Conclusions: Alternative D would have identical impacts to those described under Alternative C.

Geologic Resources

Laws, Regulations, Policies, and Criteria Guiding Impact Analysis

Within California, there are two primary legislative acts that govern construction in areas prone to geologic hazards. California's Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code Section 2621 et seq.) prohibits the location across the traces of active faults of most types of structures intended for human occupancy and strictly regulates construction of these types of structures in corridors along active faults (earthquake fault zones). The San Andreas Fault Zone (SAFZ) is the only zoned fault within the boundaries of Marin County (Snyder and Smith Associates and Nichols-Berman 2002), and it runs through the center of the Project Area.

While the Alquist-Priolo Act specifically addresses hazards associated with surface fault rupture, the Seismic Hazards Mapping Act of 1990 (California Public Resource Code Sections 2690-2699.6) specifically focuses on other hazards related to earthquakes such as ground shaking, liquefaction, and seismically induced landslides. In unincorporated areas, counties such as Marin are required to regulate development in mapped Seismic Hazard Zones or "zones of required investigation" through requiring appropriate site geologic and soil investigations and mitigation measures as part of permit review. Seismic Hazard Zone maps have only been prepared so far for a few Bay area and southern California counties, and Marin County is not one of these. However, information from state and federal geologic surveys has been used to develop various maps that assess susceptibility to earthquake-related hazards such as ground shaking, liquefaction, and landslides. Some of these maps are presented in Chapter 3 under Geologic Resources.

Local policies such as the LCP and the Point Reyes Station Community Plan emphasize the need for proper planning in known geologic hazard zones to "minimize risks to life and property in areas of high geologic …hazard" (LCP Section 30253). A more detailed description of state and local laws pertaining to geologic resources and hazards can be found under Geologic Resources in Chapter 3.

Under CEQA, the state and county require analysis of the impacts each alternative may have on exposing people to active or potentially active fault zones; landslides or mudslides; slope instability or ground failure; subsidence; expansive soils; liquefaction; tsunami; or similar hazards. In addition, it focuses on substantial changes in topography from excavation, grading, or fill, including, but not limited to, ground surface relief features; geologic substructures or unstable soil conditions; and unique geologic or physical features. In addition to these geologic hazards, the LCP for Zone II requires analysis of impacts to bluff areas that would diminish the stability of a bluff area or require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.

General Assumptions and Methodologies

- Almost all (>90 percent) of the Project Area is located in the Alquist-Priolo Fault Zone, because the San Andreas Fault runs through the center of the Project Area in a southerly to northerly direction (Figure 19). However, the proposed project does not include construction of any habitable structures.
- Seismic Hazard Zone mapping has not been conducted for Marin County, but it is assumed that the Project Area would be mapped as a Seismic Hazard Zone or "zone of required investigation" because it incorporates the seismically active San Andreas Fault.
- All of the Project Area has been rated by the California Geological Survey as having the highest earthshaking and liquefaction potential.
- Based on its sheltered location at the very southern end of Tomales Bay, the potential for hazards associated with tsunami is assumed to be universally non-existent to negligible and, therefore, is not evaluated in this document.
- Most of the Project Area is located in the San Andreas rift valley and are lowlands or alluvial areas that are not topographically elevated or located on hillsides. A small proportion of the Project Area is located on the lower elevation portions of the coastal marine terrace that borders the Giacomini Ranch pastures to the east and the location of the town of Point Reyes Station. Hillsides within the Project Area do not exceed 35 percent or are in areas with high landslide potential, and the proposed project is not expected

to affect the potential for landslides. Therefore, the potential for hazards associated with landslides is assumed to be non-existent and, therefore, is not evaluated in this document.

- Because the Project Area does incorporate some of the coastal marine terrace on the east side of the Giacomini Ranch pastures, there is a potential for changes to bluffs along the Point Reyes Mesa terrace. Because of the importance of agriculture to West Marin and Marin County in general, a number of relevant planning documents have established policies regarding agriculture.
- The potential impacts of the proposed project on geologically related wetland functions such as groundwater discharge and recharge will be evaluated under the Water Supply and Distribution section of Public Health and Services focused impact topic, because of its pertinence to the municipal groundwater supply for the local community.

Described below are methodologies for significance criteria related to geologic resources, including any specific assumptions or details on methodologies (Tables 30-34).

