bolinas Bay would be attached to a semi-permanent platform. As the slurry is pumped into the scow, water would drain over the sides or into internal weirs and back into Bolinas Bay. In order to reduce turbidity in Bolinas Bay, there would be a siltation curtain installed inside the scow to filter the overflow water. Details regarding overflow water quality impacts management would be determined in consultation with the Regional Water Quality Control Board prior to issuance of a Water Quality Certificate. The slurry would not drain completely; therefore it is estimated that the ratio of sediment to water would measure approximately 25% higher than that for the sediment removal. The disposal scows are presumed to operate 24 hours per day, seven days per week. Once filled with slurry, each scow would be towed by a tugboat to the aquatic disposal site. The scows are assumed to have a capacity of 3,000 cy, and would be towed at seven knots to the disposal site; the return trip with an unloaded scow would be at a velocity of roughly eight knots.

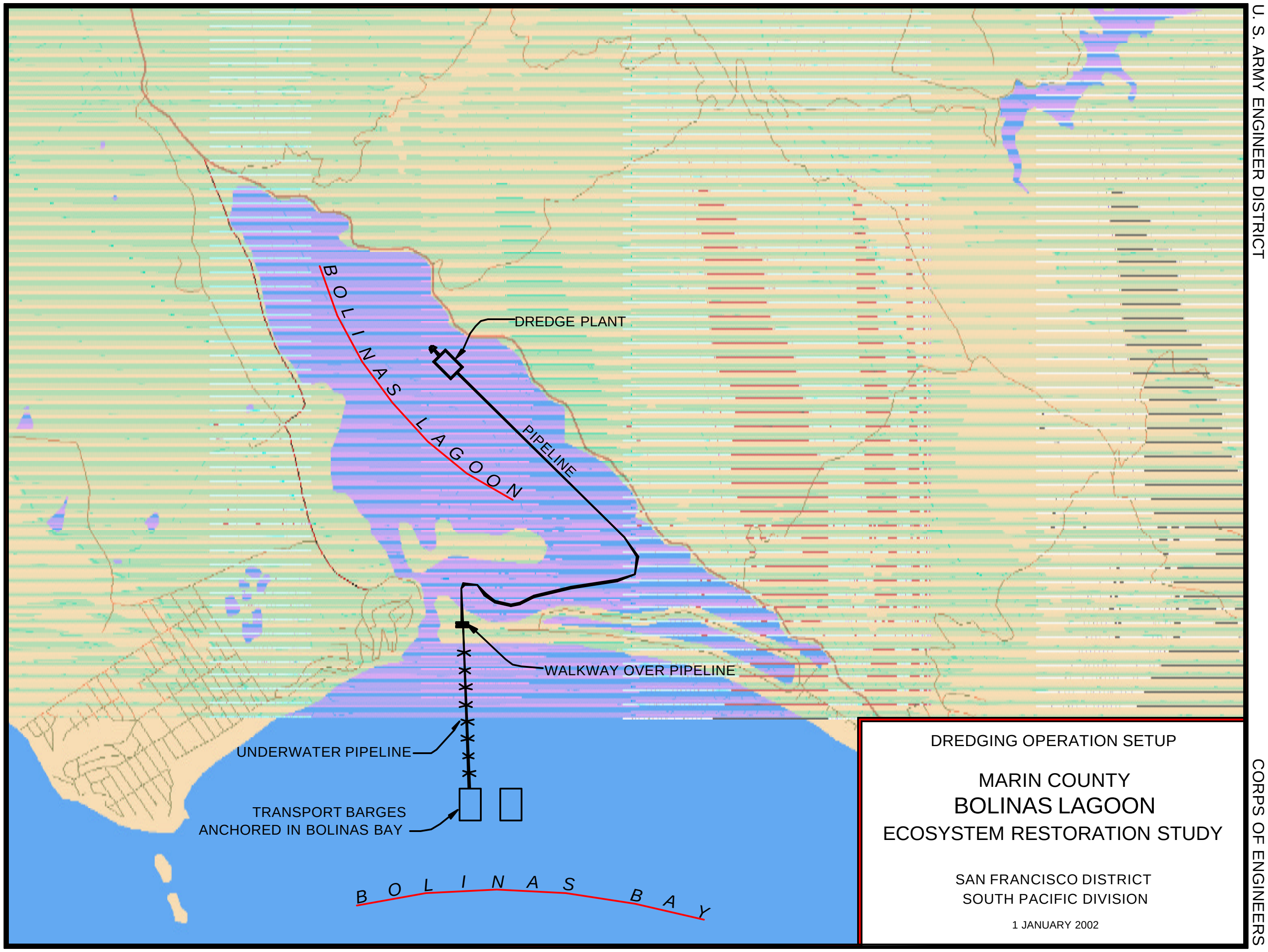

Figure 7.7 Dredging Operations Set-up for the Bolinas Lagoon Ecosystem Restoration Project

7.2.2 Land-Based Excavation

Some of the restoration components remove soil from upland sites adjacent to and within the lagoon. Land-based excavators, such as bulldozers, loaders and cranes would remove upland soils, and vegetation would be mulched, chipped or burned on site. This material would be dry, and therefore would be transported by dump trucks, rather than by barge. Each truck is assumed to have a capacity of 12 cy. Dry material would be trucked to the upland disposal site. Detailed information on hydraulic dredging, sediment excavation and disposal of the material is presented in the EIS/EIR.

7.3 Disposal of Dredged Material

During the PED phase of the project, sediment sampling will be undertaken in the lagoon to confirm that the sites listed below will be appropriate for the disposal of material removed from Bolinas Lagoon. SFDODS requires dredged material to be tested for metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and other contaminants before disposal is approved. Other tests would include sediment characteristics analyses (grain size, salinity, etc.) in case disposal at a restoration/beneficial reuse site was approved in the future. Because the surrounding watershed is relatively undeveloped, and agriculture is limited, it is assumed that the characteristics of the lagoon sediment would fit well within the parameters of the disposal sites identified in this study. Figure 7.8 shows the location of all disposal sites considered.

7.3.1 Disposal Sites Considered for the Project

7.3.1.1 Beach Nourishment at Ocean Beach

Ocean Beach is located in San Francisco, California, on the western side of the peninsula, facing the Pacific Ocean. Ocean Beach was considered as a potential reuse site, with the material removed from Bolinas Lagoon to be used for beach nourishment. On further analysis, however, it was determined that the grain size was too small and the color was inappropriate for beach use.

