CHAPTER 3
AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Bolinas Lagoon is an estuarine lagoon approximately one by three miles in size, located 12 miles northwest of the Golden Gate, south of Point Reyes (MCOSD 1996). The lagoon's watershed covers close to 17 square miles and contains a number of tributaries draining into the lagoon. On the east side of the watershed is the Bolinas Ridge, which runs northwest to southeast at about 2,000 feet above mean sea level (MSL). On the west side of the watershed is the Point Reyes Peninsula. The San Andreas Fault runs directly through the lagoon itself along its northwest-southeast axis (MCOSD 1996).

One major tributary and a number of minor tributaries feed into the lagoon. Pine Gulch Creek drains the west side of the watershed and feeds into the lagoon at a point north of the unincorporated town of Bolinas. At the mouth of Pine Gulch Creek is an extensive delta, which supports a wide assortment of bird life. Several smaller creeks drain into the east side of the lagoon from Bolinas Ridge.

3.2 HYDROLOGY AND GROUNDWATER

3.2.1 Introduction / Region of Influence

The Bolinas watershed is located in western Marin County, on the southern side of the Point Reyes peninsula. The region of influence (ROI) for water resources includes all areas that could be modified or affected by the Bolinas Ecosystem Restoration project. This would encompass all of Bolinas Lagoon, adjacent areas of the lagoon watershed, and Bolinas Bay.

3.2.2 Surface Water Drainage

The watershed of Bolinas Lagoon (Figure 3-1) covers 16.7 square miles. Average annual rainfall in the watershed ranges from about 22 to 50 inches, depending on elevation. Most of the precipitation occurs from November through April.

Pine Gulch Creek, the principal drainage to the lagoon, is a perennial (year-round) stream. Most of the drainage area of Pine Gulch Creek lies on the west side of the San Andreas Graben Fault and is underlain by Monterey Formation. The drainage area of Pine Gulch Creek is approximately 8 square miles (5,120 acres), representing about 50 percent of the watershed of Bolinas Lagoon. Instead of following the most direct route to the head of Bolinas Lagoon, Pine Gulch Creek follows a more circuitous route. Pine Gulch Creek and the drainage of Copper Mine Gulch originally followed the trace of the older western boundary of San Andreas Fault, and they continue to follow this course even after lateral movement on the younger 1906 trace shifted their channels northward. Pine Gulch Creek joins McCormick Creek, flows through Paradise Valley west of Horseshoe Hill, and enters Bolinas Lagoon about midway between the head of the lagoon and Kent Island. Pine Gulch Creek discharges on the west side of the lagoon and represents a major source of sediment inflow to the lagoon in wet years.

Easkoot Creek, by contrast, drains an area roughly 1.7 square miles (1,062 acres) on the south end of the lagoon. This is roughly 10 percent of the total calculated watershed (Fong 2000b).

The drainage areas of the next two largest (intermittent) streams on the east side of the San Andreas Fault, Morses Creek and Audubon Creek, are 0.70 square miles, and 0.46 square miles, respectively. The remainder of the watershed drains the east side of the San Andreas Graben Fault, which is underlain by Franciscan rocks. The streams are steeper on the east side than on the west side of the fault and flow intermittently. Numerous steep, straight, perennial and intermittent streams drain the approximately 1.5-mile long slope from the ridge top to Bolinas Lagoon. Three of the east side drainages discharge to Pine Gulch Creek north of the lagoon, but about a dozen others discharge directly to the east side of the lagoon.

Figure 3-2 shows historical flows measured at a USGS monitoring station at Pine Gulch Creek, operated between June 1967 and September 1970. Although the data shown in

3-1 Watershed Boundaries and Surface Features

3-2 Daily Average Flows in Pine Gulch Creek (1967-1970) the figure represent only a brief period of time, it can be seen that flows varied in magnitude over a wide range during the period. The total annual discharge from Pine Gulch Creek from October 1, 1967 to the end of September 1968 (the 1968 water year) was 3,670 acre-feet. During the following water year, the total discharge was 12,110 acre-feet. The total inflow during the 1970 water year was 14,080 acre-feet. The total annual discharge from Morse Creek in 1968 and 1969 was just 159 acre-feet and 813 acre-feet, respectively (Ritter 1973). Since November 1998, the US Geological Survey has collected water quality data at a point about 0.4 miles upstream from the mouth of Pine Gulch Creek. Samples are collected about every two months and analyzed for a range of inorganic parameters, including suspended sediment, as part of a study of water quality in coastal streams. However, only the instantaneous stream discharge (at the time of sampling) is measured, and there is no recording discharge gage.

Although the stream discharge record for Pine Gulch Creek is extremely brief, the pattern of runoff from other nearby coastal watersheds that have been gaged for longer periods of time can provide insights into the pattern of runoff that has occurred in Pine Gulch Creek over a longer period of time. For example, Figure 3-3 shows the average daily discharge in Walker Creek, near Tomales, from 1959 to 1984, and for Lagunitas Creek, near Point Reyes, from 1974 to 1997. Although the magnitude of the discharge differs due to the different sizes of the watersheds, the general patterns of stream discharge shown in each of these hydrographs are similar to each other, and similar to the discharge in Pine Gulch Creek for corresponding time periods.

3.2.3 Circulation and Tidal Flows

Elevation Datums

Historical changes in water depth and land elevation figure prominently in the discussion of sedimentation and hydraulics in Bolinas Lagoon. It is important to keep in mind that a number of different elevation datums (or bases for measurement) have been used in studies of the lagoon. The most commonly used land elevation datum in the US is the National Geodetic Vertical Datum (NGVD) of 1929. This is the land datum typically used on US Geological Survey topographic maps, and is the datum used to calculate habitats in the lagoon. It is commonly referred to as mean sea level, because it was based on the average of the mean tide levels at selected locations. It has been replaced, for some applications, by the more precise North American Vertical Datum (NAVD) of 1988. Navigational charts, however, typically reference mean lower low water, or MLLW, which is the average of the lowest daily tidal stands. The shoreline on USGS topographic maps and on navigational charts typically represents MLLW, and underwater depths are typically reported as depths below MLLW. The relationship between tidal averages and land elevation datums varies locally, and tidal averages reported in different historical documents may vary widely from each other. Since bathymetric data, or soundings, are typically reported relative to tidal averages, such as MLLW, this variability makes it difficult to accurately interpret historical water depth information.

3-3 Daily Average Flows in Other Watersheds Near Bolinas Lagoon (1959-1997)

Table 3-1 presents the relation between the NGVD and NAVD land elevation datums and the respective tidal averages at gages in the Presidio in San Francisco Bay and at Point Reyes. In this report, if not otherwise noted, elevations above and below water are referenced to the 1929 NGVD, and the term mean sea level or MSL is assumed to be equivalent to NGVD. A detailed discussion of elevation and tidal references that have historically been used as the basis for depths and elevations reported for Bolinas Lagoon is presented in Bergquist's (1978) study of the depositional history of Bolinas Lagoon.

Table 3-1
Comparison of Tidal Averages and Land Elevation Datums (1929 NGVD and 1988 NAVD)

Description	SF Presidio Elevation relative to NGVD (ft)	Bolinas Bay NGVD (estimated)	Pt. Reyes, Drakes Bay relative to NGVD (ft)
Highest Observed Water Level	5.74		5.82
Mean Higher High Water (MHHW)	2.70		2.92
Mean High Water (MHW)	2.10		2.26
Mean Tide Level (MTL)	0.05		0.30
Mean Sea Level (MSL)	0.00	0.3877	0.00
National Geodetic Vertical Datum (NGVD)	0.00	0.3877	0.00
Mean Low Water (MLW)	-2.00		-1.67
North American Vertical Datum-1988 (NAVD)	-2.99		-2.61
Mean Lower Low Water (MLLW)	-3.13		-2.85
Lowest Observed Water Level	-5.80		-5.33

Source: Bergquist 1978

Lagoon Configuration and Bathymetry

Bolinas Lagoon covers an area of about 1,100 acres at mean high water (MHW). There are two main channels within the lagoon: Bolinas Channel and the Main Channel. Bolinas Channel extends between Francisco Mesa in Bolinas and Kent Island. The Main Channel follows a course eastward between the channel inlet and Kent Island and then turns north and generally hugs the east shore of the lagoon toward the Upper Basin. The Upper Basin, previously connected to the Lagoon, lies north of the delta of Pine Gulch Creek. Sediment deposition on the delta prevents the Upper Basin from draining via the Bolinas Channel.

Figure 3-4 shows the evolution of Bolinas Lagoon between 1854 and 1969, and Figure 3-5 shows the current configuration of the lagoon. The lagoon morphology, or functional configuration, has been influenced by a number of geologic and hydrologic factors, but probably the most important factors are changes in sea level, uplift and subsidence related to movement on the San Andreas Fault, erosion and sediment transport in the watershed, and wave and tidal action. Superimposed on these natural

3-4 Historic Change in Configuration of Bolinas Lagoon (1854-1969)

3-5 Current Configuration of Bolinas Lagoon processes are human actions that influence the shape of the lagoon, including dredging and filling, upland land practices and shoreline erosion protection. These processes occur at different rates, with different cycles of periodicity, and with different degrees of predictability. The ways in which these processes overlap determines the shape and depth of the lagoon. During the past 5,000 years, sea level has been rising at an average rate of about one-half foot per century. Rising sea levels invaded the rift valley of the San Andreas Fault, forming a deep tidal inlet. As it did so, counter-clockwise longshore currents in Bolinas Bay created a sand spit in the shallow waters across the mouth of the inlet. The rift valley is a zone in which the land tends to subside due to movement along the San Andreas Fault. The subsidence occurs episodically. The 1906 earthquake, for example, caused the lagoon east of the active trace of the fault to subside about one foot. Based on evidence from sediment cores, the combination of subsidence and sea level rise was approximately equal to the rate at which sediment accumulated in the lagoon until about 1849.

In addition to natural processes that played a role in the configuration of the lagoon, human activities are also suspected to have helped shape the lagoon (Ritter 1973). Munro-Fraser estimated that about 15,000,000 board feet of lumber was cut in the immediate vicinity of Bolinas beginning in the year 1849. Munro-Fraser also noted that the same ships that could pass into Bolinas port in the mid-1800s were unable to by 1880 due to a decreasing water depth. In addition, decreasing water depth caused by siltation forced shipbuilders in the lagoon to move their operations three times before being discontinued entirely in the late 1870s (Munro-Fraser 1880). Quantitative data indicates that the lagoon, which had a high volume of 210 million cubic feet before 1849, decreased to a low volume of 90 million cubic feet by 1906 (Bergquist and Wahrhaftig 1993). More information about the effects on Bolinas Lagoon of historic human activities in the watershed are presented in the Bolinas Lagoon Watershed Study, provided in the technical appendix to this report.

Sediment Deposition and Change in Tidal Prism

The volume of water that flows in and out of the lagoon between tides is called the tidal prism. The size of the tidal prism is an important factor in maintaining sufficient tidal exchange to support many of the existing functions of the lagoon, including removing sediment, keeping the inlet channel open, and maintaining water quality.

Figure 3-6 shows the change in the tidal prism since the early 1800s. Prior to 1849, when European settlement of the watershed began in earnest, the tidal prism is believed to have been relatively stable, at about 210 million cubic feet (7.8 million cy). After 1849 it decreased at a rate of about 2 million cubic feet (74,000 cy) per year and reached a low point of about 90 million cubic feet in 1906. Subsidence from the 1906 earthquake abruptly increased the tidal prism to about 175 million cubic feet (6.5 million cy). Sedimentation continued, however. From the 1930s to the 1960s sedimentation resulted in the loss of tidal prism at a rate of about 0.7 million cubic feet (26,000 cy) per year. Since the 1960s, the rate of loss is believed to have doubled to about 1.4 million

3-6 Estimated Change in Tidal Prism of Bolinas Lagoon cubic feet (52,000 cy) per year. The tidal prism was estimated to be about 100 million cubic feet (3.7 million cy) in 1990 (Bergquist and Wahrhaftig 1993). (Throughout this document, units of volume are provided in both cubic feet and in acre-feet. Units of acre-feet are used preferentially when discussing larger volumes. One million cubic feet is approximately 23 acre-feet.)

In 1993, a causeway and dump in the southern end of the lagoon were removed. This directly increased the tidal prism by 248,000 cubic feet (9,200 cy) and led to an estimated increase in tidal prism of 435,000 cubic feet (16,000 cy) because of increased tidal circulation (MCOSD 1996).

A USGS study conducted between 1967 and 1970 (Ritter 1973) found that more sediment was carried out of the lagoon on outgoing tidal currents (ebb currents) than was carried in by incoming tidal currents (flood currents). However, the variability in the daily observations was high, suggesting that even if the measured values are highly accurate, the long-term sediment balance in the lagoon is unpredictable. The net rate of discharge of sediment from the lagoon was estimated at approximately 10,000 tons. This discharge rate has been calculated to have a volume of approximately 5.8 acre-feet per year (133 million cubic feet or 4.9 million cy) Ritter 1973).

Other sources of sediment inflow to the lagoon estimated in the USGS study included sediment inflows from streams (primarily Pine Gulch Creek), wind-blown sand, and shore erosion. The total inflow of sediment from all streams was estimated to average about 4,900 tons (218 acre-feet) per year. Nearly all of this sediment comes from Pine Gulch Creek. For example, the sediment load from Morses Creek averages about 34 tons per year (Ritter 1973). Average rates may be misleading, however. The USGS study showed that the rate of sediment inflow varies considerably with the rate of discharge. For the 1968 water year, when stream discharge was relatively low, the total annual suspended sediment inflow from Pine Gulch Creek was estimated to be about 383 tons. In 1969, the suspended sediment load was 7,580 tons. Nearly half of the sediment inflow in 1969 (about 3,430 tons) was carried by runoff from one storm occurring on December 28, 1969, when the daily discharge was 320 cubic feet per second (cfs). A glance at Figures 3-7A and 3-7B suggests that sediment loading from stream inflow is very unevenly distributed over time and that Pine Gulch Creek may become a significant source of sediment loading in some wet years.

Figure 3-7A shows a graph of daily suspended sediment loads plotted against Pine Gulch Creek discharges based on data reported by the USGS (Ritter 1973). Daily sediment loads to Bolinas Lagoon can be estimated from the discharge measured at the Pine Gulch Creek gage. Using this procedure, the daily sediment loads were estimated for the period from June 1967 through September 1969 (Figure 3-7B). Unfortunately, the relationship between stream flow and sediment loading at higher stream flows is not known. If the equation developed for the relationship between discharge and sediment

3-7A and B Estimated Suspended Sediment Loading to Bolinas Lagoon From Pine Gulch Creek (1968-1969) loading is applied to the stream flows recorded in 1970 (Figure 3-2), the total sediment load for 1970 is calculated to be about 175,000 tons, or about 25 times more than the loading estimated by the USGS for 1969.

What happens to the sediment when it enters Bolinas Lagoon from Pine Gulch Creek depends mainly on the tidal elevation and the rate of stream discharge. The tidal elevation determines the location of the mouth of Pine Gulch Creek. At lower tidal stands, the creek discharges further along its delta, and more of the sediment load will be deposited further toward the east side of the lagoon. When the tide is high, the sediment enters the lagoon further to the west and disperses over a wider area of the delta. Higher stream flows not only carry more sediment but also larger sized sediment particles. The larger sediment particles are more likely to remain in the lagoon, while fine-grained particles remain suspended and can be carried out of the lagoon on ebb currents.

Other sources of sediment loading to the lagoon are probably not as significant as tidal inflow and stream inflow. The USGS study concluded that erosion from the lagoon side of the Stinson Beach sand spit contributes an average of about 1,500 tons (0.9 acre-feet) of sediment per year, and wind-blown sand accounts for about 40,000 tons of sediment (23.2 acre-feet) per year. The estimated quantity of wind-blown sand entering the lagoon is nearly 10 times the average rate of sediment estimated to enter the lagoon from streams. According to the USGS, however:

> That value probably is high because houses and fences may interrupt sand movements. Also, the general absence of drifting sand on access roads suggests that sand movement may not be great. However, local residents affirm that quantities of sand are moved across the spit by winds (Ritter 1973).

Based on these observations and estimates by other methods, it was concluded that the rate of sediment accumulation during the period from about 1939 to 1969 was about 11 to 21 acre-feet per year, representing an average rate of filling of about 0.5 to 1.0 feet per year. Extrapolating these results to the future, it was concluded that the lagoon would fill to the elevation of mean sea level within 90 to 160 years (Ritter 1973). However, as noted above, this prediction is sensitive to errors in measurement and assumptions about the rates at which sediment enters the lagoon.

The Corps evaluated annual sediment infilling rates and changes in lagoon volume based on bathymetric surveys conducted in 1968, 1978, 1988, and 1998 (Corps 1999a). The results of this analysis are shown on Figure 3-8, which shows the change in volume of the lagoon over time. Figure 3-8A shows the change in volume with elevation, and Figure 3-8B shows the average annual rate of loss of volume plotted at the midpoint between each survey date (1973, 1983, and 1993) for elevations corresponding to the typical spring and neap high tide elevations. ("Spring" tide is the tide cycle with the greatest difference between high and low tides during a lunar month; the “neap” tide is

3-8A and B Change in Tidal Prism based on Bathymetric Data 1968 to 1998 the tide cycle with the least difference between high and low tides. The typical spring and neap tides were defined as the 1998 average spring and neap high tides and were calculated to be 3.15 feet NGVD and 2.25 feet NGVD, respectively). The figure indicates that the infilling rate declined dramatically between 1968 and 1998. The lagoon filled at an average rate of about 0.71 million cubic feet per year between 1988 and 1998, which represents a rate of about 0.26 million cubic feet above the long-term average filling rate for the period before 1850 of about 0.45 million cubic feet per year.

The infilling rates described above are based on the assumption that infilling occurs at a constant rate during any 10-year period. However, this may not be accurate for short periods of observation if sedimentation rates are significantly influenced by high-runoff events in Pine Gulch Creek. If this is so, then it may be seen that the bathymetric surveys of 1968 and 1998 each followed a series of years in which there were high runoff events, while the 1978 and 1988 bathymetric surveys each followed a series of low runoff years. If sediment inflow and deposition is episodic and related to stream discharge, then surveys in 1968 and 1998 may have overestimated the average rate of infilling, while surveys in 1978 and 1988 may have underestimated the average rate. Since the surveys in 1978 and 1988 both were done at times of low runoff, the effect on the calculation of volume loss over time might be to underestimate the average loss represented by the points plotted on Figure 3-8B at 1983. If these points were plotted higher on the graph of average volume loss rate, the trend of the projected infill rate might be much steeper, possibly intersecting the estimated pre-development infill rate. Also, if the rate of sediment infilling in 1998 were much lower than in 1968, despite comparable runoff events occurring just prior to both the 1968 and 1998 surveys, this suggests that conditions in the watershed or the channel of Pine Gulch Creek may have changed, resulting in a reduction in erosion from the watershed.

Tidal Exchange and Channel Inlet Size

The entrance channel to the lagoon is an opening in the sand spit that is formed when water rushes in and out with flood and ebb currents, respectively, as the water elevation in the sea and inside the lagoon move toward equilibrium. The size of the entrance channel is related to the size of the tidal prism and the rate at which the sand spit beach is built up. The rate at which the sand spit beach is built up is a function of wave power and the availability of sediment. If there is no shortage of sediment, then it is simply a function of wave power. As the tide changes, the elevation inside the lagoon always lags somewhat behind the water elevation of the sea outside the lagoon. It is this difference in elevations that creates tidal inflow and outflow.

The smaller the channel opening, the faster the water must move through the entrance channel to equilibrate the elevations. The greater the velocity of the water through the entrance channel, the more sediment scouring can occur. The smaller the tidal prism, the less water needs to be moved through the entrance channel during a tidal cycle, and the lower the velocity will be through a channel of a given size. There is a dynamic relationship between all of these factors which results in a particular channel entrance configuration. At some point, if the tidal prism decreases enough, the sand spit will build up enough to close the inlet channel (Williams and Cuffe 1994). Historically, however, the ratio of tidal prism to wave power has been large enough to keep the inlet open.

Tidal exchange is much more important, overall, in keeping the inlet channel open than is freshwater flow out of the lagoon, although at times freshwater outflow may be significant. Maximum daily tidal flows through the inlet channel range from about 700 cfs to about 4,000 cfs. By contrast, the combined maximum daily freshwater inflow to the lagoon from streams, measured between 1967 and 1969, was about 500 cfs (Ritter 1973).

Hydrodynamics

The highest tidal current velocities occur in the tidal channels. Velocities tend to decrease further from the inlet channel. Ritter (1973) concluded that except in the North Basin and the extreme southeastern portion of the lagoon, nearly every part of the lagoon is subjected to tidal currents strong enough to transport sediment particles of the size most prevalent in the lagoon (silt size particles). However, more energy is required to erode particles once they have been deposited than is needed to transport particles once they are suspended. Most of the erosion in the lagoon takes place in the tidal channels, which remain inundated longest and where the velocities are highest. Only very fine-grained sediments tend to be deposited in the North Basin and southeastern area, where current velocities are lowest.

The pattern of distribution of current velocities and the magnitudes of the velocities vary depending on the height of the tides and on the tidal difference. At higher stands, the flow that passes through the inlet channel is distributed over a wider area of lagoon, so that velocities tend to be lower at higher stands. However, as the tide rises, the inlet channel widens, allowing more water to enter. Flood current inflows initially follow the courses of tidal channels and then become less constrained by the channels as the tide rises. During ebb currents initially move as sheet flow over the tidal flats and gradually become channelized as the tide turns. Wind-generated wave action can resuspend sediments in shallow areas, and the ebb currents then move the resuspended sediment toward the channels, where it is transported out of the lagoon.

3.2.4 Regulatory Considerations

The federal legislation governing the water quality aspects of the project is the Clean Water Act (CWA) as amended by the Water Quality Act of 1987. The objective of the CWA is “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” California’s Porter-Cologne Water Quality Control Act (Division 7 of the California Water Code) provides the basis for water quality regulation within the state. The lead agencies will coordinate with Corps regulatory staff to comply with the CWA and Corps policies.

As part of its responsibility to protect water quality, the Corps of Engineers' Section 404 (CWA) permit program regulates alteration of channels concerning "waters of the United States." The purpose of the Section 404 program is to insure that the physical, biological, and chemical quality of our nation's water is protected from irresponsible and unregulated discharges of dredged or fill material that could permanently alter or destroy these valuable resources. While the Corps does not require permits for its own activities, Corps policy is to comply with the provisions of the CWA in as much as they are applicable to the project. Section 404 of the CWA regulates the following activities:

- Depositing fill or dredged material in waters of the US or adjacent wetlands;
- Placing site fill for residential, commercial, or recreational developments;
- Constructing revetments, groins, breakwaters, levees, dams, dikes, and weirs; and
- Placing riprap and road fills.

Waters of the United States include essentially all surface waters, such as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters.

The State Water Resources Control Board (SWRCB) administers water rights, water pollution control, and water quality functions throughout the state, while the regional water quality control boards (RWQCBs) conduct planning, permitting, and enforcement activities; the project would be subject to review under RWQCB regulations. The project must comply with sections 401 and 402 of the CWA, which are under the jurisdiction of RWQCB Region 3 for this project.

Section 401 of the CWA, Water Quality Certification, gives the state and its RWQCBs broad authority to review proposed federal activities in or affecting a region's waters. The RWQCB can recommend to the state board that it grant, deny, or approve conditionally federal permits or licenses that may result in a discharge to waters of the United States.

The RWQCB also administers the National Pollution Discharge Elimination System (NPDES) stormwater permitting program for compliance with Section 402 of the CWA and Section 13370 of the Porter-Cologne Water Quality Control Act. Construction activities of five acres or more are subject to the permitting requirements of the NPDES General Permit for Discharges of Stormwater Runoff Associated with Construction Activity (General Construction Permit). The general construction permit requires a stormwater pollution prevention plan (SWPPP) to be implemented. The plan includes specifications for BMPs that would be implemented during project construction to control contamination of surface flows through measures to prevent the potential discharge of pollutants from the construction area. Additionally, the plan describes measures to prevent or control pollutants in runoff after construction is complete and identifies a plan to inspect and maintain these facilities or project elements.

3.3 BIOLOGICAL RESOURCES

3.3.1 Introduction/Region of Influence

A comprehensive study of the ecosystem of Bolinas Lagoon has not been conducted since 1968 (Gustafson 1968). However, numerous focused studies and surveys have been conducted since that time. This section attempts to compile these focused studies and surveys into a broad ecosystem overview of the lagoon. Given the variety of techniques, focuses, and time periods with which these studies were conducted, it is important to note that some data gaps and discrepancies are inevitable.