TABLE 30. UNIQUE GEOLOGIC RESOURCES

Source: NPS Management Policies, Marin CEQA guidelines Nature: Adverse Context: Project Area, Region (Point Reyes/San Andreas Fault Area) Duration: Long-Term	
No Impact	There would be no impact to unique geologic resources associated with the proposed project in the Project Area.
Negligible	There would be a negligible impact (< 1 percent) to the areal extent of unique geologic or physical resources in the Project Area such as features associated with strike slip faults (e.g., shutter ridge, fault sag ponds, fault trenches); coastal marine terraces; or other features.
Minor	There would be a minor impact (> 1 percent and ≤ 5 percent) in the extent of unique geologic or physical resources in the Project Area such as features associated with strike slip faults (e.g., shutter ridge, fault sag ponds, fault trenches); coastal marine terraces; or other features.
Moderate	There would be a moderate impact (>5 percent and ≤ 10 percent) in the extent of unique geologic or physical resources in the Project Area such as features associated with strike slip faults (e.g., shutter ridge, fault sag ponds, fault trenches); coastal marine terraces; or other features.
Major or Substantial	There would be a substantial change (> 10 percent) in the extent of unique geologic or physical resources in the Project Area such as features associated with strike slip faults (e.g., shutter ridge, fault sag ponds, fault trenches); coastal marine terraces; or other features.

Topographic Resources: Changes in topographic resources focus on substantial changes in topography from excavation, grading, or fill, including ground surface relief features and unique physical features (Table 31). Impact thresholds focus on the extent of area affected by substantial changes in topography. There is no guidance under CEQA on how much excavation, grading, or fill constitutes a "substantial" change in topography and would, thereby, be considered significant. However, the Corps has issued some guidance for excavation in wetlands that contrasts plowing and deep ripping during agricultural operations, with plowing defined as "not to include the redistribution of surface material in a manner which converts wetlands areas to uplands [See 40 CFR 233.35(a)(1)(iii)(D)]." According to U.S. Department of Agriculture, plowing depths rarely exceed one foot into the soil and not deeper than 16 inches. In addition, guidance on changes in topographic resources can be drawn from construction standards: most grading equipment cannot accurately create or rework topography in increments of less than 0.5 feet. For the purposes of this analysis, major or substantial changes in topographic resources are considered to exceed 0.5 feet, with changes less than 0.5 feet not considered to substantially alter topography.

TABLE 31. TOPOGRAPHIC RESOURCES

Source: Marin CEQA guidelines Nature: Adverse Context: Project Area Duration: Long-Term	
No Impact	There would be no impact to topographic resources in the Project Area.
Negligible	There would be a negligible or barely detectable effect on topographic resources in the Project Area from excavation, grading, or fill activities resulting in topographic changes within ≤ 10 percent of the Project Area.

TABLE 31. TOPOGRAPHIC RESOURCES

Minor	There would be a minor or measurable effect on topographic resources in the Project Area from excavation, grading, or fill activities resulting in topographic changes within ≤ 25 percent of the Project Area. If areal extent of change <50 percent, change in existing elevation contours would average ≤ 0.25 feet.
Moderate	There would be a moderate or appreciable effect on topographic resources in the Project Area from excavation, grading, or fill activities resulting in topographic changes within ≤ 50 percent of the Project Area. If areal extent of change > 50 percent, change in existing elevation contours would average ≤ 0.5 feet.
Major or Substantial	There would be a substantial or major effect on topographic resources in the Project Area from excavation, grading, or fill activities resulting in topographic changes within > 50 percent of the Project Area, and change in existing elevation contours would average > 0.5 feet.

Geologic Hazards – Surface Fault Rupture: Because the Park Service Management Policies (2001), LCP Zone II Policies (1981), Coastal Resource and Management Policies, and Marin CWP policies stress the importance of minimizing risk to people and property, the potential risk to visitors and residents is evaluated by the number of habitable and non-habitable structures in the Alquist-Priolo Fault Zone within the Project Area (Table 32). While the Alquist-Priolo Fault Zone Mapping Act focuses exclusively on habitable structures, both non-habitable and habitable structures would attract people to the Project Area and potentially increase the risk to public safety should an earthquake occur on the San Andreas Fault, particularly in the generalized vicinity of the Project Area (i.e., within at least 10 to 50 miles of the epicenter). As noted earlier, the San Andreas Fault runs directly through the Project Area. Most of the risk with surface fault ruptures is associated with structures that either straddle or are in close proximity (within 50 feet) to an active fault. Hazards associated with surface fault rupture typically decrease exponentially with distance from an active fault such as the San Andreas Fault. "Most surface faulting is confined to a relatively narrow zone a few feet to tens of feet wide, making avoidance (i.e., building setbacks) the most appropriate mitigation method" (California Geological Survey 2002). However, in some cases, "primary fault rupture along branch faults can be distributed across zones hundreds of feet wide or manifested as broad warps," which suggests that engineering strengthening or design may be of additional mitigative value (California Geological Survey 2002). Hazards associated with surface fault rupture are also governed by soil substrate, with bedrock magnifying the impact of surface fault ruptures. Lastly, hazards associated with a surface fault rupture are strongly related to the potential for a large earthquake. The probabilities of an earthquake with a magnitude greater than 6.7 between 2000 and 2030 are 21 percent for the San Andreas Fault.

