3.0 Affected Environment

3.1 Introduction

Overview of Land Uses in the Project Area

Historically, the project area was part of a larger dairy district that provided much of the butter and cream used in San Francisco during the Gold Rush of the mid-1800s. From the 1850s through the 1950s, land uses in the area included row crop cultivation and dairy production. In addition, during World War II, embattlements were installed upslope of the Limantour Beach site.

The facilities proposed for removal were constructed during the postwar development boom of the 1950s and early 1960s, when the Limantour area was in private ownership. At this time, lands in the project area became part of the proposed Drake's Estates residential development, which was intended to comprise more than 1,000 houses, including a number of homes on Limantour spit itself. Ultimately, although fewer than 20 houses were completed as part of Drake's Estates, the major road and water system components for the development were installed.

The embankment crossing at Limantour Beach was constructed as the main access road to a group of about 10 houses located on Limantour Spit, while Muddy Hollow Road, the main transportation artery through the development, was widened and straightened. The dam at Muddy Hollow Pond was built across the former tidal estuary to enhance recreational opportunities within the development. The Glenbrook Crossing was constructed as part of the Muddy Hollow Road redevelopment; air photos show that the crossing was completed in the fall of 1963, after the park was established but before the land was acquired by NPS.

When it acquired the Limantour property, NPS relocated or removed the houses on and upslope from Limantour Spit, except for three, which remain and are used as park housing. Currently, the project sites are open-space areas that support a number of recreational uses. The road and dam infrastructure from this era of development also remain in place, and while NPS management goals for the area have evolved since the original 1963 Master Plan, the Limantour Area continues to serve as a primary beach access point.

Land Use Planning at Point Reyes National Seashore

Point Reyes National Seashore is managed according to guidelines established in the Point Reyes General Management Plan (National Park Service 1980), which defines management practices and identifies the land uses that are permitted throughout the park. The land use designations used in the General Management Plan were developed to support management of Point Reyes National Seashore lands and development of their future based on the value of the Seashore's resources,

identified management objectives, and the expectations of the public. Those relevant to the project sites and immediate vicinity are defined below.

- **Environmental Protection—Reserves:** There are 1,300 acres of reserves designated within the Seashore, consisting of the Point Reyes Headlands Reserve and the Estero de Limantour Reserve. These lands and waters have been preserved in a natural condition to protect their terrestrial and aquatic wildlife for public observation and scientific study. Management of the headlands reserve allows no human intrusion except that associated with approved research projects, and the Estero Reserve additionally protects all lifeforms from removal or disturbance without state and federal collecting permits.
- **Environmental Protection—Wilderness:** There are 32,730 acres of wilderness designated within the Seashore. These lands are managed in accordance with the mandates of the federal Wilderness Act of 1964.
- **Natural Environment:** There are 1,838 acres of natural environment designated within the Seashore. An additional 3,413 acres of wetlands designated as potential wilderness are managed as natural environment. Natural environment lands are managed to maintain their natural appearance while allowing compatible visitor use and providing a transition between human intrusions, such as roads and other developments, and the designated wilderness.
- **Development:** There are 85 acres of development within the Seashore. Development areas are managed to provide essential visitor service and administrative facilities.

The Seashore also includes a designated pastoral zone, which supports agricultural land uses, including dairy farming and beef cattle ranching.

Current Uses and Management at the Project Sites

The project sites currently support recreational uses under Reserve or Wilderness designations. None is within the designated pastoral zone, and there are no agricultural land uses at or adjacent to the project sites.

The Limantour Beach site is a designated recreation area that provides trailhead parking, restrooms, and telephones for visitors. This site supports hiking, and is used heavily by recreators enjoying the adjacent beach. Limantour Road, a paved main roadway, provides access to the site. Most of the Limantour Beach site is designated Natural Environment, Environmental Protection—Reserves, and Development. The tidal portions of the Limantour Beach site are within the Estero de Limantour Environmental Protection—Reserves management sub-zone.

The Muddy Hollow Pond site is connected to the existing trail network by the Lower Muddy Hollow Trail and by the Estero Trail. Lower Muddy Hollow Trail travels the length of the pond and lower valley, accommodating biking, hiking and equestrian use. Estero trail crosses the Muddy Hollow Pond dam, providing access to the coastal bluffs along Estero de Limantour. The Muddy Hollow Pond is within the Environmental Protection—Natural Environment. The tidal areas below the Muddy Hollow dam are within the Estero de Limantour Environmental Protection—Reserves management sub-zone. The Estero trail reroutes associated with this project site would be included in the Environmental Protection—Wilderness and Natural Environment sub-zones.

At the Glenbrook Crossing site, the Muddy Hollow Trail supports hiking through the project site and provides a nexus to other trails in the area. The Glenbrook Crossing site and trail reroute

section of the Muddy Hollow Pond site are within the Philip Burton Wilderness and are managed as Environmental Protection—Wilderness.

3.2 Physical Environment at Point Reyes

Visual Resources

Point Reyes National Seashore presents a wide variety of views, ranging from forested ridges to open grasslands to crashing waves along a dramatic shoreline. The three project sites are located in the central portion of the Seashore. Limantour Beach represents a back-beach coastal setting, Muddy Hollow is located in a modified estuarine setting, and Glenbrook Crossing is a riparian site surrounded by scrub and grassland uplands.

Limantour Beach is accessed via Limantour Road, a principal route into the central portion of the Seashore. Limantour Beach itself provides two beach access points approximately 0.5 mile apart, with a large parking lot at the north access and a smaller parking area at the south access. Limantour also offers restrooms, picnic tables, and telephones for visitor use, and overall is the most developed of the three sites. Thus, views in the Limantour Beach area, although dominated by the natural character of the beach, estuary, and upland landscapes, offer a combination of natural and built visual elements. In its current state, the proposed restoration site itself consists of a paved road crossing Limantour Beach Marsh on a culverted embankment. Visually, the existing embankment, paved road, and culvert represent an intrusion into the surrounding natural landscape. Because of its easily accessible location and the amenities it provides, the Limantour Beach area is used by as many as 180,000 visitors and is thus viewed by a wide range of recreators. Consequently, it represents an important aspect of the Seashore's "public face."

Views at Muddy Hollow also offer a combination of natural and built elements. Approaching the site from the south (Limantour Beach) side along the Muddy Hollow Trail, views are dominated by tidal marsh flatlands in the upper Estero de Limantour, cradled by rolling hills that support grassland and scrub habitat. At the site itself, the constructed dam embankment, although vegetated, is a discordant element that disrupts the unity of the largely natural views. Muddy Hollow Pond offers views of open water ringed by emergent marsh and riparian vegetation, but is nonetheless a clearly artificial feature. Like Limantour Beach, Muddy Hollow is easily accessible, and is thus viewed by a comparatively large number of recreators.

The Glenbrook Crossing site is located in the Philip Burton Wilderness, where the Muddy Hollow Trail crosses perennial Glenbrook Creek. Views in the area are primarily natural and are dominated by hilly topography and vistas of grassland, scrub, and riparian vegetation. However, topography and vegetation at the proposed spoils disposal site are obviously disturbed and as such present an obtrusive reminder of human activities in the wilderness setting. At the site itself, the embankment crossing and culvert are similarly disruptive. The Glenbrook Crossing site is accessible only by trail and is not visible from public roads. Consequently, it is viewed by fewer people than the other two sites, but viewers are likely to include a high percentage of people who particularly value its wilderness character.

Wilderness

Wilderness is managed and protected as a resource. Wilderness characteristics and values, including primeval character, preservation of natural conditions implies that the Wilderness is to be preserved and used in unimpaired condition. Prior to establishment of the Seashore, the entire

designated Wilderness was part of intensive agriculture and in many areas logging was common. Roads and ponds persist within the Wilderness. In order to manage or restore such areas in the Wilderness, it is common that motorized equipment is necessary to accomplish the work. Evaluation of physical conditions and process in the wilderness indicate that in many areas, particularly associated with roads and stream crossings, the pre-Wilderness land uses continue to influence and impede natural process, and thus the wilderness character and quality. Considering restoration within Wilderness includes weighing the impacts of implementation with those of leaving the site alone. Particularly with facilities, such as road crossings, culverts, and dams, the implications of these man-made facilities being a part of wilderness reduces the strength of the overall Wilderness objective of 'untrammeled by man'.

The Glenbrook Crossing site is located approximately one mile inside of the Wilderness boundary. It is accessible on the Muddy Hollow Trail (former road). The 20-25 foot high road embankment, 5 foot diameter culvert and 11 foot outfall are considered non-conforming wilderness features. These facilities, the materials that allow them to remain, and the equipment used to construct them are considered non-conforming with the wilderness character.

In addition to the facility deconstruction, actions at Muddy Hollow and Glenbrook Crossing would require trail reroutes through the Wilderness. Current trails are primarily converted roads leading to large scale drainage and maintenance issues. The proposed reroutes would be constructed to a scale more appropriate for wilderness, and more sustainable/compatible with the Wilderness designation.

Section 4(c) of the Wilderness Act of 1964 prohibits certain activities in wilderness by the public, and, at the same time allows the agencies to engage in those prohibited activities in some situations. Section 4(c) states:

> "… except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Through this Wilderness Act language, Congress acknowledged that there are times when exceptions are allowed to meet the minimum required administration of the area as wilderness. The minimum tool requirements analysis required determine the least impactive way of administering the wilderness. The wilderness manager may authorize any of the generally prohibited activities or uses listed in Sec. 4(c) of the Wilderness Act if they are determined to be the minimum necessary to do the job and meet wilderness management objectives.

The impacts of the proposed alternatives on wilderness character are evaluated in Chapter 4. In addition, the Wilderness Minimum Requirements Decision Guide to determine minimum tool is included as Appendix B to this EA.

Air Quality

The primary factors controlling air quality include the locations of air pollutant sources and the amount and nature of the pollutants emitted from those sources. Meteorologic processes and topography are also important factors: atmospheric conditions, such as wind speed, wind direction, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants.

Point Reyes National Seashore is located within the San Francisco Bay Area Air Basin (SFBAAB). Temperatures on the coast of Marin County are typically in the high 50s or low 60s (F) year-round. Daily and seasonal oscillations of temperature are small because of the moderating effects of the nearby Pacific Ocean. Winds in coastal Marin County are typically out of the northwest, and annual average wind speeds are approximately 8–10 miles per hour (Bay Area Air Quality Management District 1999).

The air pollutants of greatest concern in the SFBAAB are ozone, carbon monoxide, and inhalable particulate matter (particulate matter <10 microns in diameter, or PM10), and the proposed action is not expected to generate a substantial amount of any other pollutant. Consistent with the guidance of the BAAQMD (Bay Area Air Quality Management District 1999) and standard industry practice, this EA focuses on the pollutants of greatest concern in the area. Their characteristics are summarized in Table 3-1.

Table 3-1. Overview of Pollutants of Greatest Concern in the SFBAAB

Pollutant	Sources	Health and Other Concerns
Ozone	Formed by a photochemical reaction in the atmosphere; ozone precursors, including reactive organic gases and oxides of nitrogen (NO_x), react in the atmosphere in the presence of sunlight to form ozone. Ozone precursors are emitted by mobile sources such as vehicles, and by stationary combustion equipment.	■ A severe eye, nose, and throat irritant; increases susceptibility to respiratory infections. ■ An oxidant; can cause substantial damage to synthetic rubber, textiles, and other materials. ■ Produces leaf discoloration and cell damage in plants.
PM10	Results from many kinds of dust- and fume-producing activities, such as demolition, construction, and vehicular traffic; entrained road dust from motor vehicles accounts for approximately two-thirds of the regional PM10 inventory in the project area.	■ Health concerns focus on particles small enough to be drawn into the lungs when inhaled (PM10). ■ Can increase the risk of chronic respiratory disease with extended exposure.
CO	Motor vehicles are the primary source of CO emissions in most areas. In the urbanized portions of the San Francisco Bay Area, high CO levels primarily develop during the winter near congested intersections, when periods of light winds combine with the formation of ground-level temperature inversions from evening through early morning. In addition, motor vehicles exhibit increased CO emission rates at low air temperatures.	■ Combines readily with hemoglobin and thus reduces the amount of oxygen transported in the bloodstream. ■ Effects on humans range from slight headaches to nausea to death.

Sensitive receptor refers to land uses that are considered particularly sensitive to decreases in air quality. The designation typically refers to uses such as residences, schools, libraries, hospitals, and other similar facilities where there are large concentrations of children and young people; the elderly; and/or the chronically ill. Because all of the project sites are within Point Reyes National Seashore, few sensitive receptors of these types are located near the sites. However, the area is widely used for recreation, wildlife viewing, and scientific research, and all of these uses are potentially vulnerable to air quality degradation.

Geology, Geologic Hazards, and Soils

Geologic Setting

The Point Reyes peninsula is bounded on the east by the San Andreas fault zone, which defines the elongate, linear Olema Valley extending from Bolinas Bay on the southeast through Tomales Bay on the northwest. East of the San Andreas trend, basement rocks comprise graywacke, serpentinite, pillow basalt, chert, and blueschist in mélange of the Jurassic–Cretaceous Franciscan Complex. West of the San Andreas trend, on the peninsula proper, the basement consists of plutonic rocks of Cretaceous age, primarily granodiorite, tonalite, and granodiorite. Metasedimentary rocks (mica schist, quartzite, calc-hornfels, and marble) are locally present as inclusions and roof pendants within plutonic rocks (Galloway 1977, Clark et al. 1984, Wagner et al. 1991, Clark and Brabb 1997). The plutonic rocks of the Point Reyes peninsula are likely correlative with similar units exposed in the Monterey area, reflecting some 94 miles (150 kilometers) of displacement along the active San Gregorio fault (Clark and Brabb 1997).

The plutonic basement of the Point Reyes peninsula is overlain by deep-marine clastic rocks of the Paleocene or Eocene Point Reyes Conglomerate, which is exposed at the surface only in the vicinity of the Point Reyes lighthouse (e.g., Galloway 1977; see also Clark and Brabb 1997). Both the Point Reyes conglomerate and the older plutonic units are in turn overlain by two sequences of Neogene strata. A mid- to upper Miocene sequence comprises a basal transgressive shallow-marine sandstone (the Laird Sandstone of Galloway 1977) overlain by deep-marine porcellanite of the Monterey Formation. The mid- to upper Miocene sequence is unconformably overlain by marine sedimentary units of late Miocene and Pliocene age, including a basal glauconitic sandstone (Santa Margarita Sandstone); siliceous mudstones assigned to the Santa Cruz Mudstone; and siltstone, mudstone, and sandstone of the Purisima Formation (Clark and Brabb 1997).

Finally, all of the peninsula's older units are overlain by Quaternary deposits that record surficial processes in fluvial and coastal/estuarine environments on essentially modern topography. These include well-developed Pleistocene marine terraces, Holocene alluvium in the larger active drainages, and Holocene tidal sediments in the larger embayments, such as Drake's Estero and the Estero de Limantour. Active dune fields and stabilized dunes are present along segments of the coastline and are especially well-developed at Kehoe Beach, along Point Reyes Beach, and along Limantour Spit (Galloway 1977, Clark and Brabb 1997).

Geologic Hazards

Seismicity and Seismic Hazards

No faults recognized by the State of California as active traverse any of the restoration sites (Hart and Bryant 1997). Consequently, the risk of surface rupture associated with active faulting is probably quite low at these sites.