Biological resource data were collected from various sources, including a search of available literature, the CDFG Natural Diversity Database (CNDDB), and conversations with local biologists. For the purpose of this report, biological resources are defined as all habitat communities and plant and animal species, including special status species, that inhabit Bolinas Lagoon and the surrounding watershed. Special status species are defined as those plant and animal species that are listed as threatened or endangered by the USFWS, NMFS, or CDFG.

Bolinas Lagoon was designated a Wetland of International Importance in 1998 by the USFWS under the Convention on Wetlands (Ramsar 2000; USFWS 1998). The lagoon attracts more than 35,000 birds annually (Shuford et al. 1989) and is a critical feeding ground and stopover for migratory birds on the Pacific Flyway. The tidal flats of Bolinas Lagoon serve as primary foraging habitat of many of the region's most abundant shorebirds (Page and Shuford 1999), primarily feeding on invertebrates, crustaceans, and small fish (Audubon Canyon Ranch 1996; Stenzel et al. 1983).

The ROI for biological resources includes Bolinas Lagoon, adjacent upland, and Bolinas Bay.

This section includes a general description of the habitat types and associated wildlife potentially occurring in and around Bolinas Lagoon. The following description is divided into Vegetation/Habitat, Wildlife, and Sensitive Species sections. These have been further divided into Estuarine (marine influenced) and Upland (including freshwater) areas.

3.3.2 Vegetation/Habitats

Much of the Bolinas watershed is composed of overlapping habitats (Figure 3-9), which are defined differently by the Corps than they are by MCOSD. This section breaks down the habitats into two general types, estuarine and upland. Estuarine habitat contains two further subdivisions, subtidal and intertidal. When exact measurements of habitat types are presented, habitat types are defined according to the Corps' definitions (Corps 1999c); however habitat types and associated plant and wildlife species are categorized according to their descriptions in the Bolinas Lagoon Management Plan (BLMP) (MCOSD 1996).

3-9 Habitat Types

For the purposes of this EIS/EIR, habitats are defined by the Corps as follows: Upland habitat is the area between 2.54 and 7.00 ft NGVD, intertidal habitat is from -1.36 to 2.54 feet NGVD, and subtidal habitat is anything below -1.36 ft NGVD.

Estuarine Habitats

Estuarine habitat, according to the Corps, can be further subdivided into two types of habitat: subtidal and intertidal. Subtidal habitat is the "area that remains submerged during a typical spring and neap tide." Intertidal habitat is defined as "the area that experiences wetting and drying during a one-month period with typical spring and neap tides" (Corps 1999c). (Spring and neap tides are fully defined in the discussion of hydrology in Section 3.2.)

Due to sedimentation, the amount of estuarine habitat in Bolinas Lagoon decreased substantially between 1968 and 1998. The subtidal acreage decreased by 28.8 percent, while the tidal acreage decreased by 4.8 percent. At the same time, the amount of upland habitat increased by 67.1 percent (Table 3-2) (Corps 1999c).

Table 3-2
Changes in Bolinas Lagoon Habitat Acreages Over Time

Year		Upland	Intertidal	Subtidal
1968 (Acres Measured)		156	876	213
1998 (Acres Measured)		238	849	146
2058 (Acres Predicted)		316	823	83
1968-1998	**Total Measured Change (acres)**	82	-27	-67
	% Measured Change	+53%	-3%	-31%
1968-2058	**Total Predicted Change (acres)**	160	-53	-130
	% Predicted Change	+103%	-6%	-61%

Source: Romanoski 2002b.

Based on modeling by the Corps, this trend is expected to continue. By the year 2058, the amount of subtidal habitat is expected to decrease by 63 percent compared to 1968, the amount of intertidal habitat is expected to decrease by 7 percent, and the amount of upland habitat is expected to increase by 99 percent.

Given that estuarine habitats have decreased and are expected to continue to decrease, and that subtidal and intertidal habitats are the major sources of primary production, loss of biodiversity is a concern for Bolinas Lagoon. Existing species present in both the estuarine and upland habitats of Bolinas Watershed are described below.

Subtidal Channels

The bottom substrate of subtidal habitat is characterized by soft mud and sand with a general lack of vascular plants; however, some of the deeper channels may contain plants such as eelgrass *(Zostera marina)* and maiden's hair *(Gracilaria* spp.*)* (Gustafson 1968). Eelgrass beds provide important habitat for a variety of invertebrate and vertebrate species. Currently, only one eelgrass bed is known to exist in Bolinas

Lagoon. This eelgrass bed is approximately 1200 square feet in area and is located in the Kent Island Channel (Moore 2000).

The water depth, salinity, and biological composition are strongly influenced by the tidal action of the Pacific Ocean. The most significant primary producers of oxygen in subtidal habitats are phytoplankton and benthic diatoms (microflora) that become suspended in the water column during daily tidal cycles. In addition to suspending organisms already present in the area, daily tidal actions introduce a substantial volume of ocean water that carries both passively suspended and actively swimming organisms (MCOSD 1996). As described earlier, the amount of subtidal habitat in Bolinas Lagoon is decreasing (Table 3-2).

Intertidal Mudflats

The intertidal mudflat is defined as habitat between mean low lower water (MLLW) and mean high water (MHW). The habitat varies with the tide from relatively lifeless shallow water to a large exposed mudflat (MCOSD 1996). The intertidal mudflat makes up the majority of the "tidal flat" area, defined earlier as "the area that experiences wetting and drying during a one-month period with typical spring and neap tides" (Corps 1999c). The remainder of the "tidal flat" consists of emergent saltmarsh, described in the next subsection.

Intertidal mudflats have a low abundance of vascular plants. Eelgrass historically occurred in this zone of Bolinas Lagoon (MCOSD 1996). The primary producers of the intertidal and subtidal areas are the macroalgae. Filamentous algae, including *Rhizoclonium* and *Enteromorpha*, have been found on vast areas of the tidal flat. In addition, *Ulva* is commonly found on the tidal flats and forms beds in the low tide zones (Stenzel et al. 1983). Detritus and benthic diatoms are also relatively abundant.

The total amount of intertidal mudflat acreage increased from 510 to 700 acres between 1968 and 1988. This habitat, however, is expected to decrease to 480 acres by 2008 (MCOSD 1996).

Emergent Salt Marsh

Emergent salt marsh is defined as the relatively narrow elevation band between MHW and extreme high water (EHW) (MCOSD 1996). According to this definition, emergent salt marsh includes the upper portion of "tidal flat" habitat, and the lower portion of "upland habitat" as defined by the Corps (Corps 1999c). Due to the overlap between tidal and upland habitats, acreage estimates cannot be made using the Corps' 1999 survey data (Corps 1999c).

As intertidal and subtidal habitat decreases, however, the total acreage of emergent salt marsh is expected to increase. According to the Bolinas Lagoon Management Plan:

> Emergent salt marsh occurs on the margins of Pine Gulch Creek delta, Kent Island, and in a narrow band along the fringes of the lagoon. . . Benthic algae

are an important element of the primary production of tidal marshes (Zedler 1982). Algal mats in tidal marshes consist of green algae, such as *Enteromorpha*, and bluegreen algae, such as *Microcoleus* and *Schizothrix*, and numerous species of diatoms.

Two dominant plant species are Pacific cordgrass (*Spartina foliosa*) and pickleweed (*Salicornia virginica*). Pickleweed occurs at higher elevations, approximately MHW to above tidal action where salt is still present in the soil. The lower areas are dominated by pickleweed interspersed with fleshy jaumea *(Jaumea carnosa)*, arrow grass *(Triglochin concinna)*, and sea lavender *(Limonium californicum).* Salt marsh dodder *(Cuscuta salina)* is a parasitic plant found in association with pickleweed and other salt marsh species at various elevations. Alkali heath *(Frankenia grandifolia)* can be found in the midrange elevation. Salt grass *(Distichlis spicata)* and saltbush *(Atriplex watsonii)* interspersed with rush *(Juncus* spp.*)* are dominant in the higher areas. Where freshwater flows into the lagoon, brackish marsh forms with species such as cattails *(Typha latifolia)* and bulrush *(Scirpus* spp.*)* (MCOSD 1996).

Freshwater and Upland Habitats

As the estuarine habitats transition from subtidal to tidal flats and tidal flats transition to emergent salt marsh due to the sedimentation process, the upland habitat is increasing at the margins of Bolinas Lagoon (Table 3-2).

In several areas within the lagoon and along its border, exposed sand substrate has created sandbars and beaches. Proceeding inland from the margins of the lagoon, the watershed consists of freshwater streams draining steep canyons. The streams are bordered by coniferous and mixed evergreen forest. Proceeding up the canyons toward the ridges, the vegetation cover transitions from forest to coastal scrub, chaparral, and annual prairie/grassland.

Sand Bars and Beaches

Stinson Beach sand spit and Kent Island are the major sandy areas of Bolinas Lagoon. Stinson Beach sand spit, which is located at the southern perimeter of the lagoon between the towns of Bolinas and Stinson Beach, provides a buffer from storm waves. Kent Island is located just north of the entrance of the lagoon.

Freshwater Marsh and Riparian Habitat

Many freshwater creeks drain the 16.7-square mile watershed of Bolinas Lagoon. Pine Gulch Creek is a perennial stream that drains half the watershed basin and enters the lagoon from the west. Eucalyptus trees are present in the riparian areas surrounding Pine Gulch Creek. Easkoot Creek, also a tributary to the lagoon, enters the lagoon at the south end. The eastern creeks, which drain steep canyons, are intermittent/ephemeral at lower elevations but are often perennial at higher elevations (i.e., are dry for part of the year only in the lower elevations) (Fong 2000a). Where the streams enter the lagoon, the mix of fresh and salt water supports brackish marsh.

Species such as cattails and bulrush are found in the brackish marsh areas of the lagoon (MCOSD 1996).

Riparian habitat is increasing along the margins of the lagoon. The creek deltas are expanding into the lagoon due to large annual sediment loads carried out of the channelized eastern tributaries. The expanding marshlands are creating suitable substrate for riparian vegetation to establish on the landward margins (MCOSD 1996). The montane riparian vegetation typically includes red alder *(Alnus rubra)* and willow *(Salix* spp.*)* (MCOSD 1996; Mayer and Laudenslayer 1988).

Upland Habitat - Forest, Scrub, and Grassland

Mixed evergreen forests extend up the canyons, gulches, and ridges of the lagoon watershed, grading into coastal scrub and annual/perennial grasslands on more exposed slopes. Some chaparral is present, although it occurs more commonly inland. In the shady canyon areas, coast redwood forests have reestablished themselves by sprouting from the stumps left from logging operations (Gustafson 1968). Coast live oak, Douglas fir, and bay make up the mixed evergreen woods on the ridges and canyon slopes (Rowntree 1973). The main species found in the coastal scrub include *Baccharis* sp. and California sagebrush *(Artemesia californica)* (Szychowski 1999).

3.3.3 Wildlife Communities

Numerous wildlife species occupy the estuarine and upland habitats found in the lagoon. While some species are residents, others are migrant visitors. Many of the species use multiple habitats. The descriptions below are intended to illustrate representative wildlife communities within the lagoon.

Estuarine Communities

Subtidal Wildlife

Phytoplankton and benthic diatoms support a highly productive and diverse wildlife community in the subtidal regions of the lagoon. These organisms provide the base of the subtidal food chain.

Marine zooplankton, such as copepods, cladocerans, ostracods, and arrow worms, are the primary grazers of phytoplankton. During certain times of year, zooplankton may be dominated by planktonic stages of benthic invertebrates, such as bryozoans, echinoderms, polychaetes, bivalves, and gastropods. The predominant deposit feeders in subtidal habitat are polychaetes (segmented worms) (MCOSD 1996).

The primary consumers of phytoplankton and zooplankton are filter feeders and fish. The filter feeding community consists mainly of clams and worms. Prime shellfish habitat once covered a large portion of the southern half of the lagoon but now is restricted to a narrow band of sandy substrate near the lagoon mouth. Little recent information is available on the distribution and abundance of clams or other macroinvertebrates in the lagoon. Primary consumer fish species include topsmelt

(Atherinops affinis), Pacific herring *(Clupea harengus pallasi)*, and Northern anchovy *(Engraulis mordax)*. Bird species, such as the northern shoveler *(Anas clypeata)*, also feed on phytoplankton and zooplankton (MCOSD 1996).

Ghost shrimp *(Callianasa californiensis)* are commonly found in the sandy substrata within the Lagoon. In addition to filter feeding on diatoms living on the lagoon floor by pumping water from the surface through its burrows, ghost shrimp feed on subsurface organic material. It is this ability to remove organic material from mud and sand that causes ghost shrimp to be an important member of the subtidal community. Without this activity, organic debris would quickly accumulate, depleting surface oxygen, and causing anaerobic sulfur bacteria to eventually bloom (MCOSD 1996).

Fish and bird species dominate the secondary consumer community. The most common fish include the leopard shark *(Triakis semifasciata)*, bat ray *(Myliobates californica)*, several species of flatfish, and surfperch. Bird species, including herons and egrets, commonly forage in the shallow subtidal regions. For instance, herring, smelt, and surfperch are important prey for birds, such as grebes, cormorants *(Phalacrocorax* spp.*)*, ospreys *(Pandion haliaetus)*, herons, egrets, and terns *(Sterna* spp.*)* that are found in the lagoon (MCOSD 1996). Brown pelicans *(Pelecanus occidentalis)* feed in the lagoon for pelagic fish species, such as northern anchovy, and topsmelt. Terns generally feed on the smaller fish found near the surface, such as topsmelt and northern anchovy (MCOSD 1996).

Numerous other species use the subtidal areas. Other common fish species found in the subtidal open water habitat at Bolinas Lagoon are surf smelt *(Hypomesus pretiosus)*, arrow goby *(Clevlandia ios)*, shiner surfperch *(Cymatogaster aggregata)*, and English sole *(Parophyrus vetulis)*. The CDFG has sampled fish and invertebrate species in Bolinas Lagoon on several occasions between 1994 and 1998. Sampling gear used during these surveys includes beach seine, otter trawl nets, and crab traps (CDFG 2000c).

One important result of the CDFG sampling surveys has been the capture of larval Pacific herring and juvenile California halibut *(Paralichthys californicus)*. This indicates that Bolinas Lagoon provides breeding habitat for herring and juvenile rearing habitat for halibut. California halibut is an important sport fishing species, and both species are considered important commercially (CDFG 2000b).

Harbor seals *(Phoca vitulina richardsi)* use the main channel to enter and exit the lagoon and access favored haul-out and pupping sites, but it is not known to what extent they forage within the lagoon (see special status species section).

Intertidal Wildlife

The soft substrate of the intertidal mudflat makes respiration, acquisition of food, and location of attachment sites challenging for invertebrates. Consequently, a rather specialized invertebrate community has evolved in the intertidal areas (Ricketts and Calvin 1968).

The most recent biological surveys of the intertidal regions in the lagoon were presented in the BLMP (MCOSD 1996). Benthic meiofauna play a significant role in the grazing and processing of primary production by benthic diatoms. Crabs, particularly the green shore crab *(Hemigrapsus oregonensis),* are important grazers on the mudflat. The green shore crab feeds mainly on diatoms and green algae. On the higher intertidal mudflats, the California horn snail *(Cerethidia californica)* is a dominant grazer, feeding on fine organic detritus and microorganisms occurring at the mud surface.

Fish that inhabit intertidal flats include gobies and sculpin, and species such as sharks and rays move from the subtidal areas into flooded tidal flats to forage on the abundant benthic invertebrates. Some small, channel-dwelling fish species (e.g., sculpin) are prey for shorebirds (egrets, herons, and kingfishers) (Stenzel et al. 1983). Topsmelt and jacksmelt *(Atherinopsis californiensis)* enter on rising tides and are taken by osprey.

A distinctive feature of the intertidal mudflat is the abundance of shorebirds. The most numerous are the dunlin *(Calidris alpina),* least and western sandpiper *(C. minutilla* and *C. mauri),* marbled godwit *(Limosa fedoa),* willet *(Catoptrophorus semipalmatus),* and American avocet *(Recurvirostra americana).* Dowitchers *(Limnodromus* sp.*),* like other "surface" feeding shorebirds, are primarily confined to tidally exposed portions of mudflat and feed on small invertebrates on and just below the surface of the mud. The western sandpiper is a common migrant occurring in flocks of up to 30,000. American Avocets have strongly upcurved bills that allow them to forage in shallow water channels, low marsh, and on mudflats. Polychaetes and amphipods are the most important prey species for Bolinas Lagoon shorebirds (Stenzel et al 1983). They are found in the diet of nearly all lagoon species except long-billed curlew *(Numenius americanus),* which tend to feed on large burrow-dwelling prey such as mud shrimp, ghost shrimp, and mud crab (Stenzel et al. 1976). Other important prey species include small crustaceans, such as ostracods, cumaceans, and copepods (Stenzel et al. 1983).

Some nonnative invertebrate species inhabit the intertidal flats and serve as prey for shorebirds. The impacts of invasive species, including the european green crab *(Carcinus maenas),* on the Bolinas lagoon ecosystem may be important, as introduced species are thought to directly affect native populations (UCCE 2000).

Herons and egrets take fish and invertebrates in the intertidal flats but may also forage extensively in salt marsh and upland areas. The American peregrine falcon *(Falco peregrinus)* is listed as endangered by the CDFG. Peregrines take shorebirds and waterfowl in open water and intertidal mudflat habitats. Due to propagation measures, peregrine falcons have become year long residents, with migrating falcons greatly increasing the local population in the winter and spring (Stallcup 2001). The peregrines are known to forage on a variety of bird species and rodents along the shoreline and exposed mudflats (MCOSD 1996).

Emergent Saltmarsh Wildlife

Emergent saltmarsh provides less important invertebrate habitat than the adjacent subtidal and intertidal areas (MCOSD 1996). The invertebrate community consists of mainly benthic and epibenthic fauna. Molluscan communities are usually dominated by epifaunal surface feeders, such as the horn snail, which are important grazers on marsh algal mats (MCOSD 1996).

As presented in the 1996 BLMP,

> fish species likely to inhabit tidal marsh and channels include topsmelt, shiner surfperch, staghorn sculpin *(Leptocottus armatus)*, and longjaw mudsucker *(Gillichthys mirabilis)*. Fish using tidal marsh and channel employ two general strategies. Relatively efficient swimmers such as topsmelt and shiner surfperch move into intertidal habitats on incoming tides to feed, and move out on outgoing tides to avoid becoming stranded. Benthic species such as staghorn sculpin and longjaw mudsucker remain in tidal channels in the salt marsh habitat and retreat into burrows and depressions when the tide goes out (MCOSD 1996).

Tidal channels provide a significant foraging area for piscivorous (fish eating) wading birds, such as herons and egrets. The snowy egret *(Egretta thula)* and great egret *(Casmerodius albus)* are resident species that rely on upland riparian habitats for nesting.

Raptors use the emergent saltmarsh as foraging habitat. Birds and mammals such as voles could occupy densely vegetated areas in the marsh (MCOSD 1996).

Freshwater and Upland Wildlife Communities

Sandbars and Beaches

Shorebirds, terns, gulls, and brown pelicans feed and rest on the offshore bars, and in the past western snowy plover *(Charadrius alexandrinus)* nested on the beach at the tip of the spit. This habitat serves as an important haul-out and pupping area for harbor seals (Allen 2000) (see discussion in special status species section).

Freshwater, Marsh, and Riparian

Riparian vegetation along Pine Gulch Creek provides habitat for invertebrates, reptiles, amphibians, birds, and mammals.

The freshwater streams and associated riparian areas support anadromous and freshwater fish and a diversity of bird species. Since the eastern creeks are dry in the summer and drain steep canyons, they provide accessible habitat in a limited range, although striped bass (an invasive alien species) and remnant steelhead populations have been observed (MCOSD 1996). There is a growing Steelhead trout *(Oncorhynchus mykiss)* population inhabiting Easkoot Creek. Juvenile steelhead have also been observed in the creeks of Audubon Canyon (Szychowski 1999). Historically, coho salmon *(O. kisutch)* spawned and reared in Pine Gulch and Easkoot creeks. This range has been diminished, and now only Pine Gulch Creek is known to contain coho (Ketchum 2001).

Pine Gulch Creek supports three freshwater species: threespine stickleback *(Gasterosteus aculeatus)*, prickly sculpin *(Cottus asper)*, and California roach *(Hesperoleucus symmetricus)* (MCOSD 1996). Since the late 1960s, use of Pine Gulch Creek by these more estuarine species has likely declined or been restricted downstream to the mouth of the creek (MCOSD 1996). Two anadromous species, steelhead and lamprey *(Lampetra* spp.*)*, were observed in Pine Gulch Creek during surveys conducted between 1994 and 1996 (CDFG 2000b).

A dense tangle of riparian vegetation dominated by red alder and willow has been used by migrant land birds. Bird use of this area includes species never before recorded in California. These include sulphur-bellied flycatcher *(Myiodynastes luteiventris)*, sedge wren *(Cistothorus platensis)*, yellow warbler *(Dendroica petechia)*, and yellow-breasted chat *(Icteria virens)*, as well as rare transient species, such as long-eared owl *(Asio otus)*, mourning warbler *(Oporornis philadelphia)*, and dusky-capped flycatcher *(Myiarchus tuberculifer)* (MCOSD 1996). The riparian habitat in the PGC Delta, which developed during the second half of the twentieth century, is used primarily as a migrant stop from August to October, while deciduous trees still have leaves. It also is used as spring breeding habitat and migrant roost cover for several rare species, including green heron *(Butorides virescens)*, red-shouldered hawk *(Buteo lineatus)*, long-eared owl, yellow warbler, and yellow-breasted chat (MCOSD 1996). The state threatened California black rail *(Laterallus jamaicensis)* has been identified frequently at PGC Delta and is thought to be a year-round resident (Shuford 1989).

Upland Forest, Scrub, and Grasslands

Large wading birds depend upon the redwood habitat adjacent to the lagoon. As many as 150 pairs of herons and egrets have nested in the redwood canyon at Audubon Canyon Ranch (Pratt 1983), and 10 pairs of herons nest in trees near Francisco Mesa in Bolinas (MCOSD 1996). Numbers of nesting herons and egrets have fallen in recent years, down to approximately 85 nests. Some of this decrease is likely the result of predation by ravens (Shinske 1996). In the past 15 years, black-crowned night herons *(Nycticorax nycticorax)* have been sighted in the lagoon area, although reliable counts of the species have not been obtained (Stenzel 2000). More recently, black-crowned night herons have also been sighted in the cypress trees along the edge of Francisco Mesa (MCOSD 1996), while small numbers have been found nesting in McKennan Gulch (Stenzel 2000). Wintering monarch butterflies *(Danus plexippus)* roost in trees and shrubs in the vicinity of the lagoon (MCOSD 1996).

3.3.4 Special Status Species

Special status species are defined as those plant and animal species that are listed as threatened, endangered, or of special concern by the USFWS, NMFS, or CDFG, including those species proposed for federal or state listing. Plants listed by the CNPS also are included (Table 3-3, Figure 3-10).