7.3.1.2 Beach Nourishment at Stinson Beach

Stinson Beach is located south of Bolinas Lagoon, along the Stinson Beach sand spit near Seadrift Lagoon. Disposal of dredged material from Bolinas Lagoon at this site would be a low-cost beneficial reuse alternative that could potentially reduce the overall cost of the project. Several concerns associated with this disposal option center on Sanctuary guidelines currently in place restricting sediment disposal inside the GFNMS boundaries, and sediment movement in Bolinas Bay, which could potentially redistribute the material back inside Bolinas Lagoon. Although the larger California currents move north to south, in Bolinas Bay currents move in a counter-clockwise direction. It is this movement of water and sand that originally created the Stinson Beach sand spit. Further discussion with the GFNMS would determine whether or not this disposal option would

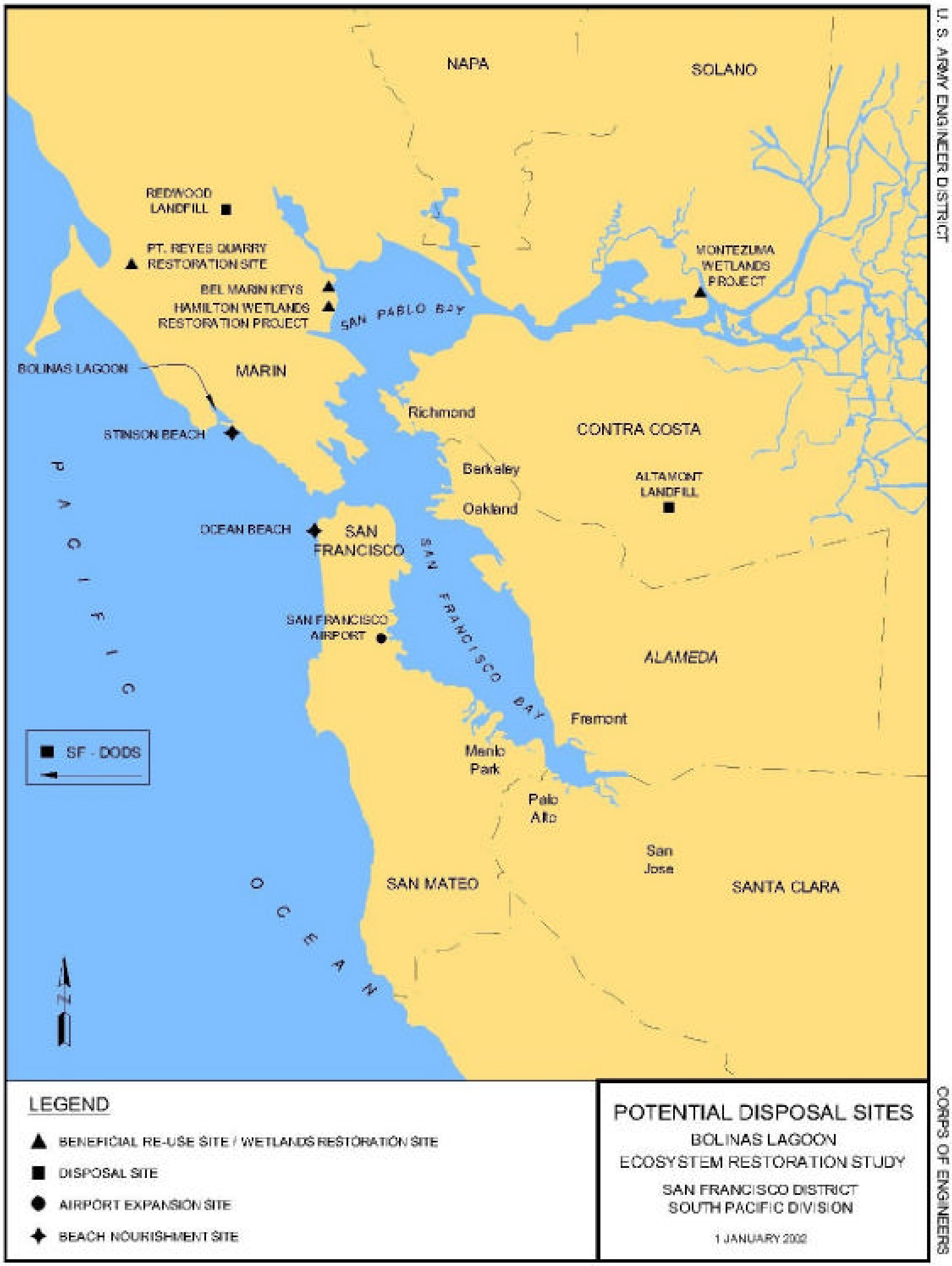

Figure 7.8 All Potential Disposal Sites for the Bolinas Lagoon Ecosystem Restoration Project

be viable. In addition, sediment movement modeling including Bolinas Lagoon and Bolinas Bay would be necessary to determine whether this option was engineeringly feasible.

7.3.1.3 Restoration of Old Mining Quarries (Pt. Reyes National Seashore)

One possibility for local upland disposal was the use of five abandoned quarries within Point Reyes National Seashore (PRNS). These quarries would provide only 50,000 cy to 75,000 cy of disposal volume, however, for dry (upland) materials. Because of concerns regarding seed dispersal from invasive exotic plants, soil erosion, and water quality issues in the PRNS, any materials deposited there would have to be carefully screened before disposal. Additionally, the Corps and Marin County would be required to pay for designing, constructing, maintaining, restoring and revegetating the quarries. While design and construction costs would be cost shared, Operations and Maintenance responsibilities would fall on the local sponsor. These requirements are significant, especially over the long term, and make the quarries less desirable as disposal sites.

7.3.1.4 San Francisco International Airport

The San Francisco International Airport is located in San Francisco, California, on the eastern side of the peninsula, facing the San Francisco Bay. The airport is currently in the planning stages of increasing the number of runways at the airport to reduce flight delays. However, a number of the alternatives have ignited public controversy due to the possibility of placing fill material in the bay, and the planning process has been delayed on several occasions because of input received from interested residents, environmental groups and other entities concerned about the long term impacts of the expansion alternatives. Because of the uncertainties in site capacity, timing of construction and approval of the project, the San Francisco International Airport cannot be identified as a potential disposal site for the Bolinas Lagoon project at this time.