However, as described above, the Point Reyes peninsula is bounded to the east by the active San Andreas fault zone. In addition, the restoration sites are located in close proximity to the offshore Point Reyes fault, which is identified as a Type B seismic source[2] by the current Uniform Building Code (UBC) (International Conference of Building Officials 1997), although it is not zoned by the State of California. The Rodgers Creek fault, the likely northward continuation of the Hayward

[2] The UBC evaluates the risk associated with active faults based on their potential to generate large earthquakes (measured as the moment magnitude for the largest earthquake anticipated on the fault) and their degree of seismic activity (measured as average annual slip rate). Under this system, a *Type A seismic source* is a fault that is capable of producing large-magnitude events ($\geq$ M 7.0) and is highly active (has a high average annual slip rate). A *Type B seismic source* is associated with smaller maximum event and/or is less active, but still constitutes a substantial seismic threat (International Conference of Building Officials 1997).

fault trend, is located about 25 miles northeast of the project area. It is zoned by the State, and is identified as a Type A seismic source by the UBC (Hart and Bryant 1997, International Conference of Building Officials 1997). Because of their proximity to several major active faults, the restoration sites are likely to experience strong groundshaking during the life of the project. Table 3-2 summarizes current estimates of the maximum earthquake anticipated on the principal active faults in the vicinity of the restoration sites.

Table 3-2. Maximum Earthquake Anticipated on Major Faults in Vicinity of Point Reyes National Seashore

Fault	Estimates of Maximum Earthquake	Estimated Mean Recurrence Interval[b]
San Andreas (northern segment)	7.9[a]	223 years
	7.45[b]	
Rodgers Creek	7[a]	205 years
	6.98[b]	
Point Reyes	6.8[a]	Unkown

Sources: [a]International Conference of Building Officials 1997, [b]U.S. Geological Survey Working Group on California Earthquake Probabilities.

Seismic hazard maps have not been issued for the any of the quadrangles in the vicinity of the proposed action (see California Geological Survey 2003). Generalized liquefaction potential mapping available from the Association of Bay Area Governments (2003) and the County of Marin (1994) suggests that unconsolidated sediments in low-lying portions of the project area may be subject to liquefaction. This would be of particular concern at the Limantour Beach Marsh site, where well-sorted dune sands may be saturated by shallow groundwater. Similar concerns may exist at the Muddy Hollow site. Liquefaction is likely less of a concern at the Glenbrook Crossing site, because the volume of sediments is probably smaller, and the deposits of high-gradient alluvial and fluvial systems are typically poorly sorted and less likely to liquefy. Geotechnical surveys have been conducted at the project sites and would be used to refine construction specifications necessary to meet potential hazard.

Landslide Hazards

As described above, seismic hazards mapping for the vicinity of the proposed action has not been published, and no quantitative analysis of slope stability has been performed for any of the restoration sites to date. Both the Muddy Hollow and Glenbrook Crossing sites are adjacent to steep slopes in rugged, hilly topography, and mapping by the U.S. Geological Survey (Wentworth et al. 1997) shows substantial landsliding in highlands in the project vicinity. Both Muddy Hollow and Glenbrook Crossing were affected by the flood/debris flow events that struck west Marin County in January 1982. In particular, aggradation above the Glenbrook Crossing site is likely due in large part to debris flows that occurred in January 1982, with the gully west of the road crossing formed as the culvert was plugged and floodflows overtopped the roadbed (see related discussion in *Hydrology, Hydraulics, and Water Quality* below). More recently, during the El Niño flood year 1998, oversaturation of colluvium following some 25 inches of rainfall in a single month triggered shallow landslides on slopes within the Muddy Hollow and Glenbrook watersheds. Thus, based on their general geologic characteristics, and evidence of recurrent past instability, some risk of slope failure is likely still present at Glenbrook Crossing and Muddy

Hollow. The existing hazard of landsliding in particular is substantially less at Limantour Beach Marsh, where the slopes adjacent to the site are more gentle.

Soils

Soils at Limantour Beach Marsh Site

The Limantour Beach Marsh site is located on humaquepts, seeped and dune land. The proposed spoils management area (shared with the Muddy Hollow site, as described in Chapter 2) is located on Tomales fine sandy loam, 30–50% slopes.

The existing embankment crossing, its immediate downstream vicinity, and the small upstream valley occupied by freshwater marsh are all underlain by **humaquepts, seeped**. This unit typically consists of 3–6 inches of sod (locally containing ≥50% peat), overlying very dark gray or black loam, clay loam, or clay. Aerially deposited sand may also be present, contributing to local development of loamy sand and loam. Humaquepts, seeped occurs in areas that are consistently saturated by shallow groundwater during the winter and spring, with the water table at or immediately below the ground surface; during the dry season, the water table is typically 2–5 feet below the surface (U.S. Soil Conservation Service 1985).

Dune land consists of loose sand moved by wind transport from adjacent beach areas. It includes both active and stabilized dune systems; at Limantour Beach, active dunes immediately behind the beach face give way to stabilized dunes on the south flank of the marsh drainage. Dune lands typically exhibit no soil profile development. Permeability is very rapid (U.S. Soil Conservation Service 1985).

Tomales fine sandy loam, 30–50% slopes is a deep, moderately well drained upland soil formed in material derived from sandstone bedrock. It consists of ~12 inches of brown fine sandy loam overlying ~12 inches of brown and grayish brown loam, which in turns overlies a subsoil consisting of brownish gray and yellow clays. Depth to bedrock is typically 40–60 inches, but is locally more. Permeability is very slow, runoff is rapid, and water erosion hazard is high. Shrink-swell potential ranges from low to high, and is higher in the clay-rich subsoils than in the overlying loamy material. Corrosion risk is high for uncoated steel and moderate for concrete (U.S. Soil Conservation Service 1985).

Soils at Muddy Hollow Site

The Muddy Hollow site is located on hydraquents, saline. The spoils management site (shared with the Limantour Beach Marsh site, as described in Chapter 2) is located on Tomales fine sandy loam, 30–50% slopes.

Hydraquents, saline typically consists of stratified silt and clay with thin peat interlayers. Soils in this unit are typically mottled. Hydraquents, saline is typical of areas inundated by tides at least during unusually high tide conditions, and is typically waterlogged. This unit is very poorly drained; surface runoff is very slow to ponded, and erosion hazard is slight.

Tomales fine sandy loam, 30–50% slopes is described in *Soils at Limantour Beach Marsh Site* above.

Soils at Glenbrook Crossing Site

The Glenbrook crossing site is located on Tomales fine sandy loam, 9–15% slopes; Tomales fine sandy loam, 15–30% slopes; and Tomales fine sandy loam, 30–50% slopes. The crossing and its immediate vicinity underlain by **Tomales fine sandy loam, 30–50% slopes**, described in *Soils at*

Limantour Beach Marsh Site above. The proposed spoils management area is underlain by **Tomales fine sandy loam, 9–15% slopes** and **Tomales fine sandy loam, 15–30% slopes**. These units are very similar to occurrences of Tomales fine sandy loam on steeper slopes, as described above.

Hydrology, Hydraulics, and Water Quality

Climate and Precipitation in the Point Reyes Area

Like the rest of California's north-central coast, the Point Reyes peninsula is characterized by a Mediterranean climate. As discussed in air quality above, temperatures on the peninsula are moderated by proximity to the ocean: summers are cool and dry, with temperatures even in inland areas rarely in excess of 100° F, while winters are chilly and rainy but rarely fall below freezing. Average annual precipitation at the Bear Valley headquarters is near 40 inches, most of which is received during the winter storm season, and almost exclusively in the form of rain. Within the project watersheds, average precipitation ranges from 30-40 inches. West of Inverness Ridge, fog is common during the summer months (Galloway 1977, Kashiwagi 1985, Jones & Stokes 2001, NHC 2002).

Surface Water Hydrology

Surface Water Drainage

Overview

Surface water drainage on the Point Reyes peninsula exhibits a generally dendritic pattern. The principal topographic features governing regional drainage are both fault-controlled: Inverness Ridge, uplifted along the active San Andreas fault to form the peninsula's steep, northwest-trending topographic backbone; and the Tomales Bay–Olema Valley–Bolinas Lagoon trough, an elongate low that marks the position of the so-called San Andreas fault zone. Most small streams on the east flank of Inverness ridge flow approximately perpendicular to the ridgecrest, discharging northward toward Tomales Bay or southward into Bolinas Lagoon. On the west side of the ridge, drainage is dominated by the generally westward gradient to the Pacific Ocean, although several larger streams flow almost due south toward the ocean from the south half of Inverness Ridge, possibly reflecting the persistence of antecedent drainage patterns (Galloway 1977).

Surface drainages of the Point Reyes peninsula include both perennial and intermittent streams. As in the rest of the Bay Area and coastal California in general, streamflow varies markedly between the wet and dry seasons. Even the upper watersheds are at comparatively low elevations, and, as described above, climate is moderated by the marine influence, so there is no significant snowmelt contribution to runoff. In addition, infiltration rates are typically slow and runoff rates are high except in sandy sediments along the immediate coastline, so runoff typically peaks during and shortly after rainfall events. Consequently, as in much of the Coast Range region, base flow is for the most part poorly sustained except where it is fed by shallow groundwater (e.g., Jones & Stokes 2001). At Point Reyes, there is also some evidence that streams in wooded drainages are fed in part by localized groundwater recharge from fog drip (Galloway 1977, Matthews 2003).

Surface Water at Limantour Beach Marsh Site

Limantour Beach Marsh occupies an elongate, east-west trending topographic low separated from the open ocean by active and stabilized dunes that compose Limantour Spit (Figure 2-1).

Freshwater flows enter the marsh both via overland runoff from immediately adjacent hillslopes and through an open-ditch channel (another remnant of 1950s-era construction) that connects with

the upstream Laguna Creek Lagoon under most conditions. Some 15–20 feet wide and 2–3 feet deep, the channel delivers most of the marsh's freshwater input; the adjacent hillslope watershed has an area of approximately 0.1 square mile, and probably contributes a comparatively minor volume of flow to the marsh. Although it is equipped with a screw gate, the channel is not maintained, and it is breached such that overbank flow now diverts directly to the ocean at flood stage (nhc 2002).

The west end of the marsh is open to tidal exchange, and historically the entire marsh area was probably subject to varying degrees of tidal influence. At present, however, the east portion of the marsh, upstream of the constructed embankment crossing that provides access to Limantour Beach, is a freshwater marsh that supports as much as 1–3 feet of standing water during the wet season. Although a 36-inch RCP culvert beneath the crossing permits some flow, the culvert was placed with an adverse slope; invert elevations up- and downstream of the crossing are 3.7 and 4.3 feet above mean sea level (MSL), respectively. Consequently, tidal flow is expected to enter the area upstream of the crossing only during extreme conditions (nhc 2002).

A plunge pool eroded 2–3 feet into soft sedimentary bedrock immediately below the culvert outfall attests to substantial freshwater discharge during the flood season. Some water may remain in the channel throughout the dry season, but typical base flow is minimal (nhc 2002).

Immediately below the embankment crossing is an intermediate tidal marsh with an extent of approximately 4.8 acres. Both natural and constructed channels are present in this area. Channel form is constrained and deflected to some extent by the presence of a second constructed embankment or berm, which originally separated the intermediate tidal marsh from open tidal marsh, with flow conveyed via a culvert. The culvert is now abandoned, and tidal exchange occurs through a breach on the south end of the berm (nhc 2002).

Tides at Limantour Beach follow a typical Pacific Coast mixed semi-diurnal pattern, with two high and two low tides of differing elevations occurring each day. Table 3-3 summarizes tidal elevations at Limantour Beach Marsh, based on data for the period 1975–1995 collected at the Point Reyes/Drake's Bay tide gaging station (NOS/NOAA Station #941 5020) (nhc 2002).

Table 3-3. Tide Elevations, Limantour Beach Marsh, Point Reyes National Seashore

Tide Level	Tide Elevation (feet NGVD29)
Mean Higher High Water (MHHW)	2.92
Mean Tide Level (MTL)	0.30
Mean High Water (MHW)	2.26
Mean Low Water (MLW)	-1.67
Mean Lower Low Water (MLLW)	-2.85

Source: nhc 2002

Surface Water at Muddy Hollow Site

The Muddy Hollow reservoir (Muddy Hollow Pond) occupies an area of slightly more than 11 acres on the lower reach of Muddy Hollow Creek (Figure 2-2). The reservoir was created by constructing an earthen dam across the stream valley at approximately the natural transition from freshwater drainage to tidal marsh. Muddy Hollow now discharges into the upstream end of the reservoir, where an alluvial delta has formed, extending downstream to within 700 feet of the dam. Bottom elevations in the reservoir range from 3 feet above MSL at the dam to 8 feet above MSL at

the delta. An overflow channel near the west dam abutment discharges into the downstream tidal marsh to maintain the surface water elevation in the reservoir at approximately 9 feet above MSL. The overflow channel is 300 feet long and has a trapezoidal cross section, with a top width of 12 feet and a depth of 3 feet (nhc 2002).

Upstream of the reservoir, Muddy Hollow Creek can be divided into several geomorphically distinct reaches. In its upper reaches, some 1.5 miles upstream of the dam, the creek is primarily considered a source reach, with a single channel with an estimated gradient of 1.7%. The central portion of the watershed remains incised but acts primarily as a transport reach, delivering most sand and gravel through the system to the depositional area below the Muddy Hollow Pump station. In this area, the channel, once confined by levees on the north side of the valley, has avulsed and has actively flooded across the valley bottom since the 1995 Vision Fire (Collins and Ketcham 2001). While likely initiated as a response to base level change triggered by dam construction, the upstream migration of this avulsion is likely now disconnected from the dam presence, and is based on local hydraulics, vegetation, and sediment supply.

Beginning below the pump station, the channel gradient decreases to about 1.3% and the channel begins to braid. Further downstream, the channel gradient decreases further, to about 1.0%. In this area, the creek typically consists of two main channels with average widths of 6–12 feet and thalweg depths 1–2 feet below the floodplain. As much as 3 feet of aggradation has been observed in places along this reach (nhc 2002).

The elevation of the tidal marsh plain downstream of the dam ranges from 2 to 3.5 feet above MSL. This area is drained by a single, strongly meandering channel approximately 25–30 feet wide and 3 feet deep (nhc 2002).

Table 3-4 shows estimated flood discharges for the Muddy Hollow basin.

Table 3-4. Estimated Flood Discharge, Muddy Hollow Basin, Point Reyes National Seashore

Flood Recurrence Interval	Peak Discharge
2 years	271 cfs
10 years	542 cfs
100 years	922 cfs

Source: nhc 2002.

Tidal elevations at the Muddy Hollow site are the same as those for the Limantour Beach Marsh site, given above in Table 3-3. Some reduction in tidal amplitude (*tidal muting*) may occur between the open ocean and inland waters, but is not expected to be substantial over the small distance separating the Muddy Hollow site from open water (nhc 2002).

Glenbrook Site

Glenbrook Creek is a perennial stream that drains a watershed of about 1.4 square miles in the uplands northeast of the Estero de Limantour (Figure 2-6). It is fed by a number of small tributaries as well as shallow groundwater, and drains into a southeasterly tidal arm of the Estero de Limantour system via a series of two constructed ponds (nhc 2002).