Table 3-3
Special Status Species Potentially Occurring in Bolinas Lagoon

Scientific Name	Common Name	Federal / State / CNPS Listing	Habitat	Likelihood of Occurrence Confirmed (C) / Potential (P)
Plants				
Alopecurus aequalis var. *sonomensis*	Sonoma alopecurus	E/-/-	Freshwater marsh, riparian scrub	P
Arctostaphylos hookeri ssp. *Montana*	Mt. Tamalpais manzanita	SC/-/1B	Serpentine slopes in chaparral and grassland	P
Arctostaphylos virgata	Marin manzanita	-/-/1B	Douglas fir forest	C
Boschniakia hookeri	Small groundcone	-/-/2	Open woods, shrubby places	P
Calamagrostis crassiglumis	Thurber's reed grass	SC/-/2	Coastal scrub, freshwater marsh	P
Castilleja affinis ssp. *neglecta*	Tiburon paintbrush	E/T/1B	Valley and foothill sites, rocky serpentine sites	P
Ceanothus masonii	Mason's ceanothus	SC/-/1B	Chaparral	P
Chorizanthe cuspidata var. *cuspidata*	San Francisco Bay spineflower	SC/-/1B	Coastal bluff, scrub, dunes, prairie	P
Cirsium hydrophilum var. *vaseyi*	Mt. Tamalpais thistle	SC/-/1B	Serpentine seeps in upland forest or chaparral	P
Cordylanthus maritimus ssp. *palustris*	Point Reyes bird's beak	-/-/1B	Salt marsh	C
Dirca occidentalis	Western leatherwood	-/-/1B	Broadleaf upland forest, chaparral, closed-cone coniferous forest	P
Fritillaria affinis var. *tristulis*	Marin checker lily	-/-/1B	Coastal scrub	P
Grindelia hirsutula var. *maritima*	San Francisco gumplant	SC/-/-	Coastal bluff, sandy or serpentine slopes	P
Helianthella castanea	Diablo helianthella (rock rose)	SC*/-/-	Chaparral, coastal scrub, riparian woodland, valley and foothill grassland	P
Hesperolinon congestum	Marin western flax	T/T/1B	Serpentine chaparral, serpentine grassland	P
Horkelia marinensis	Point Reyes horkelia	SC/-/1B	Sandy flats and dunes near coast	P
H. tenuiloba	Thin-lobed horkelia	-/-/1B	Chaparral, coastal scrub	P
Lessingia micradenia var. *micradenia*	Tamalpais lessingia	SC/-/1B	Serpentine grassland, serpentine chaparral	P
Microcina tiburona	Tiburon micro-blind harvestman	SC/-/-	Open hilly grassland in areas of serpentine bedrock, near permanent springs	P
Microseris decipiens	Santa Cruz microseris	SC/-/1B	Coastal prairie, coastal scrub, forest, chaparral	P
Navarretia rosulata	Marin County navarretia	-/-/1B	Closed-cone coniferous, chaparral, serpentine	P
Pentachaeta bellidiflora	White-rayed pentachaeta	E*/E/1B	Valley and foothill grassland, Open dry rocky slopes and grassy areas	P
Pleuropogon hooverianus	North coast semaphore grass	SC/R/1B	Wet, grassy, shady areas, freshwater marsh, forests	P
Polygonum marinense	Marin knotweed	SC/-/3	Coastal marshes and brackish swamps	P
Sidalcea calycosa ssp. *Rhizomata*	Point Reyes checkerbloom	-/-/1B	Freshwater marsh	P

Scientific Name	Common Name	Federal/ State/CNPS Listing	Habitat	Likelihood of Occurrence Confirmed (C) / Potential (P)
S. hickmanii ssp. *Viridis*	Marin checkerbloom	SC/-/1B	Serpentine chaparral	C
Streptanthus batrachopus	Tamalpais jewel-flower	SC/-/1B	Coniferous forest, chaparral	P

Table 3-3
Special Status Species Potentially Occurring in Bolinas Lagoon *(continued)*

Scientific Name	Common Name	Federal/ State/CNPS Listing	Habitat	Likelihood of Occurrence Confirmed (C) / Potential (P)
S. glandulosus ssp. *pulchellus*	Mt. Tamalpais jewel-flower	SC/-/1B	Serpentine slopes in chaparral and grassland	P
Streptanthus niger	Tiburon jewel-flower	E/E/1B	Valley and foothill grassland	P
Trifolium amoenum	Showy Indian clover	E*/-/1B	Grassland, coastal bluff scrub, serpentine	C
Triphysaria floribunda	San Francisco owl's-clover	SC/-/1B	Coastal prairie, serpentine and non-serpentine substrate	P
Invertebrates				
Adela oplerella	Opler's longhorn moth	SC/-/-	Inner coast ranges in Marin to Oakland	P
Caecidotea tomalensis	Tomales isopod	SC/-/-	Freshwater ponds, streams	C
Cicindela hiricollis gravida	Sandy beach tiger beetle	SC/-/-	Along nonbrackish areas of coast	P
Danus plexippus	Monarch butterfly	-/-/-	Wind-protected tree groves (eucalyptus, Monterey pine, cypress) with nectar and water sources nearby	C
Hydrochara rickseckeri	Ricksecker's water scavenger beetle	SC/-/-	Aquatic	C
Incisalia mossii	Marin elfin butterfly	SC/-/-	Rocky outcrops, woody canyons, cliffs	P
Speyeria zerene myrtleae	Myrtle's silverspot butterfly	E/-/-	Coastal dunes, coastal scrub, coastal grassland	P
Fish				
Eucyclogobius newberryi	Tidewater goby	E/-/-	Shallow lagoons and lower stream reaches	P
Lampetra tridentata	Pacific (river) lamprey	SC/-/-	Young: Cool, flowing, freshwater and backwater; Adults: bay and ocean water	P
Oncorhynchus kisutch	Coho salmon	T/E/-	Covered, cool streams, gravel beds	P
O. s kisutch	Critical habitat, coho salmon, central California coast	T/-/-	Covered, cool streams, gravel beds	P
O. mykiss	Steelhead trout	T/-/-	Anadromous, covered cool streams, gravel beds	C
Amphibians/Reptiles				
Clemmys marmorata marmorata	Northwestern pond turtle	SC/-/-	Near permanent water in a variety of habitats	P
Phrynosoma coronatum frontale	California horned lizard	SC/-/-	Lowlands along sandy washes with scattered low bushes	P
Rana aurora aurora	Northern red-legged frog	SC/-/-	Humid forests, woodlands, grasslands, and streamsides	P

Table 3-3
Special Status Species Potentially Occurring in Bolinas Lagoon *(continued)*

Scientific Name	Common Name	Federal/ State/CNPS Listing	Habitat	Likelihood of Occurrence Confirmed (C) / Potential (P)
R. aurora draytonii	California red-legged frog	T/-/-	Foothills/lowlands near permanent source of deep water with dense, shrubby, riparian vegetation	C
R. boylii	Foothill yellow-legged frog	SC/-/-	Partly shaded shallow streams and riffles with rocky substrate	P
Birds				
Agelius tricolor	Tricolored blackbird	SC/-/-	Freshwater marsh, tules	P
Amphispiza belli belli	Bell's sage sparrow	SC/-/-	Chaparral and scrub habitats	P
Botarus lentiginosus	American bittern	SC/-/-	Fresh and salt emergent wetlands	C
Brachyramphus marmoratus	Marbled murrelet	T/-/-	Near-shore feeder, nests along coastline	P
B. marmoratus	Marbled murrelet, critical habitat	T/-/-	Coastal waters, tide rip, bays, mountains; nests exclusively in old growth forest	P
Branta canadensis leucopareaia	Aleutian Canada goose	T/-/-	Winters on lakes and inland prairies, forages on natural/cultivated grain pastures	C
Buteo regalis	Ferruginous hawk	SC/-/-	Open grasslands, sparse shrub; nests on elevated structures	P
Charadrius alexandrinus nivosus	Western snowy plover	T/-/-	Sand spits/beaches	C
Chlidonias niger	Black tern	SC/-/-	Coastal lagoons and estuaries during migration	C
Circus cyaneus	Northern harrier	-/-/-	Emergent marsh	C
Cypseloides niger	Black swift	SC/-/-	Canyon cliffs, sea bluffs	C
Falco peregrinus anatum	American peregrine falcon	D/-/-	Breeds near wetlands or bodies of water on high cliffs, dunes, etc.	C
Gavia immer	Common loon	SC/-/-	Shallow, marshy areas	C
Geothlypis trichas sinuosa	Saltmarsh common yellowthroat	SC/-/-	Fresh and salt marsh	C
Haliaetus leucocephalus	Bald eagle	T/-/-	Ocean shorelines, roosts in old growth trees	P
Histrionicus histrionicus	Harlequin duck	SC/-/-	Breeds on western slope of Sierra Nevada, nests on shores of swift, shallow rivers	C
Laterallus jamaicensis coturniculus	California black rail	-/T/-	Tidal marsh with pickleweed,, freshwater and brackish marsh	C
Numenius americanus	Long-billed curlew	SC/-/-	Coastal estuaries, open grasslands, croplands; nests in wet meadows	C
Nycticorax nycticorax	Black-crowned night heron	MB/-/-	Marshy spots	C
Oceanodroma homochroa	Ashy storm-petrel	SC/-/-	Colonial nester in offshore coastal islands	C
Pandion haliaetus	Osprey	-/-/-	Subtidal	C
Pelecanus occidentalis californicus	California brown pelican	E/-/-	Colonial nester on coastal islands, just beyond surf line	C
Rallus longirostris obsoletus	California clapper rail	E/E/-	Tidal salt marsh and brackish marsh	C
Strix occidentalis caurina	Northern Spotted Owl	T/-/-	Old growth forest	C
Mammals				

Table 3-3
Special Status Species Potentially Occurring in Bolinas Lagoon *(continued)*

Scientific Name	Common Name	Federal/ State/CNPS Listing	Habitat	Likelihood of Occurrence Confirmed (C) / Potential (P)
Aplodontia rufa phaea	Point Reyes Mountain beaver	SC/-/-	Springs, seepages, north facing slopes with sword ferns and thimbleberries	P
Corynorhinus townsendii townsendii	Townsend's (Pacific) western big-eared bat	SC/-/-	Buildings	P
Myotis evotis	Greater western mastiff-bat (long-eared myotis)	SC/-/-	All brush, woodland, and forest habitats, from sea level to 9,000 feet	P
M. yumanensis	Yuma myotis bat	SC/-/-	Forest and woodland with water over which to feed, buildings	P
Zapus trinotatus orarius	Point Reyes jumping mouse	SC/-/-	Riparian areas, grasslands, wet meadows	P

Sources: CDFG 1996, 1998, CDFG; MCOSD 1996; Pitelka 1979; Shuford 1989; Stenzel 2000; Szychowski 1999; USFWS 2000.

Notes:

Federal Status (USFWS)

E = Endangered
T = Threatened
C = Candidate (formerly C1)
MB = Migratory Bird
PE = Proposed endangered
PT = Proposed threatened
PX= Proposed Critical Habitat
SC = Species of Concern (formerly C2)
SCR = Species of Concern—recommended listing
(*) = Possibly extirpated from area
(**) = Possibly Extinct
D= Delisted

State Status (CDFG)

E = Endangered
T = Threatened
R = Rare
SC = California species of special concern
S* = Protected under CEQA

CNPS (California Native Plant Society) Status

List 1A = Presumed extinct in California
List 1B = Rare and endangered in California and elsewhere
List 3 = Need more information - a review list
List 4 = Limited distribution - a watch list

Anadromous Fishes

Anadromous salmonids pass through the lagoon en route to many of the creeks in the watershed. While steelhead trout are found in all the creeks that feed the lagoon (MCOSD 1996), they may not be able to grow to full size. This is because the majority of the streams in the watershed are dry during the summer, while a few are also affected by water diversions at Easkoot and Pine Gulch Creeks (Fong 2000b). Steelhead typically rear in freshwater for a full year before smolting (relocating to salt water). A recent 2-year study conducted on three streams in Audubon Canyon found only juvenile (young-of-the-year) steelhead trout (Szychowski 1999). Juvenile striped bass and coho salmon have not been seen in recent surveys; however, coho salmon were once common in Pine Gulch and Easkoot creeks (MCOSD 1996).

Since steelhead trout and coho salmon are listed as threatened under the federal Endangered Species Act, management decisions will have to consider impacts on these species.

Reptiles and Amphibians

California red-legged frogs *(Rana aurora draytonii)* have been observed in the vicinity of Bolinas Lagoon (Fong 2000a). Red-legged frogs require deep permanent sources of fresh water for breeding. As a result, they may occur in some of the tributaries and wetlands surrounding the lagoon.

3-10 Sensitive Species in Bolinas Lagoon and Watershed

Birds

Many special status bird species have been observed in the region (Table 3-3). A few of these species, such as the northern harrier *(Circus cyaneus)*, osprey, saltmarsh common yellowthroat *(Geothlypis trichas sinuosa)* and the western snowy plover, are likely to use the lagoon for breeding, roosting, and foraging. The western snowy plover, which depends on sandy areas for breeding, historically nested on the beach at the tip of the Stinson Beach sand spit (MCOSD 1996) and on the sand beach of Kent Island (Stenzel 2000). A greater sandplover *(Charadrius leschenaultii)*, the first of its kind to have been observed in the Western Hemisphere, has been sighted at the lagoon (Morlan 2001).

Sensitive Plant Communities

A majority of the special status plant species observed in the region exists in upland habitats. Many of these species grow in serpentine chaparral and serpentine grassland communities. These communities live in soils derived from serpentine rock, which is a metamorphic, magnesium silicate rock, often green in color. Since serpentine soils are often low in essential nutrients, high in toxic elements, and acidic or basic, they typically support specially adapted plants. Other special status plant species located in the uplands exist in coniferous forest and coastal scrub.

A few special status plants rely on estuarine and freshwater habitats like those found in the lagoon. Point Reyes bird's beak *(Cordylanthus maritimus* ssp. *palustris)* is a federal species of concern that exists in salt marsh habitat. Point Reyes checkerbloom *(Sidalcea calycosa* ssp. *rhizomata)*, which is listed by the California Native Plant Society as having 1B status, exists in freshwater marsh. Sonoma alopecurus *(Alopecurus aequalis var. sonomensis)*, a federal endangered species, depends on freshwater marsh and riparian scrub.

Harbor Seals

Harbor seals are present throughout the year in the Gulf of the Farallones, which includes the Bolinas Lagoon, and are estimated to comprise 20 percent of the California population (MCOSD 1996). Bolinas Lagoon and adjacent waters are important to GFNMS's harbor seal population. The population peaks in the lagoon during molt (May-June) after the pupping season, which corresponds with the seasonal declines at Double Point and Tomales Bay (MCOSD 1996).

Since 1970, the total population and the number of pups at Bolinas Lagoon has increased. Surveys by Point Reyes Bird Observatory between 1971 and 1976 found a maximum of 66 seals hauled-out in the lagoon, whereas 288 seals were observed in the lagoon in July 1996, and 322 were observed between March and July 1999 (MCOSD 1996; Allen 1999). The number of pups has increased from 12 pups in 1978-89; 40 in 1992; 28 in 1993; to 50 in 1999 (MCOSD 1996, Allen 1999).

The 1996 Bolinas Land Management Plan provides the following documentation of harbor seal activity in the lagoon:

Haul-out sites secure from disturbance are critical for harbor seal populations (Allen et al. 1984, 1989). Haul-out sites provide seals with resting, breeding, and nursery areas. These sites are used daily throughout the year and successively from year to year. The haul-out sites on Bolinas Lagoon have been Kent Island and Pickleweed Island with exposed sand bars along the main channel providing secondary sites. At Bolinas, harbor seals use haul-out sites primarily during daylight hours with peak numbers in early afternoon (Allen et al. 1984, 1989). During the breeding months, no relationship occurs between tide and number of animals hauled out (Allen et al. 1984), whereas during the non-breeding season more animals hauled out at low tide.

Harbor seals are opportunistic feeders and forage on shallow water estuarine and marine species of fish, cephalopods, and crustaceans. Many of their preferred prey species (e.g., jacksmelt, topsmelt, starry flounder *(Platichthys stellatus)*, and shiner surfperch) occur in Bolinas Lagoon, but no feeding studies have been conducted in the lagoon (MCOSD 1996).

The critical period for the harbor seal population at Bolinas Lagoon is during the spring and summer. This is because the seals pup between the months of March and June and molt during the month of July. The seals typically pup at haul-out sites between the mouth of the lagoon and Highway 1, and also along a 300 yard stretch where the Main Channel parallels Highway 1 (Allen 2000).

3.3.5 Regulatory Considerations

Endangered Species Act, 16 USC §§ 1531 – 1534

The ESA protects plant and animal species (and their habitats) that are listed as endangered and threatened. Species are listed as endangered if found to be in danger of extinction throughout all or a significant portion of their ranges; species are listed as threatened if they are likely to become endangered within the foreseeable future. The ESA also protects designated critical habitat for listed species, which are areas of physical or biological features essential to the conservation of the species and which may require special management considerations. The ESA requires federal agencies to consult with USFWS or NMFS, as applicable, before initiating any action that may affect a listed species.

California Endangered Species Act, Cal. Fish and Game Code 2070

The California Endangered Species Act (CESA) places the responsibility for maintaining a list of threatened and endangered species on the CDFG (Cal. Fish and Game Code 2070). The CDFG also maintains a list of candidate species that are under review for addition to either the list of endangered species or the list of threatened species. The CDFG also maintains lists of species of special concern, which serve as watch lists. Pursuant to the requirements of CESA, an agency reviewing a proposed project within its jurisdiction must determine whether any California-listed endangered or threatened species may be present in the project area and determine whether the proposed project will have a potentially significant impact on such species. In addition, CDFG encourages informal consultation on any proposed project that may affect a candidate species.

***Magnuson-Stevens Fishery Conservation and Management Act (MSA), 16 USC § 1801* et seq.**

The MSA applies to fisheries resources and fishing activities in federal waters that extend to 200 miles offshore. Under the MSA, there are eight Regional Fishery Management Councils, which prepare fishery management plans (FMP) for those fisheries that they determine require active federal management. After public hearings, revised FMPs are submitted to the Secretary of Commerce for approval. One of the major components of this act is the protection of areas deemed essential fish habitat (EFH) for species identified in FMPs. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Federal agencies must consult with NMFS on proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH.

Fish and Wildlife Coordination Act and Implementing Regulations, 16 USC §§ 661 – 666c

Any federal agency that proposes to control or modify any body of water must first consult with the USFWS or NMFS, as appropriate, and with the head of the appropriate state agency exercising administration over the wildlife resources of the affected state.

***Migratory Bird Treaty Act (MBTA), 16 USC § 703* et seq.**

The MBTA is a federal statute that implements US treaties with several countries concerning the conservation and protection of migratory birds. The number of bird species covered by the MBTA is extensive and is listed at 50 CFR § 10.13. Further, the regulatory definition of migratory bird is broad and includes any mutation or hybrid of a listed species, as well as any part, egg, or nest of such bird (50 CFR § 10.12). Migratory birds are not necessarily federally listed endangered or threatened under the ESA. The MBTA, which is enforced by the USFWS, makes it unlawful "by any means or manner, to pursue, hunt, take, capture [or] kill" any migratory bird except as permitted by regulation. The applicable regulations prohibit the take, possession, import, export, transport, sale purchase, barter, or the offering of these activities, except as permitted by the implementing regulations.

Marin Countywide Plan

Relevant policies of the Marin Countywide Plan include:

> **Program EQ-2.43a**: Wetland Impact Mitigation. Development should be sited to avoid wetland areas so that the existing wetlands are preserved. The next priority would be to restore or enhance the wetland environment on-site, porvided that no net loss of wetlands occurs. Restoration of wetlands off-site should only be allowed when it has been demonstrated that on-site restoration

is not possible and there is no net loss of wetlands. For each acre of wetland lost, two acres shall be restored and should be of the same type of wetland habitat as the wetland which was lost.

Program EQ-2.43c: Criteria for Evaluating Projects. The following criteria shall be considered, when evaluating development projects which may impact wetland areas and should be incorporated into mitigation measures:

(a) No net losses shall occur in wetland acreage, functions and values...

3.4 Geology, Soils, and Seismicity

3.4.1 Introduction / Region of Influence

Bolinas Lagoon is in the California Coast Range physiographic province, which is characterized by northwest-trending mountain ranges that generally parallel the coast. The study area includes the watershed of Bolinas Lagoon and adjacent portions of Bolinas Bay. The watershed includes the portion of the Bolinas Peninsula that drains to Pine Gulch Creek on the west and a set of parallel drainages from Bolinas Ridge on the east. The watershed covers an area of approximately 16.7 square miles (Ritter 1973). The lagoon itself covers approximately 1.7 square miles (1,100 acres) (Bergquist 1978).

The ROI for the project includes the project site and surrounding land that would directly interact with or be influenced by project components.

3.4.2 Geology and Geomorphology

Physiographic Setting

The southern end of the peninsula, on which the town of Bolinas is situated, is a broad gently sloping marine terrace that ranges in elevation from 48 to 67 meters (157 to 220 feet) MSL. The terrace, called the Mesa, is an ancient wave-cut platform that has been uplifted. Around the outer edge of the peninsula is a shallow shelf of wave-cut shale rock called Duxbury Reef which extends 5000 feet in a southwestern direction into ocean tidal zone. The Bolinas Peninsula is divided by a northwest-trending ridge, called Stewart Point, which extends into the Point Reyes National Seashore, where it rises to elevations of more than 1,000 feet MSL. East of this ridge is the San Andreas Rift Zone, which contains the main drainage of Pine Gulch Creek.

The eastern boundary of the study area is Bolinas Ridge, an approximately 14-kilometer (8.75 mile) long northwest-trending feature that slopes from about 1,950 feet near the south end of Bolinas Lagoon to about 488 feet north of Tomales Bay.

Geology

Figure 3-11 is a regional geologic map showing the study area in relation to larger-scale geologic features. One of the most important geologic features affecting the formation of the lagoon is the San Andreas Fault, which runs from near the Gulf of California to Cape Mendocino. The San Andreas Fault represents the boundary between two plates of the earth's crust that have been moving in opposite directions at an average rate of several inches per year for approximately the past 15 million years or so. In the study area, several traces of the fault comprise a zone in which faulting has historically occurred. The fault zone is about 1.25 miles wide at the mouth of the lagoon and narrows to about 1,500 feet wide along the Rift Zone between Bolinas Lagoon and Tomales Bay.

3-11 Geology of the Bolinas Lagoon Area

The crust on the west side of the fault is moving north relative to the North American continent. The basement rocks that underlie the Bolinas Peninsula are similar to granitic rocks found in southern California. The granitic rocks are not exposed in the immediate vicinity of Bolinas Lagoon, but they are exposed further north on the Point Reyes Peninsula. At Bolinas the granitic rocks are overlain by younger sedimentary rocks. The basement rocks on the east side of the San Andreas Fault consist of an assemblage of oceanic crustal rocks similar to those that underlie most of Marin County and the San Francisco Bay Area. Together, these basement rocks are known as the Franciscan Complex. The Franciscan rocks are exposed in the study area, but in some places they are also overlain by younger sedimentary deposits.

The lagoon itself occupies a graben, a geological structure resulting from subsidence of the land that lies between traces of the San Andreas Fault. The most westerly trace, which marks the western edge of the San Andreas Fault Zone, is also the oldest. The San Andreas Graben Fault forms the eastern edge of the Fault Zone. The 1906 Trace of San Andreas Fault, that ruptured in the 1906 earthquake lies about midway between these two (Figure 3-12) (Wagner 1977; Bergquist 1979).

The oldest exposed rocks on the Bolinas Peninsula belong to the Upper Miocene age (7-9 million years old) Santa Cruz Mudstone. The Santa Cruz Mudstone is exposed on a large portion of the southern part of the Point Reyes National Seashore west of the San Andreas Fault (Clark and Brabb 1997). The Santa Cruz Mudstone is an olive-gray to pale yellow-brown silica-rich mudstone with thin to thick bedding, which contains thin concretions of carbonate. Locally, it contains thin sandstone beds with tar residues that have been chemically correlated with similar deposits exposed in the cliffs near Davenport in Santa Cruz County. The implication is that the Point Reyes Peninsula has moved northward along the San Andreas Fault about 70 miles relative to the North American continent during the past 10 million years (Stanley and Lillis 2000). The Santa Cruz Mudstone unconformably overlies the Upper Miocene Monterey Formation, which is exposed north of the Bolinas Peninsula in the upper portion of the watershed of Pine Gulch Creek, and elsewhere on the Point Reyes Peninsula.

The Santa Cruz Mudstone is highly fractured and crumbles easily. The bedding in these rocks is tilted down to the west at an angle of about 40 to 60 degrees. As a result, steep unstable slopes tend to form on the eastern uptilted side of the peninsula, such as along the west bank of Pine Gulch Creek.. Unstable cliffs tend to form where wave action attacks the foot of slopes in the Santa Cruz mudstone, such as along the cliffs facing Bolinas Bay south of the Peninsula. The south-facing cliffs of Bolinas Peninsula are estimated to be retreating at an average rate of about 0.3 to 0.6 meters (1 to 2 feet) per year (Wagner 1977).

Overlying the Santa Cruz Mudstone, on the east side of the older trace of the San Andreas Fault are massive blue siltstones, clays, buff-colored sandstone, and gravels of the Merced Formation. The Merced Formation is more than 90 meters (292 feet) thick

3-12 Principal Regional Active Faults

in the study area and forms cliffs along the west side of Bolinas Lagoon. The bedding in the Merced Formation slopes down to the east at an angle of between 5 and 35 degrees. The deposits are not very well consolidated and erode easily, making them susceptible to debris-flow landslides (Wagner 1977). The cliffs between Brighton Road and Wharf Road, on the Bolinas Peninsula opposite the Stinson Beach sand spit, are estimated to be retreating at a rate of about 0.5 meters (1.6 feet) per year (Wagner 1977).

Filling depressions in the Santa Cruz Mudstone on the Bolinas Mesa are relatively thin unconsolidated deposits of silt, sand, and gravel derived mainly from erosion of the Santa Cruz Mudstone. In some areas, these terrace deposits contain boulders of Franciscan rocks that must have originated from the slopes east of the San Andreas Fault. The terrace deposits were formed during the last Ice Age, less than about 2 million years ago, when the Mesa was partially submerged below sea level.

At about the same time the terrace deposits were formed, stream gravels derived mainly from Franciscan rocks, but also containing Monterey and Merced formation material, were being deposited. These older stream gravels, in a sandy matrix, have been named the "Older alluvium" and are common in former streambeds within, or immediately adjacent to, the San Andreas Fault Zone. These deposits are easily eroded.