7.3.1.5 Altamont Landfill

The Altamont Landfill and Resource Recovery Facility is a privately held Class II and Class III facility in Alameda County, northeast of Livermore on Altamont Pass Road. The material to be transported to Altamont Landfill would be dry soil removed by land-based excavation equipment from the upland areas adjacent to the lagoon. Dry upland soils would be loaded onto 12 cy dump trucks for transport to Altamont Landfill. The exact route is yet to be determined, but it could include traveling south on Highway 1, north on US 101, or north on Highway 1 and west on Sir Francis Drake, across the Richmond/San Rafael Bridge, and south on Interstates 880 and 580 to eastern Alameda County. Disposal at Altamont Landfill was found to be cost prohibitive and therefore not implementable as a disposal site.

7.3.1.6 Montezuma Wetlands Restoration Site

The Montezuma Wetlands site is near Collinsville in the Suisun Marsh, in Solano County. The Montezuma Wetlands are being restored to tidal wetlands with approximately 20 million cy of dredged material spread over 1,822 acres of historic tidal wetlands. The material to be transported to Montezuma Wetlands would be wet sediment removed by hydraulic dredge from Bolinas Lagoon. The barge would be towed through the Golden Gate and then north and east through San Pablo Bay to the Montezuma Wetlands. Because of the distance of this restoration site from Bolinas Lagoon, however, it was cost prohibitive and therefore not implementable as a disposal site.

7.3.1.7 Hamilton Army Airfield Wetlands Restoration Site (HAAF)

Hamilton Airfield is located in Novato, California. The Hamilton Wetlands Restoration project is currently in the design phase to become an "acceptor" site for dredged material to be reused for restoring wetlands habitat. Currently, Hamilton can accept 10 million cubic yards of dredged material, some of which will most likely be received from the Oakland Harbor deepening project. A component that might be added to the Hamilton restoration complex in the future, which has yet to be authorized by Congress, is the Bel Marin Keys complex. Bel Marin Keys would increase the capacity of the Hamilton site by 15 million cubic yards. (For more information on this site, please refer to the *Hamilton Army Airfield Wetlands Restoration Project Feasibility Report and EIS/EIR*).

Because of the habitat restoration benefits that would be generated by disposing at Hamilton, the Bolinas Lagoon project would prefer to designate Hamilton as the disposal/beneficial reuse site for material taken out of Bolinas Lagoon. Due to some significant uncertainties about Hamilton, however, the Bolinas Lagoon project cannot, with certainty, designate Hamilton as its preferred site for disposal during this Feasibility phase. Hamilton may, however, be selected as the disposal site for the Bolinas Lagoon project in the future if such uncertainties are resolved before the construction phase for Bolinas Lagoon begins.

One uncertainty surrounding the Hamilton restoration/dredged material disposal site is capacity. As mentioned before, a significant portion of Hamilton's capacity is scheduled to be taken up by the Oakland Harbor deepening project. It is uncertain whether Hamilton would have sufficient capacity to accept all of the material from Bolinas Lagoon, or whether the timing of the two projects would be congruent. Bel Marin Keys would add substantially to the capacity at Hamilton, and would allow for disposal further out in the future, but because that project has not yet been authorized, it is unknown whether Hamilton or Bel Marin Keys would be available to receive material from Bolinas Lagoon.

Another factor yet to be resolved is the concern of the Hamilton project that species not found in the Hamilton project area would be inadvertently transplanted via dredge spoils. The Hamilton project seeks to prevent any invasive species or species of concern from unnecessarily "contaminating" the Hamilton restoration site. It is currently unknown whether the material excavated from Bolinas Lagoon would possess species not found at Hamilton, nor, if foreign species were found in the sediment, what effect they would have on the Hamilton restoration site if the sediment they were found in was capped by "clean" cover material. This issue remains unresolved.

Due to the above uncertainties involving Hamilton, SFDODS has been designated as the disposal site for feasibility evaluations of the Bolinas Lagoon project. As Hamilton becomes more defined, and the uncertainties of using the site diminish, future ecosystem restoration opportunities might be presented to allow material from the Bolinas Lagoon project to be disposed of at Hamilton. In that case, all of the Bolinas Lagoon material that would be suitable for reuse at Hamilton would be taken to Hamilton; the remainder would be disposed of at SFDODS or at the Redwood Landfill, as necessary. As it currently stands, however, this report assumes that all wet material (dredged) would be taken to SFDODS and all dry material (excavated) would be taken to the Redwood Landfill.

7.3.2 Disposal Sites Selected for the Project

7.3.2.1 San Francisco Deep Ocean Disposal Site (SFDODS)

SFDODS is located 55 nautical miles (100 kilometers) offshore of San Francisco, and was designated in 1994 by the Environmental Protection Agency as an approved location for "disposal of suitable dredged material removed from the San Francisco Bay region and other nearby harbors or dredging sites" (USEPA 1994). The disposal site has an area of approximately 6.5 square nautical miles (nmi), and is located 49 miles west of the Golden Gate and six nautical miles west of the boundary of the Gulf of the Farallones National Marine Sanctuary. It sits in waters ranging from 8,200 to 9,800 feet deep (USEPA 1998). Any material that would be disposed of at the SFDODS would have to be within the parameters set by the EPA for that site.

In order for a dredging project to be authorized to dispose of dredged material at the SFDODS, sediment evaluations, including appropriate physical, chemical, and biological testing as described in the national sediment testing manual popularly referred to as the Green Book, must first be conducted. Under these guidelines, EPA and the Corps determine suitability of dredged material for ocean disposal, in large part, by comparing the results of tests conducted on the material to be dredged against the results of the same tests conducted on designated reference sediment. Reference sediments are identified by EPA to be substantially free of contaminants, and to be as representative as possible of conditions at the disposal site had no dredged material ever been disposed there.

Only wet material removed by hydraulic cutterhead dredge would be disposed of at SFDODS. Wetting dry material for the purpose of aquatic disposal would be considered "double handling" and would be economically infeasible. All wet material will be taken to SFDODS by barge.

7.3.2.2 Redwood Landfill

Redwood Landfill is a Class III facility in northeastern Marin County, northwest of Novato. It is on the Redwood Highway on the east side of US Highway 101. The material to be transported to Redwood Landfill would be dry soil removed by land-based excavation equipment from the upland areas adjacent to the lagoon. Any plant material that could not be mulched, chipped or burned on-site would also be disposed of at

Redwood Landfill. All of the dry material taken to Redwood would be loaded onto 12 cy dump trucks and transported via surface roads. Table 7.1 illustrates the disposal and transportation method for each restoration component, while Table 7.2 outlines the dredging quantities of each.