The Glenbrook Crossing site is located where the Muddy Hollow Trail crosses the creek channel on an earthen embankment to connect with the trace of the Old Glenbrook Road. Flow is culverted beneath the roadway embankment via a 60-foot length of 60-inch CMP. The steeply sloped, eroded, and bowed culvert delivers water downstream via an 11-foot vertical drop to the streambed below.

The existing crossing represents a substantial discontinuity in stream channel and floodplain profile and hydrologic connectivity within the watershed. Marked aggradation has occurred as much as 700 feet upstream of the crossing, the approximate upstream extent of backwater when the water surface elevation reaches the culvert crest. Although smaller events may also have contributed, it is assumed that at least some of this aggradation is the result of debris flows that occurred in January 1982, with the beheaded gully west of the crossing likely formed as the culvert became obstructed and flows overtopped the road. Following the 1982 floods, the culvert was replaced at the new upstream bed level, approximately 12 feet above the downstream bed elevation. The very flat floodplain in this reach is likely the result of settling following installation of the new culvert. While the road embankment likely captured most of the sediment and debris during the 1982 event, most of the floodwaters likely continued on over the embankment scouring new material from the channel downstream. Since 1982, although some bedload is carried through the culvert, starved flows below the crossing have continued to erode the scour pool below the drop, and the channel is impassable to fish (nhc 2002, Jones & Stokes and nhc 2003a).

Upstream of the crossing, Glenbrook Creek is confined in a single main channel. In its upper reaches, 1400–1700 feet upstream of the crossing, bedrock is visible in the channel bed, and likely controls the stream gradient. Downstream, a terraced geometry with an upper and lower floodplain develops. The width between the upper floodplains in this portion of the channel is 70–100 feet. Closer to the crossing, only one floodplain terrace is evident; in this area, the low-flow channel is 4–8 feet wide, with bankfull widths of 7–20 feet. In general, both the channel and the floodplain maintain a gradient of approximately 2.0% upstream of the crossing. In the aggraded reach immediately upstream of the crossing, the channel gradient decreases to approximately 1.1% (nhc 2002).

About 50 feet upstream of the crossing, a small tributary flows across a gently sloping alluvial cone to join Glenbrook Creek from the east. The tributary channel is poorly defined at the confluence, which represents the distal portion of the cone (nhc 2002).

Immediately below the culvert outfall, the channel bed has been rip-rapped with broken concrete and rock to control channel incision. Downstream of the crossing, the creek continues to be confined within a single main channel incised some 10–16 feet into the floodplain. The low-flow channel is approximately 6 feet wide, with bankfull widths of 35–70 feet. At the outfall, the channel gradient is approximately 1%, increasing downstream to approximately 1.3%, or roughly equivalent to the floodplain gradient. Abundant large woody debris is present in the reaches downstream of the crossing (nhc 2002).

An incised gully, located about 100 feet west of the main channel centerline, parallels the main channel downstream of the embankment. It is believed to have formed during a 1982 storm event, when the roadway embankment was overtopped (nhc 2002).

The channel continues downstream through the remnants of two breached ponds approximately a mile to the Glenbrook arm of the Estero de Limantour. Table 3-5 shows estimated flood discharges for Glenbrook Creek at the Glenbrook Crossing site.

Table 3-5. Estimated Flood Discharge, Glenbrook Creek Basin, Point Reyes National Seashore

Flood Recurrence Interval	Peak Discharge
2 years	128 cfs
10 years	261 cfs
100 years	447 cfs
Source: nhc 2002.	

Surface Water Quality

The quality of surface waters on the Point Reyes peninsula is generally good, but reflects the influence of current land uses. For instance, NPS water quality monitoring has shown that pathogen, sediment, and nutrient levels are elevated in areas with active livestock or dairy operations. NPS conducts water quality monitoring in the Laguna and Muddy Hollow watersheds, and uses water quality results from these watersheds as control indicators for the park's other pastoral watersheds. Results of monitoring pathogens, sediment, nitrogen and orthophosphorus show that water quality conditions are generally in good condition in these watersheds (NPS 2001).

To the east of the project area, Tomales Bay and its tributaries have been identified as water quality–limited for the same constituents that affect pastoral drainages at Point Reyes (State Water Resources Control Board 2003). Total maximum daily load (TMDL) limits for nutrients, sediment, and pathogens are now being identified through an ongoing management effort for the Tomales Bay watershed. The project area is not within a TMDL planning area.

Groundwater Hydrology

Little site-specific information is available on groundwater in the immediate vicinity of the restoration sites. The following sections provide a regional overview.

Water-Bearing Units and Groundwater Flow

Regionally in the North Bay the principal aquifers consist of unconsolidated and poorly consolidated marine and terrestrial sediments. Permeability varies widely. Groundwater is typically unconfined in shallow alluvial deposits and confined in deeper alluvial/fluvial strata and nonalluvial units. Principal sources of recharge include infiltration of precipitation through permeable valley-margin and valley-floor sediments, and infiltration in influent streams. Discharge occurs via seepage in effluent stream reaches, spring outflow, evapotranspiration, and well withdrawal. Prior to development, groundwater flow largely followed surface-water drainage paths. For the most part, this is still the case, although withdrawal has locally altered groundwater flow patterns. In particularly, historic overdraft in the lower Sonoma and Petaluma basins has led to substantial saltwater intrusion along the Bay margin (Planert and Williams 1995). This is probably less true along the Point Reyes coast, where historic groundwater usage has been less intensive.

At the project sites, shallow groundwater is contained in unconfined aquifers that receive recharge directly via in-channel infiltration. The Muddy Hollow corridor is developed for groundwater production supplying the Clem Miller Ed Center, American Youth Hostel, and a handfull of park residences. The well and pump station were redeveloped following the 1995 Vision Fire. The well is 156 feet deep, and screened from 55-150 feet below ground surface (BGS). Production from this well originally was to supply a 1500 unit development. A new well was installed at this site in 1997. The well completion report (Weeks Drilling 1997) showed that the estimated the water yield from the well at 48 gallons per minute (gpm) and that during a 33 hour pump test, the

well drawdown was 46 feet. Current water supply needs are far less than the well production. No new development is planned for the area, so water demand is not expected to increase.

Groundwater Quality

One groundwater well is used for domestic water production within the Muddy Hollow watershed. The well water quality is tested monthly as required for public water supply, and well production samples show that the raw water is high in some heavy metals including iron and manganese. While saltwater intrusion would be a concern over high production, the limited use of the well does not threaten the aquifer.

3.3 Biological Environment

Vegetation

As with other areas of western Marin County, the Seashore supports a high number of vegetation communities that are diverse in nature. More than 64 vegetation communities or "alliances" have been mapped within the boundaries of the Seashore and the north district of GGNRA. This diversity can be attributed in large part to this area's varied geologic history and structure, hydrology, and climate. Bordered by the San Andreas Fault, movement of the Pacific plate relative to the North American Plate has led to the Point Reyes Peninsula having a community and flora composition that is sometimes distinct from that of the Marin County "mainland." Tectonic uplifting of granitic rock such as quartz-diorite and granodiorite along the fault has created an incredibly steep, varied, and unstable topography punctuated by ravines along the backbone of the Point Reyes Peninsula that borders Tomales Bay. Topography on the west side of the Inverness Ridge is more gradual as it descends to Drakes Estero and the Pacific Ocean, with many of the higher elevation upland areas characterized by soft, rolling hills that have been formed within the marine-influenced Purisma Formation.

The geologic instability of this area has produced a diverse array of hydrologic sources for vegetation communities, including isolated lakes, ponds created within "sags" along the fault, and an abundance of groundwater seeps that often serve as sources or "headwaters" for perennially and seasonally flowing streams. These freshwater influences mix with tidal waters from the Pacific Ocean to create estuarine habitats within sheltered embayments and coastlines along the Peninsula's perimeter. Over geologic time, the Pacific Ocean has alternately encroached upon and retreated from the Marin coastline because of a number of factors, including sea level rise caused by melting of the once extensive glaciers present in North America and land uplift. Not only does this geologic action control the extent of tidal influence in this area, but it has created elevated marine depositional terraces in areas such as the town of Point Reyes Station that are extremely permeable to groundwater seepage. This seepage has created unusual wetland communities that have established on the steep sides of these mesa bluffs.

Superimposed on this geologic matrix are coastal climatic influences that create an extremely mesic environment for vegetation. Unlike more inland areas, the summer season in this Mediterranean climate area often remains very cool due to extended periods of fog or marine layers. Because of this mesic influence, even so-called upland vegetation communities such as coastal prairie often support plant species that would normally only be found in wetlands within more inland areas. Moisture is often concentrated within some of the steep ravines or valleys along the Inverness Ridge, leading to development of highly mesic communities such as coast redwood (*Sequoia sempervirens*) and Douglas Fir (*Pseudotsuga menziesii*) forests on north-facing slopes with more arid shrublands on the opposing south-facing slopes. Arid vegetation communities such as chamise (*Adenostoma fasiculatum*)-dominated chaparral are often isolated in areas that receive much less fog and rain.

There are a number of vegetation communities within the Project Area. Most of these communities within the Project Sites are wetland- and riparian-associated communities or ones that are ecotonal or adjacent to wetlands and riparian areas. In addition to special status plants, the California Natural Diversity Database (NDDB) also tracks occurrences of rare and significant vegetation communities that have been imperiled by commercial and residential development, invasion by non-native species, etc. (CDFG 2003). A search of the NDDB identified several special habitats or Natural Communities with potential to occur within the Seashore, although none occurred within the Project Area or immediate vicinity. Special habitats included Coastal and Valley Freshwater Marsh, Northern Coastal Salt Marsh, Central Dune Scrub, Coastal Terrace Prairie, and Northern Maritime Chaparral. Descriptions of the primary communities observed within the Project Area are listed below.

Coastal Freshwater Marsh (NDDB Natural Community) Coastal Freshwater Marsh communities are flooded perennially or at least through the large portion of the growing season, establishing in slow-moving, low gradient, or stagnant water areas fed by groundwater, seeps, and streams consists of a mixture of herbaceous hydrophytic species.[3] Marshes are often defined by either supporting tall emergents such as bulrush (*Scirpus californicus*), cattails (*Typha* spp.), or bur-reed (*Sparganium* spp.) or by low-growing emergents such as water parsley (*Oenanthe sarmentosa*), hydrocotyle (*Hydrocotyle ranunculoides*), knotweed (*Polygonum* spp.), and water plantain (*Alisma* spp.). The nearest documented NDDB occurrence of this special habitat is a 34-acre marsh west of Drakes Beach (NDDB).

Northern Coastal Salt Marsh (NDDB Natural Community) Northern Coastal Salt Marsh is a transitional habitat between freshwater and marine environments that develops within sheltered embayments, stream mouths, and along the fringes of larger water bodies such as estuaries and bays. It is dominated by species that have developed a tolerance to salt water. Most of this community supports a low-growing emergent community on large flood or marshplains, with slightly taller emergents occurring in the "low marsh" directly adjacent to intertidal and subtidal tidal channels. The most common species at the project sites are pickleweed (*Salicornia virginica*). Other common associates include saltgrass (*Distichlis spicata*) and fleshy jaumea (*Jaumea carnosa*). Sea lavender (*Limonium californicum*), arrow-grass (*Triglochin concinna*), alkali heath (*Frankenia salina*) and Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*) are often associates as well. The nearest documented NDDB occurrences of this special habitat are at Tom's Point and the Lagunitas Creek delta within Tomales Bay (NDDB).

Coastal Brackish Marsh The boundary between Coastal Freshwater Marsh and Coastal Salt Marsh often constitutes a highly dynamic zone in terms of variable salinity throughout the year. Plant species that thrive in this interface zone must be capable of tolerating salinities that drop during the winter to 0-2 parts per thousand (ppt) and climb as high as 18-20 ppt or even higher during the summer (Ocean salinity is approximately 34 ppt). Coastal Brackish Marsh is also variable in terms of vegetation height. Low-growing plant species occur on marshplains with medium- to tall emergents occurring alongside or within channels or in open water areas. Because brackish marsh does not typically have a unique group of species -- most of these plant species can occur either in Coastal Freshwater Marsh or Coastal Salt Marsh – these areas are often characterized more by the mixture of species and a knowledge of salinity regimes present. Some common species in Coastal Brackish Marsh include bulrush (*Scirpus californicus*), alkali bulrush (*Scirpus maritimus*), fat hen (*Atriplex triangularis*), brass-buttons (*Cotula coronopifolia*), and annual beard grass (*Polypogon monspeliensis*).

Riparian Forest/Scrub within the Project Area is typical of low gradient streams and systems within western Marin County, being dominated by fast-growing, pioneering species such as arroyo

[3] *Hydrophytic species* or *hydrophytes* are plants that grow in water or on a substrate that is at least periodically deficient in oxygen as a result of high water content.

willow and red alder that often grow in almost impenetrable thickets. Forests at Project Sites typically have an overstory of red alder (*Alnus rubra*), with arroyo willow (*Salix lasiolepis*) and/or yellow willow (*S.lucida* ssp. *lasiandra*) in the subcanopy. Understory is usually moderate to dense. Berry species salmonberry (*Rubus spectabilis)*, thimbleberry (*R. parviflorus*), California blackberry (*R. ursinus*) and red elderberry (*Sambucus racemosa*) are the common shrubs. Hedgenettle (*Stachys ajugoides*), sedges (*Carex spp*.), rushes (*Juncus spp*.), small-fruited bulrush (*Scirpus microcarpus*), and ferns such as sword fern (*Polystichum munitum*) and lady fern (*Athyrium felix-femina*) dominate the herbaceous layer. Scrub is a shorter vegetation community occurring along streams that is characterized either by young willow or alder that fall within the subcanopy or shrub layer or by hydrophytic shrubs such as blackberry, elderberry, etc.

Coastal Scrub Approximately 90% of coastal scrub is dominated by coyote brush (*Baccharis pilularis*), a small-leaved evergreen shrub. Coyote brush scrub is highly diverse and variable, ranging from fairly low open areas where coyote brush associates with grasses to tall dense multi-species scrubs. Coyote brush scrub can be roughly equally divided in the project area between these open and dense variations. In its more open variation, coyote brush commonly associates with non-native and native grasses and California blackberry. It may also be found in association with sedges (*Carex* spp.) and rushes (*Juncus* spp.). In its taller, denser variation, poison oak (*Toxicodendron diversilobum*) is the most commonly associating shrub, often in fairly high cover. Coffeeberry (*Rhamnus californica*), thimbleberry, California blackberry and California sagebrush (*Artemisia californica*) are common associates in dense coyote brush scrub.

Coastal Grassland (Coastal Terrace Prairie – NDDB Natural Community) Although pristine coastal prairie is dominated by native perennial bunchgrasses, roughly 80% of the grasslands in the Seashore are dominated by non-native grasses, as are most of the grasslands within California. The most common non-native is the hydrophytic, invasive perennial purple velvet grass (*Holcus lanatus*), although the hydrophytic, annual Italian wild rye (*Lolium multiflorum*), farmer's foxtail (*Hordeum murinum*), and rattail fescue spp. (*Vulpia* spp.) also cover large acreage. Pacific reedgrass (*Calamagrostis nutkaensis*), along with tufted hairgrass (*Deschampsia cespitosa*), California oatgrass (*Danthonia californica*), meadow barley (*Hordeum brachyantherum*), and California brome (*Bromus carinatus*) are constituents of the native coastal grassland. Native grasses are often found in association with annual non-native grasses, coyote brush, California blackberry, and a variety of native and weedy herbs. The nearest documented NDDB occurrence of Coastal Terrace Prairie – a coastal grassland dominated by native grass species – occurs at Tom's Point in Tomales Bay.