The east side of the San Andreas Fault Zone is underlain by rocks that are quite distinct from those on the west side. While the rocks on the east side of the fault share some general characteristics, they represent a variety of materials that were scraped onto the North American continental plate as it slid beneath the Pacific plate near the end of the age of dinosaurs, more than 65 million years ago. In the study area, the Franciscan rocks consist of melange, a chaotic mixture of sandstone, greenstone, chert, and other rocks in a sheared clayey matrix (Clark et al. 1991; Wagner 1977). The matrix is weak subject to erosion and slope failure. Because the slopes east of the San Andreas Fault Zone tend to be steep, erosion is slow but they are prone to landsliding.

Recent unconsolidated deposits in the study area consist of landslide deposits, alluvium, beach sand, and Bay mud. The Stinson Beach sand spit, which is about 3 kilometers (1.9 miles) long and nearly connects the Bolinas Peninsula to the mainland, is composed of beach sand deposits. In the mid-1960s, the lagoon side of the spit was dredged in order to extend the land upon which houses were later constructed. Between this extension and the original spit, Seadrift Lagoon, an artificial lagoon, was created (Bergquist 1978). A narrow opening in the sand spit at the foot of the Bolinas Peninsula, about 50 meters (163 feet) wide, allows water to flow in and out of the lagoon with changing tides. Kent Island, located just inside the lagoon from the mouth, is a tidal delta composed of beach sand deposits and formed from changing tides that move sand in and out of the inlet.

Wagner (1977) described the deposits within Bolinas Lagoon as Bay Mud. Bay Mud is a mixture of silt, clay, sand, shells, and organic material of recent age. It is watersaturated and poorly-consolidated, with the consistency of jelly. Ritter found that the median grain size of lagoon sediment and the sediment on beaches along the Stinson Beach sand spit is in the fine sand range. A larger proportion of silts and clays were found in the extremities of the lagoon than in the center of the lagoon, while the coarsest sediment was found near the mouths of some of the east shore streams on the east shore. Based on circulation studies using a dye tracer, Ritter concluded that the southeast extremity of the lagoon, the upper basin (north of the Pine Gulch Creek delta), and the tidal flat north of Kent Island are areas of net sediment deposition in the lagoon. Elsewhere, he concluded that current velocities are sufficient to transport and to resuspend sediment.

Seismicity

The US Geological Survey (USGS) estimates that there is a 70 percent probability of at least one magnitude 6.7 or greater earthquake, capable of causing widespread damage, striking the San Francisco Bay region before 2030. For the North Coast South segment of the San Andreas Fault (the segment that crosses Bolinas Lagoon), the probability of a magnitude 6.7 quake is estimated to be 12 percent in the next 30 years (Working Group 1999). Figure 3-12 shows active faults in the greater San Francisco Bay area. Refer also to Figure 3-11.

The USGS estimates that there is a 30 percent probability that within the next 30 years an earthquake similar in magnitude to the 1906 earthquake will occur on the northern segment of the San Andreas Fault. The 1906 earthquake is likely to have been associated with both vertical and horizontal displacement. Vertical displacement along the 1906 trace of the fault was estimated to be about 30 to 35 centimeters (12 to 14 inches) (Bergquist 1978). Horizontal displacements in the area, measured after the earthquake, ranged from about 3.7 meters (12 feet) near Bolinas Lagoon to about 6.1 meters (19.8 feet) near Point Reyes Station (Wagner 1977). Under the Alquist-Priolo Earthquake Fault Zones Act of 1972, the California Division of Mines and Geology is charged with delineating zones along active faults in which construction of structures for human habitation should be discouraged. Such a fault-rupture hazard zone has been designated within the project area along the trace of the San Andreas Fault.

Slope Stability, Bearing Capacity, and Liquefaction Potential

The Franciscan melange east of the San Andreas Fault is locally variable in stability. Depending on soil structure, landsliding can be common on steep slopes, but where large blocks of rock occur within the melange, its stability can be increased locally.

On the Bolinas Peninsula the principal stability problem is undercutting and collapse of cliffs underlain by Monterey shale. The slopes adjacent to the floodplain of Pine Gulch Creek are classified in the two least stable slope categories. This includes areas in which the slopes are near the stability limits of the underlying materials, or areas in which active downslope movement (landslides or slope creep) is occurring.

Level areas classified as stable slopes may be underlain by unstable deposits as well. Areas on the floodplain and delta of Pine Gulch Creek, which are underlain by loose, sandy materials with a high water table, may be vulnerable to liquefaction in an earthquake.

3.4.3 Soils and Erosion

Soils on Bolinas Ridge are generally thin, derived from the Franciscan melange, and easily eroded when disturbed or exposed to rainfall. Soils derived from the Monterey Formation, on the west side of the San Andreas Fault, are much less stable and much more easily eroded (Ritter 1973). Appendix C contains a comprehensive list of soils found in the Bolinas watershed and their properties.

Soils on land adjacent to the Bolinas Lagoon, including most of the Bolinas Peninsula and most of the watershed on the eastern side of Bolinas Lagoon belong to the Cronkhite-Dipsea-Centissima group. These include deep to moderately deep soils on steep slopes. The soils are generally described as moderately well drained (Kashiwagi 1985). Soils on the central ridge of the Bolinas Peninsula, west of Pine Gulch Creek, belong to the Palomarin-Wittenber group. These are shallow, well drained soils on moderately steep upland slopes. Soils on upland portions of the watersheds of most of the creeks that drain the east side of the San Andreas Fault (north of Morses Creek) belong to the Maymen-Maymen group, which are described as shallow to moderately deep, excessively-drained soils on steep slopes. Many of the soils in upland areas are characterized by a high degree of susceptibility to erosion. Erosion increases when the vegetation cover is reduced, such as from grazing or logging. Soil erosion also increases where slopes fail or are cut and filled.

3.4.4 Regulatory Considerations

The proposed project is within unincorporated Marin County and is subject to policies and programs of the Marin Countywide Plan, the Local Coastal Plan, and the GFNMS. A detailed discussion of regulations and policies related to the project is presented in Section 3.7, Land Use, and is therefore not repeated here.

3.5 CULTURAL RESOURCES

3.5.1 Introduction / Region of Influence

This section includes a definition of cultural resources and a summary of the cultural background of the project area. Also included are discussions of known resources and previous investigations and brief descriptions of federal and state regulations that pertain to cultural resources.

Cultural resources include prehistoric resources, Native American resources, and historic resources. Prehistoric resources are physical properties resulting from human activities that predate written records and are generally identified as isolated finds or sites. Prehistoric resources can include village sites, temporary camps, lithic scatters, roasting pits / hearths, milling features, petroglyphs, rock features, and burials.

Native American resources are sites, areas, and materials important to Native Americans for religious, spiritual, or traditional reasons. These resources may include villages, burials, petroglyphs, rock features, or spring locations. Fundamental to Native American religions is the belief in the sacred character of physical places, such as mountain peaks, springs, or burials. Traditional rituals often prescribe the use of particular native plants, animals, or minerals. Therefore, activities that may affect sacred areas, their accessibility, or the availability of materials used in traditional practices are of primary concern.

Historic resources consist of physical properties, structures, or built items resulting from human activities that post-date written records. Historic resources can include archaeological remains and architectural structures. Historic archaeological site types include townsites, homesteads, agricultural or ranching features, mining-related features, refuse concentrations, and features or artifacts associated with early military use of the land. Historic architectural resources can include houses; cabins; barns; lighthouses; local structures, such as churches, post offices, and meeting halls; and early military structures, such as hangars, administration buildings, barracks, officers' quarters, warehouses, and guardhouses.

The ROI for cultural resources is the Bolinas Lagoon and adjacent upland, and Bolinas Bay.

3.5.2 Cultural Background

The cultural background for the project area can be separated into three broad categories. Precontact history describes events prior to European exploration and influence in the Americas. Ethnohistory represents information gleaned from ethnographic sources (including oral histories and anthropological and sociological studies) and historical accounts of Native American groups within the project area. History is generally post-contact information gathered from written documents from the time of early European exploration until today.

Precontact History

California

It is generally believed that human occupation of the West Coast dates back to at least 10,000 years before present (BP). Several sites around California are thought to have been occupied between 40,000 to 200,000 years BP; however, the reliability of the dating techniques used and the validity of the artifacts found in those sites remains highly controversial (Moratto 1984).

Archaeological evidence for occupation of California during the Holocene Epoch (10,000 years BP to present) is stronger. Early Holocene Period (12,000 to 8,000 years BP) sites are common throughout California, including several located around the Bay Area from Monterey to Bodega Bay. Hunter/gatherers during this period appear to have been attracted to lacustrine, marshland, and estuarine settings for the varied and abundant resources found there. Milling-related artifacts are lacking during this period, but the atlatl (spear-thrower) and dart are common. Heat-treating of lithic materials for tool manufacture is also evident. Fishing and hunting of large and small game appears to have occurred. Limited permanent settlements may have been established near large water sources, but a nomadic lifestyle appears to have been more common (Moratto 1984).

Milling of plant materials appears to have commenced during periods of occupation later in the Holocene Epoch. Milling-related artifacts first appear in sites dating to the Early Horizon Period (8,000 to 4,000 years BP). Hunting and gathering continued during this period but with greater reliance on vegetal foods. Mussels and oysters appear to also have been a staple. This gave way to greater consumption of shellfish in the Middle Horizon Period (4,000 to 2,000 years BP). Use of bone artifacts appears to have increased during this period, and baked-earth steaming ovens were developed. Occupation of permanent or semi-permanent villages occurred in this period, as did reoccupation of seasonal sites. During the Late Horizon Period (2,000 years BP to European Contact), settlement of villages increased, as did trade between different groups (Moratto 1984). During this period, regional subcultures are thought to have developed, each with their own geographical territory and language or dialect.

Marin County

Relatively few archaeological investigations have been undertaken in Marin County. The earliest occupations currently recognized are shell middens that date to approximately 3,000 years BP (Gerike et al. 1996). Other excavations have focused primarily on the protohistoric or historically recognized villages of Coast Miwok (Dietz 1976). Although little archaeological research has been undertaken in the area, existing archaeological sites could nonetheless become significant sources of cultural data.

Ethnohistory

The Coast Miwok territory centered in present day Marin County and extended north to Sonoma County and Bodega Bay. Shelters were conical-shaped and covered with grass. Villages included sweathouses and ceremonial chambers. Seines, rafts, and weirs were constructed from tule balsa for fishing, and intricate baskets were woven for household uses. Subsistence was based on hunting, fishing, and gathering. A variety of large and small mammals were hunted, and fish, eels, and shellfish were taken from the ocean, lakes, and rivers. Vegetal staples included acorns, seeds, and kelp. Groups were generally organized without political leaders, yet large villages had a non-hereditary chief (Kelly 1978). Although some reports indicate that upon death, the Miwok cremated the deceased by binding them to three long poles, then burning litter and all possessions together, recent archaeological evidence may suggest otherwise. One such example is the large number of human remains discovered in one location, indicating specific burial grounds, at the D Street site in the city of San Rafael.

While Coast Miwok populations were believed small even in the Precontact period, few Coast Miwok individuals survived the events of the 18th and 19th centuries in California. By the 1930s, only a handful of individuals with predominantly Coast Miwok ancestry were alive (Kelly 1978). The Coast Miwok tribe affiliated with the project area is the Federated Indians of Graton Rancheria. Listing over three hundred registered descendants, the tribe has recently gained federal recognition. Ethnohistorical records indicate that a Coast Miwok village called "Bauli-an" existed on the eastern shoreline of Bolinas Lagoon (Kelly 1978, Kroeber 1925).

History of Bolinas Lagoon

The Bolinas Land Use History, found in the Technical Appendices to this report, provides an extensive discussion of the history of the Bolinas Lagoon watershed since European settlement.

The Bolinas Lagoon was formed as a result of tectonic movements along the San Andreas Rift Valley before 7,700 years ago (Atwater 1978). A sand spit developed, isolating the lagoon waters from the larger Bolinas Bay. Bergquist (1978) determined that the depth and configuration of the lagoon remained in dynamic equilibrium until the early 1800s. Beginning in 1849, the slopes of the Bolinas watershed became a source for timber, particularly redwood. According to one historical account, these trees could measure up to 50 feet in circumference, or roughly 16 feet in diameter. The lumber was then milled at nearby Dogtown, and was used to build the rapidly expanding city of San Francisco. Mills were reported to generate nearly 15 million board-feet of lumber each year (Munro-Fraser 1880). The depth of the entry bar of the lagoon was measured as only 1 foot at low tide in 1854, and allowed for the use of only shallow draft vessels in the lagoon (Rowntree 1973). To transport lumber, embarcaderos or wharves were built in the lagoon, and lumber was transferred from shallow draft schooners to waiting heavier ships in Bolinas Bay. Lumber was also towed as rafts to San Francisco, presumably only during good weather (MCOSD 1996). Small, shallow-draft schooners were built near McKennan Gulch until 1870, but boat building and embarcadero activities were eventually rendered unfeasible due to siltation of the lagoon (Ritter 1973).

Lands harvested of timber along the steep slopes on the Bolinas Ridge were then converted to cattle grazing or agricultural uses. Butter, milk, and other commodities were produced near Bolinas Lagoon and transported to customers in San Francisco (Munro-Fraser 1880). Several mining operations were also active in the area by 1863 (Compas 1997). From the late 19th century until World War I, 22,500 pounds of copper ore were transported from Bolinas Lagoon to Pittsburg, California (Mason 1973).

New land-use practices of the late 19th century, including logging, mining, and ranching, increased the rate of erosion and sedimentation, and caused Bolinas Lagoon to fill at five times the pre-development rate (Winkelman n.d.). The 1906 earthquake on the San Andreas fault caused the lagoon floor to drop by approximately one foot and restored a reported 50 million cubic feet of tidal prism (Bergquist 1993). The tidal prism is currently less than half of that estimated from bathymetric data in 1850, and sediment continues to accumulate in the lagoon at a higher rate than the estimated long-term sedimentation rate prior to development, despite improvements in land use patterns in the last century (Winkelman n.d.). The effects of past practices may be long-lasting. Some of the sediment currently entering the lagoon probably derives from the continued erosion and downcutting by Pine Gulch Creek into flood plain deposits that resulted from past periods of abnormally high erosion induced by intensive logging, grazing, and other destructive management practices in the watershed.

Prehistoric and Historic Archaeological Resources

It is estimated that less than 5 percent of the land area of the Bolinas Lagoon Watershed has been examined by archaeological surveys. The largest archaeological surveys completed in this area were two surveys covering approximately 50 acres, both east of Mesa Road in Bolinas. Archaeological surveys of 46 smaller areas have largely focused on the developed areas near Stinson Beach and along the Highway 1 corridor. Highway 1 largely follows the coast south of Stinson Beach and from Stinson Beach northward follows the eastern shore of the Bolinas Lagoon, and then into the San Andreas Rift Zone valley.

Additional surveys were conducted for the purposes of this project along the shore of the lagoon above the high water line where the shoreline was accessible. The survey area also included the sand spit at the terminus of Stinson beach, and Kent Island. The majority of the lagoon shoreline is covered in mud or sand, making identification of cultural sites difficult. An attempt was made to relocate recorded sites, although surficial evidence was not present in the areas surveyed. The fact that silt continues to be deposited in the lagoon, and that the majority of previously recorded sites were located in shoreline areas, indicates the possibility that if sites exist below the mud they will be well preserved.

A record search conducted at the Northwest Information Center identified eleven archaeological sites recorded within the Bolinas watershed. Nine of these sites have been identified as prehistoric shell middens (trash dumps), one site is a midden of undetermined age, and one site is a historic mining site. One of these sites appears to be close to the area of excavation for the Main Channel, and another is within the area of excavation for the Highway 1 Fills, although they have not been precisely mapped. Additionally, no eligibility determination has been made for any of these sites, and it is possible that one or more of them may have been destroyed since they were recorded.

The prehistoric midden sites consist of shell, ash, fire-cracked rock, and other debris accumulated during the utilization or collection of shellfish resources. Artifacts collected from these sites include both flaked and non-flaked lithic tools, including small amounts of obsidian. These sites range in size from 1,000 square meters of dense midden deposits to 25 square meters of sporadic deposits of shell and artifacts. The other midden site, consisting of compacted ash, is of undetermined age or association and may also have been the site of a historic 19th century structure near the town of Bolinas.

The majority of known prehistoric shell midden sites in the Bolinas watershed are clustered along the shoreline of the Bolinas Lagoon. This “clustering”, however, may be due to the fact that few surveys have been conducted or may mean that the shoreline has experienced a high degree of prehistoric and ethnographic use. Concentrations of archaeological sites are also expected on alluvial fans of freshwater creeks that drain into the lagoon. Shell middens represent the most visible and most widely encountered site type in this region.

Other than the remains of a possible 19th century structure related to the compacted ash midden described above, only one historic archaeological site has been recorded to date within the Bolinas watershed. This site consists of a 19th century copper mine, including a cabin, boiler, adits, a large tailing pile, and other associated footings, debris, and artifact scatters. On GGNRA property, in a canyon northeast of the lagoon, and therefore outside the area of potential effect for project excavation activities, this site is estimated to have been an active copper mine from 1848 to the World War I era. The NPS has not made an eligibility determination for this site.

Native American Resources

Other than archaeological resources of Native American origin, as described in the preceding section, no cultural resources of special concern to Native Americans, including sacred sites, burial sites, or traditional cultural properties, have been identified in the project area.

The Corps has initiated formal consultation with the Federated Indians of Graton Rancheria, the federally recognized Native American Tribe associated with Bolinas Lagoon.. Although it is common for tribes to wish not to disclose the exact location or specific information regarding traditional cultural properties, tribal concerns will be addressed as required by legislation and in consideration of the customs of the tribe.

Architectural Resources

The Lighter Wharf is located north of the town of Bolinas along Highway 1 and is listed in the California Inventory of Historical Resources as an important demonstration of the economic/industrial theme of California history. The Lighter Wharf is not listed in the National Register of Historic Places (NRHP). This wharf played an important role in the shipping industry that once flourished in Bolinas Lagoon. Four buildings along Highway 1 constructed between 1850 and 1900 may become eligible for the NRHP as contributing properties of a potential historical district, according to the California Office of Historic Preservation. Slightly outside the eastern boundary of the watershed, the Hill 640 Military Reservation has been determined eligible for listing on the NRHP.

Within the lagoon itself, the remains of an abandoned dredging barge are visible at both high and low tide. The barge was reported to have been abandoned following the dredging of the Seadrift Lagoon, and although not historic, it has become a local landmark.

Submerged Cultural Resources and Bolinas Bay

There is no record of any survey for submerged cultural resources within the lagoon itself or in Bolinas Bay. Within the lagoon, there may be the remains of watercraft dating to both the prehistoric and historic period, in addition to the possible remains of early habitation sites that at one time were on land. If the proposed dredging removes sediments that were deposited over 50 years ago, there is a possibility that cultural sites may be affected.

There are 18 reported shipwrecks in the vicinity of Bolinas Bay reported in the State Lands Shipwreck Data Base. The earliest reported wreck is that of the *Duxberry*, wrecked in 1849. The location given in the database is at Duxbury Reef, and it is likely the reef was named after the wreck as is often the case. The second earliest reported wreck is that of the *El Dorado*, a sidewheel steamer wrecked in 1851. The reported location is Bolinas Bay. Because most of the wreck locations are vague, and the final outcome of the disasters are not always reported (some may have been salvaged), it will be necessary to complete a survey in areas where barge anchoring may occur.

3.5.3 Regulatory Considerations

Archaeological and Architectural Resources

Cultural resources are protected primarily through the National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. § 470 et seq.) and its implementing regulations (found at 36 CFR 800). Other pertinent legislation covering this project includes the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§ 469 – 469c); the Archaeological Resources Protection Act of 1979 (16 U.S.C. §§ 470aa – 470mm), and CEQA. If submerged cultural resources are encountered in Bolinas Bay or submerged in the lagoon, the Abandoned Shipwreck Act (ASA) (43 U.S.C. § 8) may also apply to the project. To determine if a property is considered "historic" the property must meet certain criteria and usually be of at least 50 years of age. If the property meets the criteria, it may be considered eligible for the National Register of Historic Places (NRHP) or the California Register of Historic Resources or both.

NRHP Listing requirements

The following significance criteria are the basis for determining inclusion of a property on the NRHP (36 CFR 60.4). The property must have or be:

- Association with events that have made a significant contribution to the broad patterns of our history;
- Association with the lives of persons significant to our past;
- Resources that embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master or that possess high artistic values or that represent a significant and distinguishable entity whose component may lack individual distinction; or
- Resources that have yielded or may be likely to yield information important in prehistory or history.

Any property considered eligible for the NRHP is also automatically subject to protection under CEQA.

CEQA Requirements

Under Section 15064.5 of the CEQA guidelines, a "historic resource" is a property listed on the California Register of Historical Resources or a local register of historic resource, or determined eligible for the state or local register of historic resources by a lead agency, where such determination is supported by substantial evidence of the historical or cultural significance of the property. "Historic resources" under CEQA include archaeological sites.

The eligibility criteria of the California Register of Historic Resources are nearly identical to those of the NRHP and therefore are not repeated here.

Native American Resources

Section 101(d)(6)(A) of the NHPA, as amended, allows properties of traditional religious and cultural importance to a tribe to be determined eligible for inclusion in the NRHP. The *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1990) provide information on the identification, recordation, and evaluation of Native American sites that may be considered eligible for the NRHP and that are designated "traditional cultural properties (TCPs)." Some TCPs also may qualify as Sacred Sites under Executive Order 13007, which directs agencies, to the extent possible, to accommodate access to and use of such sites and to avoid adversely affecting their physical characteristics. The American Indian Religious Freedom Act of 1978 also allows for access to sites of religious importance to Native Americans. The Native American Graves Protection and Repatriation Act of 1990 provides for the repatriation of human remains and funerary items to identified Native American descendants. Section 15064.5 of CEQA contains provisions concerning the discovery of human remains that are of Native American origin.

3.6 PUBLIC ACCESS AND RECREATION RESOURCES

3.6.1 Introduction/Region of Influence

Within the project area are many recreational resources (Figure 3-13). These resources provide opportunities for hiking, biking, and horseback riding on the trails of GGNRA, PRNS, Mount Tamalpais State Park, MCOSD, and Audubon Canyon Ranch; boating on the lagoon and in Bolinas Bay; fishing in the lagoon and Bolinas Bay; swimming, surfing, boating, and beach-going along Bolinas Bay; and wildlife viewing nearly everywhere in the project area, but particularly in the lagoon.

The ROI for recreational resources encompasses the lagoon and its watershed, the beaches near the lagoon, and Bolinas Bay.

3.6.2 Public Access

Most of the project is in public ownership; however, there is some privately-owned land around the communities of Bolinas and Stinson Beach (MCOSD 1996). Public entities holding title to the watershed include the NPS (GGNRA and PRNS), GFNMS, Mount Tamalpais State Park, and MCOSD. GFNMS has jurisdiction over Bolinas Bay and the lagoon up to the high tide line. Audubon Canyon Ranch, a private non-profit organization dedicated to wildlife protection, owns and manages a preserve as an inholding within the boundaries of GGNRA.

All publicly held land within the watershed is accessible to the public; however, certain uses (such as the use of motorized vehicles) are prohibited on NPS or MCOSD lands. Among the approved recreational uses in the lagoon and its watershed are birding, photography, fishing, clamming, shrimping, kayaking, canoeing, sailing, horseback riding, bicycling, jogging, hiking, picnicking, and educational/environmental tours. Access to Bolinas Lagoon is provided by Highway 1, Olema-Bolinas Road, Wharf Road, Seadrift Road, and Dipsea Road (MCOSD 1996).

The public can access the shore along Bolinas Bay east of the inlet via the publicly-owned access points at Stinson Beach (Stinson Beach Park and Upton Beach), as well as via public easements from Calle del Arroyo (MCCPD 1980). There is an easement in place for public access to the privately held beachfront in Seadrift, between the mean high tide line and the riprap; however this easement can only be used for low-intensity recreation activities. In addition, the California Tidelands Trust mandates that the public must have access to all beaches below the high tide line. Bolinas Beach runs from the lagoon inlet west to Duxbury Point, and is a popular location for beach-going, boating, surfing, and fishing. Agate Beach is a County Park west of Duxbury Reef, and provides access to nearly two miles of beach (Marin County Parks 2001).

3.6.3 Fishing

Clamming in Bolinas Lagoon was prohibited in the 1970s because of sewage contamination in the lagoon from Stinson Beach. That prohibition is no longer in place,

3-13 Recreation Resources

and clamming and shrimping are now permitted in the lagoon; however, changes in habitat have severely limited opportunities for these activities on both a sport and commercial level (Moore 1999).