Table 7.1 Dredged Material Disposal Sites and Transportation Methods

Excavation Site	Type of Material	Disposal Location	Transportation Method
PGC Delta	Dry soil	Redwood	Truck
	Wet sediment	SFDODS	Barge
	Trees/Vegetation	Redwood	Truck
Bolinas Channel	Wet sediment	SFDODS	Barge
Kent Island	Wet sediment	SFDODS	Barge
	Trees/Vegetation	Redwood	Truck
Main Channel	Wet sediment	SFDODS	Barge
North Basin	Wet sediment	SFDODS	Barge
South Lagoon Channel	Wet sediment	SFDODS	Barge
Highway 1 Fills	Dry soil	Redwood	Truck
Dipsea Road Fills	Dry soil	Redwood	Truck
	Trees/Vegetation	Redwood	Truck
Seadrift Lagoon	Dry soil	Redwood	Truck
	Wet sediment	SFDODS	Barge

Table 7.2 Alternative Dredge Disposal Plan

	Dredge Volume and Location	
	Redwood	**SFDODS**
Alternative	truck (cy)	barge (cy)
North		
North	0	458,537
Main Channel	0	216,241
Central (Estuarine)		
Bolinas Channel	0	130,799
Pine Gulch Creek Delta (Estuarine)	34,753	155,953
Kent Island	0	376,749
Highway One Fills	4,828	0
Central (Riparian)		
Bolinas Channel	0	130,799
Pine Gulch Creek Delta (Riparian)	9,533	149,084
Kent Island	0	376,749
Highway One Fills	4,828	0
South (Seadrift)		
South Lagoon Channel	0	89,246
Dipsea Road	37,692	0
Seadrift Lagoon	3,555	41,403
South (No Seadrift)		
South Lagoon Channel	0	89,246
Dipsea Road	37,692	0
Seadrift Lagoon	0	0
North and Central (Estuarine)	39,581	1,338,273
North and Central (Riparian)	14,381	1,331,410
North and South (Seadrift)	41,722	805,427
North and South (No Seadrift)	37,692	764,024
Central (Estuarine) and South (Seadrift)	80,828	794,150
Central (Estuarine) and South (No Seadrift)	77,273	752,747
Central (Riparian) and South (Seadrift)	55,628	787,281
Central (Riparian) and South (No Seadrift)	52,073	745,878
North, Central (Estuarine), and South (Seadrift)	80,828	1,468,928
North, Central (Estuarine), and South (No Seadrift)	77,273	1,427,525
North, Central (Riparian), and South (Seadrift)	55,628	1,462,059
North, Central (Riparian), and South (No Seadrift)	52,073	1,420,656

7.4 Dredging Schedule

The construction plan and implementation schedule will be developed during the Pre-construction, Engineering and Design phase, which is scheduled to last one t two years. The Construction phase could begin as early as 2004. Once dredging activities begin, it is assumed that dredging would take place three months out of every year. Because Bolinas Lagoon serves as important habitat to many species, including migratory waterfowl, fish, harbor seals and species listed as Threatened and Endangered, dredging must be limited to the times when species activity is lowest in the lagoon. Species activity in Bolinas Lagoon is illustrated in Table 7.3.

Table 7.3 Species Activity in Bolinas Lagoon

Alternative	Species Activity	Months (JAN–DEC)
North Lagoon		
North Basin	Wintering Shorebirds (foraging)	JAN–MAY
	Wintering Shorebirds (foraging)	JUL–DEC
	American Avocets	JAN–APR
	American Avocets	AUG–DEC
	Egrets & Herons (staging) (egg formation) (feeding nestlings) (juvenile foraging)	JAN–OCT
	Leopard Sharks (breeding)	JUN–AUG
	Steelhead (juveniles)	JAN–JUN
	Steelhead (adults)	NOV–DEC
Main Channel	Pelicans, Heermann's Gulls & Terns (& their prey)	JUL–OCT
	Harbor Seals (pupping)	MAR–JUL
	Diving Birds	JAN–MAY
	Diving Birds	OCT–DEC
	Steelhead (juveniles)	JAN–JUN
	Steelhead (adults)	NOV–DEC
Central Lagoon		
Highway 1 Fills	Harbor Seals (pupping)	MAR–JUL
Kent Island	Harbor Seals (pupping)	MAR–JUL
	Steelhead (juveniles)	JAN–JUN
	Steelhead (adults)	NOV–DEC
Bolinas Channel	Diving Birds	JAN–MAY
	Diving Birds	OCT–DEC
	Steelhead (juveniles)	JAN–JUN
	Steelhead (adults)	NOV–DEC
	Pelicans, Heermann's Gulls & Terns (& their prey)	JUL–OCT
PGC Delta	Steelhead (juveniles)	JAN–JUN
	Steelhead (adults)	NOV–DEC
South Lagoon		
Seadrift Lagoon	Diving Birds	JAN–MAY
	Diving Birds	OCT–DEC
S. Lagoon Channel	Pelicans, Heermann's Gulls & Terns (& their prey)	JUL–OCT
	Harbor Seals (pupping)	MAR–JUL
Dipsea Road	-none-	

7.5 Design and Construction Considerations

Following report approval, the Pre-construction, Engineering and Design phase, which includes preparation of plans and specifications, could be accomplished within two years (from 2002 to 2004). Afterwards, the construction phase would commence with real estate activities, including mapping, legal descriptions, appraisals, obtaining possession of the land, and certification of all necessary LERRD (this process is described in more detail in the Real Estate Appendix). Real estate activities would last about two years, or until the spring of 2006. Construction of the recommended plan would then commence in the summer of 2006, and would continue for nine dredging seasons, ending in the year 2014. Post-implementation monitoring and adaptive management would continue for five years thereafter, concluding in 2019. At that point, the Operations and Maintenance (O&M) plan would be implemented (The O&M plan is discussed in more detail in Section 7.12).

During the construction period, measures cited in Engineering Pamphlet 1165-2-501, *Environmental Policies, Objectives, and Guidelines for the Civil Works Program of the Corps of Engineers*, would be followed to maintain public dialogue, minimize disturbance to environmental and cultural resources, and ensure proper disposal methods. Safety measures would be taken to protect individuals present at the site or living near the construction area.