For this analysis, it is assumed that any structure in the fault zone would potentially attract people to a known hazard zone and increase the risk to public safety, even if it is not habitable. Impact thresholds are based on the number of structures proposed under the various alternatives, along with the distance from the fault, because hazards associated with surface fault rupture generally decrease rapidly with distance from an active fault. Impact thresholds were developed on the assumption that the Project Area is not located on bedrock soils, which are associated with magnification of fault rupture impacts. Non-habitable structures evaluated were defined as buildings, including Visitor Centers, bathrooms, and other constructed structures (e.g., education centers, youth hostels) that are open for public use, as well as constructed features of trails such as bridges. Analysis takes into account construction of structures such as bridges as part of the public access component, as well as the potential for the proposed project to increase use of existing structures.

TABLE 32. SURFACE FAULT RUPTURE HAZARDS

Source: NPS Management Policies, Alquist-Priolo Fault Zone Mapping Act (state); CCC/LCP Zone II, Marin CWP Nature: Adverse Context: Project Area Duration: Long-Term	
No Impact	There would be no structures within the Project Area that would attract people to a known hazard area.
Negligible	Habitable structures or a moderate to high number (>1) of non-habitable structures (e.g., centers, bathrooms, bridges) would be at a considerable distance from an active fault (>500 feet); *OR* A low number (≤1) of non-habitable structures would be within 100 to 500 feet of an active fault.
Minor	Habitable structures or a moderate to high number (>1) of non-habitable structures (e.g., centers, bathrooms, bridges) would be within 100-500 feet from an active fault; *OR* A low number (≤1) of non-habitable structures would be within 50 to 100 feet of an active fault.

TABLE 32. SURFACE FAULT RUPTURE HAZARDS

Moderate	Habitable structures or a moderate to high number (>1) of non-habitable structures (e.g., centers, bathrooms, bridges) would be within 50-100 feet from an active fault; *OR* A low number of non-habitable structures (≤1) would be within 5 to 100 feet of an active fault.
Major or Substantial	Non-exempt habitable structures would be across or within 50 feet of an active fault; *OR* Non-habitable structures (e.g., centers, bathrooms, bridges) would be placed astride or across an active fault trace.

Geologic Hazards – Groundshaking and Liquefaction: Because Park Service Management Policies (2001), LCP Zone II Policies (1981), Coastal Resource and Management Policies, and Marin CWP policies stress the importance of minimizing risk to people and property, the potential risk to visitors and residents from groundshaking and liquefaction is evaluated by the number of structures, facilities, and uses that would attract people to the Project Area, a known hazard area, and potentially increase risk to public safety (Table 33). Hazards associated with groundshaking or liquefaction do not typically decrease as rapidly with distance from an active fault as those associated with surface fault rupture and are more strongly affected by other confounding factors such as soil substrate (i.e., mud versus rock) that can amplify shaking. Based on the scale of the Project Area and the relative homogeneity of the soil substrate, it is assumed that the potential for earthquake shaking and liquefaction does not vary measurably and is the same for the entire Project Area as shown in the California Geological Survey maps. As with surface fault rupture, potential hazards associated with groundshaking and liquefaction are strongly related to the potential for a large earthquake. The probabilities of an earthquake with a magnitude greater than 6.7 between 2000 and 2030 are 21 percent for the San Andreas Fault. The average length of an earthquake is 40 seconds (R. Grasetti, GeoCon, *pers. comm*.).

The number of structures, facilities, and attractions/uses proposed or envisioned under each of the various alternatives has been ranked as low, moderate, and high based on a relative comparison with the total number of structures, facilities, and attractions/uses currently present in specific destination areas or points in the park (e.g., Tomales Point, Bear Valley, Olema Valley, Limantour, etc.). This ranking system incorporates not only physical structures such as Visitor's Centers and bathrooms, but non-structural attractions/uses, as well, such as bird-watching, kayaking, backpacking, bicycle riding, swimming, and viewpoints. A more detailed description of the system for ranking structures, facilities, and attractions/uses can be found under Visitor and Resident Experience in Chapter 3. Because groundshaking and liquefaction hazards are expected to be universally very high throughout the Project Area, impact thresholds do not include distance from an active fault. This analysis focuses on the number of structures and facilities that would be constructed or operated under Park Service and CSLC lands as part of the proposed project in high to very high hazard zones. In addition, the number of people expected to potentially utilize public access resources in the Project Area vicinity is incorporated into the analysis, using a relatively broad ranking system of low, moderate, and high based on a relative comparison of daily numbers of people visiting other subregions or destinations within the Seashore and north district of the GGNRA. This ranking system is also discussed in more detail under Visitor and Resident Experience in Chapter 3. In assessing risk to public safety, impact thresholds take into account the low probability of a major earthquake along the San Andreas Fault in the vicinity of the Project Area and the short duration of actual earthquake episodes.