Recreational fishing is common in Bolinas Lagoon. People fish along Highway 1 from Audubon Canyon Ranch east to Stinson Beach during the incoming and high tides for striped bass, rays, and leopard sharks. Others fish in Bolinas Channel on the west side of the lagoon, and those fishermen catch striped bass, rays, leopard sharks, surf perch, and the occasional smelt (O'Connor 2001). In addition, recreational anglers fish in Bolinas Bay, both from the shoreline and from motorboats in the bay.

3.6.4 Boating

Motorboat use in Bolinas Lagoon is extremely limited, as they are only permitted to be used at the extreme southwestern corner of the lagoon, near the inlet, unless they have special permits. However canoe and kayak use is much less restricted. Approximately 1,800 to 2,500 people per year take commercial kayak tours through the lagoon (Tye 1999). It is estimated that each year somewhere between 3,000 and 5,000 private individual day-trips are taken on the lagoon in kayaks, canoes, and rowboats. "User-days" are difficult to define, as kayak and other boat uses of the lagoon are dependent upon tide, weather, and light issues; however, kayaking may occur year-round, weather permitting. An average kayak trip in the lagoon usually lasts no more than three hours because of tidal constraints. Commercial kayak outfitters estimate that the increasing sedimentation of the lagoon has greatly reduced the amount of kayaking in the lagoon during the past ten years. Commercial kayak trips usually include no more than six boats, which may be doubles or singles. Most commercial outfitters make an effort to avoid seal haul-outs and migratory birds while staying within the confines of the lagoon.

Boat launches used by kayakers include a launch site on Highway 1 across from the Stinson Beach School and another in Bolinas at Wharf Road. Other put-in places exist, but the MCOSD discourages their use in order to reduce the impact to wildlife. The Wildlife Disturbance Subcommittee of the BLTAC has developed signs and pamphlets for public awareness and education regarding wildlife viewing on Bolinas Lagoon (Tye 1999, MCOSD 2000a). These include pamphlets distributed to outfitters in Stinson Beach and around Marin and signs erected around the lagoon.

In addition to boating in the lagoon itself, extensive surfing and boating occurs along Bolinas Beach and Stinson Beach. The breaking surf along the beaches, combined with the strong Bolinas Beach currents in the channel, make this a popular site for surfing and white-water kayaking. The commercial sea kayak outfitters rarely leave the lagoon because of the strong currents in the channel (Tye 1999), however private recreational kayakers can often be seen paddling in Bolinas Bay.

Windsurfing is legal in the lagoon but is not common, as the water depth limits the use. Personal motorized water craft (such as Jet Skis ®) have been banned from the lagoon

(MCOSD 1996), and as noted above, motorboat use in the lagoon is extremely restricted.

There are approximately 50 private moorings in the lagoon, approximately half of which are owned and maintained by the Bolinas Rod and Boat Club (BRBC) (O'Connor 1999; MCOSD 1996). The ramp on the beach at the end of Wharf Road in Bolinas belongs to Marin County, however the BRBC maintains access rights to it. This ramp is also used for beach access in cases of accident or emergency. A ramp located off Dipsea Road in Seadrift is available only to Seadrift residents and their guests (O'Connor 1999). Across from Volunteer Canyon on Highway 1 is an illegal launch site that is used occasionally by power boats in bad weather (O'Connor 1999). Boaters with a permit from MCOSD may stay overnight on the lagoon (MCOSD 1996). Docking facilities include "finger wharves" and "strings" in Bolinas Basin (a deeper section of the lagoon located in front of the Bolinas downtown area) which are maintained by the BRBC, and are open to the visitors approved by BRBC. There is no official harbormaster in Bolinas; however, the BRBC Docks and Yards Committee serves unofficially to regulate docks and moorings in the lagoon (O'Connor 1999).

3.6.5 Hiking/Biking

Hiking is permitted on all trails within MCOSD's jurisdiction; however, bicycling is permitted only on fire roads. GGNRA has extensive hiking trails throughout the park. GGNRA allows biking on approximately 64 percent of the trails within the Marin County portion of the park (NPS 1992). Point Reyes allows biking within the National Seashore but limits it to paved roads, fire roads, and some trails, all outside the wilderness areas (NPS 1997). Bicycling is allowed in Mount Tamalpais State Park but is limited to fire roads and paved roads (California State Parks 1999a).

The entire watershed is traversed by a network of hiking trails, only a few of which are mentioned here. Bolinas Ridge Trail starts on Bolinas-Fairfax Road, at or near the summit of the ridge, and runs northwest along the ridgeline all the way to just east of Olema. There it meets up with the Jewell Trail and eventually ends at Sir Francis Drake Boulevard. On the western side of the watershed, Teixeira Trail leads west from the Olema Valley Trail up to the Inverness Ridge Trail within PRNS. The Ridge Trail has views of the watershed, and a spur trail leads to Pablo Point, an 800-foot high ridge. However, the trail to Pablo Point has been closed because of severe damage from the storms of recent winters (NPS 1999b).

While there are no formal bike routes or paths along the paved roads in the project area, bicyclists are common in the summer months, especially on Highway 1 between Stinson Beach and Bolinas-Fairfax Road. On summer weekends dozens of bicyclists may pass through the project area.

3.6.6 Education

GFNMS, PRNS, MCOSD, and the Audubon Canyon Ranch provide educational information about the lagoon. PRNS runs numerous educational programs open to the public, ranging from free half-hour lectures to extended courses on wildlife photography. In addition, the park has a curriculum for school children, designed for use by local teachers, with participation by park rangers (NPS 2000). GFNMS runs school programs to educate Bay Area students in the ecological importance of the sanctuary, including Bolinas Lagoon.

MCOSD rangers lead nature walks and discussions about the lagoon's environmental significance. MCOSD has recently developed, with input from the BLTAC Wildlife Disturbance Subcommittee, a brochure on nonintrusive methods of viewing wildlife in the lagoon (MCOSD 2000b). Audubon Canyon Ranch maintains a small museum with historical and environmental exhibits on the lagoon. Point Reyes Bird Observatory (PRBO) maintains an office on the east side of the lagoon, but its field station and visitor center, the Palomarin Field Station, is located outside the lagoon watershed on the west side of the Bolinas mesa.

Bolinas Museum, in downtown Bolinas, maintains a collection of historical artifacts to educate the public about prehistoric and historic life in the Bolinas area. The Stinson Beach Historical Society maintains an extensive collection of material relating to the history of West Marin, which is located at and curated by the Stinson Beach Public Library.

Commercial kayak outfitters often take advantage of the opportunity to educate their customers about the sensitive ecosystem and wildlife in Bolinas Lagoon (Tye 1999).

Marin County Park Rangers have initiated more public education efforts at Agate Beach, in order to protect Duxbury Reef from illegal gathering of sensitive species (Bolinas Lagoon Technical Advisory Committee 1999b).

3.6.7 Parks

Agate Beach

Agate Beach is a 6-acre County Park located off Elm Road on the west side of Bolinas, north of Duxbury Point. While outside the immediate project area, this beach gives the public access to the shoreline. Parking is free, but there are no facilities at the beach. (Marin County Parks and Recreation Department 2001),.

Bolinas County Park

Located on Brighton Avenue in Bolinas, this small community park contains a tennis court and restrooms. There is no parking lot. The park is used for occasional local community events and year-round tennis. During 1999, Marin County purchased an adjoining parcel, increasing the size of the park to nearly 3 acres (Jauch 1999).

Bolinas Lagoon Open Space Preserve

Managed by the Marin County Open Space District, this 1,100 acre preserve encompasses the area of the lagoon itself. Management of the lagoon was transferred from Marin County Parks to Marin County Open Space District in 1988 (Bramham 2000). The lagoon is part of a larger protected natural habitat that is part of the Gulf of the Farallones National Marine Sanctuary, Point Reyes National Seashore, Golden Gate Biosphere Reserve, Mount Tamalpais State Park, and the GGNRA. The preserve offers protected habitat for a variety of species, including fish, migratory birds, and harbor seals. The preserve also provides an area for recreational pursuits such as wildlife viewing and fishing (MCOSD 2000b).

Golden Gate National Recreation Area

GGNRA is a multi-parcel unit of the National Park Service, covering 76,500 acres in three counties. Among the property under its jurisdiction is the section of the Bolinas Lagoon watershed on the east side of Highway 1, running from a point approximately 2 miles north of the lagoon to its border with Mount Tamalpais State Park on the south edge of the watershed.

Hiking and walking are activities available throughout the park. Bicycling is allowed on fire roads only. There is limited parking at some of the trailheads in the GGNRA, including at Five Brooks and the Bolinas Ridge Trailhead on Bolinas-Fairfax Road. Visitor centers are located at Muir Woods National Monument and the Marin Headlands and contain restrooms, picnic tables, parking lots, and educational exhibits. There are two small campgrounds in the Marin Headlands portion of the Park, available to hikers, bikers, and groups. In addition, there is a youth hostel that sleeps 109 near the Marin Headlands Visitor Center (NPS 1999c).

Gulf of the Farallones National Marine Sanctuary

West of San Francisco north to Bodega Bay, the GFNMS is 1,235 square miles of near shore and offshore waters ranging from wetlands and inter-tidal to pelagic and deep-sea communities. Recreational uses include fishing, sailing, kayaking, surfing and whale watching. Shipping lanes pass through the Sanctuary into the San Francisco Bay. Bolinas Lagoon and the surrounding ocean waters fall within the jurisdictional boundaries of the Sanctuary.

Mesa Park

Mesa Park is a twelve acre park that surrounds the firehouse located on Mesa Road in Bolinas. The land, which was originally privately owned, was acquired by the Bolinas Community Public Utility District (BPUD) (Buchanan 2001a) in the late 1970's through money made available by a community block grant program. Mesa Park is now jointly owned by the BPUD and the Bolinas-Stinson Union School District, and managed by the appointed Mesa Park Board of Commissioners. (Buchanan 2001b).

Mesa Park hosts a number of community activities through its soccer field, softball field, baseball field, playground, and basketball court. The park is accessible during daylight hours, and has a parking lot off of Mesa Road. A water reclamation project proposal is currently being developed through BPUD to facilitate the construction of a recreation center and public restrooms, and to begin irrigation of the park (Buchanan 2001b).

Mount Tamalpais State Park

Part of the upper section of the Easkoot Creek watershed runs through Mount Tamalpais State Park. The park includes 6,300 acres of redwood groves and oak woodlands with a spectacular view from the 2,571-foot peak. The Upper Mountain is open during daylight hours only, with all highway access gates locking at sunset. Campgrounds and lower portions of Mt. Tamalpais are accessible 24 hours a day. More than 50 miles of trails are within the park and connect to a larger, 200-mile-long trail system. Bicyclists are welcome on the park's fire roads but are prohibited on single-track or hiking trails. The park has a picnic area with tables, stoves, piped drinking water, and flush toilets. The East Peak Summit features a visitor center, refreshment stand, phone, picnic tables, and fully accessible restroom. Camping is available, and facilities include 16 developed sites with parking, 6 environmental walk-in sites, and 10 rustic cabins with running water and pit toilets (California State Parks 1999).

Olema Ranch Campground

This private campground is located outside of the Bolinas watershed on Highway 1, about 13 miles north of the lagoon. Its facilities include 203 campsites, including 175 tent sites. It is a full-service campground and provides showers, restrooms, laundry, store, bicycle rentals, kayak tours, conference facilities, and a post office to its visitors (Olema Ranch Campground 1999).

Point Reyes National Seashore

PRNS is an independent unit of the National Park System, covering nearly the entire Point Reyes peninsula. Part of the park extends into the Bolinas watershed, on the west side of Highway 1. Recreational activities allowed in the park include kayaking, hiking, camping, bicycling, horseback riding, wildlife viewing, and ranger-led tours on local history, geology, and environmental issues. Visitor centers with facilities, including parking, picnic tables, telephones, educational exhibits, and restrooms, are located at Bear Valley, Drakes Beach, and Point Reyes Lighthouse.

There are also parking and restrooms at the Five Brooks Trailhead on Highway 1, Limantour Beach on Drakes Bay, McClures Beach, Kehoe Beach, Point Reyes Beach North, and Point Reyes Beach South. Four campgrounds exist within the park, but there are no car-camping sites available; all campgrounds are accessible only by hiking, biking, or horseback (NPS 1999b).

Stinson Beach Park

Stinson Beach Park was originally a state park, but by 1977 it had been transferred to the federal government. It is now administered by GGNRA. The park covers approximately 50 acres, including 0.6 miles of beach. Park facilities are free to the public and include picnic tables and barbecue grills, restrooms, changing rooms, and one outdoor shower. Volleyball poles are permanently erected on the beach, and visitors can borrow nets and balls from the park. Park users include bathers, surfers, boogie-boarders, kayakers, and surf fishers. Lifeguards are on duty May through October. The central area of the park has 160 parking spaces, and two auxiliary lots accommodate over 1,000 additional cars. Peak use of the park occurs on hot summer weekends, when all the parking lots may fill up, and traffic may back up for up to a mile north and south on Highway 1 (Giambastiani 1999).

Stinson Beach Village Green

Stinson Beach Village Green, administered by Marin County, was completed in 1994. It is located in Stinson Beach at the intersection of Highway 101 and Calle del Mar. The less than one acre plot of land is used for recreational purposes only and includes a playground, a basketball court, an amphitheater, and a grassy area (Jauch 2000).

Upton Beach

Upton Beach is an approximately 1.5-mile-long public beach that is between Seadrift Beach and the Stinson Beach area of GGNRA. The beach has been managed by Marin County since 1932, and is zoned for recreational use only. To date, there has been no recreational development at Upton Beach (Jauch 2000). Upton Beach, like Stinson Beach and PRNS, borders the GFNMS.

3.6.8 Regulatory Considerations

The section below summarizes the plans and policies relevant to recreation and public access issues resulting from the two project alternatives.

Stinson Beach Community Plan

Objective 7.1: Visitor oriented facilities and activities should not be substantially increased and should be provided through cooperation with the National and State Parks.

Policy F: Existing hiking trails around and within Stinson Beach must be maintained and repaired on a regular basis.

Bolinas Community Plan

The Bolinas Community Plan calls for full support of the preservation and minimal development of the Bolinas Lagoon Park.

Marin Countywide Plan

Environmental Quality Element, Open Space and Recreation

Policy EQ-4.1 Provision of Facilities. Adequate parks, recreation facilities, and open space shall be provided. Appropriate public access shall be established.

Policy EQ-4.4 Categories of Open Space Preservation. The Countywide Plan identifies permanent preservation open space in the following categories: ... Recreation: Public parks, trails, water sports areas, commercial recreation.

Policy EQ-4.7a Public Open Space. Bolinas Lagoon, formerly a County Park, is now managed by the Marin County Open Space District as an Open Space Preserve. The District is currently evaluating its management policies in order to develop a management program for the lagoon that will balance public use with preservation of the lagoon's fragile resources.

Policy PR-2.3 Replacing Closed Facilities. The county will attempt to replace countywide park and recreation facilities that are closed or that become unavailable for other reasons, if the need for these facilities still exists.

Policy TR-4.1 Trails Maintenance Responsibility. Trails should be maintained by Property owners or entities accepting dedicated trails or easements unless other arrangements have been contractually agreed upon.

3.7 LAND USE

3.7.1 Introduction / Region of Influence

This section discusses current land ownership and land use in and surrounding the proposed project area. In addition, local policies relating to land use are summarized. The ROI for the project includes the project site and surrounding land that would directly interact with or be influenced by the project or its components. The types of land use surrounding the lagoon have been divided into three broad categories that describe the type of development and activity that occur in the area including agriculture, public use, research and education, and urban land use. The predominant use of the land within the watershed is for recreational purposes, a public use discussed in detail in Section 3.6.

3.7.2 Land Ownership

The land within the Bolinas Lagoon watershed covers approximately 10,700 acres within Marin County. Figure 3-14 shows the distribution of land ownership and jurisdiction within the Bolinas Lagoon watershed. The majority of this land is publicly owned, while a small portion is privately held. Most of the acreage administered by government agencies is undeveloped open space property, while the privately held acreage is devoted to residential and agricultural uses.

Federal Land Ownership

The US government is the owner of extensive federal land within the watershed and National Park Service agencies manage this land. GGNRA manages federal lands in and around Stinson Beach and in the Olema Valley. Point Reyes National Seashore (PRNS) manages federal land bordering GGNRA lands in the Olema Valley. A total of approximately 4,121 acres are part of the GGNRA and 2,647 acres at PRNS.

State and Local Land Ownership

The 1,100-acre Bolinas Lagoon is owned by Marin County and managed by the Marin County Open Space District as the Bolinas Lagoon Open Space Preserve. Marin County also owns a small parcel immediately adjacent to the west side of the lagoon north of the community of Bolinas. Mount Tamalpais State Park, managed by the California Department of Parks and Recreation, is the largest state land area and a portion of this park falls within the watershed. Approximately 1,572 acres of the park fall within the watershed. Marin Municipal Water District is the owner and manager of land that borders the State Park but this District land is not in the Bolinas Lagoon watershed and therefore is not part of the ROI for this project. Small land holdings are owned by the College of Marin, which maintains a marine biology station on the shore of the Lagoon and the Bolinas Public Utilities District and the Bolinas-Stinson Beach School District. (MCPRD 1996). The Marin Municipal Water District holds land on the west side of the lagoon.

3-14 Land Use and Ownership in Bolinas Watershed

Private Land Ownership

The Audubon Canyon Ranch, an environmental, research, and education organization, is the largest private landowner, with 1,014 acres in the eastern portion of the watershed. The remaining private lands are owned by individuals and are located throughout the watershed, but primarily in the Bolinas, Stinson Beach, and Seadrift communities. A portion of privately held land on the west side of the watershed is used for agriculture; however, exact acreages are not available at this time. There are small private parcels of land in and around the lagoon on the Stinson Beach sand spit and along the entrance to the Lagoon in Bolinas.

3.7.3 Public Land Use

Public land within the watershed is managed by federal agencies, including the National Park Service, and by state agencies, including the California Department of Parks and Recreation.

Federal Land

Land within the Olema Valley portion of the Golden Gate National Recreation Area makes up most of the watershed east of Bolinas Lagoon. The property includes forested canyons, tree-lined ridges, open grassy slopes, and historic farm buildings. The Olema Valley property is zoned as Natural Space, for which the management emphasis is on the conservation of natural resources and processes and the accommodation of uses that do not adversely affect these resources and processes (National Park Service 1992). This land is largely undeveloped and provides numerous hiking and biking trails. Golden Gate National Recreation Area (GGNRA) also manages three properties on the west side of the lagoon that occupy a combined area of approximately 45 acres (Fong 2000a). The NPS operated a shooting range for Park Service law enforcement training in Morses' Gulch during the 1980s; it was closed primarily because of community complaints about the noise, and the training was moved to San Quentin (Danielsen 2001).

Property within the Point Reyes National Seashore covers most of the watershed west of Bolinas Lagoon. This property is used for purposes similar to those of Olema Valley, including hiking and mountain biking. Stinson Beach, part of GGNRA, is managed for typical beach activities, including swimming and sunbathing. The beach also provides barbecue and picnic facilities.

State Land

A small portion of Mount Tamalpais State Park is present at the southern tip of the Bolinas Lagoon watershed between McKennan Gulch and Stinson Gulch above Stinson Beach. Most of this property is undeveloped with few hiking or biking trails. The park includes Red Rock Beach, a hike-in beach that people usually access by parking their cars on the shoulder of Highway 1; the beach is for day use only and no amenities are present.

Local Government Land

Bolinas Lagoon is used primarily for natural resource protection and for recreation. Recreation activities described in section 3.6 include swimming, surfing, boating, and beach-going along Bolinas Bay; and wildlife viewing nearly everywhere in the watershed, but particularly in the lagoon.

A small area below the high water line of the lagoon was used as an unofficial dumpsite by Bolinas residents in the 1950s and 1960s. Refuse was dumped, burned, and bulldozed into the mud on the edge of the lagoon (Cammiccia 2001). This area is not within the excavation footprints of any of the project alternatives.

Although not landowners themselves, the unincorporated Marin County communities of Bolinas and Stinson Beach are both within the watershed. Land use within the two communities is primarily residential, as discussed in the Urban Land Use section below.

Research and Education Land Use

While much of the public lands discussed above have research and education as a component of their management strategy, Audubon Canyon Ranch's Bolinas Lagoon Preserve is managed primarily for research and education activities. The public is admitted to the preserve from mid-March to mid-July on weekends between 10 AM and 4 PM and on weekdays by appointment. Research activities are conducted throughout the preserve by groups from the Point Reyes Bird Observatory and the University of California at Berkeley, among others. Educational facilities at the preserve include teaching ponds, artificial wetlands, a display, and a library. The ranch also conducts nature hikes for Bay Area schoolchildren. The natural areas of the preserve are passively managed as plant and wildlife habitat. The Ranch preserves nesting habitat of the Great Blue Heron.

In addition to research and educational activities operated through the preserve, the College of Marin operates a marine laboratory off Wharf Road in the town of Bolinas.

3.7.4 Private Land Use

Bolinas

The Bolinas community is located between Bolinas Lagoon and the Pacific Ocean. The 2000 Census reports that the population of Bolinas is 1,246 (US Census Bureau 2002). The portion of Bolinas within the watershed is zoned for single-family residential, residential commercial, open space, and agriculture. The areas adjacent to the lagoon are zoned for Coastal Open Space, Coastal Agriculture and Coastal Single Family (Figure 3-15). The Marin LCP identifies agricultural uses on the west side of Bolinas Lagoon, including livestock and other domestic animal husbandry, and small and large scale vegetable cultivation.

3-15 Bolinas Land Use Policy Map

Stinson Beach

The Stinson Beach community is located primarily southeast of the lagoon, but also includes the Seadrift sand spit . The 2000 Census records the population of Stinson Beach (including Seadrift) to be 751 (US Census Bureau 2002). Areas of Stinson Beach that are not adjacent to the Lagoon are are zoned for retail, residential, commercial, open space, and agriculture (Figure 3-16).

Seadrift

Seadrift is a gated community that is officially part of Stinson Beach. It is a thin strip of filled lagoon located south of the lagoon and encompasses approximately 125 acres. This land is privately owned and subdivided into 320 single-family residences, of which 280 have been developed and approximately 15 are under construction. Areas in Seadrift that are adjacent to the Lagoon are zoned for Coastal Single Family and Coastal Open Space (Figure 3-16). Located in the center of Seadrift is a 45-acre human-made lagoon, also privately owned. No commercial activity currently occurs on Seadrift (Kamieniecki 2000).

Agriculture

While no longer a dominant land use in the watershed, agriculture was historically important in the Bolinas watershed (see Appendix B, Land Use History of Bolinas Watershed). Agricultural uses are currently confined to the northern and western sections of the watershed, particularly in the Pine Gulch Creek watershed. These uses include vegetable cultivation and the raising of livestock.

Full time farms in Marin County totaled 172 in 1997 (USDA 1997), approximately two dozen of which are dairies (MALT 2001). These dairies provide 20 percent of the Bay Area's milk supply. Dairy cows in the area are housed indoors in winter by some ranchers, but generally are grazed on pastures for most of the year. Approximately 4,500 head of beef cattle are raised in Marin County (MALT 2001). About 17,000 sheep and lambs were raised and 140,000 pounds of wool produced in Marin County in 2000.

Within Point Reyes National Seashore, working ranches exist under special use agreement with the National Park Service. This area of open landscape is known as the "Pastoral Zone" and is intended to preserve the agricultural history of the Peninsula. There are currently 13 working ranches in the park. Holstein dairy cows are found on seven of these ranches. Six beef ranches have Black Angus and Herefords. These ranches were purchased by the National Parks Service in 1962 when the National Seashore was created, and leased back to the existing ranchers with 5-20 year terms. Local grass is now supplemented with feeds grown in drier climates.

3.7.5 Regulatory Considerations

Most of the major landowners and government agencies with management authority within the watershed have management plans or policies that guide the activities allowed on their properties or in their jurisdiction. The sections below summarize the portions of those plans that are applicable to the restoration of Bolinas Lagoon.

3-16 Stinson Beach Land Use Policy Map

Gulf of the Farallones National Marine Sanctuary

Bolinas Lagoon is within the Gulf of the Farallones National Marine Sanctuary (GFNMS) and is identified in the GFNMS Management Plan as an area of overlapping resources and as an impacted area. The Management Plan states that its highest priority is the, "protection of the marine environment and resources of the sanctuary." (NOAA 1987). Permitted sanctuary uses include recreation, commercial fishing and mariculture, shipping, education and interpretation, scientific research and military operations. GFNMS regulations contain provisions that state that prohibited activities include, "Dredging or otherwise altering the seabed in any way … except for routine maintenance and navigation, ecological maintenance, mariculture…" (15 CFR 922.82). The Director of the GFNMS has the discretionary authority, however, to permit activities that are normally prohibited in National Marine Sanctuaries (15 CFR 922.48).