7.6 Construction Scheduling and Implementation

The construction phase of the project could begin as early as the summer of 2004 (after completion of the PED phase). All construction activities are scheduled to avoid impacts to sensitive species during important life cycle stages, such as migration, breeding, nesting, pupping, etc. The primary species of concern are the steelhead and Coho salmon (migration season), harbor seals (pupping season), and migratory waterfowl (nesting and foraging seasons). The major life cycle events of these species start in the beginning of October (with salmon migration) and continue to the end of July (the end of the harbor seal pupping season) every year. Monitoring will take place before, during and after construction to measure the effects of construction on the habitats in Bolinas Lagoon. During construction, monitoring will be especially important in preventing unforeseen adverse impacts to sensitive habitats or species and developed lands adjoining the lagoon.

Priority will be given to the completion of work within sensitive habitat areas during less sensitive seasons. These activities would include dredging in the North Basin and at Kent Island, dredging in the Main Channel, South Lagoon Channel and Bolinas Channel, and excavation work at Pine Gulch Creek Delta. The channel areas and Kent Island should not be dredged during the harbor seal pupping season or during the anadramous fish migration season. Activities in the North Basin and at Pine Gulch Creek Delta should not take place during important migratory waterfowl activities, such as the breeding, nesting and foraging seasons. It is possible that land excavation in other areas, such as at the Highway One Fills, Pine Gulch Creek Delta and Dipsea Road could take place outside of these windows. A detailed construction and implementation plan will be developed for the recommended plan during the PED phase.

A significant advantage of both the LPP and NER Plan is that they have numerous components addressing a variety of problem areas in the lagoon and encompassing the widest range of possible actions to address the lagoon's sedimentation problem. With a recommended plan this comprehensive, a long construction window should not be a problem because as each element is implemented, benefits will begin to accrue immediately. Future inlet closure will be warded off increasingly with each sequential component.

7.7 Summary of Benefits

A summary of project benefits for the NER Plan and the LPP are presented in Chapters 5 and 6 of the Feasibility Report, including the Incremental Cost Analysis (ICA) and the NER account. For those analyses, the benefits are expressed as cubic yards of intertidal volume, calculated as an annualized average. Other project benefits that are not quantified in the ICA include improvement in tidal circulation throughout the lagoon, increased quantity and quality of subtidal and intertidal habitats, restoration of historic ecological benefits, preservation of existing ecological benefits, and an overall improvement to the Bolinas Lagoon ecosystem.

7.8 Summary of Costs

Project costs are presented in Chapters 5 and 6, and a more detailed list of project costs, using the Corps of Engineers Micro-Computer Aided Cost Estimating System (MCACES), is illustrated in the Cost Estimates Appendix. Real Estate costs were based on an appraisal of the current cost of acquisition. Details of the real estate cost estimate are included in the Real Estate Appendix. The MCACES cost estimate was developed using 2001-year price levels.

A Fully Funded Estimate was developed based on the construction costs. The Fully Funded Estimate adjusts the construction costs for budget purposes to better anticipate the actual future costs recognizing the impact of future price levels. The Fully Funded Estimate is escalated to the mid-point of construction using Office of Management and Budget designated inflation rates, which posts an escalation factor of 12%.

Interest During Construction (IDC) is calculated using a 6.125% discount rate over an estimated construction period of nine years. Costs used for calculating IDC include construction costs, the development of plans and specifications, engineering during construction, supervision and administration of construction, and economic real estate costs. The total IDC for the LPP is $32,446,323 and $32,716,077 for the NER Plan. These figures assume 9 years for construction at Fiscal Year 2002 price levels, a Federal Discount Rate of 6.125% (required for all Federal water resource projects), and a 50-year period of economic evaluation. The project's financial costs (project first costs) and investment costs (IDC) are added together, then averaged out over 50 years, and the result is equal to the average annual cost of the project. The average annual cost of the LPP would be $8,156,165, and for the NER Plan, $8,223,975.

7.9 Real Estate Requirements

The real estate requirements consist of a permanent easement for 275.94 acres, permanent channel improvement easement for 8.58 acres, temporary pipeline easement for 0.52 acres, temporary road easement for 0.12 acres, and temporary work area easements for 1.28 acres. The required standard estates for this project include fee, permanent channel improvement easements, temporary pipeline easement, temporary road easement, and temporary work area easements.

The non-standard estate of permanent channel improvement easement is requested, however, in lieu of fee for the lands within the Bolinas Lagoon that are to be acquired from private property owners and some of the Government and local agencies. Because the lagoon is governed by the GFNMS, the lands cannot be acquired for fee. Further, fee acquisition would not be feasible due to complications and costs that would arise from acquiring fee title from such government agencies that cannot transfer title and private owners where such acquisitions would involve severing their parcels. Existing strict permitting requirements and regulations affecting private and public lands in and around the lagoon provide sufficient protection to maintain project integrity for as long as the project is authorized.

Other considerations include: 1) an area in Bolinas Lagoon waters owned by Golden Gate National Recreation Area (GGNRA), a Federal agency, which is a temporary construction area that requires fee; 2) the area along Highway One owned by the California Department of Transportation (CalTrans) that requires a temporary work area easement; 3) and a small area in Bolinas lagoon waters owned by the State of California that requires fee. Permits or licenses will be requested in lieu of the standard estates for these particular areas because they are actually located in the lagoon waters, are required for one-time dredging only, and are protected by the governing laws of the Marine Sanctuary (as stated above).

Marin County owns 216.37 acres of Bolinas Lagoon that are required for this project. They were granted these lands through legislation in 1969, from the State Lands Commission (SLC). This grant provided them with sufficient rights to provide these lands for the purposes of this project, in which the SLC concurs. Marin County, however, is not the local sponsor but is part of same political body as MCOSD, the proposed local sponsor. An MOU, as discussed at the AFB held on December 13, 2001, will be executed between Marin County and MCOSD. The MOU would allow MCOSD to use County lands in perpetuity for the project. Because the local sponsor is providing the lands in the Bolinas Lagoon via an MOU with Marin County, with Marin County retaining the "ownership" granted to them by the State Lands Commission, and because Marin County will not, in fact, have to purchase/acquire these lands, LERR credit for such submerged lands will not be given to the sponsor.

The Real Estate Plan, which is detailed in the Real Estate Appendix, contains details of the real estate requirements and costs for the LPP and the NER Plan, including a delineation of all properties required to implement the project features.

7.10 Monitoring and Adaptive Management Requirements

The monitoring and adaptive management requirements for the LPP or NER Plan are outlined in the Draft Conceptual Monitoring and Adaptive Management Plan below. As stated in this plan, monitoring would be conducted before implementation of the project (during the PED phase), during construction, and for five years after completion of construction. Monitoring is assumed to be 1% of the project first costs, and adaptive management is assumed to be 3% of the project first costs. The Corps and the local sponsor would share all of these costs.