Coastal Dune (**Central Dune Scrub – NDDB Natural Community**) Coastal Dune communities are extensive along the Seashore's land edge, but they, as with many other habitats, have been negatively affected by non-native invasive species such as European dunegrass (*Ammophila arenaria*) and iceplant (*Carpobrotus edulis*). The invasion of these dense, fast-spreading species into dunes has altered natural dune dynamics such as the ability of dune systems to shift and move and has reduced habitat for special status plant species that are specifically adapted to the dune environment. European dunegrass often excludes almost all other species, accounting for 99 percent of the vegetative cover (Seashore, unpub. data). Conversely, within dunes dominated by native species (native dunes), vegetative cover consists of a mixture of species such as coastal sagewort (*Artemisia pycnocephala*), beach-bur (*Ambrosia chamissonis*), gumplant (*Grindelia stricta*), wild pea (*Lathyrus littoralis*), and others. Total vegetative cover is also higher within European dunegrass systems, with open sand only accounting for 38 percent of the dunes versus 66 percent in dunes dominated by native species (Seashore, unpub. data). The nearest documented NDDB occurrences of Central Dune Scrub stretch from the Point Reyes Lighthouse to Abbotts Lagoon.

One of the more interesting features of dune communities are **Dune Swale Ponds** or **Seasonal Wetlands** that form between dunes and that support hydrophytic plant species despite the sandy substrate. These features typically are dominated by a low-growing community of perennial and

annual herbaceous plant species. The ponds support mostly species associated with freshwater communities such as Seasonal Wetlands despite their proximity to the ocean. The primary hydrologic source appears to be seasonal groundwater discharge and, to a lesser degree, precipitation and fog (Amy Parravano, pers comm.). Pond species include fat hen (*Atriplex triangularis*), water star-wort (*Callitriche heterophylla*), slough sedge (*Carex obnupta*), brass-*buttons (Cotula coronopifolia*), umbrella sedge (*Cyperus eragrostis*) spikerush (*Eleocharis macrostachya*), western mannagrass (*Glyceria occidentalis*), hydrocotyle (*Hydrocotyle ranunculoides*), rush (*Juncus bufonius* and *phaeocephalus*), loosestrife (*Lythrum hyssopifolium*), pennyroyal (*Mentha pulegium*), water parsley (*Oenanthe sarmentosa*), and annual beard grass (*Polypogon monspeliensis*).

With the exception of Glenbrook Creek, vegetation communities within the Project Area reflect a transition from the freshwater environment of the Inverness Ridge to the saltwater environment of the Pacific Ocean. Both the Muddy Hollow and Limantour Beach Marsh Project Sites have changed greatly since the 1800s in terms of vegetation communities due to construction of dams and berms. Coast Survey maps from the 1860s, combined with aerial photographs starting in the 1940s, document a considerable amount of change in these coastal Project Sites. Prior to the 1960s when the Muddy Hollow dam was constructed, the area functioned as an estuarine Coastal Salt Marsh, bisected by a meandering tidal creek. This creek eventually transitioned into a freshwater system probably dominated by a Riparian Forest as the valley slope increased.

The present-day Limantour Marsh Coastal Salt Marsh was much smaller, with most of it being open water subtidal areas and intertidal mudflats. Construction of the dam caused a rapid conversion of the estuarine marsh into a freshwater open water pond fringed by Coastal Freshwater Marsh, Riparian Forest, and Riparian Scrub. The Pond has shrunk in size over the years since its construction, but it remains ponded throughout the year. Downstream of the dam, changes in hydraulic and sediment delivery patterns encouraged rapid development of marshplains and Coastal Salt Marsh. Coastal Brackish Marsh established at the base of the dam, fed by the mixing of tidal flows, freshwater from the pond spillway, and seepage at the base of the dam itself. As previously described, the upland areas adjacent to the project site are dominated by Coastal Scrub and Coastal Grassland that has suffered to some degree from the introduction on non-native species, particularly non-native annual and perennial grasses.

Based on Coast Survey maps from 1860 and subsequent aerial photographs, the Limantour Beach Marsh Project Site actually appeared to be a Coastal Dune complex that supported some Dune Swale Ponds. This area was hydrologically isolated from Laguna Creek unlike today, but it probably was still heavily influenced by freshwater from drainages on its northern edge, as well as overwash of the dunes by tides on its southern edge. Berming on the western end of this area, as well as redirection of Laguna Creek, has created a less saline mix of habitats, although some salinity still exists probably due to historic deposition of salts in sediment, overwash into the pond during storm-related extreme tidal events, aerial deposition of salts, and possibly even some limited groundwater connection with the ocean through the porous dunes. The center of Limantour Beach Pond is open water, but the proportion of open water relative to Muddy Hollow Pond is much smaller, and it often dries up in the late summer and fall. A significant portion of the Pond and upstream areas support Coastal Freshwater Marsh, Coastal Brackish Marsh, and some pockets of Coastal Salt Marsh and Seasonal Wetlands. The dunes along its southern perimeter have lost some of their mobility due to construction of a path for visitors and establishment of Coastal Scrub and extensive patches of the non-native European dune grass, *Ammophila arenaria*. North of Limantour Beach Marsh are areas of Coastal Scrub that are dominated by coyote brush and non-native grasses and a large drainage swale dominated by Coastal Freshwater Marsh.

The Glenbrook Creek Project Site occurs at a higher elevation within the Glenbrook Creek watershed and is dominated by freshwater vegetation communities. Aerial photographs dating from the 1940s show a much larger expanse of Riparian Forest relative to today, even though a

road had already been constructed in this area at that time. However, in subsequent years, the road was redirected south of the historic road alignment to run directly through the project site, and it appeared that other land-clearing activities may have occurred that substantially reduced the amount of Riparian Forest. Based on aerial photographs, it actually appears that the Riparian Forest has expanded from conditions in 1963-1974, with a much larger riparian zone both upstream and downstream of the road crossing. However, at least downstream of the crossing, continued downcutting of the channel bottom could be slowing or even reversing this trend and increasing the distance between the channel bottom and the floodplain. Eventually, this channel deepening could cut off the groundwater supply to riparian species and cause these areas to convert to more upland communities such as Coastal Scrub or Coastal Grassland.

Wetlands

Wetlands and riparian habitats are integral components of many watershed functions, such as reduction of flood flow velocity, water quality improvement, food support for aquatic organisms, and wildlife habitat. The value and importance of these functions for both people and wildlife may represent one of the primary reasons that impacts to wetlands and their watersheds have become more closely regulated in recent decades. The U.S. Army Corps of Engineers (Corps) oversees Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, both of which serve to ensure that impacts to navigable waters and special aquatic sites such as wetlands are minimized. In addition, wetlands are also regulated under other federal statutes, including Section 401 of the Clean Water Act and the federal Coastal Act, both of which are administered by state agencies – RWQCB and California Coastal Commission (CCC), respectively.

The NPS also scrutinizes projects with the potential to impact wetlands in order to comply with an executive order that decreed that federal agencies should "...avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct and indirect support of new construction in wetlands wherever there is a practicable alternative..." In compliance with this Executive Order, the Park Service adopted a policy of "no net loss of wetlands," with a longer term goal of net gain Service-wide. Implementation of this policy meant that, for new development or new activities, the Park Service pledged to avoid adverse wetland impacts to the extent practicable; minimize impacts that could not be avoided, and compensate for remaining unavoidable adverse impacts through restoration of degraded wetlands at a 1:1 ratio. Unlike Section 404 of the Clean Water Act, adverse impacts under Executive Order 11990 are not interpreted strictly as discharge of dredged or fill material, but encompasses a much broader range of actions, including groundwater withdrawals, water diversions, nutrient enrichment, livestock grazing, pumping, flooding, and impounding.

These regulations have seemingly increased the amount of confusion regarding how wetlands are defined. The confusion stems from the fact that jurisdiction or the amount and type of wetlands regulated under these statutes can vary between administrative agencies. While the RWQCB relies largely upon the Corps and its 1987 methodology to determine Section 401 jurisdiction, the CCC has taken a broader, more expansive interpretation of wetlands, and so has the NPS. The net result is that there could be substantially more CCC- and NPS- regulated wetlands than Corps-regulated wetlands within the same Project Area. Riparian zones often fall into one of these regulatory "gray" zones. Riparian zones can be defined as "wetlands" by the Corps if they remain wet enough to support hydrophytic or "water-loving" plant species and have soils that show indications of prolonged ponding or saturation. Typically, juvenile or young riparian stands often qualify as Corps' "wetlands" and then transition to non-jurisdictional wetlands as the elevation becomes higher through sediment deposition and the older plants become more capable of surviving through tapping into groundwater tables rather than relying on surface inundation or saturation. The CCC, however, might continue to classify them as wetlands based exclusively on the predominance of hydrophytic or water-loving plant species. Ultimately, these disparities in

regulatory interpretation really reflect differences in the jurisdiction of these various state and federal agencies, not differences in the definition of wetlands.

Wetlands and waters within the Project Areas principally occur in creek channels; active floodplains or floodplain terraces along creeks; artificially created ponds; vegetated swales, drainages, or gullies flowing into the creeks and ponds; and depressional features adjacent to creeks and ponds. In addition to creek surface flow and precipitation, hydrologic sources for these creeks and ponds included small, sometimes eroded vegetated and unvegetated drainages that conveyed surface run-off from adjacent roads, hillsides, and seeps. Based on the Cowardin wetlands classification system (Cowardin et al. 1979) developed by the U.S. Fish and Wildlife Service (USFWS), most of the wetlands ranged from palustrine forested areas to unconsolidated bottom estuarine areas (Parsons 2003, Parsons and Allen 2003, Allen and Parsons 2003).

For the purposes of complying with federal regulations, three separate wetland delineations were performed to determine whether areas subject to the jurisdiction or oversight of the Corps, CCC, and NPS existed.

Corps Jurisdiction. The Corps regulates several types of activities in waters of the United States, which includes navigable waters, tributaries to navigable waters, special aquatic sites (e.g., wetlands), and areas that are "adjacent" to navigable waters. These waters are regulated under Section 404 of the Clean Water Act (40 CFR Section 328.3) or Section 10 of the Rivers and Harbors Act (33 U.S.C. 403). Wetland delineations were performed. The Corps has verified two of the three delineations to date: Muddy Hollow and Glenbrook Creek Project Sites. Jurisdictional or potential jurisdictional tidal waters or tidal wetlands occurred in the Muddy Hollow and Limantour Beach Marsh Project Sites. Section 10 waters were only in the Muddy Hollow Project Site and included navigable waters both currently and historically below Mean High Water: historic Section 10 waters occurred in the Pond itself where tidal creeks once occurred before the area was dammed. Jurisdictional non-tidal waters and wetlands were mapped within all three Project Sites and typically included portions of the Project Site creeks and drainages or "tributaries" to these creeks, as well as the artificially created ponds and pond fringes. Jurisdictional adjacent wetlands and waters consisted of vegetated or unvegetated drainages or "tributaries" and swales "adjacent" to creeks and ponds that were not directly connected to creeks and ponds, but that showed some evidence of connectivity, typically hydrologic. Adjacent features also included depressional features that may have some hydrologic or ecological connection with nearby creeks and ponds.

Table 3-6 Acreages of jurisdictional and potential jurisdictional Section 404 wetlands and waters and Section 10 waters.

	Section 404 Waters			***Section 404 Wetlands***			***Section 10***
	Tidal	*Non-Tidal*	*Adjacent*	*Tidal*	*Non-Tidal*	*Adjacent*	Waters
Muddy Hollow	0.24	9.10	0.00	1.28	10.86	0.31	1.07
Limantour Beach*	0.98	1.92	0.00	2.33	5.40	7.76	0.00
Glenbrook Creek	0.00	0.35	0.03	0.00	0.13	0.67	0.00

* These are potential jurisdictional acreages. Delineation has not yet been verified.

CCC Jurisdiction. Within California, the CCC administers the state program (California Coastal Act) for implementation of the federal Coastal Zone Management Act (CZMA). Any action by a federal agency such as the NPS requires a federal consistency determination by the CCC as required by CZMA. The CCC reviews all proposed wetland development projects within the California coastal zone. In the coastal zone, the CCC, with assistance from CDFG, is responsible

for determining the presence and size of wetlands subject to regulation under the California Coastal Act (1976). The CCC has adopted the CDFG wetland definition and classification system. Within the Project Area, all three Project Sites appear to fall within the Coastal Zone.

Table 3-7 presents a list of Project Sites and acreages of wetlands delineated within these areas that would appear to be potentially subject to regulatory oversight by the CCC. Because the CCC takes a broader interpretation of wetlands relative to its regulatory oversight, acreages of wetlands potentially subject to CCC jurisdiction are greater than that subject to Corps' jurisdiction. The Project Sites with the largest amount of wetlands potentially subject to CCC oversight would appear to be Limantour Beach and Muddy Hollow, with 37.9 and 22.2 acres, respectively. However, it should be noted that, because of the way that the CCC delineates wetlands, these totals include coastal prairies and grasslands that appear to be dominated by hydrophytic plant species because of the mesic coastal climate, not necessarily because wetland hydrology is present. Systems delineated within the Project Area include Lacustrine Limnetic (L1), Lacustrine Littoral (L2), Palustrine (P), and Estuarine Subtidal (E1) and Estuarine Intertidal (E2). Classes were Unconsolidated Bottom (UB), Streambed (SB), Rock bottom (RB), Emergent (EM), Scrub-Shrub (SS), Forested (FO), and combinations of these classes.

Table 3-7. Acreage of areas potentially subject to CCC oversight under the California Coastal Act.

	Cowardin Classification Codes																
Site	L1UB	L2EM	PUB	PRB	PEM/UB	PEM	PEM/SS	PSS	PFO	PFO/SS	E1UB	E2UB	E2SB	E2EM	E2EM/SS	E2SS	TOTAL
Muddy Hollow	9.03	1.79	0.01	0.07	0.06	0.31		0.45	9.2	0.12	0.21			0.90			22.2
Limantour Beach							7.47	10.9			0.06	1.90	0.42	13.9	0.70	2.57	37.9
Glenbrook Crossing						1.54		2.95	1.90								6.39

NPS Oversight. Director's Order #77-1 established Park Service policies, requirements, and standards for implementing Executive Order 11990, which directs federal agencies to avoid long- and short-term impacts to wetlands. The Park Service uses the Cowardin classification system (Cowardin et al. 1979) as the basis for creating a NPS standard for defining, classifying, and inventorying wetlands that might be subject to adverse impacts and NPS oversight. Table 3-7 presents a list of the Project Sites and acreages of wetlands delineated within these areas that would appear to be subject to Executive Order 11990, as well as the CCC.