Golden Gate National Recreation Areas/Point Reyes National Seashore

There is a General Management Plan for both GGNRA and PRNS that gives background and general guidance regarding these two areas. (National Park Service 1980). The southern Olema Valley, which is in the Bolinas Lagoon watershed, is identified in this Plan as a Natural Landscape Management Zone. GGNRA also has prepared a Resources Management Plan which includes a natural resources section that identifies natural resource values, conditions and threats in the GGNRA. (National Park Service 1994). There is also a GGNRA Statement of Management which includes broad natural resource inventories and management objectives. (National Park Service 1992). This plan identifies the areas in GGNRA that serve as watershed west of Bolinas Lagoon as a "Natural Zone." There is little mention of Bolinas Lagoon or specific management measures for the Bolinas Lagoon watershed. However, management objectives for GGNRA include, "Minimize or avoid human caused or accelerated impacts and processes including erosion, invasion by alien plants, degradation of air and water quality and disruption of the natural flow of water." (National Park Service 1992).

California Coastal Act

The proposed project is within the designated coastal zone of Marin County and is therefore subject to the California Coastal Act of 1976 (California Public Resources Code § 30001 et seq.). The Coastal Act provides statutory protection for coastal zone areas and provides for local government entities, such as Marin County to prepare Local Coastal Plans (LCPs) and permit activities, in accordance with the LCPs. The following provisions of the Coastal Act (located in the California Public Resources Code) are particularly relevant to any development or alteration of Bolinas Lagoon:

> <u>Section 30230</u>
> Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance.

Section 30233

(a)The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to the following:

… (7) Restoration purposes.

(b) Dredging and spoils disposal shall be planned and carried out to avoid significant disruption to marine and wildlife habitats and water circulation. Dredge spoils suitable for beach replenishment should be transported for such purposes to appropriate beaches or into suitable long shore current systems.

(c) In addition to the other provisions of this section, diking, filling, or dredging in existing estuaries and wetlands shall maintain or enhance the functional capacity of the wetland or estuary. Any alteration of coastal wetlands identified by the Department of Fish and Game … shall be limited to very minor incidental public facilities, restorative measures, nature study, commercial fishing facilities in Bodega Bay, and development in already developed parts of south San Diego Bay, if otherwise in accordance with this division.

Section 30236

Channelizations, dams, or other substantial alterations of rivers and streams shall incorporate the best mitigation measures feasible, and be limited to (1) necessary water supply projects, (2) flood control projects… or (3) developments where the primary function is the improvement of fish and wildlife habitat.

Section 30251

The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas.

Tidal and Submerged Land – State Approval

Special consideration would be taken regarding that portion of the project that would take place in tidelands trust land, which is defined as that area water ward of the mean high tide line. For activities in those areas, the State Lands Commission would need to approve a special lease and the California Coastal Commission would be consulted regarding special permit requirements (Cal. Public Resource Code §§6103, 30600.5, 30601).

The proposed project would include activities within that portion of the coastal zone (below mean high tide) for which the California Coastal Commission has retained jurisdiction, and therefore a coastal development permit from the Coastal Commission could be required. In addition, because the proposed project is being conducted in part by a federal agency (the Corps), a coastal consistency determination pursuant to the Coastal Zone Management Act (16 U.S.C. §§ 1451 et seq.) will be required. A coastal consistency determination is required for all federal actions within the coastal zone to ensure project consistency with the provisions of the LCP and must be submitted to the California Coastal Commission for concurrence. (The coastal consistency determination will be prepared as a separate document).

Marin County Local Coastal Program

In accordance with the Coastal Act, Marin County must prepare a Local Coastal Program (LCP) Land Use Plan for land within the coastal zone of the county. Marin County has developed an LCP, which the California Coastal Commission has certified (MCCPD 1980). Certification of the LCP grants permitting authority to the county for development actions within the coastal zone. In accordance with this permitting authority, this project, which involves construction and movement of earth material within the coastal zone, will require a Level 5 development permit from the county. The entire project area, including most of the Bolinas Lagoon watershed, is within the coastal zone. The LCP contains policies that apply to Bolinas Lagoon. The LCP incorporates by reference the Bolinas Lagoon Management Plan.

The Marin County Local Coastal Program (LCP), Unit I (MCCPD 1980) is divided into resource areas. LCP policies regarding public access and recreation are addressed in Section 3.6. LCP policies regarding habitat protection are addressed in Section 3.3. The LCP includes the following applicable land use policies:

Stream Protection

> Policy II-1
>
> Stream impoundments and diversions shall be limited to necessary water supply projects, flood control projects where no other method for protecting existing structures in the flood plain is feasible and where such protection is necessary for public safety or to protect existing development, or developments where the primary function is the improvement of fish or wildlife habitat.
>
> Policy II-2
>
> All such developments (mentioned above in Policy 1) shall incorporate the best mitigation measures feasible, including erosion and runoff control measures and revegetation of disturbed areas with native species.

Policy II-4

No construction, alteration of land forms, or vegetation removal, shall be permitted within the riparian protection area [defined as "all existing riparian vegetation on both sides of the stream"]. However, if a parcel is located entirely within the stream buffer, design review shall be required for any proposed structure and shall consider impacts on water quality, riparian vegetation, and the rate and volume of streamflow. In general, development shall be located on that portion of the site which results in the least impact on the stream, and shall include provision for mitigation measures to control erosion and runoff and to provide restoration of disturbed areas by replanting with plant species naturally found on the site.

Lagoon Protection

The Bolinas Lagoon Plan's primary emphasis is summarized as: "Restoration and preservation of the intertidal and subtidal marine environment.

Policy II-12

A single coordinated resource management plan to guide the future use and activities in and around Bolinas Lagoon shall be developed with the involvement of the various public agencies….

Policy II-13b

The diking, filling, dredging and other alternations of these wetlands shall occur only for minor public works projects and shall be in conformance with Coastal Act Section 30233.

Policy II-16

The vacant lots along the east sides of Calle de Arroyo and Dipsea Road shall be redesignated as a Resource Management Area. Permitted uses of the Resource Management Area shall include fishing, birdwatching, photography, nature study, and other similar scientific and recreational uses. Uses that may be allowed by a use permit include small boat and equipment storage, non-commercial private parking, apiaries, truck farming (with application of pesticides and toxic chemicals prohibited), and other uses of similar type and intensity.

Policy 17

Changes in grazing use of the 11-acre Henry Wilkins property shall be preceded by detailed environmental investigation and shall assure protection of the habitat values, and public acquisition of the site is encouraged.

Policy

Any conflicts between agriculture and resource protection or public access or recreational uses within the Golden Gate National Recreation Area and Point

> Reyes National Seashore should be resolved in such a way that resources and public safety are protected and agricultural operations can continue.

Bolinas Lagoon Resource Management Plan

Marin County prepared the Bolinas Lagoon Resource Management Plan (Bolinas Lagoon Plan) that was adopted by the County Board of Supervisors in 1981 and updated in 1996 (MCPRD 1981, MCPRD 1996). The Bolinas Lagoon Plan, while not establishing land use designations, is referred to in the LCP and incorporated into LCP policies on Lagoon Protection (MCCPD 1980). Specific relevant policies from the 1996 Management Plan follow:

Geology and Morphology

Dredging should be permitted only after documentation of need is established and the absence or mitigation of adverse environmental impacts is established.

Hydrology and Water Quality

Proper land use practices shall be followed to minimize degradation of water quality in the Lagoon.

Biotic Resources

Diking, filling, dredging and other alterations of the Bolinas Lagoon wetlands may occur only as permitted under existing Coastal Act Policies. Any further impoundments and diversions on Pine Gulch Creek should be limited to developments where the primary function is the improvement of fish and wildlife habitat.

Goals of the 1996 updated Bolinas Lagoon Plan include preserving and enhancing diversity and aquatic habitats. More specifically,

> Goal I is to preserve and restore the ecological values of Bolinas Lagoon. Objectives are to: 1) Preserve the abundance and diversity of Lagoon life; 2) Preserve and enhance, over the long term, an ecological system including aquatic habitats(subtidal, intertidal, marsh, riparian, sand bar, and beach) that best protects the abundance and diversity of Lagoon life; 3) Restore water quality and hydraulic functions that will decrease sedimentation and prevent the loss of rich estuarine habitats.

The Bolinas Lagoon Plan also states that "it is likely that remedial actions are necessary to meet the stated management goals and objectives" The Plan further states, "Limited dredging could occur in areas where hydraulic studies indicate sediment removal would open channels and promote ongoing tidal scouring." and that "further studies are required to identify the range of dredging options" (MCPRD 1996).

Marin Countywide Plan

The Countywide Plan contains general designations and policies for land use in Marin County. However, some specific land use designations and restrictions are listed in the Local Coastal Plan which is incorporated by reference into the Countywide Plan. Policy EQ-2.41 regarding Conservation of Coastal Resources states that "The conservation of coastal resources shall be maintained following detailed policies in the Local Coastal Plans I and II adopted by the County and the Coastal Commission." The project area is located completely within Local Coastal Plan I.

The Community Development Element of the Marin Countywide Plan (MCCDA 1999) includes the following policies for the West Marin Planning Area, of which the Bolinas Lagoon watershed is a part:

> <u>Policy CD-15.1 Designation of Lands for Agriculture</u>
> The county shall designate land for agriculture at very low densities in the Inland Rural and Coastal Recreation Corridors and maintain these land use designations.
>
> <u>Policy CD-15.2 Lands in the Coastal Zone</u>
> The LCP, Parts I and II, shall govern land use in the Coastal Zone. Community plans in the Coastal Zone shall be subject to LCP policies.
>
> <u>Policy CD-15.3 Mariculture</u>
> The county supports and encourages mariculture in the Coastal Zone for the purposes of producing food, enhancing and restoring fisheries stocks, and contributing to the state's economy. The need for mariculture sites in coastal waters should be balanced with the need to provide for other uses, such as commercial fishing, recreational clamming and boating, and the need to protect coastal wildlife, water, and visual resources.

Bolinas areas alongside the Bolinas Lagoon are classified, from south to north, as Coastal Single Family, Coastal Agricultural 1 Unit/10-30 Acres and Coastal Agricultural 1 Unit/31-60 acres. Stinson Beach areas alongside Bolinas Lagoon are classified as Coastal Single Family and at the tip of Seadrift Spit, Coastal Open Space. (MCCDA 1999). The east and north sides of Bolinas Lagoon are designated as Open Space. Figure 3-15 shows the Bolinas Land Use Policy Map and Figure 3-16 shows the Stinson Beach Land Use Policy Map from the Countywide Plan.

Stinson Beach Community Plan

The Stinson Beach Community Plan (Marin County Planning Department 1985) contains the following "Land Use Goal and Objective:"

General Goal

Maintain the present balance between commercial, residential, and recreational uses within Stinson Beach. Foster the maintenance of the present socio-economic diversity and levels within the town.

Objective 4.0

Restructure land use controls to reflect the general and specific goals of this plan.

Bolinas Community Plan

The Bolinas Community Plan (MCCDA 1997) contains the following goals:

Community Goal

The Community Plan recognizes a reasonable mix of agricultural and residential uses as the 'highest and best' use for the land in the planning area. Both growth rate and scale of future development should not drastically change the existing pattern. The community has expressed preference for a growth rate lower than that which has occurred since 1960. Speculation on Bolinas land is not considered an essential element of the community.

Agriculture Goal

Agriculture on the peninsula will be encouraged as a source of food, income, and way of life.

Landforms (Opens Space, Parks) Goal

The unique aesthetic value of Bolinas landforms both spatially and visually shall be preserved. Areas of geologic and hydrologic hazard shall be defined, and limitations placed on their future development due to these hazards.

Bolinas Lagoon Goal

The Bolinas community shall be responsive to all the elements of this extraordinary lagoon including the effects of human activity in its watershed and on its shoreline.

Under Parks, recreation and Open Space, the Bolinas Community Plan states that,

"11. ... We urge the county to begin studies to determine the possibility of dredging the mouth of the channel, to improve the flushing capabilities of the lagoon, and to allow Bolinas fisherman better access to the sea."

3.8 AIR QUALITY

3.8.1 Introduction / Region of Influence

This section provides a discussion of ambient air quality standards, the general federal and state regulatory context associated with those standards, and existing air quality conditions for the project area. The project area is in Marin County, which is part of the nine-county San Francisco Bay Area. The regional Bay Area Air Quality Management District exercises local air quality management responsibilities. The ROI for air quality issues should generally be considered to be the entire San Francisco Bay Area, although the area of impact for some pollutants tends to be much more localized.

Air quality can be affected by primary pollutants, such as carbon monoxide and directly emitted particulate matter, which have localized areas of effect, and secondary pollutants, such as ozone, which have broader areas of effect.

3.8.2 Regional Air Quality Conditions

Both the federal government, through the Clean Air Act (CAA), and the state of California have established ambient air quality standards to protect public health and welfare. Standards have been adopted for six criteria pollutants—ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, inhalable and fine particulate matter (PM_{10} and $PM_{2.5}$), and airborne lead particles. Federal and state ambient air quality standards are presented in Table 3-4.

Areas that violate air quality standards are designated nonattainment areas for the relevant pollutants. Nonattainment areas are sometimes further classified by degree (marginal, moderate, serious, severe, extreme). Areas that comply with air quality standards are designated attainment areas for the relevant pollutants. Areas of questionable status generally are designated unclassifiable areas.

3.8.3 Local Air Quality Conditions

The California Air Resources Board (CARB) publishes annual summaries of air quality monitoring data collected by various agencies within California. The Bay Area Air Quality Management District (BAAQMD) operates the monitoring stations within the Bay Area. The closest monitoring station to Bolinas Lagoon is in San Rafael, approximately 10 miles east of Stinson Beach. This station is also approximately eight miles south of one of the potential disposal sites in Novato, California. The station monitors a variety of pollutants, including ozone, carbon monoxide, and PM_{10}. The monitoring results for these pollutants from 1992 through 1999 are shown in Table 3-4. These are the most current years for which air quality data are available.

As shown in Table 3-4, federal air quality standards were not exceeded between 1992 and 1999. The state PM_{10} standard has been exceeded a few times each year between 1992 and 1999, and the state ozone standard was exceeded a few times in 1996, 1997, and 1999. As of August 30, 1999, the Bay Area had exceeded the federal 8-hour ozone

Table 3-4
Air Quality Standards and Summary of Recent Air Quality Monitoring Data for Marin County

Pollutant	Parameter	1992	1993	1994	1995	1996	1997	1998	1999	Federal Standard	State Standard
Ozone	Peak 1-hour value (ppm)	0.07	0.08	0.09	0.09	0.11	0.11	0.74	0.102	0.12	0.09
	Days above federal standard	0.0	0.0	0.0	0.0	0.0	0.0	0	0	NA	NA
	Days above state standard	0.0	0.0	0.0	0.0	2.0	1	0	2	NA	NA
Carbon Monoxide	Peak 1-hour value (ppm)	8.0	9.0	6.0	6.0	7.0	6	NA	NA	35.0	20.0
	Peak 8-hour value (ppm)	5.0	4.0	3.0	3.3	4.0	2.6	3.30	2.92	9.0	9.0
	Days above federal standard	0.0	0.0	0.0	0.0	0.0	0.0	0	0	NA	NA
	Days above state standard	0.0	0.0	0.0	0.0	0.0	0.0	0	0	NA	NA
Inhalable Particulate Matter, PM_{10}	Peak 24-hour value ($\mu g/m^3$)	63.0	69.0	72.0	74.0	50	72	52.4	75.6	150	50
	Annual geometric mean ($\mu g/m^3$)	22.0	21.3	21.6	19.2	20.0	20.2	18.7	19.5	NA	30
	Annual arithmetic mean ($\mu g/m^3$)	24.5	23.3	24.1	20.9	21.8	21.9	20.1	22	50	NA
	Number of 24-hour samples	61.0	61.0	61.0	61	61	61	61	61	NA	NA
	% of samples above federal standard	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0	0	NA	NA
	% of samples above state standard	8.2%	1.6%	6.5%	1.6%	0.0%	3.2%	1.6	33.3	NA	NA

Notes: ppm = parts per million by volume.
$\mu g/m^3$ = micrograms per cubic meter.
NA = not applicable

Source: CARB 1992; CARB 1993; CARB 1994; CARB 1995; CARB 1996, CARB 1997; CARB 2000.

standard on six days and the one-hour state ozone standard on eleven days. According to the BAAQMD, during 1999, the North Counties, including Marin County, have exceeded the state one-hour ozone standard four times, and the federal 8-hour ozone standard once (BAAQMD 1999).

Because the monitoring station is 10 miles from the project area and on the opposite side of the ridge, the data are not a direct indication of the air quality in Stinson Beach.

3.8.4 Existing Air Emission Sources

The primary sources of air emissions within the Bolinas Lagoon watershed include building heating, maintenance activities, vehicle use (both land and water), recreation, and agriculture. These activities are small in scope and do not require air permits from the BAAQMD. No emission inventory data by source category are currently available for the project area.

3.8.5 Regulatory Considerations

The CAA requires federal agencies to comply with state and local air quality regulations. Section 176(c) of the act requires that federal agencies evaluate their proposed actions before proceeding to ensure consistency of such actions with the act and with applicable state air quality implementation plans. Proposed federal actions must not cause or contribute to new air quality standard violations, must not increase the frequency or severity of any existing violations, and must not delay the timely attainment of air quality standards.

The US Environmental Protection Agency (US EPA) has promulgated rules establishing conformity analysis procedures for transportation-related actions and for other (general) federal agency actions. The US EPA general conformity rule requires preparation of a formal conformity determination document for federal actions in federal nonattainment areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The federal nonattainment and maintenance pollutants subject to conformity analyses in the Bay Area include ozone precursors (reactive organic compounds and nitrogen oxides) and carbon monoxide. Applicable threshold levels for federal actions in the San Francisco Bay Area are 100 tons per year of reactive organic compounds, 100 tons per year of nitrogen oxides, and 100 tons per year of carbon monoxide.

3.9 ONSHORE TRAFFIC AND TRANSPORTATION

3.9.1 Introduction / Region of Influence

This section provides a discussion of the transportation system in the vicinity of Bolinas Lagoon, including a description of the regional and local street system serving the watershed. The ROI for traffic and transportation is wider than for most other resource areas, and would include the routes followed by loaded trucks between the lagoon and Redwood Landfill.

3.9.2 Road Network

Bolinas Lagoon is bounded by Highway 1, the Shoreline Highway, Calle del Arroyo and Dipsea Road on the Seadrift peninsula, Olema-Bolinas Road, and Wharf Road in downtown Bolinas (Figure 3-17). Access to the sites where dry materials would be extracted from the lagoon would occur along these roadways. Staging of trucks, materials and other project related equipment is planned toward the northern end of Bolinas Lagoon at Winnebago Point located about 0.3 miles north of the Audubon Canyon Ranch on Highway 1. Other staging areas may be developed along Olema-Bolinas Road; however, very few locations in the form of pull-outs exist along any of the roads that access Bolinas Lagoon.

The project sponsor has recommended using Redwood Landfill in northern Marin County for disposal of upland soils and vegetative debris. To access Redwood Landfill, trucks could take one of several possible routes. One route would involve traveling north on Highway 1 through Point Reyes Station, east on Point Reyes-Petaluma Road to Novato Boulevard and San Marin Drive, and then north three miles on Highway 101 to the landfill. Another route would be south from Bolinas Lagoon along Highway 1 through Tamalpais Valley to Highway 1 near Manzanita. Trucks would then proceed northward on Highway 101 to either Hamilton Army Airfield or the Redwood Landfill in Novato.

Highway 1

Highway 1 (Shoreline Highway) is a two-lane state highway that links the Golden Gate Bridge to the south with Marin County and other coastal counties and communities to the north. Highway 1 is a rural coastal roadway and provides access to Mount Tamalpais State Park and Muir Woods. Highway 1 has numerous switchbacks and significant changes in grades. During the summer, significant numbers of visitors travel to Stinson Beach and Muir Beach, which are located along Highway 1 south of Bolinas. Traffic volumes along Highway 1 west to the west of Highway 101 in Marin County is highest just west of Highway 101 in Tamalpais Valley, where the daily traffic reaches about 31,500 trips and the peak hour traffic is about 2,700 trips. West of the Tamalpais Valley, traffic reduces to about 3,400 daily and 370 peak hour vehicle trips near Muir Beach. Near Stinson Beach the traffic increases again to about 5,400 daily and 590 peak hour trips. These traffic levels continue past Bolinas Lagoon to a point just north of the intersection of Highway 1 and Olema-Bolinas Road, where the daily traffic decreases to about 2,600 daily and 290 peak hour trips.

3-17 Local Roadways

Highway 1 to Redwood Landfill

Point Reyes-Petaluma Road is a two-lane rural highway that travels northeast toward Novato and Petaluma. East of Point Reyes Station, Point Reyes-Petaluma Road accesses the Nicasio Valley past the Nicasio Reservoir into the Hicks Valley. In Hicks Valley, it intersects with Novato Boulevard. Novato Boulevard proceeds easterly into the city of Novato along the northern portions of Highway 101 in Marin County. Novato Boulevard is a two-lane roadway to the west of the city in the rural portions of Marin County. Novato Boulevard intersects with San Marin Drive about three miles west of Highway 101. San Marin Drive proceeds north and east to Highway 101. San Marin Drive is a four-lane arterial roadway and a designated truck route within Novato. At Highway 101, the Redwood Landfill is located about three miles north of the San Marin Drive interchange.

Highway 101

Highway 101 near Manzanita has eight lanes and carries about 133,000 daily trips and about 10,600 peak hour trips. Highway 101 maintains eight lanes northward to the Sir Francis Drake interchange, where it reduces to six lanes. The six-lane section is maintained throughout most of Marin County to a point just north of San Marin Drive in Novato where it is reduced to four lanes. The peak traffic loads along Highway 1 occur in San Rafael at San Pedro Road. At this location, the average daily traffic reaches about 188,000 vehicles, while the peak hour traffic is about 15,000 vehicles per hour. Congestion occurs during the peak hours along Highway 101 during the AM and PM peak hours. Morning congestion occurs southbound from the junction of Highway 101 and Route 580 in southern San Rafael backward to the north to locations near the Marinwood exit south of Novato. During the PM peak hours, the northbound portions of Highway 101 are congested between Manzanita and San Pedro Road. In addition, on Highway 101 north of San Marin Drive in Novato, where the highway narrows from six to four lanes, congestion occurs during the PM peak hours. Vehicles queue toward the south as far as Highway 37. In May 2002, Caltrans started construction of the Highway 101 Gap Closure Project. This project will create a reversible High Occupancy Vehicle (HOV) lane between the Sir Francis Drake Boulevard/Highway 101 interchange and the existing HOV lane just north of San Pedro Road in San Rafael. Construction is estimated to require two to three years to complete.

Local Roadways

Olema-Bolinas Road is a two-lane roadway, which has no sidewalks, curbs, or gutters. The roadway is about 24 feet wide and accommodates unmarked parking. Traffic counts along Olema-Bolinas Road were not available.

Seadrift

Calle Del Arroyo provides access to the residential areas to the north of Stinson Beach. It is a two-lane roadway without curb and gutter. The roadway is about 24 feet wide and accommodates parking. No traffic volume data was available for this facility.

Seadrift Road and Dipsea Road are at the northern terminus of Calle Del Arroyo and serve as the internal roadways within the Seadrift residential area. Both of these roadways are between 20 and 24 feet wide. They have no sidewalks and accommodate parking on both sides. Access to the Seadrift community is controlled with security gates at the main entrance.

3.9.3 Traffic Volumes

Roadway operating conditions are described in terms of level of service (LOS), which indicates operational conditions as influenced by speed, travel time, freedom to maneuver, safety, driving comfort, and convenience. Uncongested free flow conditions are assigned LOS A, while gridlock conditions are represented by LOS F. Marin County has not yet made a finding concerning LOS in the area around Bolinas Lagoon (Wagner 1999).

Caltrans conducts annual average traffic counts on Highway 1 at the intersections with Bolinas Road and Bolinas-Fairfax Road. As can be seen from Table 3-5, the traffic counts on Highway 1 are relatively low.