TABLE 33. GROUNDSHAKING AND LIQUEFACTION HAZARDS

Source: NPS Management Policies, CCC/LCP Zone II, Marin CWP Nature: Adverse Context: Project Area Duration: Long-Term	
No Impact	There would be no structures, facilities, or uses located in high hazard zones within the Project Area vicinity that would attract people to a known hazard area.
Negligible	There would be only a low number (≤25) of structures, facilities, or attractions/uses located in high hazard zones within the Project Area vicinity that would collectively attract low average numbers (<250 daily) of people to a known hazard area.
Minor	There would be a low number (≤25) of structures, facilities, and attractions/uses located in high hazard zones within the Project Area vicinity that would collectively attract moderate to high average numbers (≥250 daily) of people to a known hazard zone; *OR* A moderate to high number (>25) of structures, facilities, and attractions/uses located in high hazard zones

TABLE 33. GROUNDSHAKING AND LIQUEFACTION HAZARDS

	within the Project Area vicinity that would be expected to collectively attract low average numbers (<250 daily) of people to a known hazard area.
Moderate	There would be a moderate number (>25 and ≤40) of structures, facilities, and attractions/uses located in high hazard zones within the Project Area vicinity that would collectively attract moderate to high average (≥250 daily) numbers of people; *OR* A high number of structures, facilities, and attractions/uses (>40) located in high hazard zones within the Project Area vicinity that would be expected to collectively attract moderate average numbers (<1,000 daily) of people to a known hazard area.
Major or Substantial	There would be a moderate number of structures, facilities, and attractions/uses (> 25 and ≤ 40) that would collectively attract very high average numbers (>1,500 daily) of people; *OR* A high number of structures, facilities, and attractions/uses (> 40) that would be expected to collectively attract high to very high average numbers (≥ 1,000 daily) of people to a known hazard area.

Geologic Hazards – Coastal Bluff Stability: LCP Zone II Policies (Marine County Comprehensive Planning Department 1981) require project proponents to ensure that proposed projects would not diminish the stability of a bluff area through development, construction of protective devices, or other factors (Table 34). Within the Project Area, bluffs have been identified in the LCP in Point Reyes Station directly adjacent to the Giacomini Ranch East Pasture.

TABLE 34. COASTAL BLUFF STABILITY

Source: CCC/LCP Zone II Nature: Adverse Context: Project Area Duration: Long-Term

No Impact	There would be no impact to bluffs associated with implementation of the proposed project.
Negligible/ Minor/ Moderate	The proposed project would affect bluffs, but would NOT develop bluffs or violate the bluff-related policies in the LCP Plan.
Major or Substantial	The proposed project would affect bluffs and would violate the bluff-related policies of the LCP Plan.

Impact Analysis

TABLE 35. INTENSITY, NATURE, TYPE, DURATION, AND CONTEXT OF IMPACTS FOR GEOLOGIC RESOURCES
All impacts are Adverse unless stated otherwise and Project Area and are assumed to be uniform for all duration periods (Construction/Short-Term/Long-Term) unless otherwise noted.

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Impact Indicator	Intensity, Nature, Type, Duration, and Context of Impact				
Unique Geologic Resources	No Impact	No Impact	No Impact	No Impact	No Impact
Topographic Resources	Beneficial - Negligible	Beneficial - Moderate	Beneficial - Moderate	Beneficial - Moderate	Beneficial - Moderate
Geologic Hazards – Surface Fault Rupture and Impacts on Public Safety	No Impact	Minor	Minor	Minor	No Impact
Geologic Hazards – Groundshaking and Liquefaction and Impacts on Public Safety	Negligible	Minor	Minor	Minor	Minor
Coastal Bluff Stability	No Impact	Negligible/ Minor	Negligible/ Minor	Negligible/ Minor	Negligible/ Minor

No Action Alternative

Analysis: The impacts for the No Action Alternative on geologic and topographic resources and geologic hazards would generally range from negligible adverse to negligible beneficial (Table 35).

Geologic Resources and Coastal Bluff Stability: There are no unique geologic resources within the Project Area. While the San Andreas Fault does run through the Project Area, the best opportunities for geologists and non-geologists to view the fault and fault-associated features occur in the Olema Valley, which is a frequent destination for geology-associated field trips. There would be no potential to impact to coastal bluff stability under this alternative.

Topographic Resources: This alternative would result in only negligible impacts to topographic resources associated with the approximately 11 acres of restoration that would be performed to comply with the Park Service's existing mitigation agreement with CalTrans. This agreement transferred mitigation obligations for wetland impacts caused by CalTrans on Highway 1 in Marin County to the Park Service in exchange for monies to purchase the Giacomini Ranch. Construction of the restoration component would affect topographic resources within a very minor portion of the Project Area (< 2 percent) and would result, on average, in changes in existing topographic contours or elevations of much less than 0.25 feet (<0.05 feet; Table 36). Because this component would involve restoring wetlands through removal of fill, the effects on topographic resources would be characterized as beneficial.