7.11 Draft Conceptual Monitoring and Adaptive Management Plan

This plan provides a general framework for monitoring the success of the Bolinas Lagoon Ecosystem Restoration Project. Included is guidance for monitoring the performance of the constructed project, including lagoon hydraulics and biological success. This conceptual plan will be greatly expanded and quantified in the detailed design phase of the study.

This plan covers the pre-construction baseline measurement period as well as the during-construction and post-construction monitoring periods. This "post-construction monitoring and adaptive management period" will extend for 5 years after completion of project construction, or after completion of a functional portion thereof. All monitoring and adaptive management activities will be cost-shared by the Corps and the local sponsor (65% Federal and 35% Non-Federal). All monitoring phases will be fully described in the plans and specifications for construction.

Should it become apparent after completion of the designated monitoring and adaptive management period that the design or construction processes have caused a significant departure from the project's authorized purposes, full project usefulness, or project function as originally intended by Congress at the time of original project development, appropriate steps to modify the completed project will be taken under USACE Engineering Regulation 1165-2-119. In general, if the standards of application of this modification process are met, corrective action will be taken by re-opening the project under its original legislative authorization. Any such corrective activities would be cost-shared between the Government and the Sponsor under the original 65% federal and 35% local proportions.

Monitoring of biological, ecological and hydraulic conditions will track the evolution of the lagoon before, during, and after sediment removal. Periodic comparisons of measured conditions with expected conditions will determine whether the lagoon is functioning as desired. A monitoring and adaptive management advisory panel will be established to participate in the development of the program and make recommendations to the Corps and local sponsor regarding the program. Annual reporting from this panel will provide decision-makers with invaluable information on the success of the project as it progresses, and for five years after it is in place.

Restoration goals and objectives for the project are qualitative statements in the Feasibility Report and Environmental Impact Report/Environmental Impact Statement (EIR/EIS) regarding expected future conditions, such as increasing intertidal and subtidal habitat, and the expected ecological changes that will coincide with an increase in these habitats. Quantitative standards intended to measure progress towards these goals and objectives will be developed later for the detailed monitoring and adaptive management plan.

7.11.1 Measurements and Data Gathering

Measurements and data gathering for the project fall under three categories: 1) pre-construction baseline measurements; 2) during-construction monitoring; and 3) post-construction monitoring, with different purposes for each. Many hydraulic measurements were taken as part of the Feasibility Phase to determine baseline conditions of the hydraulics. Before construction, a variety of measurements will be taken to better determine baseline conditions, focusing primarily on the ecology of the lagoon. Such measurements would include surveys of benthos, birds, fish, rare, threatened, endangered and protected species, eelgrass habitat, turbidity, and salinity, as well as hydraulic measurements of flow, channel and inlet geometry, wind and wave power, tidal volume, etc. Other important measurements at this juncture would include spot elevations of structures adjacent to Bolinas Lagoon (homes along Wharf Road) and bulkheads of Seadrift homes adjacent to Bolinas Lagoon, as appropriate.

Monitoring during construction will include the same parameters, but with the specific purpose of determining whether the project is proceeding successfully, according to project goals and predicted results. Specific hydraulic measurements would look at tidal flow through channel, flood shoal, delta and basin areas; changes in intertidal and subtidal habitat; inlet flow, geometry and closure potential. These measurements would be taken to monitor progress of the construction project to ensure the project was being constructed as designed, and the hydrology was behaving as predicted. Ecological measurements, such as benthic recruitment, bird counts, fish surveys, etc., would be taken to confirm that ecological benefits were developing as predicted, and that the restoration goals of the project were being met. Measurements of water quality parameters such as turbidity, salinity, dissolved oxygen, etc., would be required as part of the construction contract. If unacceptable levels of any particular parameter, attributable to project implementation, were measured during construction, management measures would be developed and implemented to address the problem areas.

Post-construction monitoring would focus on the same hydrological and biological parameters, but would focus specifically on the lagoon's function as an ecological system. If unacceptable levels of any particular parameter were measured during the 5-year period after construction, management measures would be developed and implemented to address the problem areas. Some management measures will be developed as part of the adaptive management plan prior to construction. If unforeseen or unpredicted circumstances arise, new management measures would have to be developed by the advisory panel for consideration by the local sponsor and Corps of Engineers. It is assumed that the adaptive management plan would be flexible enough to address such unforeseen circumstances, and is important specifically for that reason. The concept of the adaptive management plan will be explained later in this document, and will be developed in more detail during the Pre-Construction, Engineering and Design (PED) phase of the project.

7.11.2 Monitoring

The monitoring program will have three basic components: hydraulics, water quality, and biological resources.

Hydraulics

Measurements of hydraulic parameters will ensure that hydraulics are behaving as predicted, and that there are no areas of excessive scour or deposition. If unacceptable levels of any given parameters are measured during construction, the design of the sediment removal alternatives would be modified to bring about the desired results. If unacceptable levels are measured after construction, remedial actions may be necessary to correct for scouring or accreting areas.

Pre-Dredging Monitoring: Baseline measurements taken before construction will be taken during the PED phase.

Tidal Volume and Flow – Measurements of tidal volume and flow may be necessary for monitoring and predicting the effects of the project, as well as for verification of the hydraulic and sediment model(s) used during the final design phase. For example, depth and flow characteristics of the channels and other important hydraulic areas (e.g., flood shoal, delta, and basin areas) could be measured.

Wind and Wave – Measurements of wind and wave characteristics before construction would help inform decision-making during and after construction.

Inlet Measurements – Measurements of inlet geometry and flow characteristics would also be important to the overall hydraulic monitoring plan since tidal prism and inlet geometry are directly related.

During Dredging Monitoring: Construction monitoring will take place during the entire construction period; some measurements would only be taken during the dredging season, while others would be taken periodically throughout the year. Monitoring during this phase would focus on the same parameters as those listed in the Pre-Construction Monitoring plan, but the specifics would depend on the final design of the selected alternative, construction methods and sequencing, and even the construction contractor.

Bathymetry – For the purposes of consistency in data, a bathymetric survey of the lagoon may be called for in 2008, since the last one was conducted in 1998, and bathymetric surveys have been conducted every ten years since 1968. A bathymetric survey would help calibrate hydraulic and sediment models developed during the PED phase, and would serve as a basis of comparison for future monitoring and modeling. If costs are prohibitive, cross-sections or other simple measurements could be taken in important areas for the same purpose. A bathymetric survey, however, would be ideal.