Table 3-5
2000 Traffic Counts on Highway 1 near Bolinas Lagoon and on Highway 101 through Marin County

					Two-Way Traffic			
District	Route	County	Milepost	Description	Peak Hour	Peak Hour LOS	Peak Month ADT	Annual ADT
4	1	Marin	17.07	Fairfax/Bolinas Roads	590	A	5,800	5,400
4	1	Marin	17.2	Bolinas Road	280	A	2,750	2,550
4	101	Marin	5.69	Junction Route 131 East	13,300	E	176,000	166,000
4	101	Marin	12.69	San Rafael – San Pdero Road	14,100	F	181,000	176,000
4	101	Marin	19.09	Junction Route 37	12,100	D	151,000	147,000
4	101	Marin	22.00	San Marin Drive/Atherton Avenue Interchange	6,100	F	81,000	78,000

Source: Caltrans 2001
ADT: Average Daily Traffic

Anecdotal evidence from GGNRA staff indicates that although average traffic volumes are low through the lagoon watershed, traffic on hot summer weekends can be very heavy. When the parking lots at Stinson Beach Park are full or close to full, traffic on Highway 1 can back up for close to a mile in each direction (Giambastiani 1999).

3.9.4 Public Transportation

Golden Gate Transit provides weekend-only bus service from Marin City to Stinson Beach. Bus 63 stops at Stinson Beach Park. Eight buses run each weekend day at one-hour intervals, from 9 AM until approximately 6 PM. This is the only scheduled public transportation in the Bolinas watershed (Bay Area Transit Information Project 1999).

3.9.5 Parking

There are a few pull-outs along Highway 1 where people, such as birdwatchers and picnickers, park their cars in order to observe the wildlife on Bolinas Lagoon (MCOSD 1996). MCOSD allows these uses, although overnight parking or camping is not permitted (MCOSD 1996). Stinson Beach Park, administered as part of GGNRA, has over 1,000 parking spaces in its three lots, and these lots sometimes fill up on hot summer weekends (Giambastiani 1999). There is a small amount of public parking in Bolinas, along Wharf Road, and on Brighton Avenue, near the public access point to Bolinas Beach.

3.9.6 Regulatory Considerations

The following transportation objectives for Marin County (MCCDA 1999) are particularly applicable to the Bolinas Lagoon Watershed:

> Policy
>
> To minimize environmental disruption and condemnation of private or publicly owned land due to implementation of transportation projects.
>
> Policy
>
> To maintain the rural character of West Marin by maintaining the transportation system at a rural scale.

3.10 MARINE TRAFFIC AND TRANSPORTATION

This section focuses on the existing conditions of commercial vessel transportation in and around San Francisco Bay. The ROI for marine transportation is Bolinas Bay to SFDODS.

3.10.1 Vessel Transportation Service (VTS)

Pursuant to the passage of The Ports and Waterways Safety Act of 1972, the Coast Guard established a Vessel Transportation Service (VTS) for San Francisco Bay. The VTS is used to monitor all commercial, Navy, and private marine traffic within San Francisco Bay and local coastal waters. Vessels required to use the VTS are as follows:

- Power-driven vessels of 40 meters or more in length;
- Towing vessels of 8 meters or more in length, while navigating; and
- Vessels certificated to carry 50 or more passengers for hire, when engaged in trade (US Coast Guard 1999).

The only vessels excluded from coordinating traffic movements with VTS are small private vessels. However, all vessels over 20 meters long, as well as all dredges and floating plants, are required to keep VHF watch on designated sector frequencies. In addition, all fishing vessels and recreational vessels are encouraged to monitor VTS radio channels in order gather traffic movement information.

VTS services include the following:

- Designation of traffic lanes for inbound and outbound vessel traffic;
- Designation of separation zones between vessel traffic lanes; and
- Development of a set of rules to govern vessel traffic entering and leaving ports and San Francisco Bay.

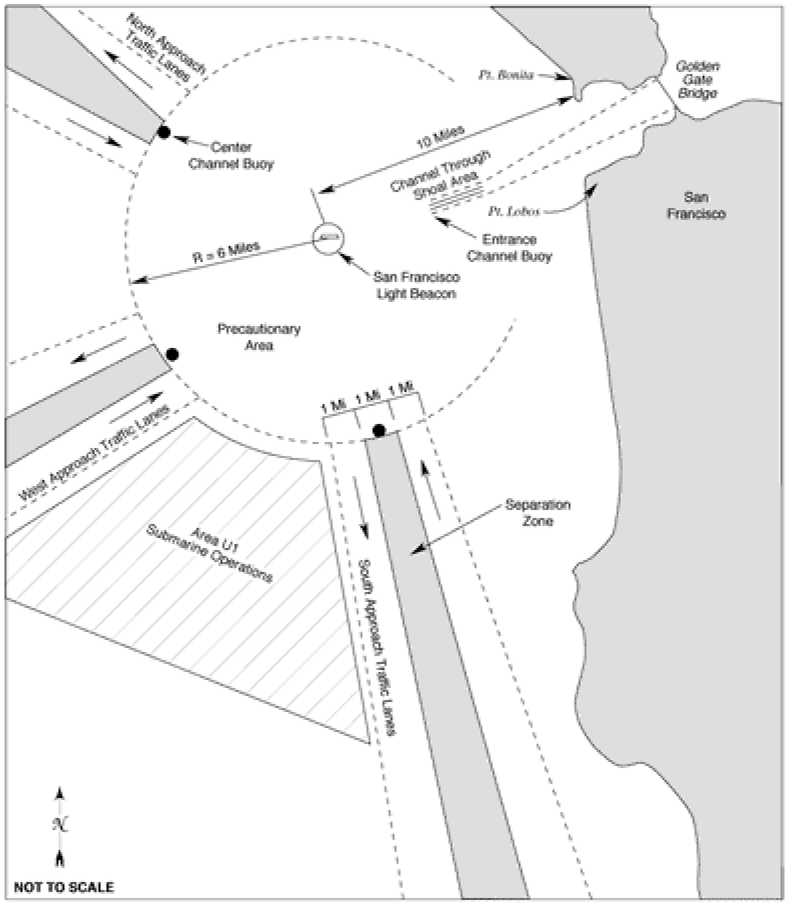
The VTS, which is on Yerba Buena Island, controls marine traffic throughout the San Francisco Bay Area.

Designated Traffic Lanes approaching San Francisco Bay

Dredge barges traveling from Bolinas Lagoon to the San Francisco Deep Ocean Disposal Site (SFDODS) would need to travel through the designated navigation channels approaching the Golden Gate Bridge. The following section describes the navigation channels in these areas.

Approach lanes to the entrance of San Francisco Bay have been established west of the Golden Gate Bridge in the Gulf of the Farallones, from the north, west, and south, as shown in Figure 3-18. Approach lanes are composed of one-mile-wide inbound and outbound traffic lanes, with a one-mile-wide separation zone between the traffic lanes.

Figure 3-18
Navigation Channels into San Francisco Bay



Source: Corps and Port of Oakland 1998.

The US Navy has designated areas for submarine operations outside these lanes, in which barge operations are not allowed. The approach lanes lead to an offshore light station with a rotating beacon that marks the beginning of the main channel to the Golden Gate Bridge. The beacon, 10 miles west of Point Bonita, is in the center of a precautionary area where all ships leaving and entering port converge.

Piloting in and out of the bay and adjacent waterways is compulsory for all vessels of foreign registry and US vessels under enrollment not having a federally licensed pilot on board. San Francisco Bar Pilots, who provide pilotage for vessels moving to and from all terminals in the bay and tributaries to the bay, embark or disembark from vessels at this point.

Ships bound for San Francisco Bay proceed in an easterly direction toward the Golden Gate Bridge through a narrow channel, which consists of inbound and outbound traffic lanes that are 600 yards wide with a separation zone between them (approximately 150 yards wide).

3.10.2 Hazards to Navigation

Hazards to navigation can be caused by a combination of shoals and islands, bridges and other structures, fog and inclement weather, vessel traffic, and, tides and currents.

The four-fathom bank (or Potato Patch) shoals are just west of the Golden Gate Bridge and north of the main entry channel to the bay.

Fog during the warmer months and storms in the winter can contribute to navigation difficulties. Fog typically occurs during the summer, especially in the late afternoon.

Strong currents are created in San Francisco Bay during periods of maximum ebb and maximum flood tides, reaching 4.5 knots at maximum ebb. However, currents above two knots are considered strong and potentially hazardous if not properly adjusted for. Currents are strongest at the Golden Gate and from the Golden Gate Bridge to the Bay Bridge.

In conjunction with the severe tides and currents in the bay, and the possibility of other ships straying from the traffic lanes, navigation can be extremely difficult during bad weather conditions.

Vessel traffic is the greatest hazard to vessel navigation in San Francisco Bay. As documented above, large commercial and naval vessels are required by US Coast Guard regulations to use designated traffic lanes when traveling into and within San Francisco Bay. However, smaller commercial vessels, such as tugboats, ferryboats, and private vessels, often do not navigate within specific traffic lanes, but rather travel in the most direct route. These vessels can pose hazards to navigation, particularly if other circumstances such as fog are present. Private vessel traffic is heaviest during weekend days and can pose hazards to dredge scows under tow, if the tugboats have trouble controlling their tows. Sporadic incidents, such as towing bridles that break and barges that run aground, can be found in many US Coast Guard vessel traffic reports (Corps and Port of Oakland 1998).

3.10.3 Vessel Traffic Entering/Exiting San Francisco Bay

The US Army Corps of Engineers reports that 7,541 commercial vessels transited the entrance to San Francisco Bay in 2000, including both inbound and outbound trips (i.e., 3,797 inbound and 3,744 outbound transits). Foreign vessels accounted for approximately 72 percent of these transits (5,444 transits) with domestic vessels accounting for the remaining 28 percent of transits (2,097 transits). Most of the transits were by self-propelled vessels (94 percent, or 7,059 transits) with six percent by auxilliary-propelled vessels (482 barge transits) (Corps 2000).

The US Coast Guard VTS Service in San Francisco Bay reported that more than 100,000 vessels participated in the VTS program in 1998 and 1999 (111,273 in 1998 and 107,826 in 1999) (Table 3-6). Most of the vessels were ferry/passenger boats and tug/tow boat combinations that remained inside San Francisco Bay and did not transit outside into the Pacific Ocean. Vessels transiting outside San Francisco Bay accounted for approximately six percent of all vessels tracked by the VTS system (US Coast Guard 2001).

Table 3-6
Participants in VTS in San Francisco Bay in 1998 and 1999

# of Participants	1998	1999
Tanker	3,136	3,039
Freighter	7,128	7,798
Tug/Tow	19,239	19,115
Ferry/Passenger	76,421	73,694
Public	2,179	2,542
Other	3,168	1,945
Total	111,273	107,826

Source: US Coast Guard 2001

According to San Francisco VTS, dredges or tug and tow combinations were involved in a limited number of physical incidents, in which damage actually occurred, including 14 incidents in 1998, 13 incidents in 1999, and 7 incidents in 2000. These incidents primarily involved striking a fixed object, such as a pier or bridge abutment, and vessel casualties. Some incidents also involved dragging anchors, a drifting barges, and a near miss, among other incidents. Only three of these incidents occurred in the deep water channels leading outside San Francisco Bay (US Coast Guard 2001).

3.10.4 Boating Activity

Recreational Vessels

According to the California Department of Boating and Waterways, there were approximately 173,000 registered recreational boats in the counties surrounding San Francisco Bay, down slightly from 177,000 registered boats in 1997.

Most recreational boating activity takes place between May and September. In addition, approximately 63 pecent of boating activity occurs on weekends, with the remaining 37 percent spread across all weekdays.

Most recreational boating activity in the area occurs inside San Francisco Bay. However, a small percentage of boaters also exit San Francisco Bay for trips along the coast to Bodega Bay, Drakes Bay, Pillar Point Harbor, and other coastal destinations or for an ocean cruise or for longer voyages to southern California, the Pacific Northwest, and beyond. Boaters frequently wait until there is a slack tide prior to crossing the bar. A frequent waiting place is along Bolinas Bay, where the beauty of the coastline combines with calmer water to make the crossing easier.

In 2000, a total of 906 boating accidents were reported to the Department of Boating and Waterways, involving 524 injuries, 51 fatalities, and $3,038,400 in property damage throughout all areas of California (California Dept. of Boating and Waterways 2000). Most of the accidents involved collisions with other vessels (341 instances, involving mainly other recreational craft, 33.4 percent of total), skier mishap (113 instances, 11.1 percent of total), flooding/swamping (88 instances, 8.6 percent of total), grounding (88 instances, 8.6 percent of total), and sinking (76 instances, 7.4 percent of total). Most of these accidents were caused by operator inexperience (381 instances, 28.2 percent), operator inattention (286 instances, 21.2 percent), excessive speed (219 instances, 16.2 percent), passenger/skier behavior (107 instances, 7.9 percent), hazardous weather/water (94 instances, 7.0 percent) (California Dept. of Boating and Waterways 2000).

Most fatalities involved falls overboard (15 instances, 25.4 percent), capsizing (15 instances, 25.4 percent), skier mishap (6 instances, 10.2 percent), flooding/swamping (4 instances, 6.8 percent), and collision with a fixed object (4 instances, 6.8 percent). Most of the fatalities were caused by operator inattention (18 instances, 21.4 percent), operator inexperience (16 instances, 19.0 percent), overloading/improper loading (10 instances, 11.9 percent of total), hazardous weather/water (8 instances, 9.5 percent of total), and excessive speed (7 instances, 8.3 percent of total) (California Dept. of Boating and Waterways 2000).

Approximately 73 percent of vessels involved in all accidents and 89 percent of vessels involved in fatal boating accidents were less than 26 feet in length. Accidents occurred mostly from May through September, on weekends, between 10:00 A.M. and 6:00 P.M. (California Dept. of Boating and Waterways 2000). The largest number of accidents (50 percent) occurred on lakes, followed by ocean/bay waters (28 percent) (California Dept. of Boating and Waterways 2000).

Commercial Fishing Vessels

There is an active commercial fleet engaged in fishing the waters in and around San Francisco Bay. In 1999, approximately 79 million pounds of fish products, with a value of nearly $27 million, was harvested in the area immediately in and around San Francisco Bay, representing 17 percent of the catch in California waters and 20 percent of the value (California Department of Finance 2000).

Safety Trends in Boating Accidents & Fatalities

There are several instructions for recreational and commercial boaters to improve safe transit.

As noted above, the most dangerous part of the San Francisco Bay Bar is considered to be the shallow northwest portion, better known as the Potato Patch. The Bonita Channel, between the shoal and the Marin coast, can also become very dangerous during large swell conditions. The safest part of the bar is the main ship channel

Table 3-7
Participants in VTS in San Francisco Bay and Number of Vessels not in Compliance

Area	Landings (In pounds)	Value
Bodega Bay	2,758,325	3,945,468
San Francisco	14,912,621	12,100,340
Monterey	61,376,614	10,634,184
subtotal	79,047,560	26,679,992
% total	14%	20%
Total	**545,299,578**	**132,701,264**

Source: US Coast Guard 2001

through the center of the bar; but even that area can be extremely dangerous when the tidal current is ebbing. It may be safer to remain at sea or in the bay until tide and wind conditions change and calmer seas occur. This is a very difficult crossing to make in bad weather or predominantly strong ebb tide conditions. Steep waves 20 to 25 feet high have been reported over the bar. Conditions over the bar may change considerably in a relatively short period. These are the conditions facing boaters attempting to transit the bar, as well as those boating along the coast of Marin County (US Coast Guard 1999).

Boaters are advised not to attempt to cross the bar without first consulting Chart #18649 of San Francisco Bay and the US Coast Pilot No. 7. The chart and the Coast Pilot No. 7 can be purchased through authorized nautical chart agents (US Coast Guard 1999).

To minimize the risk of collisions and groundings of large ocean-going vessels, the US Coast Guard's Vessel Traffic Service (VTS) was established in 1972. The system designates separated traffic lanes, a precautionary area and restricted areas, to coordinate the flow of deep-draft traffic into, out of and within the central portion of the bay (US Coast Guard 1999).

The rules state that vessels of less than 20 meters (66 feet), vessels engaged in fishing, and all sailboats shall not impede the passage of a vessel that can safely navigate only within a narrow channel or fairway (i.e., the traffic routing system). When practicable, boaters should travel in the direction specified by the routing system, staying to the right-hand side of channels, precautionary areas, and traffic lanes. In addition to these legal requirements, common sense should tell boaters that the right-of-way should be given to any large vessel navigating in a narrow channel. Because these ships require a greater area to maneuver and longer distances to stop, small craft should give them a wide berth. Due to their size, large vessels may appear to move slowly, but actually move very rapidly. The traffic lanes to which the deep-draft vessels are restricted are deeply dredged but narrow; because of the length of the deep-draft vessels, a sharp maneuvering turn can easily result in grounding. The location of the pilot houses on some vessels and their height above the water may limit the visibility afforded pilots of the areas directly surrounding their ships, particularly the area immediately to the fore and aft of the ship. In addition, the superstructure of a large vessel may block the wind, and persons operating sailboat and sailboard may unexpectedly find themselves unable to maneuver. Bow and stern waves can be hazardous to small vessels. Because of these factors and the congestion of vessels in the bay, it is essential that recreational boaters observe the rules and use common sense. Boaters should use extreme caution in the Precautionary Area between Treasure Island and the San Francisco waterfront because larger vessels and ferries transit this area from various directions. Boaters are cautioned that inbound deep-draft vessels normally use the Deep Water Route north of Harding Rock and Alcatraz Island. The traffic lanes are shown in Figure 3-18, along with the Precautionary Area and the Deep Water Route. Chart #18649, which shows the route and the routing system in detail, can be obtained from authorized chart agents (US Coast Guard 1999).

Boaters transiting the bay should first obtain information regarding major shipping traffic in their area by temporarily monitoring Channel 13 VHF-FM or Channel 14 VHF-FM. The VTS is in operation 24 hours a day and in all types of weather. In addition to the traffic system, VTS incorporates radar surveillance of marine traffic, radiotelephone communication, and information gathering and display.

Outside the bay, the Coast Guard maintains the Offshore Sector (see Figure 3-18). Regular broadcasts of the reported movement of large vessels transiting the approaches to San Francisco Bay are made at 15 minutes and 45 minutes past the hour. Boaters can listen to these broadcasts on Channel 12 VHF-FM (US Coast Guard 1999).

3.11 Noise

3.11.1 Introduction / Region of Influence

This section provides a discussion of noise terminology, relevant state and local guidelines concerning land use compatibility with respect to noise, important aspects of local noise ordinances, and the general range of existing noise levels expected for various land use conditions. Because noise levels decline rapidly with increasing distance from the noise source, the ROI for noise issues is localized in the immediate vicinity of the areas where construction activity would occur. In general, noise intensities associated with project construction activities would become similar to background noise conditions at distances of about 1,000 to 2,000 feet from the construction site.

3.11.2 Noise Terminology

Noise can be defined as "unwanted sound." Sound travels through the air as waves of minute air pressure fluctuations caused by some type of vibration. Sound level meters measure pressure fluctuations from sound waves, with separate measurements made for different sound frequency ranges. These measurements are reported in a logarithmic decibel (dB) scale. Because the human ear is not equally sensitive to all frequencies, the "A-weighted" decibel scale (dBA) is used to weight the meter's response to approximately that of the human ear.

Average noise exposure over a 24-hour period is often presented as a community noise equivalent level (CNEL). CNEL values are calculated from average hourly noise levels, with the values for the evening period (7 PM to 10 PM) increased by 5 dB and values for the nighttime period (10 PM to 7 AM) increased by 10 dB. The weighting of evening and nighttime noise levels reflects the greater disturbance potential from nighttime noises.

The geographic area where noise effects may be felt from any potential Bolinas Lagoon sedimentation project is currently defined as the Bolinas Lagoon watershed. A secondary area of effects includes disposal truck routes to the upland disposal sites, as well as the area of the disposal sites themselves.

3.11.3 Existing Noise Conditions

Noise Receptors

Sensitive receptors are land uses, such as residences, schools, libraries, hospitals, and other similar uses, that are considered to be sensitive to noise. Sensitive receptors located within the watershed include hundreds of residences, two schools, and two libraries within the communities of Stinson Beach and Bolinas, which are both within three miles of the lagoon and the expected project area.

The sensitive noise receptors in the project area also include the Golden Gate National Recreation Area and Point Reyes National Seashore lands surrounding the lagoon, as well as the lagoon itself. In addition, although wildlife populations are not highly sensitive to noise per se, the protected harbor seal and bird populations within the lagoon would be considered sensitive receptors.

Noise Sources

The primary noise source at Bolinas Lagoon is motor vehicle use from traffic on major roads such as Highway 1, Olema-Bolinas Road, Bolinas-Fairfax Road, and smaller local thoroughfares. Although such motor vehicle use is generally low in comparison to traffic levels in the rest of the San Francisco Bay Area (see Traffic discussion section), traffic on hot summer weekends can be quite heavy and may have some noise effects. In addition, motorboat traffic from Bolinas Bay and the limited motorboat traffic on the lagoon itself may be audible within the lagoon watershed.

Ambient noise levels will vary somewhat, depending on proximity to highways and urban development. Wind conditions, insects, birds, and other wildlife will contribute to noise conditions away from developed areas. In general, ambient noise levels are likely to vary from about 35 dBA during quiet periods to about 60 dBA during windy periods. Depending on wind and wave conditions, noise levels may exceed 65 dBA at times along the Bolinas Bay beach portions of the Seadrift spit. Average CNEL levels for undeveloped areas around Bolinas Bay would be expected to be about 45 to 50 dBA. Average CNEL levels may be about 55 dBA for areas near highways.

3.11.4 Regulatory Considerations

The federal Noise Control Act of 1972 (P.L. 92-574) established a requirement that all federal agencies must comply with applicable federal, state, interstate, and local noise control regulations. Federal agencies also were directed to administer their programs in a manner that promotes an environment free from noise that jeopardizes public health or welfare.

Although the lagoon itself is not within National Park Service (NPS) control, the extent of NPS jurisdiction within the watershed would require the application of NPS noise regulations. Under 36 CFR 2.12, the use of machinery or instruments to create a noise exceeding 60 dBA, or the use of a motor or engine without a permit, is forbidden within park boundaries.

The California Department of Health Services (1987) published guidelines for the noise element of local general plans. These guidelines include a noise level/land use compatibility chart that categorizes various outdoor CNEL ranges into as many as four compatibility categories (normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable), depending on land use.

The state noise element guidelines chart identifies normally acceptable noise levels for low-density residential uses as CNEL values below 60 dB. The normally acceptable range for high-density residential uses is identified as CNEL values below 65 dB. For educational and medical facilities, CNEL values of 60 to 70 dB are identified as conditionally acceptable. For office and commercial land uses, CNEL values of 67.5 to 77.5 are categorized as conditionally acceptable. For recreation uses, CNEL values of 65 to 70 are conditionally acceptable.

The Marin Countywide Plan standards are based on the state guidelines. Under the Land Use Compatibility standard in the plan, residential neighborhoods, schools and libraries, and neighborhood parks are considered compatible with a CNEL of up to 60 dB. Such sensitive land uses cannot occur where the CNEL is between 60 and 70 dB unless noise reduction features are implemented in the new construction (MCCDA 1994.)

The Noise Element also sets forth the standard for stationary noise sources. Nighttime noise levels must be kept below 45 dB, with single-event noises of no more than 60 dB.

In addition, the lagoon is subject to the requirements set forth in the Marin County Open Space District (MCOSD) Code, which does not establish numerical noise standards but does prohibit “any loud, unnecessary or unusual noise which disturbs the peace or quiet within any area within the district.” (MCOSD 1999).

3.12 AESTHETICS AND VISUAL RESOURCES

3.12.1 Introduction/Region of Influence

This section addresses visual quality issues related to the proposed project. The visual character of the project area is described, and potentially sensitive visual resources are identified. In addition, local policies relating to the maintenance of visual quality are summarized. The ROI for the visual resources analysis encompasses the project site, as well as those portions of the adjacent residential and rural areas that are visible in the line of site of the proposed project. This would include the lagoon and adjacent upland, areas of the watershed with views of the lagoon and Bolinas Bay, Bolinas Bay itself, and Stinson and Bolinas beaches.

3.12.2 Character of Project Area

Bolinas Lagoon is a roughly triangular body of water separated from the waters of Bolinas Bay only by a narrow spit along the southeast edge of the lagoon. Much of the lagoon floor is exposed at ebb tide, and even at high tide numerous islands and marshes are exposed (Figure 3-19).

The lagoon rests in a narrow cleft running northwest to southeast, bordered on the northeast by Bolinas Ridge, which rises to approximately 1,500 feet above sea level, and on the southwest by a plateau that rises to about 450 above sea level and culminates at Duxbury Point on the southern tip of the plateau. The visual color of the watershed uplands varies with the season. In the winter months, depending on the amount of rain, the predominant color of the study area ranges from medium to bright green. In the drier summer and fall months, open lands are typically tan or light gold, with the wooded canyons and hillsides remaining the dark green of evergreen foliage.

West of the lagoon the land nearest the shore is wooded but clears to meadow and scrub as one moves westward towards the ocean. Highway 1 parallels the shore of the east side of the lagoon; from there the ground climbs quickly eastward into the heavily wooded slopes of Bolinas Ridge.