TABLE 36. TOPOGRAPHIC RESOURCES: EXTENT OF AREA WITH TOPOGRAPHIC CHANGES AND AVERAGE CHANGE IN EXISTING ELEVATION CONTOURS

This includes excavation, fill, scraping, and loose spreading of excavated soils .

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Impact Indicator					
Approximate Extent of Area with Topographic Changes	<2 %	53%	76%	90%	95%
Average Change in Existing Elevation Contours	<0.05	<0.05	<0.25	<0.25	<0.5

Geologic Hazards: In terms of geologic hazards, there would be no potential impact to public safety related to surface fault rupture, because no construction of habitable or non-habitable structures would occur under this alternative. Potential impacts to public safety relating to groundshaking and liquefaction would be negligible compared to baseline conditions despite the fact that the Project Area is rated as potentially being subject to the highest liquefaction and groundshaking rates or impacts. Based on California Geological Survey hazard maps, potential Impacts from liquefaction would be restricted to those structures and facilities constructed or operated in lowland or alluvial valley portions of the Project Area, while groundshaking impacts would extend to those structures and facilities constructed or operated along the Point Reyes Mesa terrace and along the low hill or shutter ridge on the east side of Olema Marsh.

This alternative would not involve construction of new public access structures and facilities, but there would be continued use of existing public access facilities. This alternative would have a relatively low number of public access-related structures, facilities, and attractions/uses (26) that would occur in high hazard zones, identical to baseline conditions. The total or collective number of people projected to use these structures and facilities on a daily basis would be expected to continue to be low relative to visitation rates for major destination areas or points within the Seashore and north district of the GGNRA, although numbers may climb slightly with closure of the dairy and assumption of full management of the Giacomini Ranch by the Park Service. Therefore, the low number of public access facilities and projected users, combined with the low probability of a major earthquake along the San Andreas Fault in the vicinity of the Project Area, would suggest that potential impacts from this alternative would be negligible relative to baseline conditions.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: There is only one project that would potentially have a cumulative impact should the No Action alternative be implemented. The proposed Bear Valley Creek Watershed Enhancement Project would replace undersized or otherwise hydraulically limiting stream crossing infrastructure in the middle and upper portions of the watershed. Changes in erosion or sedimentation patterns resulting from this project could have cumulative effects on topographic resources through changing sediment transport patterns in the subwatershed, patterns of deposition and erosion, leading to even further increases in marsh surface elevation. Because of the flat gradient through lower Bear Valley Creek and Olema Marsh, the Bear Valley

Creek project is unlikely to increase erosion rates. Therefore, cumulative impacts on topographic resources would be considered to be potentially adverse, though minor in intensity. Other than the Bear Valley Creek project, there are no currently proposed or reasonably foreseeable projects that would have the potential to cause cumulative impacts in the Giacomini Ranch should the No Action Alternative be implemented.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The impacts of the No Action alternative on geologic and topographic resources and geologic hazards would generally range from negligible adverse to negligible beneficial (Table 35). This alternative would result generally in either no to negligible impacts on unique geologic and topographic resources and potentially no to minor impacts on public safety associated with operation of public access structures and facilities in known hazard zones within the Project Area. While the Project Area is located in a geologically volatile area, the San Andreas Fault Zone, the probability of a major earthquake in the vicinity of the Project Area is low, and the total or collective number of people projected to use public access facilities on a daily basis is also low relative to visitation rates for other major destination areas or points within the Seashore and north district of the GGNRA.

Alternative A

Analysis: The impacts of Alternative A on geologic and topographic resources and geologic hazards would generally range from have minor adverse to minor beneficial (Table 35).

Geologic Resources and Coastal Bluff Stability: As discussed under No Action, there are no easily viewable unique geologic resources within the Project Area that would be affected by the proposed project, and the Project Area does not represent the best viewing opportunities for the fault and fault-associated features. This alternative would affect bluffs through removal of invasive vegetation, but slopes would be revegetated with native vegetation, so these activities would not develop bluffs or violate the bluff-related policies in the LCP Plan. Therefore, this alternative would have only a negligible/minor/moderate effect on coastal bluff stability.

Topographic Resources: This alternative would result in minor impacts to topographic resources. There would be varying degrees of sediment excavation and fill in the Giacomini Ranch East Pasture associated with removal of levees and other agricultural infrastructure, excavation of manure disposal areas and tidal channels, grading of creek banks, filling of drainage ditches and manure ponds, spreading of excess excavated material, creation of trails and viewing areas and platforms, and construction of a bridge. There would be no restoration or public access constructed under this alternative in the Giacomini Ranch West Pasture or Olema Marsh, with the possible exception of the possible future extension of the southern perimeter trail to Inverness Park. The possible future trail extension to Inverness Park could involve widening of the Sir Francis Drake Boulevard road berm through placement of fill by as much as 5 feet in areas, which would change existing topographic resources considerably. While approximately 53 percent of the Project Area would be affected, changes in existing topographic contours would average less than 0.25 feet (<0.05 feet; Table 36). Most of the intensive excavation and fill activities (> 1.0 foot) are concentrated within a relatively small area (~ 9 percent) of the East Pasture, with shallow redistribution (~0.1 feet – 0.25 feet) of excess excavated sediments over much larger portions of the East Pasture accounting for most of the changes to existing topographic elevation contours in the East Pasture. This redistribution or loose spreading of excavated sediment is intended to be as shallow as possible to minimize any buildup in elevations that could affect establishment of intertidal or salt marsh communities. Because restoration actions focus on restoring historic marsh conditions prior to diking, changes in topographic resources proposed under this alternative are characterized as beneficial.