<u>Post-Dredging Monitoring (5 years):</u> Post-Construction monitoring would be conducted by the Corps and MCOSD for five years after sediment removal ceases in the lagoon. Annual reports providing an analysis of lagoon progression or evolution would be provided.

Bathymetry – A bathymetric survey conducted in 2018 would be an important contribution to the "historical" database. The information obtained from this project would not only be useful to the Bolinas Lagoon project, but could also be useful to projects outside the lagoon, especially in the area of hydraulic and sediment modeling. Information on channel geometry, function of the delta, flood shoal and basin areas, as well as hydraulic function of the lagoon would be obtained from the bathymetric survey.

Tidal Volume and Flow – Measurements of tidal volume and flow would be taken post-construction to measure the hydraulic success of the project against predictions. For example, insufficient flows in important areas would necessitate development and implementation of management measures listed in the adaptive management plan.

Wind and Wave – Wind and wave measurements would continue post-construction to get an overall picture of the lagoon hydraulics, and would aid in decision-making for adaptive management.

Inlet Measurements – As mentioned in the During Construction Monitoring section, measurements of inlet geometry and flow characteristics would be an important component of the overall hydraulic monitoring plan since tidal prism and inlet geometry are directly related, and both are related to project goals.

<u>Water Quality</u>

Basic water quality measurements will be taken before construction in order to inform measurement-taking during and after construction. Water quality monitoring would be similar for each phase of the project, but may vary in timing and/or duration. Measurements would be taken at several locations in the lagoon, and would most likely be taken four to six times per year to account for dredging-induced changes and natural variation. Water quality parameters would include salinity, turbidity, dissolved oxygen, etc. Because dredging only causes short-term impacts to water quality in areas of significant tidal flow (like Bolinas Lagoon), water quality is expected to improve quickly after each dredging season. If water quality deficiencies attributable to project implementation were substantial and persistent, remedial actions would be developed and implemented.

Biological Resources

Because the primary purpose of the Bolinas Lagoon Ecosystem Restoration Project is restoration, monitoring will focus on ecological parameters for measurements of project "success." Data collected under the monitoring program will be compared to the ecological success criteria for the project, which will be based on restoration goals. It is expected that dredging will cause short-term impacts to the ecology of the lagoon, which will be offset by an increase and improvement of intertidal and subtidal habitats, which will in turn bring about long-term ecological benefits. It is also expected that certain regulatory requirements (like water quality parameters) will eventually be included in the monitoring plan after public review of the Feasibility Report and EIR/EIS.

Pre-Dredging Monitoring: Baseline measurements of different ecological parameters will be taken before construction in order to assess the effects of sediment removal in the lagoon.

Vegetation and Habitat Delineation in Intertidal and Adjacent Upland Zones – Surveys would be conducted to determine the extent, location and composition of the intertidal zones of the lagoon. Information on intertidal and adjacent upland habitats will be correlated to bathymetric survey elevations; therefore, field surveys would most likely be minimal, used only to confirm general habitat composition. Use of this habitat, found in measurements of fish use, bird use, etc., would be more important for determining project success.

Biological Surveys – Surveys of algae composition, benthic macroinvertebrates, birds, fishes, harbor seals, threatened, rare and endangered species, and invasive species would be conducted before construction starts to determine baseline conditions. If appropriate, the Bolinas Lagoon monitoring plan will tap into local resources and on-going monitoring [like Point Reyes Bird Observatory (PRBO) bird counts, for example].

During Dredging and Post-Dredging Monitoring: Similar monitoring programs would be conducted during and post construction.

Indicators That Would Demonstrate Ill Effects from Dredging

Algae Composition – An algal expert would be needed on the Advisory Panel to provide input on algal monitoring. Algae are an important component of the ecosystem in Bolinas Lagoon; a decrease in this group of species may signify unexpected and detrimental effects from dredging.

Benthic and Planktonic Biomass – Measurements of benthic and planktonic biomass would be an important indicator of the overall health of the base of the lagoon ecosystem. Development of a benthic macroinvertebrate community should occur within the first year after dredging is completed at each site. The presence of a thriving benthic macroinvertebrate community (together with abundant fish and bird populations) would indicate that the lagoon was ecologically healthy. The composition of the benthic community can be expected to change rapidly and unpredictably due to normal, natural fluctuations, which might lessen the value of monitoring trends in these species. Although there are a lot of "unknowns" regarding the benthic community in Bolinas Lagoon, this parameter would be important to measure because it represents the food base for many species, including intertidal shorebirds and some fish species. At each restoration location, benthic surveys would be conducted during the construction period of each site, and for two to three years afterwards to document the colonization of the lagoon by these species. Additional surveys may be conducted later if site deficiencies arise.

Use by Birds – As emergent marsh and upland habitat are converted to lower elevation intertidal habitat like tidal flats and subtidal habitat, the assemblage of bird species that inhabit the lagoon should change similarly. For example, bird species that specialize on subtidal and tidal flat habitats (like diving ducks, certain shorebirds, etc.) should increase in number, while those dependent on emergent marsh (fewer in number), should decrease. Periodic bird surveys would document trends in use of the site by birds as compared to present use, and would be a gauge for determining the success of habitat restoration in the lagoon.

Invasive Species – Surveys of identified invasive species (e.g., *Potamocorbula* spp. and *Spartina* species, like *S. alterniflora*, *S. densiflora*, *S. angilica* and *S. patens*) would be conducted to determine whether the project caused these particular species to increase in population. If measurements indicate increasing numbers of invasive species attributable to project implementation, management measures would be developed and implemented to address the problem areas. Increasing numbers of invasive species would be an indication that the restoration project may be failing at some level.

Indicators That Would Demonstrate an Overall Improvement to the Bolinas Lagoon Ecosystem

Eelgrass Habitat – Because eelgrass was historically abundant, but has declined over time with decreasing channel depths and subtidal habitat, restoration of eelgrass in the lagoon would be a major success for the Bolinas Lagoon restoration project. Eelgrass surveys would be conducted (or coordinated with agencies who currently conduct surveys) to determine the presence and abundance of this species. Replanting of eelgrass has been largely unsuccessful, but it is thought that creating deeper channels and subtidal areas would provide, at the minimum, an area appropriate for recolonization. In addition, propagation of local eelgrass species (from within Bolinas Lagoon) might be an option for restoration. If eelgrass coverage did not increase, management measures may be developed and implemented, if practicable.