Wetland Functionality. A key component of wetland functionality is hydrologic connectivity. For wetland and riparian areas to perform functions such as water quality improvement, floodwater retention, and carbon export, these areas have to be hydrologically connected to both upstream lands and upstream and downstream water bodies. Construction of the dam at Muddy Hollow substantially reduced the connection between Muddy Hollow Creek and Muddy Hollow Pond and their downstream water body, Limantour Estero. Some connection still exists via a spillway channel, but, to a large degree, most of the carbon from Muddy Hollow Creek and the Pond resides in the Pond and is probably not exported to Limantour Marsh and Estero for use by marine and estuarine organisms. Muddy Hollow Pond does act as a sediment trap and floodwater detention basin for Muddy Hollow Creek. However, conversion of the historic estuarine marsh into an open water pond with little vegetation decreases the potential for this area to transform -- if not retain -- nutrients from Muddy Hollow Creek for uptake into the estuarine food web.

Limantour Beach Marsh suffers from many of the same problems with regards to wetlands functionality. Construction of the beach access berm has largely disconnected the marsh from its downstream water body, Limantour Estero, with a small spillway providing the only connection between the two. Potential functions performed by the Project Site have shifted dramatically from historic conditions, with the historic Dune Swale complex being converted to an impounded freshwater marsh through construction of the berm and diversion of Laguna Creek to the south. Limantour Pond probably plays a much less important role relative to Muddy Hollow Creek and Pond with regards to trapping sediments and detaining floodwaters. However, the higher percentage of vegetation present in the Pond probably increases its potential to transform nutrients for later uptake into the food web. In addition, Limantour Pond may produce more carbon that would be available for export, but the relatively small amount of flow occurring through the spillway limits its export capability.

While the road crossing at Glenbrook Creek is not intended to be a dam, it has, to some degree, acted as a dam and created some hydrologic disconnection between the upstream and downstream sections of creek. Backwater flooding at the culvert has probably encouraged discontinuities in flood dynamics and sediment transport, unnaturally increasing the amount of floodwaters and sediment deposited just upstream of the road crossing. These factors increase the potential for deposition and transformation of nutrients, reduction in flood flow velocities, and export of both large woody debris and detritus available for transport downstream. However, downstream of the road crossing, incision or deepening of the stream channel is disconnecting the stream from its floodplains, thereby reducing functionality of this section of the creek. Only larger storm events can overwash onto the elevated floodplains, thereby reducing the potential for floodwater retention, dissipation of flood flows, and water quality improvement. In addition, incision downstream of the culvert is actually causing water quality problems by increasing suspended sediment in creek waters.

Wildlife

One of the most important functions associated with wetlands and riparian areas is the habitat that they provide for wildlife species. Some wildlife species use creeks, wetlands, and riparian habitat for a portion of their life cycles such as breeding or spawning, foraging, refugia, or as a migration corridor. Others are resident species that spend their entire lives within these systems. Adjacent uplands not only support wildlife typically considered upland species, but are also important to wetland- and riparian-associated species for refugia during high tides or high freshwater storm flows, foraging, movement between sites, etc. Most of the Project Area supports wetland and riparian vegetation communities that provide important habitat for common and special status wildlife species. The value of these areas is enhanced by the fact that there is a mosaic of habitat types present that allows wildlife to move between them for nesting, foraging, roosting, etc. Some of the most important habitats are described below:

Open Water habitat typically consists of ponds or lakes that are created naturally or unnaturally from damming, excavation, for use as reservoirs, stockponds, etc. These ponds or lakes are fed either by inflowing streams or seeps, or they are hydrologically isolated and reliant primarily on being a catchbasin for rainwater. Some ponds and lakes are perennially flooded, while others only have water during the winter, spring, and/or early summer. Vegetation cover is very low within the open water area itself, but these areas often have a fringe of marsh vegetation along the edges. Most of these ponds have a large insect, algae, and invertebrate community that provide food for other organisms. The density of benthic invertebrates is typically low, because of the anoxic or low oxygen conditions in the pond substrate. Because most of these are freshwater ponds or lakes, they support native fish species such as rainbow trout (*Oncorhynchus mykiss*), as well as non-native, introduced game fish such as bass (*Micropterus ssp.*). Fish species within some of the more shallowly ponded areas often have to be tolerant of high temperatures and large swings in

oxygen within waters due to the lack of shading cover and high productivity of algal species and aquatic organisms.

The ready supply of food and water attract species such as waterfowl, including mallard (*Anus platyrhynchos*), canvasback (*Aythya valisineria*), American coot (*Fulica americana*), ruddy duck (*Oxyura jamaicensis*), and American wigeon (*Anus americana*) that use these areas for foraging, as well as breeding. Other types of bird species such as common yellowthroat (*Geothlypis trichas sinuosa*), marsh wren (*Cistothorus palustris*), blackbirds (*Agelais ssp.*), rails, herons and egrets may use the tall emergent Coastal Freshwater Marsh that fringes many of these features. At some point, Open Water ponds or lakes that dry down seasonally may attract shorebirds that prey on invertebrates within the sediment. These ponds and lakes are also important habitat for reptiles and amphibians such as the California red-legged frog (*Rana aurora draytonii*; federally threatened) and the Northwestern pond turtle (*Clemmys marmorata marmorata*) federal Species of Concern). Red-legged frogs use Open Water ponds for egg laying and tadpole rearing during the winter and spring months, and pond turtles are typically found along the edges of Open Water areas, using submerged logs and other features for basking. These and other special status wildlife species would be discussed in more detail in the Special Status Species section. While most of these species are resident or at least long-term users of Open Water, a number of common wildlife species are at least transient visitors that water or forage in the ponds. These species include black-tailed deer (*Odocoileus hemionus columbianus*), tule elk (*Cervus elaphus nannodes*), racoons (*Procyon lotor*), mountain lion (*Felis concolor californicus*), bobcats (*Lynx rufus californicus*), etc.

Freshwater Streams While streams also incorporate "open water," they are typically much more narrow and have flowing, as opposed to, standing water. In addition, because streams are narrow, they are often covered by riparian forest that provides significant shade and a source of detritus for the creek. For these reasons, Freshwater Streams are consistently more well oxygenated with lower temperatures than ponds, but are generally less productive in terms of the algal and zooplankton community. However, aquatic insects are abundant and provide an important food source for larger stream organisms such as fish and macroinvertebrates such as crayfish (P*rocambaru ssp.*). As with ponds, Freshwater Streams support a number of resident and transient fish species in west Marin, including federally threatened coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*). These anadromous species that move between ocean and freshwater environments use freshwater streams within the Seashore for spawning and rearing of young. Streams that are disconnected from the ocean through construction of dams or culverts that prohibit upstream fish passage often lose their populations of anadromous species. Red-legged frogs are also found in Freshwater Streams, representing critical non-breeding habitat. Frogs within the Seashore appear to move into Freshwater Streams with riparian habitat in the summer after breeding (Fellers and Guscio 2002). These species are discussed in more detail under Special Status Species.

Tidal Channels While also largely open water, Tidal Channels support a very different suite of species typically than Open Water ponds and Freshwater Streams. As with Open Water ponds, a fringe of vegetation is often present on the perimeter of the channel and is dominated by so-called "low marsh" plant species such as Pacific cordgrass (*Spartina foliosa*) and alkali bulrush (*Scirpus maritimus*). Organisms must be able to tolerate higher water salinities and temperatures due to the lack of shading vegetation. Tidal Channels are, again, less productive generally than Open Water Ponds in terms of the algal, zooplankton, and aquatic insect community because tidal action and freshwater inflows from streams keeps waters moving in and out of the system. However, exposure of the channel bottom twice daily during low tides also promotes oxygenation of the sediment, which dramatically increases the number of benthic invertebrates in these channels relative to Open Water ponds and Freshwater Streams. These benthic invertebrates, as well as other aquatic organisms, provide an important food source for resident estuarine fish species such as threespine stickleback (*Gasterosteus aculeatus*), staghorn sculpin (*Leptocottus armatus*), goby, etc. Non-resident estuarine and marine fish species also use these tidal channels for foraging or as

nurseries for young. In addition, during low tides, shorebirds such as semipalmated plovers (*Charadrius semipalmatus*), willet (*Catoptrophorus semipalmatus*), long-billed curlew (*Numenius americanus*), western sandpiper (*Calidris mauri*), and dunlin (*Calidris alpina*) may forage on invertebrates within the exposed intertidal mudflat. Rail species such as the federally listed endangered California clapper rail (*Rallus longirostris obsoletus*) and the stated-listed threatened California black rail (*Laterallus jamaicensis coturniculus*), as well as Virginia rail (*Rallus limicola*), yellow rail (*Coturnicops noveboracensis*), and sora (*Porzana carolina*) also forage in tidal channels and use fringing vegetation for refugia from predators.

Tall emergent Coastal Freshwater Marsh and Coastal Brackish Marsh As noted earlier, a number of bird species use tall emergents within Coastal Freshwater Marsh and Coastal Brackish Marsh. These marshes are typically dominated by species such as cattails (*Typha* spp.), bulrush (*Scirpus californicus*), tules (*Scirpus acutus*), and even bur-reed (*Sparganium* spp.). These tall emergents often attract songbirds and other bird species such as marsh wrens, common yellowthroats, blackbirds, rails, and herons and egrets. Freshwater marsh may also provide high-tide refugia for California black rail (*Laterallus jamaicensis coturniculus*) and other coastal marsh species; seasonal foraging and resting habitat for migratory shorebirds and waterfowl; and foraging habitat for raptors, herons, egrets, blackbirds (*Agelaius* spp.). Most of these species are residents that may nest and forage within marshes, while others are migrants.

Coastal Salt Marsh adjoins Tidal Channels and provides foraging and roosting habitat for landbirds such as osprey (*Pandion haliaetus*) and northern harrier (*Circus cyaneus*), herons and egrets, and Canada geese (*Branta canadensis*). These species forage on small voles (*Microtus californicus eximus*) or mammals within the marsh or invertebrates such as snails and crabs that utilize "mid-marsh" areas dominated by pickleweed (*Salicornia virginica*). In addition, rail species such as the California clapper rail and California black rail use marshplains or associated low marsh habitat for nesting. Physically contiguous "high marsh" areas and uplands directly adjacent to the marsh provide refugia during extreme high tides or storm tides for these poor-flying birds. Recent studies suggest that Coastal Salt Marsh supports a lower diversity of avian species than does Open Water ponds or Coastal Freshwater Marsh (Warnock et. al. 2002). However, Coastal Salt Marshes within the Seashore are also utilized by some species not typically associated with marshes such as deer and tule elk that graze extensively on the marshplains. Fishes that use coastal salt marsh habitat at Point Reyes include longfin smelt (*Spirinchus thaleichthys*), Pacific herring (*Clupea pallasii*), Pacific lamprey (*Lampetra tridentata*), green sturgeon (*Acipenser medirostris*), and California roach (*Hesperoleucus symmetricus*).

Riparian Forest/Riparian Scrub Riparian habitat adjacent to Freshwater Streams and Open Water ponds plays an extremely important role for wildlife species. Not only does it provide woody debris and detritus that is used for refugia and food sources for aquatic invertebrates, it supports a tremendous number and diversity of breeding and non-breeding species. Both non-migrant and migrant birds use riparian habitat for breeding during the spring, and migrant birds such as neotropical migrants from south and central America are protected under the Migratory Bird Treaty Act of 1918. Breeding birds utilizing riparian habitat include warblers (*Dendroica ssp.*), raptors, swallows (*Tachycineta ssp.*), hummingbirds , common and salt marsh yellowthroat, and yellow-breasted chat (*Icteria virens*). The density of trees and shrubs, as well as the variety in vegetation layers, often plays a key role in these areas' attractiveness to breeding bird species and is typically associated with healthier, non-disturbed riparian areas. Riparian habitat, particularly unfragmented or continuous habitat, also provides an important corridor for migration of terrestrial and aquatic species such as bobcat and racoons. While much attention has been focused on special status species such as steelhead, coho salmon, California red-legged frog, and breeding birds, these areas also play an important role for common wildlife species such as the Pacific giant salamander (*Dicamptodon tenebrus*), California newt (*Taricha torosa*), rough-skinned newt (*Taricha granulosa*), and wood rat (*Neotoma fuscipes*).

Coastal Dunes Coastal Dunes have attracted a lot of attention in recent decades, because some species associated with dunes have declined dramatically. Numbers of snowy plovers (*Charadrius alexandrinus nivosus*) , which establish nests within open, sandy areas of dunes, have dropped so low that this species is in danger of extinction. In addition to trampling by beach users and even cattle, dune habitat has been threatened by the invasion of non-native European dune grass (*Ammophila arenaria*) that decreases habitat value for plovers. Other species associated with dunes and adjoining beaches include roosting and foraging gulls (*Larus ssp.*) and shorebirds, as well as occasionally sea lions (*Zalophus californianus*) and elephant seals (*Mirounga angustirostris*).

The Muddy Hollow Project Site appeared to once consist of a Tidal Channel-Coastal Salt Marsh habitat that linked to a Freshwater Stream/Riparian Forest at its upstream end, as the valley gradient began to increase. Construction of the Muddy Hollow dam converted the Project Site into Open Water pond fringed by tall emergent Coastal Freshwater Marsh. The Freshwater Stream/Riparian Forest habitat remained, but may have moved upstream slightly due to water impoundment. It also probably changed in nature from a defined Freshwater Stream channel adjacent to Riparian Forest-dominated floodplain terraces to a more diffuse, delatic riparian system with no well defined, primary stream channel. The Coastal Salt Marsh and Tidal Channel habitats once present shifted downstream, forming on the outboard portion of the dam and into Limantour Estero.

Muddy Hollow Pond is currently a perennial Open Water area that has shrunk somewhat since its construction. Documented fish species known to occur within the Pond include native rainbow trout/steelhead (*Oncorhynchus mykiss*), threespine stickleback, and sculpin, but some non-native, game fish species such as bass are also believed to be present, as well. While the *Oncorhynchus mykiss* observed are likely resident, they are considered part of the federally threatened population. The Pond also supports a considerable number and diversity of waterfowl species, including canvasback, American coot, ruddy duck, American wigeon, and mallards, as well as some less common species (bufflehead, scaup, ring-necked duck, gadwall, northern shoveler, cinammon teal, green-winged teal). The Pond attracts a moderate number of Seashore visitors interested in bird-watching. Tall emergent marsh fringes may be used by songbirds, although none were documented during area search bird inventories (White 1999). A small population of red-legged frog occurs at the Pond, but does not appear to be a breeding one based on the absence of egg masses and tadpoles (Fellers and Guscio 2002). The potential presence of non-native game fishes within the Pond may preclude successful breeding as these species, as well as native bird species such as black-crowned night herons, can predate upon tadpoles (Fellers and Guscio 2002). At least one northwestern pond turtle was also observed within the Pond (Fellers and Guscio 2002). Upstream of the Pond, the dense Riparian Forest along Muddy Hollow Creek likely provides good habitat for breeding birds such as Allen's hummingbird (*Selasphorus sasin*), Bewick's wren (*Thryomanes bewickii*), common yellowthroat (*Geothlypis trichas sinuosa*), song sparrow (*Melospiza melodia*), Swainson's thrush (*Catharus ustulatus oedicus*), and Wilson's warbler (*Wilsonia pusilla*), all of which have been documented within riparian corridors of this and adjacent Coast Trail watersheds (Toniolo and Gardali 2002). The value of Muddy Hollow Creek as Freshwater Stream habitat has been decreased significantly for at least anadromous species by construction of the dam as mentioned earlier and the diffuse nature of the channel system within this section of the creek. Downstream Tidal Channel and Coastal Salt Marsh habitats support characteristic marine and estuarine invertebrate and fish species, as well as probably herons, egrets, shorebirds, raptors, and even deer and tule elk.