Over the long term, topographic resources would continue to undergo changes in the East Pasture, because removal of levees would increase exposure to flood flows, which can alter topography through successive episodes of erosion and sediment deposition. Since the 1860s and the massive influx of sediment that extended the Lagunitas Creek delta considerably out into Tomales Bay, the dominant forces shaping the Project Area have shifted from tidal ones to fluvial or river/creek ones (KHE 2006a). This shift is evident in the absence of complex, highly sinuous tidal creek channels depicted in the 1860s map, the formation of alluvial levees, and the flood-scarred landscape of the southern portion of the East Pasture in the 1940s as documented in aerial photographs taken prior to installation of the levees. The Project Area occurs in a very

dynamic hydrologic zone at the confluence of three major creeks where topographic resources are expected to be actively reworked by storm events.

Sediment deposition can, over time, lead to an increase in vertical elevations of the floodplain that could tilt evolutionary trajectory trends towards establishment of uplands. However, within naturally dynamic systems such as estuaries, these trends are often counterbalanced by sea level rise and subsidence (either compaction- or fault-associated) that act to maintain or regenerate wetlands even within depositional environments. Predicted rates of sea level rise over the next century vary greatly, with recent estimates calling for a substantial increase, but, even using conservative estimates such as somewhere less than 3 feet, the northern two-thirds of the East Pasture would become submerged, leaving only the southern one-third above water. This dramatic change in tidal influence would, in essence, result in tidal influences once again being the dominant force shaping the southern Tomales Bay landscape, much as they did in the 1860s.

Geologic Hazards: In terms of geologic hazards, there would be a potential minor impact to public safety related to surface fault rupture, because construction of non-habitable structures within 100-300 feet of the San Andreas Fault would occur under this alternative. The southern perimeter trail proposed in the Project Area would cross Lagunitas Creek using a bridge that would be approximately 150 feet from the San Andreas Fault. In addition, connecting the East Pasture of Giacomini Ranch to the existing trail in White House Pool County Park could increase use of the White House Pool trail, and there is a very small bridge over the existing Bear Valley Creek channel that is approximately 118 feet from the fault. The Alquist Priolo Fault Zone Mapping Act strongly discourages construction of habitable structures on or within 50 feet of an active fault and requires local agencies to strictly regulate construction of any kind in fault zones. While risks associated with non-habitable structures are less than habitable ones, potential impacts to public safety can still occur if non-habitable structures are located on or near an active fault. In this case, the risk to public safety would be very minor, because the structures are non-habitable and located more than 100 feet from the fault and that the soils are alluvial and less likely to magnify the impact of any earthquake that may occur. In addition, despite the proximity of the San Andreas Fault, the probability of a large earthquake in the vicinity of the Project Area is relatively low.

Potential impacts to public safety relating to groundshaking and liquefaction would be minor despite the fact that the Project Area is rated as having the highest liquefaction and groundshaking potential. As discussed under the No Action Alternative, potential impacts from liquefaction would be restricted to those structures and facilities constructed or operated in lowland or alluvial valley portions of the Project Area, while groundshaking impacts would extend to those structures and facilities constructed or operated along the Point Reyes Mesa terrace and along the low hill or shutter ridge on the east side of Olema Marsh. This alternative would involve both construction of new public access structures and facilities, as well as continued operation and use of existing facilities. While this alternative had a high number of public access-related structures, facilities, and attractions/uses (42) that would occur in high hazard zones, the average number of people projected to collectively use all the public access facilities within the Project Area vicinity is low (<150 people daily) relative to visitation rates for other public access facilities within major destination areas or points of the Seashore and north district of the GGNRA. Therefore, the low number of users, combined with the low probability of a major earthquake along the San Andreas Fault in the vicinity of the Project Area, would suggest that potential impacts from this alternative would be minor. There would be no potential to impact to coastal bluff stability under this alternative.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The impacts of Alternative A on geologic and topographic resources and geologic hazards would generally range from have minor adverse to minor beneficial (Table 35). Alternative A would have no impacts on unique geologic resources and minor beneficial effects on topographic resources, because changes in topographic resources would involve primarily the removal of fill to restore historic marsh conditions with

the exception of the eastern perimeter trail and the possible future extension of the southern perimeter trail to Inverness Park. There would be potential minor adverse impacts on public safety related to geologic hazards associated with construction and/or operation of public access structures and facilities in known hazard zones within the Project Area. While the Project Area is located in a geologically volatile area, the San Andreas Fault Zone, the probability of a major earthquake in the vicinity of the Project Area is low, and the total or collective number of people expected to use public access resources in the Project Area vicinity is also low relative to visitation rates for other major destination areas or points within the Seashore and north district of the GGNRA.