Use by Fish – Fish surveys would commence during the PED phase, at least one year prior to construction, and would continue throughout the construction phase. They would document the habitat quality and suitability of the lagoon habitats for fishes. Ongoing surveys would document use of the lagoon by fishes as intertidal and subtidal habitat increased, and tidal volume and flow subsequently increased. Restoration of habitat for fish and a concomitant increase in use of the lagoon by fish, especially by fish species that once inhabited the lagoon, but are no longer found, would indicate that the restoration project was particularly successful.

Use by Rare, Threatened, Endangered and Protected Species (e.g., *Cordylanthus maritimus*, Coho Salmon, Steelhead, California Black Rail, and Harbor Seals) – As tidal flow and intertidal and subtidal habitats increase, the quality of the habitats for these species is expected to improve. After suitable habitat has developed in the lagoon, periodic surveys will be coordinated with the US Fish and Wildlife Service, California Department of Fish and Game, and National Marine Fisheries Service to ensure compliance with endangered species laws and regulations.

7.11.3 Adaptive Management Planning

To facilitate long-term planning and implementation of solutions for the Bolinas Lagoon Ecosystem Restoration Project, a comprehensive adaptive management plan will be developed during the PED phase to provide a roadmap for the long-term stabilization, restoration, and management of the lagoon. The plan will be comprehensive in nature, covering all the important issues facing the lagoon, but also will be easily adaptable, in order to reflect the changing conditions and needs of the lagoon. The Bolinas Lagoon Comprehensive Adaptive Management Plan (AMP) is not intended to be a capital improvement plan, focusing just on implementing engineering solutions. Instead, this document would serve as the basis for consideration of implementation of the monitoring and adaptive management actions recommended by the Expert Panel during the planning process, and as a guidance instrument from which to develop a long-term management plan with full stakeholder involvement.

Adaptive management provides for studies and management programs that can be adapted to uncertain or unforeseen circumstances. A well-designed adaptive management plan anticipates as many circumstances as possible before designing monitoring and data assessment approaches. The adaptive management plan would identify circumstances or issues, such as stream flow, erosion and sedimentation rates, or problems with restoration activities or operation. However, unexpected circumstances such as institutional changes (e.g., changes to the Endangered Species Act or other laws), new natural resource management directives (e.g., maximizing tidal exchange, increase seal haul out areas), newly understood ecological phenomena (e.g., global climate change), or land and water use changes (e.g., upstream development) may arise. While some of these may fall outside of the scope of the plan (e.g., toxic spills) and would be addressed through other programs or directives, others might be related to shortcomings in the project that could arguably be included under these adaptive management objectives (e.g., possible beach erosion).

Adaptive Management, as used for the Bolinas Lagoon project, will be "passive" adaptive management. Changes in management will be made in response to monitoring results, versus an "active" type of adaptive management where specific experiments are conducted in order to learn about ecological processes. No specific experiments are contemplated, and the AMP does not include experimental changes in instream flow designed to determine the relationship between stream flow and sedimentation.

Several objectives to determine the efficacy of the project will be identified in the AMP. These objectives will be based on the purpose and need identified in the EIS/EIR. For each objective, the Adaptive Management process will follow a systematic process, beginning with a testable hypothesis, to indicate whether an objective is being met. The methods used to test the hypothesis will be identified in the AMP, and will be comprised of established and routine procedures, surveys, analysis, and/or modeling. An implementation schedule will list the duration and order of monitoring activities for each objective, and include trigger events and end points. Trigger events are circumstances indicating that an adaptive response should be taken, and end points are circumstances indicating that an objective has been attained, and monitoring and data assessment is no longer needed for that objective. Some objectives may not have end points and would require monitoring and data assessment for the entire term of the AMP.

If a trigger event occurs, indicating an objective has not been met, then an adaptive response will be required. This could involve further diagnostic studies or modification of the restoration activities or operations; or changes to natural features of the project area designed to bring the system closer to achieving the objective. All responses must be feasible, practical, reasonable, prudent, and will take into account the views of the local community, though this does not preclude potentially major modifications to project facilities or operations. However, each response would have response limits that describe the absolute scope of actions that can be taken in response to a trigger event.

In general, response limits under the AMP will be identified through consensus to the extent practicable, guided by principles of feasibility, practicality, reasonability, prudence, local community acceptance, and would conform to limits identified by the US Army Corps of Engineers. Possible adaptive responses that fall outside the project's scope, such as major upstream modifications, would require further decisions through the established Corps processes. In addition, nothing in this AMP is intended to bind the Sponsor or the US Army Corps of Engineers, or otherwise limit their respective authorities, in the performance of their responsibilities under applicable state and federal laws.

All adaptive responses will be evaluated, and their outcomes compared to the objective. If the objective has been met, then the original monitoring and data assessment approach would be resumed. If the objective is still not met, the monitoring and data assessment approach may be modified to diagnose the problem.

An important component of the adaptive management process will be reporting, which includes emergency reporting procedures, regular periodic reporting, and final long-term reporting. An annual adaptive management report will summarize all data collected under these monitoring and data assessment approaches and will present analyses required within each objective. Certified raw data and reports generated under these objectives will be updated to appropriate agency and publicly accessible/locally endorsed and maintained information systems using database standards.

7.12 Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) Requirements

Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) requirements of the Bolinas Lagoon ecosystem restoration project are the responsibility of the local sponsor, in accordance with provisions contained in the Water Resources Development Act of 1986 (PL 99-662). The obligations will remain in effect for as long as the project remains federally authorized. Unexpected future actions would have a separate, currently unknown cost. Since one of the goals of this project is to create a self-sustaining ecosystem, regular maintenance dredging in Bolinas Lagoon is not expected or planned. General OMRR&R responsibilities will include maintaining the features of the project, repairs of a routine nature that maintain the project in a well-kept condition, replacement of worn-out elements or portions thereof, and rehabilitation activities to bring a deteriorated project back to its original condition. However – in light of the project plans that envision limiting dredging activity to the construction period, only; the strict controls on dredging exerted by agencies having jurisdiction over Bolinas Lagoon, particularly including the GFNMS; and the expectation of limited further sedimentation from watershed sources – these maintenance and rehabilitation responsibilities will be articulated so that they do not include rigid preservation of dredged channel depths, dredging prisms, or similar initial design parameters. An official O&M Manual describing all of the OMRR&R requirements will be developed by the Corps during the PED phase.