The Limantour Marsh Beach Project Site has also changed greatly in terms of wildlife habitat since the 1800s. Historically, it appeared to be a Coastal Dune complex with several Dune Swale Ponds. However, construction of the berm, as well as redirection of Laguna Creek, has created a seasonal Open Water pond that is much smaller in size and less deep than Muddy Hollow Pond. In addition, a significant portion of the Pond supports extensive patches of tall emergent Coastal Freshwater Marsh and Coastal Brackish Marsh characterized by bulrush (*Scirpus californicus*) and

cattails (*Typha* spp.). Further upstream along the diverted Laguna Creek are patches of Coastal Salt Marsh, Seasonal Wetland, and short- to medium-sized emergent Coastal Freshwater Marsh. The Open Water Pond probably is used during flooded periods by waterfowl, with bird use shifting perhaps to shorebirds during drawdown or when water levels become low enough to expose the pond bottom. Tall emergent marsh could provide habitat for songbirds such as common yellowthroat, red-winged blackbirds (*Agelaius phoeniceus*), marsh wren, etc., although none of these species were sighted during area search bird inventories (White 1999).

The Pond does support a moderately sized population of red-legged frog that appear to breeding based on the observation of egg masses and tadpoles (Fellers and Guscio 2002). It is possible that the lower water levels, combined with increased vegetation cover along the edges, provides better breeding habitat for the frogs, because they like to attach their eggs to emergent vegetation. Also, the seasonal nature of the pond precludes establishment of fish species that might predate upon the egg masses or tadpoles. No fish or northwestern pond turtles were observed during surveys (Seahsore, unpub. data; Fellers and Guscio 2002). A more detailed discussion of special status wildlife species occurs under the Special Status Species section. While Coastal Dunes are still present on the northern side of the Pond, they are dominated by European dune grass (*Ammophila arenaria*) and provide poor nesting habitat for plovers, which have never been documented by the Seashore in this area. The dunes and associated Coastal Scrub are heavily used, however, by deer and perhaps tule elk for foraging and "deer beds."

Wildlife habitats within the Glenbrook Creek Project Site have not changed as dramatically as those within other Project Sites. However, impacts from the road construction, installation of culverts, and other land-clearing activities did reduce the amount of riparian habitat at one point relative to historic conditions. The Riparian Forest and Riparian Scrub along this portion of Glenbrook Creek probably provides moderate to good habitat for breeding birds such as Allen's hummingbird, Bewick's wren, common yellowthroat, song sparrow, Swainson's thrush, and Wilson's warbler, all of which have been documented within riparian corridors of this and adjacent Coast Trail watersheds (Toniolo and Gardali 2002). Habitat for breeding birds and other riparian-associated wildlife has been negatively affected downstream of the road crossing by the deterioration of the riparian corridor. Not only is total riparian cover decreased relative to upstream conditions, but the density of vegetation is lower, as well. Riparian habitat in this section appears to have declined in areal extent and quality because of a number of reasons, including past land disturbance and possibly disconnection of the floodplain terrace from the groundwater/surface water supply due to channel downcutting. Federally threatened steelhead have been observed within the Glenbrook Creek watershed (B. Ketcham, *pers. comm*.), both upstream and downstream of Glenbrook Crossing. No red-legged frogs or northwestern pond turtles were observed in this Project Site (Fellers and Guscio 2002).

Special-Status Species

Special-status species refers to species that fall into any of the following categories.

- Plant and wildlife species **listed as endangered pursuant to the federal Endangered Species Act** (species in danger of extinction throughout all or a significant portion of their national range).
- Plant and wildlife species **listed as threatened pursuant to the federal Endangered Species Act** (species identified as likely to become endangered species within the foreseeable future throughout all or a significant portion of their national range).

- Plant and wildlife species **listed as endangered pursuant to the California Endangered Species Act** (species in danger of extinction throughout all or a significant portion of their range in the state).
- Plant and wildlife species **listed as threatened pursuant to the California Endangered Species Act** (species likely to become endangered within the foreseeable future throughout all or a significant portion of their state range).
- **California species of special concern** (plant and wildlife species that may become vulnerable to extinction on a state level from declining population trends, limited range, and/or continuing threats; i.e., species at risk of threatened or endangered status).
- **Native plants identified as rare by the California Native Plant Society** (CNPS) (plants that, although not currently threatened with extinction, are present in small numbers throughout their range, and are considered at risk of endangered status).

A total of 81 special-status species (31 plants species, 3 fish species, and 47 avian and terrestrial wildlife species) were considered for this EA analysis. They are listed in Tables 3-8 and 3-9. The following sections provide brief descriptions of the special-status species that have the potential to be found at the project sites, and thus could be affected by the proposed restoration activities.

Special Status Plant Species

Marin Knotweed, FSC

Marin knotweed (*Polygonum marinense*) is found in coastal salt marsh and brackish marsh habitats in Marin, Napa, Sonoma, and Solano Counties. It is considered a "List 3" species by the CNPS, meaning that existing information is inadequate to resolve the species' status and prognosis. Several recorded locations of this species are known from the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites. However, a botanical survey performed in conjunction with the project wetland delineations did not observe Marin knotweed (Parsons and Allen 2003).

Point Reyes Bird's-Beak, FSC

Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*) is found in coastal salt marshes in Humboldt, Marin, and Sonoma Counties, and in Oregon. It is considered a "List 1B" species by CNPS, meaning that it is rare, threatened, or endangered in California and elsewhere. Several recorded locations of this species are known from the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites, and it has been informally reported from the area in recent years, but it was not observed during the project site botanical surveys (Parsons and Allen 2003).

Marin Checker Lily, FSC

Marin checker lily (*Fritillaria affinis* spp. *tristulis*) (=*Fritillaria lanceolata* var. *tristulis*) has been identified in some 10 occurrences in coastal bluff scrub, coastal prairie, and coastal scrub habitats in Marin County. It is considered a List 1B species by CNPS. Several recorded locations of this species are known from the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites, but it was not observed during the project site botanical surveys (Parsons and Allen 2003).

Fragrant Fritillary, FSC

Fragrant fritillary (*Fritillaria liliacea*) is known from Alameda, Contra Costa, Monterey, Marin, San Benito, Santa Clara, San Francisco, San Mateo, Solano, and Sonoma Counties. It is found in cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland habitats, commonly on serpentine soils. It is considered a List 1B species by CNPS. Several recorded locations of this species are known from the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites, but it was not observed during the project site botanical surveys (Parsons and Allen 2003).

Special Status Fish Species

Three listed fish species; tidewater goby (*Eucyclogobius newberryi* FE), coho salmon (*Oncorhynchus kisutch* FT), or steelhead trout (*Oncorhynchus mykiss* FT) have the potential to occur in the Drakes Bay and Inverness Quadrangles.

Steelhead (FT)

The only special-status fish known to occur at the project sites is the steelhead. Steelhead in the project area belong to the Central California Coast Evolutionarily Significant Unit (ESU), which is federally listed as threatened. The Central California Coast ESU includes all naturally spawned populations of steelhead in California streams from the Russian River south to Aptos Creek, and those in the drainages tributary to San Francisco and San Pablo Bays eastward to and including the Napa River, except for the Sacramento–San Joaquin River Basin.

Steelhead begin migrating up coastal and inland streams from November through early May to spawn in freshwater streams. Juvenile steelhead spend up to 3 years rearing in freshwater, and then migrate to the ocean, where they feed and mature for another 3 years before returning to their natal streams to breed. NPS has documented the presence of steelhead at the Glenbrook Crossing site and in the Muddy Hollow drainage below the existing dam (Self and Ranlett 1984;Cappellini and Everly 1997). They may also be present at Limantour Beach, although this drainage offers even more limited connectivity to inland waters.

The project area also lies within the ESU and includes designated critical habitat for Central California Coast Coho salmon, but Coho have not been found in streams within the project area (Jones 2001; Ketcham pers. comm. 2004).

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act requires all federal agencies to consult with NOAA Fisheries on all cumulative and synergistic actions or proposed actions that may adversely affect Essential Fish Habitat (EFH). The assessment of cumulative effects on EFH is consolidated with the assessment of cumulative effects under ESA.

EFH is the aquatic habitat (water and substrate) necessary for fish to spawn, breed, feed, or grow to maturity (National Marine Fisheries Service 1998) that would allow a level of production needed to support a long-term, sustainable commercial fishery and contribute to a healthy ecosystem.

The species covered under EFH include coho salmon (*Oncorhynchus kisutch*), chinook salmon (*Oncorhynchus tshawytscha*), and pink salmon (*Oncorhynchus gorbuscha*). Neither pink nor chinook salmon have been documented in the project area historically or presently, but coho were historically present in the watersheds of PRNS. Coho are currently unknown in the project area and are believed to be extirpated from the action area.

Tidewater Goby (FE)

The Recovery Planning Team for the tidewater goby is drafting a recovery plan for the species which includes documentation of potential habitat for reintroduction to establish satellite populations to protect of unique genetic stocks. Tidewater goby have been documented within Tomasini Creek at the head of Tomales Bay (Fong 2002). While not documented in the Estero de Limantour action area, it does provide suitable habitat and introduction of the species into the area has been proposed (Jacobs pers comm 2004). Goby introduction would not occur prior to the proposed restoration activities in 2005 or 2006. Given the long-term improvements to habitat that the project would facilitate, it is likely that introductions should not be considered until after restoration and enhancement activities are complete and vegetation and habitat within the actions areas have reestablished.

Special Status Amphibian Species

California red-legged frog (FT)

The only special-status amphibian known to use the project sites is the California red-legged frog (*Rana aurora draytonii*) (CRLF). The CRLF was once an abundant frog throughout much of California, but is now completely extirpated in the floor of the Central Valley (Fisher and Shaffer, 1996) and nearly extirpated in both the Sierra Nevada foothills and in the southern 1/4 of its range. The listing under the Endangered Species Act in 1996 was necessary because the frog is absent from more than 70% of its original range and is threatened within its remaining range by a wide variety of human impacts, including urban encroachment, construction of reservoirs and water diversion, contaminants, agriculture, and livestock grazing (USFWS 2000). In a few parts of the central coast range, there are still large, vigorous populations, some of which probably rival what was present 200 years ago (Fellers, *in press*). CRLF requires permanent or semi-permanent ponded water habitat with emergent and submergent vegetation, and may use stock ponds and pools within streams. The species is most often found near ponds, creeks, marshes, and other vegetated wetlands, but may disperse several miles from water to aestivate in rodent burrows or cracks in the soil during summer and fall dry periods. California red-legged frogs are most common in intermittent waters that lack bullfrogs and introduced fish species.

The largest known populations of CRLFs are at PRNS where there are more than 120 breeding sites with a total adult population of several thousand frogs. Peak egg laying by CRLFs at Point Reyes is in January and occurs in slow moving or static water systems. Most of the breeding sites at PRNS are artificial stock ponds constructed on lands that have been grazed by cattle for 150 years. There is much less information on habitat requirements away from the breeding sites. Data from radio-tagged CRLFs suggest that riparian areas provide critically important habitat for frogs during most of the year (Fellers, *in press*). This type of habitat is likely essential to the continued survival of CRLFs, particularly in dry years when water in breeding ponds is not likely to persist.

The Project Area falls within a region of California that was proposed as Critical Habitat for the red-legged frog in 2001. PRNS is within the Point Reyes Critical Habitat Unit (Unit 12), which consists of "watersheds within and adjacent to Bolinas Lagoon, Point Reyes, and Tomales Bay in Marin and Sonoma counties" and "contains one of the largest known populations of California red-legged frogs" (USFWS 2001). However, a federal court ruling in fall 2002 required the US Fish & Wildlife Service (USFWS) to review the economic analysis performed for the red-legged frog Critical Habitat designation, so the designation remains a proposal. For the purposes of this EA, Critical Habitat for red-legged frog is treated as a proposed designation.

Though not as concentrated, there are good populations of CRLFs elsewhere in the San Francisco Bay area (especially Alameda and Contra Costa Counties) and in the coastal drainages from San Mateo County (just south of San Francisco) south to Santa Barbara County. One of the largest single populations consists of an estimated 350 adult frogs at Pescadero Marsh (San Mateo County) (Fellers, *in press*).

The Draft Recovery Plan for the CRLF reports that eggs exposed to salinity levels greater than 4.5 ppt experience 100 percent mortality and that larvae die when exposed to salinities greater than 7.0 ppt (USFWS 2000). Although Fellers and Guscio (2002) recorded a maximum salinity of 1.1 ppt, PRNS has observed salinity ranges from 0.1 ppt to 13.1 ppt at the Horseshoe Pond site, known to support the California red-legged frog. Based on the data in the Recovery Plan, it can be assumed that breeding success is lower during breeding seasons where salinity in these brackish water bodies is high. Even under high winter salinity conditions, tadpoles were observed in areas with salinities up to 8.6 ppt. (B. Ketcham, pers. com.).

PRNS contracted with Dr. Gary Fellers of the USGS-BRD to perform focused surveys for CRLFs within the project areas. Extensive surveys of the project sites were conducted in 2002, and CRLF is known to be present at the Limantour Beach Marsh site (Fellers and Guscio 2002). It may also

use the Muddy Hollow drainage and ponded portions of Glenbrook Creek. The final report of CRLF observations within the Coastal Watershed Restoration Project area were completed in May 2002 (Fellers and Guscio 2002).

Critical Habitat

PRNS, and adjoining areas of Marin County comprise one of the 57 core areas for focused recovery of red-legged frogs established in the Draft Recovery Plan for the species. The central peninsula has roughly 75 stock ponds in an area extending from the Kehoe Ranch near Pierce Point south to Point Reyes itself and east to Tomales Bay, Mt. Vision, and the Laguna Ranch (now the Clem Miler Environmental Education Center). Approximately 50 of these ponds are located on land currently used for ranching, with most of the remaining 25 on former ranch lands on Inverness Ridge and above Limantour Estero. Most of these ponds retain water at least 20" deep well into the summer, and a number are perennial in typical rainfall years. Evidence of breeding red-legged frogs has been observed in many of these ponds. Pond habitat and several perennial creeks are densely clustered on the Point. Distances of under 1.25 miles separate one or more adjacent aquatic habitats, and the ground between them is suitable for red-legged frog overland movement.

Special Status Reptile Species

Northwestern pond turtle (FSC)

The only special-status reptile at issue for the proposed action is the northwestern pond turtle (*Clemmys marmorata marmorata*), which is a state species of special concern. Northwestern pond turtles are typically observed in quiet waters of ponds, reservoirs, and slow-moving streams. They may leave the water to bask on rocks or logs and to deposit eggs along the streambank or in nearby uplands. They are also capable of overwintering in upland sites, which may allow them to use habitat in intermittent waterways (Stebbins 1985). Northwestern pond turtles have been recorded in major drainages in the project vicinity, and may use Muddy Hollow Pond.