Alternative B

Analysis: Alternative B would generally have similar impacts to Alternative A, with impacts ranging in intensity from minor adverse to minor beneficial (Table 35).

Geologic Resources, Geologic Hazards, and Coastal Bluff Stability: As discussed under Alternative A, there would be no impact to unique geologic resources, and geologic hazard and coastal bluff stability impacts would be identical to those discussed under Alternative A.

Topographic Resources: As with Alternative A, this alternative would result in minor impacts to topographic resources in both the Giacomini Ranch East and West Pastures. There would be varying degrees of sediment excavation and fill in the East and West Pastures associated with removal of levees and other agricultural infrastructure, excavation of manure disposal areas and tidal channels, grading of creek banks, filling of drainage ditches, borrow ditches and manure ponds, spreading of excess excavated material, creation of trails and viewing areas and platforms, and construction of a bridge. There would be no restoration or public access constructed under this alternative in the Olema Marsh. While approximately 76 percent of the Project Area would be affected, changes in existing topographic contours would still average less than 0.25 feet (Table 36). Most of the intensive excavation and fill activities (> 1.0 foot) are concentrated within a relatively small area (~ 9 percent) of the East Pasture and, to a much lesser degree, the West Pasture, with shallow (< 0.1 feet - 0.25 feet) redistribution of excess excavated sediment over much larger portions of the ranch accounting for most of the changes to existing topographic elevation contours. This redistribution or loose spreading of excavated sediment is intended to be as shallow as possible to minimize any buildup in elevations that could affect establishment of intertidal or salt marsh communities. One of the potential mitigation measures for flooding would involve possible construction of a levee or levees around private properties on the east side of Sir Francis Drake Boulevard in Inverness Park, specifically lower elevation properties that would be potentially more subject to flooding. This could involve placement of approximately 2-3 vertical feet of fill in existing pastures along private property boundaries. In Alternative B, both the East and West Pastures would be subject to flood flows that would alter topography through erosion and sediment deposition, as well as vulnerable to sea level rise.

Because restoration actions focus primarily on restoring historic marsh conditions prior to diking, changes in topographic resources proposed under this alternative would be characterized as beneficial. Earthmoving associated with public access would be greatly reduced under Alternative B relative to Alternative A, because the eastern perimeter trail would involve construction of a boardwalk rather than importation of fill for a culverted dirt trail. However, as part of the possible future extension of the southern perimeter trail to Inverness Park, there would still be the potential for placement of fill to widen the Sir Francis Drake Boulevard road berm by as much as 5 feet in areas, which would change existing topographic resources considerably.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative B would generally have similar impacts to Alternative A, with impacts ranging in intensity from minor adverse to minor beneficial (Table 35). Alternative B would have no impacts on unique geologic resources and minor beneficial effects on topographic resources, because changes in topographic resources would involve primarily the removal of fill to restore historic marsh conditions with the exception of the possible future extension of the southern perimeter trail to and construction of levees around lower-elevation homes on the east side of Sir Francis Drake Boulevard in Inverness Park. There would be potential minor adverse impacts on public safety related to geologic hazards associated with construction and/or operation of public access structures and facilities in known hazard zones within the Project Area. While the Project Area is located in a geologically volatile area, the San Andreas Fault Zone, the probability of a major earthquake in the vicinity of the Project Area is low, and the total or collective number of people expected to use public access resources in the Project Area vicinity is also low relative to visitation rates for other major destination areas or points within the Seashore and north district of the GGNRA. This alternative would affect bluffs through removal of invasive vegetation, but slopes would be revegetated with native vegetation, so these activities would not develop bluffs or violate the bluff-related policies in the LCP Plan.

Alternative C

Analysis: Alternative C would generally have very similar impacts to Alternative B, with a few exceptions (Table 35).

Geologic Resources, Geologic Hazards, and Coastal Bluff Stability: Similar to Alternatives A and B, Alternative C would have no impacts on unique geologic resources and negligible/minor/moderate impacts on coastal bluff stability. There would be potential minor adverse impacts on public safety related to geologic hazards associated with construction and/or operation of public access structures and facilities in known hazard zones within the Project Area.