The southern edge of the lagoon is a long narrow spit of sand, which was developed in the 1950s as a gated community with an artificial lagoon in the center of the spit. On the other side of the Stinson Beach sand spit is a 3-mile expanse of private beach and then Bolinas Bay.

On the southwest corner of the lagoon is the Bolinas business district, which includes a small developed waterfront and a small harbor with docks and moorings. A number of houses along Wharf Road in Bolinas are built on stilts over the lagoon. South and west of the lagoon inlet is Bolinas Beach. Both Stinson Beach and Bolinas Beach look south over Bolinas Bay.

3-19 Views of Bolinas Lagoon and Bolinas Ridge

3.12.3 Views of Project Area

While title to the lagoon itself is held by the County of Marin, much of the watershed is in federal ownership. The two national parks, GGNRA and PRNS, meet in the Bolinas Lagoon watershed. As a result, the public has access to most of the watershed for recreational purposes.

Uplands

The hills and canyons east of the lagoon are mostly wooded with some meadows and scrub. The ground rises sharply from the shore of the lagoon to the top of Bolinas Ridge (Figure 3-19). Seven creeks have carved canyons into the western face of Bolinas Ridge and feed directly into the lagoon on its eastern side. Farther north, four other creeks feed into Pine Gulch Creek, which curves west around the north end of the lagoon to enter just above Bolinas. These canyons are overgrown with riparian trees and low-growing vegetation.

The view west of the lagoon is less dramatic visually, rising gradually to the mesa overlooking Duxbury Point. Much of this area is in private ownership, and there is extensive residential development on the southwestern tip of the mesa near Duxbury Point. The hills south and west of the Bolinas downtown are wooded but developed with residential and vacation houses, many of which can be seen from Agate Beach.

Lagoon Views

The southern boundary of the lagoon is a sand spit approximately three miles long. The northern third of the sandpit, known as Seadrift, was developed in the 1950s as a gated community with a long artificial lagoon occupying the inner portion of the Seadrift sand spit. The residences are mostly one- and two-story single-family homes, constructed in a variety of architectural styles. Most have extensive landscaping, including trees and fenced yards. The development on Seadrift is clearly visible from the north.

At the far western end of the spit are sand dunes and the narrow channel that is the mouth of the lagoon, opposite the buildings and piers of the community of Bolinas. The southern side of the Stinson Beach sand spit is a private beach with public access provided through Upton Beach. Above the high tide line on the ocean side of the Seadrift subdivision is a rock revetment designed to protect Seadrift residences from winter storm damage. Much of the western length of the lagoon is wooded along the shoreline, with little development discernable from other locations. The heavily-vegetated area of Pine Gulch Creek Delta protrudes into the lagoon and can be easily discerned from the road along the western and northern edges of the lagoon. Similarly, Kent Island is heavily wooded and can be seen clearly from Wharf Road in Bolinas, as well as from the Stinson Beach spit along the inlet, although it is less clearly discerned from the eastern or southern portions of the lagoon. The eastern shore of the lagoon is bordered by Highway 1, which, with its associated traffic, can be seen from other areas of the lagoon.

The lagoon itself, as seen in Figure 3-19, can appear to be either a broad expanse of open water interrupted by mudflats, or a broad expanse of mudflats interrupted by water, depending on the tide cycle. The edges of the lagoon and Kent Island contain wetland vegetation. The southeastern corner of the lagoon is primarily wetland, and there the vegetation is the primary visual element of the lagoon, along with the remains of a dredge that has in the past decades become a roost for a variety of bird-life.

Ocean Views

The expanse of Bolinas Bay immediately adjacent to Stinson Beach is within the project area. This area can be seen from the hillsides in the Bolinas watershed, as well as from Agate and Stinson Beaches. Visual elements frequently identified in Bolinas Bay include fishing vessels, recreational motor boats, kayakers, and surfers. The beaches are rarely devoid of human activity except in inclement weather, and during the summer months Stinson Beach in particular can be quite crowded.

3.12.4 Key Viewing Locations

Viewers most sensitive to changes in visual quality are local residents and those engaged in recreational activities. In general, motorists are only moderately sensitive to visual considerations because of their transitory exposure to the viewshed. However, there are multiple pull-outs along Highway 1 where motorists can watch wildlife and the scenery of the lagoon. The most sensitive viewers in the Bolinas Lagoon watershed are the permanent residents of Stinson Beach, Bolinas, and Seadrift, followed by the more transient recreational users of the public uplands, the lagoon, and Bolinas Bay.

Residential Views

The residents of the communities in the watershed have varied exposure to the visual resources of the project area because of their differing geographical locations. Stinson Beach and Seadrift residents would be particularly sensitive to visual impacts in the project area because of their location at the southeastern tip of the lagoon. Residents of Seadrift in particular have extensive views of the entire watershed, as well as views of Bolinas Bay. Residents whose homes overlook the lagoon from either side of Seadrift lagoon would also be sensitive to visual impacts in the lagoon. Residents of Bolinas and Stinson Beach whose homes overlook the ocean would be sensitive to visual impacts in Bolinas Bay.

Bolinas residents generally have views of the eastern side of the watershed. Although there is some residential development close to the lagoon, most Bolinas residential development has occurred closer to the ocean, just north of Duxbury Point. Only some of the residences in this area are within the watershed, and most of them have only limited views of the lagoon or Bolinas Ridge. However, many of the houses along the bluff have views of Bolinas Bay and the hills south of Stinson Beach.

Recreational Views

Because of the public status of most of the watershed, recreational users have extensive opportunities to appreciate the visual quality of the project area. The watershed is traversed by a network of hiking trails, many of which offer excellent views of not only the lagoon and Bolinas Ridge, but of the open ocean, Point Reyes, and Mount Tamalpais. Hiking trails are further described in Section 3.6, Public Access and Recreation.

Highway 1, which parallels the eastern side of the lagoon, has a number of unofficial pull-outs built upon deposited fill that provide clear views of the lagoon. Birders and other wildlife enthusiasts often use these pull-outs to observe wildlife in the lagoon. South of Stinson Beach, Highway climbs rapidly and provides extensive views of Bolinas Bay as well as the entire watershed.

Kayakers frequent the lagoon when the tides allow, and they appreciate the visual quality of the lagoon and the watershed during their paddling trips. Although kayaking is most popular in the summer, some recreational kayaking occurs year-round, weather allowing. The view of Bolinas Bay is appreciated by recreational users of Bolinas Beach and Stinson Beach, as well as surfers and boaters in Bolinas Bay.

3.12.5 Regulatory Considerations

Marin Countywide Plan Visual Protection Policy

According to the Marin Countywide Plan (MCCDA 1999) visual and aesthetic resources, especially scenic vistas, shall be protected by review of planned projects and removal of inconsistent existing elements.

> Policy EQ-2. 72, Viewshed Protection. The County shall protect visual access to the bay front and scenic vistas of water and distinct shorelines through its land use and development review procedures.
>
> Policy EQ-2. 73, View Corridor Identification and Enhancement. Existing built elements, such as overhead utilities, which detract from the shoreline and marsh landscape should be eliminated or blended into the environment. Sites with opportunities for near and distant views of the bay front and bay should be identified, protected and enhanced by improvements (turnouts, benches, etc.) where possible. View corridors and a low profile should be maintained on adjoining sites as well.
>
> Policy EQ-2. 74, Design of Waterfront Development. Waterfront development should be designed for openness and to permit optimal views for public enjoyment of the bay front.

3.13 Public Services and Utilities

3.13.1 Introduction/Region of Influence

This section describes public services, utilities, and related infrastructure that could be affected by the Bolinas Ecosystem Restoration Project. Placement of utility pipes and cables and ownership of such utilities are considered. Although utilities include freshwater distribution and treatment services, wastewater and sewage collection and treatment, telephone, gas, electricity, and solid waste, only those utilities that may have piping or cables that could interfere with the proposed project were considered in depth in this section. These utilities include: freshwater distribution and treatment services, wastewater and sewage collection and treatment, and telephone, gas, and electricity utilities.

Local agencies, municipalities, and companies, including the MCOSD, the Marin County Department of Public Works, Caltrans, Pacific Bell, the Bolinas Community Public Utility District (BPUD), the Stinson Beach Community, and the Stinson Beach County Water District (SBCWD) were contacted to provide information on the positions of utilities and location maps of utilities that may be impacted by the project.

The ROI for public utilities are all areas of the Bolinas Lagoon and watershed. Particular focus, however, was given to those areas where excavation is proposed.

3.13.2 Water and Wastewater

There are two water and wastewater districts in the Bolinas Watershed responsible for ensuring the adequate treatment and distribution of freshwater and for maintaining the sanitary sewer system. These districts include the BPUD and the SBCWD.

Bolinas Community Public Utility District (BPUD)

The BPUD manages the freshwater system, sanitary sewer system, and associated treatment facilities for the community of Bolinas. The area of jurisdiction ranges from historic downtown Bolinas to the Bolinas Mesa. The area of jurisdiction also stretches eastward along Olema-Bolinas Road to Dogtown (Kirker 1972).

All active water and sewage mains under BPUD jurisdiction are located at or above sea level. The only pipe that actually exists within the lagoon within BPUD jurisdiction is an unused sewage pipe that juts into the Bolinas Channel from the last house on Wharf Road. This pipe had marginal functionality until 1990. At this point, plans are not underway to reinstate the usability of this pipe, as such use would violate GFNMS regulations (Buchanan 2001a).

The BPUD constructed a pump station, a force main, and a treatment facility in 1975 in response to a state order to cease and desist disposing of system waste into Bolinas lagoon (BPUD 2000). The 90 acre sewage treatment facility, owned by BPUD, is located adjacent to Mesa Road (Buchanan 2001a).

The BPUD experiences occasional difficulties with the sanitary sewer system during times of particularly high rainfall or extremely high tides. These problems have been alleviated somewhat as a result of the ongoing Sanitary Sewer Collection System Rehabilitation Project (BPUD 2000).

In addition to managing water and wastewater, BPUD has joint ownership of Mesa Park, a recreation area located on Mesa Road, with the Bolinas-Stinson Union School District as the co-owner of Mesa Park. Other public utilities with potential to be managed by the BPUD include solid waste and energy. The BPUD and its associated five-member commission has served in the past as a forum for people to voice comments on community and government issues (Buchanan 2000).

Stinson Beach County Water District (SBCWD)

The SBCWD provides water and wastewater management services for the Stinson Beach community. The area of jurisdiction includes the areas of Stinson Beach and the Seadrift Community, and all areas of the watershed east of Highway 1 (Dinges 2001).

Several water and/or wastewater pipes maintained by the SBCWD exist within or adjacent to the lagoon. These include, in particular, one eight-inch PVC pipe, that serves the community of Seadrift with fresh water. The pipe runs between Highway 1 and Seadrift sand spit, along the route of an old causeway. A four-inch pipe also runs parallel to Highway 1, between the lagoon and the highway. The pipe is exposed in some areas (Dinges 2001).

3.13.3 Electricity and Natural Gas

Pacific Gas and Electric Company (PG&E) has ownership of the electric lines within the Bolinas watershed and supplies the communities of Stinson Beach, Seadrift, and Bolinas with electricity. Electric lines are located both above and below ground throughout the developed areas of the watershed, and above-ground mounted on poles in the lagoon parallel to Highway 1. There is no natural gas supplied to the areas of Stinson Beach, Seadrift, or Bolinas.

3.13.4 Telephone and Cable

Pacific Bell manages the telephone and cable equipment within the towns of Stinson Beach, Seadrift, and Bolinas. Telephone and cable lines are located both above and below ground throughout developed areas of the watershed. In particular, a bundle of cable is located under water in the Bolinas Channel running from the western tip of Seadrift sand spit to Wharf Road in the town of Bolinas. This line, which originates at the Pacific Bell switch on Calle del Arroyo in Stinson Beach and runs underground along the right side of Seadrift Road until it reaches the channel, is the only source of telephone and cable service for the town of Bolinas (Ford 2001).

Other telephone and cable lines are located parallel to Highway 1, mounted on poles that are in the lagoon during high tide. These lines provide telephone and cable service to areas north of Stinson Beach in the watershed, including Audubon Canyon Ranch (Ford 2001).

3.14 SOCIOECONOMICS

3.14.1 Introduction / Region of Influence

This section describes the contribution of Bolinas, Stinson Beach, and Marin County to the economy and social conditions in the region. The socioeconomic indicators for this study include economics, general population, race and ethnicity populations, and school, police, and fire information.

The ROI for socioeconomics is defined as Marin County and the unincorporated cities of Bolinas and Stinson Beach. Marin County encompasses 332,660 acres and is one of nine counties that comprise the San Francisco Bay Area. Bolinas Lagoon is approximately 12 miles north of San Francisco. Stinson Beach is immediately east and Bolinas is directly west of Bolinas Lagoon.

3.14.2 Economics

Employment

Between 1990 and 1999, total employment in Marin County increased by 19.6 percent (Table 3-8). The greatest increase at 38.3 percent was in the services sector, followed closely by transportation and public utilities at 36.0 percent and construction and mining at 32.7 percent. Wholesale trade experienced the largest decline in employment (-12.2 percent), and employment in the finance, insurance, and real estate, state government, and manufacturing sectors decreased by 5.9 percent, 5.5 percent, and 2.0 percent, respectively.

Table 3-8
Sector Employment, Marin County

Sector	1990	1995	1999	Percent Change 1993 to 1999
Farm	**0**	**700**	**500**	**NA**
Nonfarm	**93,300**	**100,000**	**111,100**	**19.1**
Mining and Construction	5,200	4,600	6,900	32.7
Manufacturing	5,100	4,700	5,000	-2.0
Transportation and public utilities	2,500	2,600	3,400	36.0
Wholesale trade	4,900	4,800	4,300	-12.2
Retail trade	21,500	23,200	24,300	13.0
Finance, insurance, and real estate	10,100	9,200	9,500	-5.9
services	31,100	37,300	43,000	38.3
Government	**12,900**	**13,600**	**14,700**	**13.9**
Federal	900	1,100	1,100	22.2
State	1,800	1,800	1,700	-5.5
Local	10,200	10,700	11,800	15.7
Total	**93,300**	**100,700**	**111,600**	**19.6**

Source: California Employment Development Department 1999.

In 1999, the civilian labor force for Marin County totaled 135,700, and 2,600 people were unemployed (1.9 percent unemployment rate). The unemployment rate was slightly higher for 1990 at 2.5 percent; whereas, in 1995 the unemployment rate was 4.3 percent (Table 3-9).

Table 3-9
Marin County Labor Force and Unemployment

	1990	1995	1999	Percent Change 1990-1999
Labor Force	130,600	128,600	135,700	3.9%
Employed	127,200	123,100	133,100	4.6%
Unemployed	3,300	5,600	2,600	-2.1%
Unemployment Rate	2.5%	4.3%	1.9%	-0.6%

Sources: California Employment Development Department 1999, DOF 2000b.

Marin County is primarily a residential county, with nearly half of the employed residents commuting to jobs in San Francisco or other Bay Area locations (Corps 1998). Most of the commercial and industrial development within the county is located along the US Highway 101 corridor that links communities within the county to San Francisco. Many also commute out of the area to find higher paying jobs in order to afford the higher cost of living in Marin County. Employment is concentrated in the services, retail, and government sectors, while agriculture and mining do not employ many county residents. More than 600 business establishments have been added to the county between 1987 and 1994. Most establishments (91 percent) are small businesses, employing fewer than 20 persons. Nearly one-quarter of all Marin resident workers are employed in professional occupations (Marin Economic Commission Undated).

Income

Marin County residents tend to have exceptionally high per capita incomes, with large sums derived from sources other than wages, and work in jobs that generally pay well. On a per capita basis, Marin County is California's wealthiest county. The county ranked first in the state in per capita personal income every year from 1981 through 1994 (Corps and Port of Oakland 1998).

In 1998, the per capita personal income for the affected area was $52,897, an increase of 47.2 percent over the 1990 income. Total personal income increased from $8,277 million in 1990 to $12,497 million in 1998, an increase of 51.0 percent. Between 1997 and 1998 total personal income increased by 5.4 percent, and per capita income increased by 4.6 percent. Table 3-10 lists the annual income in the affected area between 1990 and 1998.

Table 3-10
Personal Income Marin County

	Total Personal Income ($1,000,000s)	Per Capita Income ($)
1990	**8,277**	35,944
1991	8,515	36,679
1992	8,980	38,447
1993	9,230	39,346
1994	9,583	40,828
1995	9,747	41,679
1996	10,992	47,278
1997	11,856	50,556
1998	12,497	52,897

Sources: BEA Undated b, 2000.

Earnings by Industry

Earnings by persons employed in Marin County increased from $3,816,358 thousand in 1990 to $6,186,500 in 1998, an increase of 62.1 percent. The largest industries in 1998 were services with 44.0 percent of earnings; finance, insurance, and real estate, with 14.8 percent; and retail trade with 10.8 percent. Of the industries that accounted for at least 5 percent of earnings in 1998, the slowest growing from 1997 to 1998 was state and local government, and the fastest growing sector was construction (BEA Undated c). Between 1990 and 1998 earnings in transportation and public utilities; finance, insurance, and real estate; and services experienced the greatest amount of growth (more than 80 percent each); while farm earnings declined by 26.4 percent (Table 3-11).

Table 3-11
Earnings by Industry ($1,000s), Marin County

Sector	1990	1995	1998	Percent Change 1990 to 1998
Farm	15,116	10,630	11,132	-26.4
Agricultural services, forestry, fishing	57,006	66,348	NA	NA
Mining	1,923	5,496	NA	NA
Construction	334,285	310,235	430,556	28.8
Manufacturing	195,068	225,376	287,101	47.2
Transportation and public utilities	108,983	146,945	200,785	84.2
Wholesale trade	220,798	247,506	258,591	17.1
Retail trade	488,682	569,267	669,521	37.0
Finance, insurance, and real estate	499,577	659,897	917,701	83.7
Services	1,508,185	2,148,891	2,721,556	80.5
Government and government enterprises	386,735	561,297	605,401	56.5
Total	**3,816,358**	**4,951,888**	**6,186,500**	**62.1**

Sources: BEA 2000, Undated b.

The primary sources of income within the areas surrounding Bolinas Lagoon are recreation and tourism, with some agriculture on the western and northern sides of the watershed. The many parks and other recreational resources (discussed in Section 3.6) draw tourists and locals to these areas. Businesses in Stinson Beach and Bolinas rely on these summer and weekend visitors to provide income through boat rentals and recreation supplies, lodging, and food service. In the greater Bolinas/Stinson Beach area, sports-related recreation generates approximately $1.5 million per year, and more general tourism and recreation income is estimated at approximately $10 million per year (Tye 2000).

Stinson Beach

Stinson Beach derives much of its income from recreation and tourism. Businesses that rely heavily on these visitors include two kayak shops that provide boat rentals and guided tours of the lagoon, a theater, motels and hotels, gift shops, and restaurants. The Stinson Beach Community Plan has adopted goals for recreational use and activities for this area:

> Resident oriented recreational facilities should be provided within the village. Visitor oriented recreational facilities should not be substantially increased but improvements should be made through cooperation with the national park service and the state park system. (MCPD 1985).

Bolinas

As discussed in Section 3.6, there are various recreational areas throughout Bolinas. Businesses within Bolinas itself that rely on tourism and recreation include a surf shop, several small restaurants, and a small number of bed-and-breakfasts. While the Bolinas community benefits from recreational visitors, the stated community goals are to resist the pressure to overdevelop these resources. The Bolinas Peninsula Community Plan goals related to recreation are as follows:

> The Bolinas Lagoon community shall be responsive to all the elements of this extraordinary lagoon including the effects of human activity in its watershed and on its shoreline;
>
> The Bolinas Planning Area should not become the site of major commercial, tourist, and recreational development, either as a comprehensive plan for undeveloped lands, or as a piecemeal granting of larger scale development approvals;
>
> Tourist facilities (e.g., hotels, resort developments, motels, lodges, restaurants, bars, sports clubs, camp grounds, recreational vehicle parks, retail complexes) of such scale that they become destinations in their own right are not considered appropriate for the Bolinas Planning Area;

> The degree of environmental impact of the project on all natural systems but especially [causing] increased recreational use will affect beaches reefs, water edge lands, and other recreational areas endangered by overuse. (MCCDA 1997).

Commercial Fishing

While reduced in recent years, commercial and recreational fishing remains a source of income in the ROI, particularly in the community of Bolinas. There are approximately 12 commercial fishing craft and 25 to 30 recreational fishing boats out on Bolinas Bay on any given day in the season. Most activity occurs in the summer months (July through September), when there are around 30 to 45 total fishing boats on the Bay per day.

An estimated twelve commercial fishing boats are based in Bolinas Harbor. Fishing has diminished substantially since 1988, when there were more than 20 commercial fishing boats and 5,000 crab pots. The decrease in commercial (and recreational) fishing is due to the shallow depth of the water in the lagoon. The conditions under which boats can enter and exit the lagoon are much more limited, since higher tides are required to float the boats through the inlet. Sedimentation and the shallowness of the inlet have also made the surf line more hazardous and difficult to get through. When the lagoon inlet was less shallow, larger boats of up to 40 feet were able to dock in Bolinas Harbor; now the largest boats are no more than 24 feet long.

Salmon and halibut have been caught within 100 feet of the lagoon inlet, and halibut can be found all around the bay. Crabbing occurs between 3 and 15 miles out. Crabbing is a winter activity, occurring primarily November through June. Commercial fisherman receive a significant percentage of their income from Dungeness crab.

Species diversity has declined substantially: there are almost no perch anymore. However this is not the cause for the decline in commercial fishing, since the principal commercial fisheries are salmon, halibut, and crab.

3.14.3 Demographics

Population

As reported in the 2000 census, the population of Marin County was 247,289, that of Stinson Beach was 751, and that of Bolinas was 1,246 (US Census Bureau 2000; US Census Bureau 2000a; US Census Bureau 2000b). The population distribution of Marin County residents is concentrated along the US 101 corridor. This highway extends in a north-south orientation and provides a key transportation link between the employment centers of San Francisco and the suburban cities of Marin County. Extensive portions of central and western Marin County are sparsely populated with low density residential, agricultural, and recreational open space areas.

Regional growth since 1970 has been steady, with the total Marin County population increasing from a 1970 level of 208,652 to a 2000 level of 247,289 (California Department of Finance 1970; California Department of Finance 1980; MCCDA 1998).

Housing

Marin County had 104,990 housing units in 2000 with a 4.1 percent vacancy rate. The housing stock increased approximately 4.7 percent from the 1990 level of 99,757 when vacancy was around 4.8 percent. Approximately 63.6 percent of the housing is single-family units. Mobile homes make up about 1.7 percent of the Marin County housing stock. Multiple-family residences comprise about 29.4 percent of the remaining housing stock (DOF 2000a).

There are 629 housing units in Bolinas, with a 22.7 percent vacancy rate due primarily to seasonal and recreational usage (US Census 2000). Stinson Beach has 693 housing units with a 46 percent vacancy rate, again due to seasonal and recreational usage (US Census 2000a).

3.14.4 Public Health and Safety

The Marin County Sheriff's Point Reyes substation is responsible for 420 square miles, the vast majority of which is rural property. This substation, approximately 20 minutes north of Bolinas, covers both Bolinas and Stinson Beach. Other areas that are covered within this substation include Point Reyes, Olema, Inverness, Marshall, Tomales, and Dillon Beach. Police coverage is 24 hours a day, seven days a week. Substation staff includes one sergeant, one lieutenant, and eight deputy sheriffs. One officer is on duty per shift and patrols occur on two shifts, with each shift lasting twelve hours (Brunslick 1999).

The Bolinas Fire Department is at 100 Mesa Road, between Overlook and Olema-Bolinas streets. The fire department is approximately 2.5 miles from Bolinas Lagoon and is the only fire department in Bolinas. The department has four fire engines and two pickups and is manned from 8:00 AM to 5:00 PM with full-time employees. Between the hours of 5:00 PM and 8:00 AM, one duty officer is on-call, with volunteers available upon request if emergency assistance is needed. The Bolinas Fire Department has 1 fire chief, 5 full-time firefighters, 1 assistant chief, and 20 volunteers, 16 of which are Emergency Medical Training Defibrillator-certified (EMTD) (Brown 1999).

The Stinson Beach Fire Department is at 3410 Shoreline Highway and is the only fire department in Stinson Beach. The department has two type I engines, one type III engine, and one water tender, squad, ambulance, and utility vehicle. A type I engine is used in structural fires, while a type III engine is used for wildland fires. The department has one fire chief and 40 volunteers, 20 of which are EMT trained and a number of which are trained in cliff rescue work. Because the department is manned entirely by volunteers, there is not a staff consistently present at the station for a determined amount of time; however, all volunteers are on-call 24 hours a day, 7 days a week (Rand 1999).