Special Status Bird Species

The short-tailed albatross, and California least tern are migratory marine birds, with albatross preferring nesting at offshore islands near California and in the northern latitudes of the Pacific. Albatross are only very rare visitors to PRNS. Viable California least tern breeding habitat does exist at PRNS, but the species has not been recorded within the action areas of the proposed projects and is relatively rare in the vicinity Point Reyes. Marbled murrelets and bald eagles are also uncommon visitors to PRNS, but are preferential to mature forest canopies at outside of the action area and are uncommon on Point Reyes. Marbled murrelets occur in Drakes Bay nearshore in the non-breeding season but not in the proposed action area. For these reasons, it is highly unlikely that the proposed projects would impact these species. The northern Spotted owl occurs in the park in very high densities. The project would occur outside of the nesting season, and none of the project areas are within ¼ mile of known nesting sites.

Western snowy plover (FT)

Western snowy plovers use the Point Reyes peninsula as both wintering and nesting habitat. Wintering birds occur around Drakes Estero and Abbott's Lagoon, and along Limantour Spit and the Great Beach. During the 1980' s nesting took place along the entire Great Beach Drake s Beach, and at Limantour Spit. In recent years, erosion along the southern portion of the Great Beach has diminished the upper beach area such that the entire beach can be washed by waves. Nesting is occurring on the northern portion of this beach, between the North Beach parking area and Kehoe Beach, which is backed by extensive dunes. Snowy plovers also nest along the western edge of Abbott's Lagoon. Erosion has also affected Limantour Spit, and it has not been used by snowy plovers for nesting since 2000 when Limantour had three nests on it. Limantour beach and spit continue to be used as wintering habitat by plovers.

Monitoring of nesting snowy plovers in 1986-1989 and 1995-2003 indicates a decline in the number of nesting birds through 1996, followed by a gradual rebound in recent years. PRBO Conservation Science (PRBO) monitored individual nests at all nesting areas during the period 1986 - 2003. On the Great Beach, where most nesting took place, the number of chicks fledged per egg laid during 1986-89 and 1995 ranged from 1%-7%.

In 1996, a program to increase snowy plover nesting success was initiated, and this program continues to the present. The program consists of signs and habitat fencing to minimize disturbances and nest enclosures to prevent nests and egg predation by both terrestrial and avian predators. Visitors are advised to avoid walking on upper beach areas used by plovers, and dogs are prohibited from nesting areas. Since the program began, the rate of chicks fledged per egg has increased to 20%-58% (Ruhlen and Abbott 2000), and between one and three chicks per female have fledged. Several nesting areas, including Limantour Spit and sections of the Great Beach accessed by the Abbott' s Lagoon and Kehoe Beach trails, experience regular visitor use. During a study in 1999 and 2000, biologists found a higher rate of snowy plover chick loss in these areas on weekends, when disturbance by human visitors and dogs is more likely. In response, PRNS began a weekend Plover Docent Patrol Program to place volunteer docents on plover nesting beaches and beach trailheads to educate visitors about beach restrictions. In 2000-2003, although egg laying remained high, fledging rate declined. Causes for the decline could include predation by ravens, owls, falcons, and disturbance by visitors or cattle.

California Brown Pelican (FE)

The California brown pelican (*Pelecanus occidentalis californicus*) is one of six recognized subspecies of brown pelican. Brown pelicans are distinguished by their large size and brown color. Adults weigh approximately 9 pounds, and have a wingspan of over 6 feet. They have long, dark bills with big pouches for catching and holding fish. The brown pelican is easily distinguished from the American white pelican, the only other pelican in its range, which is white with black primary and secondary flight feathers.

Pelicans breed in nesting colonies on islands without mammal predators. They typically build a nest of sticks on the ground. All courtship occurs at the nest site. The male brings nesting materials to the female and she builds the nest. Normal clutch size is three eggs, which are laid in March or April. Both take turns incubating the eggs and rearing the chicks.

The brown pelican is found in estuarine, marine subtidal, and marine pelagic waters along the California coast. Brown pelicans breed on Channel Islands: Anacapa, Santa Barbara, and Santa Cruz (Garrett and Dunn 1981) from March to early August; most numerous then within 20 km (12 mi) of those islands (Briggs et al. 1981). In northern California, the species is common June to November, rare to uncommon December to February and May, and very rare and irregular March and April (Anderson and Anderson 1976, Cogswell 1977, McCaskie et al. 1979).

Tricolored Blackbird (FSC)

Tricolored blackbird (*Agelaius tricolor*), a state species of special concern, is a permanent resident in California's Central Valley from Butte County south to Kern County, and is also found at scattered coastal locations from Marin County south to San Diego County. The species breeds at scattered locations in Lake, Sonoma, and Solano Counties and rarely in Siskiyou, Modoc, and Lassen Counties as well. Tricolored Blackbirds forage in open areas that offer abundant insect prey, such as marshes, pastures, agricultural wetlands, dairies, and feedlots. They are colonial nesters and prefer nest sites in emergent marsh vegetation such as cattails, or upland nest sites that offer blackberries or grain crops and a nearby source of water. Suitable habitat is present around Muddy Hollow Pond, and possibly also at Limantour Beach Marsh.

Little Willow Flycatcher (FSC)

The little willow flycatcher (*Empidonax traillii brewsteri*) is a state species of special concern. This species nests in wet meadows with abundant willows, and may use willow thickets in the Muddy Hollow area.

Salt Marsh Common Yellowthroat (FSC)

The salt marsh common yellowthroat (*Geothlypis trichas sinuosa*) is a state species of special concern. Yellowthroats inhabit areas between freshwater and tidal marsh and are also found in upland grasslands. They typically use salt marshes during winter and prefer brackish or freshwater marshes during the breeding season. Nests are found on the ground in low herbaceous vegetation or emergent vegetation, to a height of approximately 5 feet above the ground. Suitable nesting habitat for this species is present in the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites.

California Black Rail (FSC)

The California black rail is listed as threatened under the California Endangered Species Act. The species' range is currently confined to the northern San Francisco Bay Estuary, with small, isolated populations along the outer coast in Tomales Bay, Bolinas Lagoon, Morro Bay, and Bodega Bay (Manolis 1978, Evens et al. 1991); in the Sacramento Valley and foothills (Aigner et al. 1995); and in the Colorado River basin (Evens et al. 1991). Black rails primarily use tidal salt marsh habitat, but they are also observed in freshwater marsh (Evens et al. 1991, Evens and Page 1986, Grinnell and Miller 1944, Manolis 1978, Aigner et al. 1995). Suitable habitat may be present at Limantour Beach and Muddy Hollow, but habitat in these areas is likely too exposed to support sustained use by rails.

Special Status Mammal Species

Point Reyes mountain beaver (FSC)

The only special-status mammal at issue for the proposed action is the Point Reyes mountain beaver (*Aplodontia rufa phaea*), which is not listed but is considered a species of concern by the U.S. Fish and Wildlife Service. This subspecies of the common mountain beaver is only known to occur in Marin County, and its range is almost entirely within Point Reyes National Seashore. The Point Reyes mountain beaver inhabits moderately dense coastal scrub habitat in colluvial hollows, and may use scrub habitat in the vicinity of all three project sites.

Point Reyes jumping mouse (FSC)

The Point Reyes jumping mouse (*Zapus trinotatus orarius*) occurs in riparian and grassland habitat within the Seashore. The mouse has been documented near Abbotts Lagoon and Limantour beach and could occur within the Muddy Hollow Pond Project area. The mouse has not been documented during any surveys at the project site.

Special Status Invertebrate Species

Myrtles Silverspot Butterfly (FT)

Myrtle's silverspot butterflies inhabit coastal dune, coastal prairie, and coastal scrub habitats at elevations ranging from sea level to 300 meters, and as far as 5 kilometers inland (Launer et al. 1992). The species historic distribution is believed to have extended from near Fort Ross south to Punta Ano Nuevo. By the 1970's populations south of the Golden Gate were believed to be extinct and extant populations of the butterfly were believed to exist only within PRNS. Reasons for this decline include urban and agricultural development, invasive non-native plants, livestock grazing, over-collecting, and other human impacts.

Following discovery of a population near the Estero de San Antonio in the early 1990's, field surveys were conducted by the Center for Conservation Biology at Stanford University. Two additional apparently separate populations in PRNS were located and fieldwork was done to

estimate population sizes. One population, centered on North Beach, extended from Abbott's Lagoon to South Beach and east to Drakes Estero and Drakes Beach. The highest numbers were found along the dune-scrub interface in the back dune area of the central peninsula on F and G ranches and the AT&T property, and on the bluffs on either side of the Drakes Beach visitor center. The population was estimated to number in the low thousands in 1993. More recent survey work in 1997 put the population estimate at 50-200 individuals, with no silverspots being found in portions of the 1993 range. The other population was found on the Tule Elk Reserve, with small numbers on the adjacent J Ranch. In 1993, the number of individuals in this population was estimated to be in the mid-hundreds. The 1997 survey of this northern Point Reyes population gave a population estimate of 250-500 (Launer et al. 1998).

Silverspot numbers in the area outside of park lands around the Estero de San Antonio were estimated at 2,000-5,000 individuals in 1991. Other nearby areas with potentially suitable habitat was not surveyed. Together with those found at Point Reyes, estimated numbers for the three known populations of the species total less than 10,000 individuals (USFWS 1998).

Known Myrtle's silverspot nectar plants include bull thistle (*Cirsium vulgare*), gum plant (*Grindelia* spp.), western pennyroyal (*Monardella undulata*) yellow sand verbena (*Abronia latifolia*), seaside daisy (*Erigeron glaucus*), and mule ears (*Wyethia* spp.). Brownie thistle (*Cirsium quercetorum*) and groundsel (*Senecio* spp.) are also fed upon. Many of these species are commonly found at Point Reyes. Oregon silverspot (*Speyeria zerene hippolyta*) feeds on other common plant species that may also be used by Myrtle's silverspot.

Myrtles silverspot larvae are known to use only one species as a host plant, western dog violet (*Viola adunca*). It is possible that, like other subspecies of *Speyeria zerene* and other species of silverspots, Myrtle's silverspot uses other violet species as larval hosts, although this has not been observed. The perennial, rhizomatous western dog violet is found on open grassy slopes sandy flats behind dunes, and on the edge of brush under pines (Howell 1970). While it is described as "rather common near the coast", including the Point Reyes dunes, distribution of the species is patchy. Abundance of western dog violet alone is not a good predictor of silverspot presence. Myrtle's silverspot presence also is associated with protection from high coastal winds that are common during the summer flight season (Launer et al. 1992). The complex habitat needs of breeding Myrtle's silverspots may be the species' limiting factor.

Due to the lack of historic data previous to the 1990's, it is not known if the silverspot has declined at Point Reyes. While surveys of the two populations during the period 1993-1997 found that the Tule Elk Reserve population remained stable and the central Point Reyes population declined sharply, such variation is well within that normally found in *Speyeria* species (USFWS 1998).

In 2002 and 2003, Point Reyes National Seashore biologists conducted vegetation surveys for the larval host plant and nectar sources and butterfly surveys for Myrtle's silverspot butterflies. In 2002, the first Myrtle's silverspot butterfly sighting was made on June 26th and the last sighting was on September 10th, with the peak population size the last week of July. Over 30 butterfly transects (203 km) were performed in the 2002, spanning a period of 13 weeks and included areas in Tomales Point, North Beach, South Beach, and Drakes Estero. Overall, biologists observed a total number of 598 butterflies in all areas. Similar efforts and results were obtained in 2003 Adams, 2004) Very few observations of the butterfly were made within the project area. Biologists' notes additional nectar species used by Myrtle's silverspot butterflies during survey transects, including goldenrod (*Solidago* sp., 2 visits), Yarrow (2 visits), *Cammisonia* (1 visit), *Jaumea carnosa* (1 visit), *Ericomeria ericoides* (1 visit), the coast fiddleneck (*Amsinkia spectabilis*, 1 visit) (Adams 2004).

Globose dune beetle (FSC)

The globose dune beetle (*Coelus globosus*) is a subterranean dweller of the California coastal dunes. The distribution and abundance of the species is unknown but it could occur near the Limantour Beach Pond project area.

3.4 Social Environment

Cultural Resources

The following overview of cultural resources research in the Point Reyes area is summarized from a technical report prepared for the project (Newland 2004).

Prehistoric and Historic Context

Prehistoric Period

The Point Reyes area can be included in the analytic framework for the interpretation of North Coast and central California prehistory constructed by Fredrickson (1974), who divided human history in California into three broad periods: the Paleoindian period, the Archaic period, and the Emergent period. This scheme used sociopolitical complexity, trade networks, population, and the introduction and variations of artifact types to differentiate between cultural units. With minor revisions, it remains the dominant framework for prehistoric archaeological research in the project region.

The Paleoindian period (10,000–6,000 BC) was characterized by small, highly mobile groups occupying broad geographic areas. During the Archaic period, consisting of the Lower Archaic period (6,000–3,000 BC), Middle Archaic period (3,000–500 BC), and Upper Archaic period (500 BC–AD 1000), geographic mobility may have continued, although groups began to establish longer-term base camps in localities from which a more diverse range of resources could be exploited. The addition of milling tools and obsidian and chert concave-base points, and the occurrence of sites in a wider range of environments, suggest that the economic base was more diverse. By the Upper Archaic period, mobility was being replaced by a more sedentary adaptation in the development of numerous small villages and the beginnings of a more complex society and economy began to emerge.

During the Emergent period (AD 1000–1800), social complexity developed toward an ethnographic pattern of large, central villages where political leaders resided, with associated hamlets and specialized activity sites. Artifacts associated with this period are the bow and arrow; small serrated corner-notched points; mortars and pestles; and a diversity of beads and ornaments that became especially abundant (Gerike et al. 1996).

Most sites within Point Reyes National Seashore that have been dated appear to fall into the Emergent period (e.g., Origer 1982, 1987; King and Upson 1970; Von der Porten 1963), although at least two substantial sites may belong to the Upper Archaic period, the McClure site and the Cauley Site (CA-Mrn-242) (Beardsley 1954). Other sites dating to the Upper Archaic or earlier may be present in the Point Reyes National Seashore under alluvial or colluvial sediments.

Ethnographic Period

The Point Reyes Area is within the traditional territory of the Coast Miwok. The Coast Miwok language, a member of the Miwokan subfamily of the Utian family, is divided into two dialect groups: Western (Bodega) and Southern (Kelly 1978, Shipley 1978). Based on common linguistic associations, the territory of the Coast Miwok extended from Duncan's Point on the

Sonoma County coast south to the Marin headlands (Kroeber 1925), and east to a point approximately halfway between the Sonoma and Napa Rivers (Kelly 1978).

The fundamental unit of Coast Miwok political organization was tribelet, which encompassed the village community (Kroeber 1925); Coast Miwok sociopolitical organization did not extend beyond the village. Larger villages had a chief, whose position was nonhereditary. The chief's responsibilities included advising and caring for the villagers and overseeing activities in the dance house. Incipient chiefs were tutored by the current chief and four elderly women (Kelly 1978). Other important leaders included the woman chief and the *máien*. The woman chief appears to have been primarily a ceremonial leader, who was involved in the Bird Cult and coordinated the Acorn Dance and the Sünwele Dance. The *máien* was the head of the female ceremonial house, and was responsible for directing the construction of new dance houses, having wood hauled for festivals, supervising the preparation of foods for special events, sending invitations to dances, and sometimes also for selecting dance performers (Kelly 1978).

Historic Period

The Point Reyes–Drakes Bay–Tomales Bay region was one of the first areas described by European explorers who traveled the California coast. Contact between the Coast Miwok and Europeans first occurred on the Marin County coast as early as 1579, when Sir Francis Drake spent 5 weeks on the coast to repair his damaged ship (Kroeber 1953). Some 16 years after Drake's landing, the *San Agustín*, a Manila galleon piloted by Sebastián Rodríguez Cermeño, entered Drakes Bay. The ship, loaded with trade goods from Asia and bound for Acapulco, was wrecked by a violent storm 3 weeks after its arrival in November of 1595; Asian ceramic fragments from the wreck have been found on the beaches throughout Drake's Bay. Before returning to the sea in a launch, the crew explored several miles inland from the coast, making contact with several Coast Miwok villages and obtaining acorns from them (Hoover et al. 1990, Moratto 1974).

Juan Sebastián Vizcaíno's 1603 expedition was the one to bestow the name *Punta de los Reyes* on the point, after the day of *los reyes magos*, the "three holy kings" (Gudde 1998). The Vizcaíno expedition also entered Tomales Bay that same year, though they assumed that the narrow bay was a river (Gudde 1998).[4]

After the visits of these explorers, it was almost 200 years before Europeans returned to the area, but by 1776, Mission San Francisco de Asís had been founded, and before long numerous other missions and their associated pueblos were in place across the bay area. The mission *padres* began forced conversions of Native Americans to Christianity and brought Coast Miwok to mission lands, causing a partial abandonment of native settlements. Many of the Coast Miwok were taken to San Francisco's Mission Dolores (established in 1776), to Mission San José de Guadalupe (established in 1797), and to Mission San Rafael Arcangel (established in 1817), to be converted. Large groups (40–150 people) were taken at one time (Milliken 1995). Their numbers decreased rapidly, as did those of Native American populations throughout the Bay Area and California. Subsequent ranching and settlement by Mexicans and, later, by Americans further displaced Coast Miwok from their homes and subjected the group to intense depredation as a result of homicide and epidemic diseases (Cook 1976).

With the secularization of mission properties in the early 1800s, large ranchos began to be established through the Mexican government's land grant program. The project area is in the Rancho Punta de Los Reyes Sobrante land grant. The nearby Rancho Punta de Los Reyes (a

[4] The bay may derive its name from the Tamal Indians, a group of Coast Miwok who appear in the baptismal records of Mission Dolores between 1802 and 1810 (Milliken 1995), or from the Coast Miwok word for "bay," *tomales* (Gudde 1998, Hoover et al. 1990).

separate grant from the Sobrante property), consisted of 35,000 acres granted in 1836 to James Richard Berry, an Irishman, who shortly thereafter sold a portion of the rancho to Joseph Snook, who in turn sold his portion to Antonio María Osio in 1843. Osio obtained the rest of the original Los Reyes grant and was also granted the remaining 48,000 acres of land on Point Reyes, which was given the name Rancho Punta de los Reyes Sobrante, *sobrante* meaning "surplus" or "leftover land." This settlement eventually lead to the founding of numerous ranches and dairies in the Point Reyes region (Newland 2004).

The acquisition of Alta California by the United States as a result of the Mexican-American War of 1846–1848 had little effect on the established ranching and dairying economy. The area became an increasingly important center for dairy production, providing much of the butter and cream used in the San Francisco area during the Gold Rush of the mid-1800s. Row crop cultivation also became important, and from the 1850s through the 1950s, dairy production and row crop cultivation were the area's economic mainstay.

In the early 1920s, the Bureau of Indian Affairs purchased land near the city of Graton and placed it in government trust as a ranchería for the remaining 75 Coast Miwok and Southern Pomo that shared their territory (Campbell et al. 2002). Today, the Coast Miwok population has increased to 366 individuals and is represented by the federally recognized Federated Indians of the Graton Ranchería located in Graton, with offices in Santa Rosa and Novato (Newland 2004).

Archeological Sites in the Project Area

An archaeological survey conducted for the proposed action by staff of Sonoma State University's Anthropological Studies Center (ASC) in November and December of 2001 identified one cultural resource site within the general project area. CA-Mrn-236/H is a prehistoric and historic archaeological site located adjacent to the Limantour Beach Marsh site (Newland 2004).

CA-Mrn-236/H is a prehistoric campsite with a historic artifact scatter component. The site was initially discovered and excavated in 1941 by Beardsley and was re-excavated in 1967 by Edwards. Treganza then conducted several excavations at the site in 1965 and 1968. These multiple excavations recovered Ming porcelain fragments, several iron spikes, miscellaneous ceramic fragments, and a light shell scatter (Newland 2004). CA-Mrn-236/H was revisited by ASC staff in 1999; at that time, a light concentration of shell was still visible on the surface (Jablonowski et al. 1999), although when ASC staff archaeologist Michael Newland and Frank Ross of the Federated Indians of the Graton Ranchería conducted the archaeological survey for this project in December 2001, no archaeological remains were visible (Newland 2004). However, NPS archaeologists who visited the site in 2003 were again able to observe the remains of the site, although approximately 50% of the area was vegetated at the time of their visit. The NPS survey included surface scraping and random troweling to a depth of approximately 5 inches. No midden deposits or fire-affected rock were observed in this survey, although several shell fragments of possible archaeological origin (fragments of *Clinocardium* and *Protothaca*) observed at various locations on the surface indicated at least a possibility of buried archaeological deposits (Rudo and Maxey pers. comm.).

While the five most recent investigations of CA-Mrn-236/H (Rudo and Maxey pers. comm., Newland 2004, Jablonowski et al. 1999, Moratto 1974, Edwards 1967) did not definitively locate substantive remains of this site, it is still possible that the site, possibly including human remains, may be partially intact beneath the sand and paved roadway (Rudo and Maxey pers. comm.); a number of archaeological sites along the ocean coast and Tomales Bay that have been identified as destroyed have been rediscovered. Though the remains of this archaeological site may not be eligible for listing in the National Register of Historic Places (NRHP), the possibility that there are human remains increases the potential significance of CA-Mrn-236/H, particularly in regard to compliance with the Native American Graves Protection and Repatriation Act (Rudo and Maxey pers. comm.) (see additional discussion under *Cultural Resources* in Chapter 4).

Noise

Ambient noise levels within and adjacent to the project areas are generally low. The primary sources of noise are traffic on nearby Limantour Road, and general noise from recreators utilizing hiking trails and service areas.

There are no permanent sensitive receptors within or adjacent to the project area. However, the project sites are used extensively for recreation throughout the year, and therefore a large number of sensitive receptors are present year round within and adjacent to the project area. In addition, this area supports a wide range of wildlife species that are sensitive to noise and area present at all of the sites throughout the year.

Public Health and Safety

Two issues related to public health and safety are specifically relevant to the proposed action:

- current and continuing safety of the existing dam and embankment structures, and
- potential effects of altered hydraulics and circulation on mosquito population levels.

Dam and Embankment Safety

No embankment safety concerns have been identified at Limantour Beach Marsh.

The Muddy Hollow Pond dam is on the NPS dam inventory (CA10262 – "Lower Muddy Hollow Dam") and requires regular inspection for condition and safety purposes. The U.S. Bureau of Reclamation (USBR) has assessed the condition of the Muddy Hollow dam as "seriously deficient" and has suggested that "consideration should be given to deactivation" (USBR 2001). Erosion on the downstream face of the dam indicated that it had been overtopped in the past (USBR 2001). While the downstream Hazard Classification (based on potential loss of life and property if the dam were to fail) is low, public safety is nonetheless a concern because the dam supports a heavily used trail corridor.

The condition of the Glenbrook Crossing embankment is uncertain. Details of construction are unknown, but it is assumed to consist of unengineered fill. Because of its age and uncertainty about the quality of its construction, it is assumed to be at risk of failure over the long term. The current condition of the culvert (eroded and bowed with water piping around it) makes the site a high risk of catastrophic failure under high flow conditions. Although public safety risks associated with failure are minimal because of the remote location, the remaining structure and trail access could pose risk to visitors following a potential failure.

Mosquito Populations

Public health and safety concerns related to mosquito populations focus on the potential for mosquitoes to spread disease. The greatest concern in coastal northern California, where malaria and other common mosquito-borne diseases are not endemic, is West Nile virus, which has been identified in several counties in the state (e.g., California Department of Health Services 2004) and is expected to become an increasing concern in the Bay Area in the near future.

All species of mosquitoes require standing water to complete their growth cycle, and any body of standing water represents a potential breeding site. However, the productivity of mosquito breeding is related to water quality: as water quality increases, mosquito productivity typically

decreases. In addition, permanent bodies of open water that have good water quality typically have a stable nutrient content and support a rich diversity of floral and faunal species, including mosquito predators. Other specific factors that influence mosquito breeding success include salinity and degree of stagnancy. Mosquito productivity is inversely related to water salinity, with increased salinity tending to lower mosquito productivity. Current action also tends to lower mosquito productivity, in part because currents foster mixing that improves water quality. In addition, currents (particularly river currents and wave action across larger bodies of water) physically retard mosquito production by inhibiting egg laying and reducing the survival rate of larvae (Collins and Resh 1989).

The most productive mosquito breeding environments thus occur in stagnant waters and water bodies with stable or slowly changing water levels. Rapid fluctuations in water level (e.g., wave disturbance of the water surface) typically reduce mosquito breeding success. This is because mosquito larvae live at or immediately below the water surface and breathe oxygen; if the water surface is disturbed, they may drown (Malamud-Roam pers. comm.).

At present, both the Limantour Beach Marsh and Muddy Hollow sites support ponded water, and water in Glenbrook Creek is also intermittently ponded near the crossing site. Thus there is some potential for mosquito breeding at all three site, although none of the sites has been identified as a particular concern for mosquito breeding; in particular, Muddy Hollow Pond is large enough to experience wind-driven wave currents that likely impede breeding, while Glenbrook Creek flows throughout most years. Of the three sites, Limantour Beach Marsh is most likely to support mosquito breeding under existing conditions.

Recreational Use

Point Reyes National Seashore welcomes more than 2.5 million visitors annually, many of them drawn by the area's outstanding recreational opportunities, which include hiking; horseback riding; backcountry camping; beachwalking; wildlife viewing and birdwatching; and mountain biking (National Park Service 1999).

The project sites support a number of recreational uses. Limantour Beach is a designated recreational area, and can be accessed easily via Limantour Road, one of the Seashore's major roadways. Serving some 180,000 visitors per year, Limantour Beach offers various amenities, including a developed parking lot, restrooms, telephones, and picnic tables. The crossing at the Limantour Beach Marsh site is the primary access point for Limantour Beach, and the parking area provides access to a number of local trails. The Muddy Hollow and Glenbrook sites are both located adjacent to the Muddy Hollow Trail, an important wilderness trail that connects with the networked trail system serving the central part of the Seashore and is used by hikers and equestrians. At Muddy Hollow, the ponded open water habitat and riparian vegetation provide outstanding opportunities for birdwatching. The dam is also used and maintained as part of the Estero Trail.

Transportation and Traffic

Overview

Point Reyes National Seashore is located in unincorporated Marin County. The major roads through the park, including Sir Francis Drake Boulevard to the Chimney Rock Road intersection, and Pierce Point Road to the Pierce Point Ranch, and Bear Valley Road are county roads, and maintained by their Department of Public Works. State Route 1 is maintained by Caltrans. Other roads in the park, including Limantour Road are maintained by the NPS.

Because the County maintains roads leading to, and within the park, the transportation element of the Marin Countywide Plan (County of Marin 1994) provides guidance for traffic planning at the Seashore. The transportation element's purpose is to (1) describe existing and projected transportation conditions in Marin County, and (2) articulate County transportation policy. It describes and evaluates the existing (1991) condition and function of the County's transportation system and projects anticipated function if growth and land use evolve as predicted in the Countywide Plan's community development element. With certain exceptions, it also defines level of service[3] (LOS) D as the minimum goal for all streets in unincorporated areas, and for area highways, and identifies infrastructure improvements that would be required to continue to achieve that LOS under the anticipated growth and land use patterns (County of Marin 1994, 2003). In response to state requirements following passage of Propositions 111 and 116 in 1990, the County of Marin and eleven Marin city jurisdictions designated the Countywide Planning Agency as the congestion management agency responsible for developing and adopting a countywide plan to reduce traffic congestion (County of Marin 1994).

Transportation access to Point Reyes National Seashore is limited, in keeping with the area's open space/wilderness character. The Seashore is not directly served by air, rail, or mass transit. Road access from the south occurs from Highway 1 northbound via Bear Valley Road. From the east, visitors access the Seashore via Sir Francis Drake Boulevard from U.S. Highway 101. Visitors can also approach from the north, entering the town of Point Reyes Station from Highway 1 southbound and following the continuation of Sir Francis Drake Boulevard across Olema Valley into the Seashore area. All primary access roads are two-lane corridors in the vicinity of the Seashore. Most intersections are controlled by stop signs only or are uncontrolled.

Within the Seashore, Sir Francis Drake Boulevard continues as a two-lane rural road to serve the Point Reyes Lighthouse and Lighthouse Visitor Center at Point Reyes proper, with spurs providing visitor access to the Estero trailhead and to the Kenneth C. Patrick Visitor Center at Drake's Beach. Pierce Point Road, a smaller two-lane rural road, diverges from Sir Francis Drake Road about 2 miles northwest of Inverness to serve the northern beaches (Kehoe and McClure's) as well as historic Pierce Point Ranch and the Tomales Point trailhead. A narrow, winding spur descends to Heart's Desire Beach on Tomales Bay.

Limantour Beach Marsh and Muddy Hollow Pond are accessed via Limantour Road from Bear Valley Road. Limantour Road is a winding two-lane rural road with limited shoulder width. The intersection at Bear Valley Road is controlled by a stop sign, and sight distance is limited by vegetation along the roadside. Limantour Road provides access to a network of hiking trails in the central portion of the Seashore.

The Glenbrook Crossing site is accessed from the Muddy Hollow Parking area, just north of Limantour Road. The site is approximately one mile from the parking area, on the Muddy Hollow Trail, within the Philip Burton Wilderness.

Access for Emergency Services

Emergency services access the project sites and surrounds from Bear Valley Road and Limantour Road. NPS maintains a wildland and engine fire crew based at the Hagmaier complex 5 miles

[3] *Level of service* (LOS) is a measurement used to describe how well a roadway is operating. LOS is evaluated either on the basis of delays experienced by motorists, or the ratio between the roadway's design capacity and the number of vehicles it actually conveys. To describe LOS, roadways are assigned a letter designation (A–F). The letters A through F represent progressively worse conditions: LOS A indicates free-flow operation with excellent maneuverability, stable speeds, and little or no delay, and LOS F indicates a breakdown of flow, substantial delay, and unstable and erratic speeds. LOS D describes traffic that is approaching an unstable condition; at LOS D, queues develop rapidly but motorists do not experience excessive delays (Transportation Research Board 2000).

south of Olema. The NPS law enforcement staff provide resource enforcement and initial response to most medical and traffic related emergencies on federal lands. Depending on need and location, federal, state, county, and local fire agencies can and do respond to calls within the Seashore. The County of Marin maintains primary fire and EMT services based in Point Reyes Station, and the area is also served by local emergency and fire response through the Inverness Public Utilities District.

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