Topographic Resources: This alternative would result in moderate impacts on topographic resources in the Giacomini Ranch East and West Pastures and Olema Marsh. There would be varying degrees of sediment excavation and fill in the Giacomini Ranch associated with removal of levees and other agricultural infrastructure, excavation of manure disposal areas and tidal channels, grading of creek banks, filling of drainage ditches, borrow ditches and manure ponds, spreading of excess excavated material, creation of trails and viewing areas and platforms, and construction of a bridge. In addition, in Olema Marsh, there would be excavation of a small berm and a more defined creek channel, as well as potentially future replacement of one or both of the Levee Road and Bear Valley Road culverts through an adaptive restoration approach.

Under this alternative, the extent of area affected by changes in existing topographic contours would increase from approximately 76 percent under Alternative B to approximately 90 percent under Alternative C (Table 36). In general, changes in existing topographic contours would remain less than 0.25 feet under Alternative C, similar to Alternatives A and B (Table 36). The extent of area affected by intensive excavation and fill (> 1.0 foot) activities would climb from approximately 9 percent under Alternative B to 16 percent of the Project Area, with shallow (< 0.1 feet - 0.25 feet) redistribution of excess excavated sediment spread over a larger portion of the ranch relative to Alternatives A and B. This redistribution or loose spreading of excavated sediment is intended to be as shallow as possible to minimize any buildup in elevations that could affect establishment of intertidal or salt marsh communities. As with Alternative B, there would still be the potential for construction of a levee or levees around lower-elevation private properties on the east side of Sir Francis Drake Boulevard in Inverness Park as a possible flood control–related mitigation measure (see Public Health and Safety – Flooding). This could involve placement of approximately 2-3 vertical feet of fill in existing pastures along private property boundaries.

Most of the increase in intensive excavation or fill under Alternative C comes from projected impacts to topography associated with excavation of the small berm near the mouth of Bear Valley Creek in Olema Marsh and possible future replacements of the culverts. The small berm at the mouth of Bear Valley Creek adjacent to Levee Road, along with culvert under Levee Road, appear to be substantially limiting drainage of Bear Valley Creek waters that flow under Bear Valley Road into Olema Marsh (KHE 2006a). Poor drainage has converted Olema Marsh into an extensive vegetated and open water pond with an essentially flat water surface slope and almost no gradient, and there is some evidence that water levels are continuing to increase over time (KHE 2006a). Under this alternative, a small berm in the marsh that strongly limits drainage of waters into Bear Valley Creek would be removed, and the Bear Valley Creek channel, which is currently choked with vegetation in Olema Marsh, would be shallowly excavated to improve the hydraulic flow gradient. In future years, should these restoration actions not appear to lead to the desired degree of restoration, the

Park Service, CSLC, and Audubon Canyon Ranch (ACR) would consider replacement of the culverts at Levee Road or Bear Valley Road or both culverts.

Because excavation and/or culvert replacement would be expected to substantially improve hydraulic connectivity of Olema Marsh and Lagunitas Creek and decrease drainage of ponded waters, water surface elevations within Olema Marsh would drop, exposing the thick layer of peat or organic rich-soils to air. Aeration of the underlying peat materials would cause rapid decomposition or breakdown of organic materials, which would start to drop the topographic surface elevation of the marsh relative to existing topographic conditions. The expected range of water surface level change would range from 4 feet with removal of the berm and shallow excavation of the channel up to 6 feet with replacement of the Levee Road culvert (KHE 2006a). Excavation of the berm and channel and replacement of the culverts would decrease permanently impounded areas in Olema Marsh from 37.4 acres to 16 to 2.2 acres (KHE 2006a), thereby leaving the remainder of the marsh vulnerable to oxidation and marsh surface subsidence. In Connecticut, a lowering of the water table by almost 3 feet following draining of ponded waters resulted in rapid decomposition and loss of peat, causing the marsh surface to drop or subside by at least 2 feet relative to its former elevation (Rozsa 1997). Marsh surface elevations are approximately 1- 2 feet higher than the culvert invert elevation, which suggests that compaction could range anywhere from 1 to 4.5 feet depending on the adaptive restoration elements implemented. The adaptive restoration approach proposed would enable changes in surface topography to occur more gradually than if all the proposed restoration elements were implemented simultaneously.

Ultimately, this change in existing topographic conditions, as with the changes in Giacomini Ranch, would be considered beneficial, because increases in water surface levels -- and potentially surface elevations through continual build-up of undecomposed peat material -- continues to drive Olema Marsh even further away from its historic condition as an intertidal marsh, with water and ground surface elevations currently precluding almost all tidal influence. More information on the hydrologic, biogeochemical, and biological effects of this change in drainage and water impoundment conditions is presented in subsequent sections of this chapter. Over the long-term, subsidence leaves the marsh more vulnerable to sea level rise, but, to some extent, the levee and culvert system would provide a buffer that might slightly reduce impacts.

Several other changes occur under Alternative C relative to Alternative B. One is that, for California red-legged frog mitigation purposes, several ponds totaling approximately 2 acres in size would be created in the adjacent Olema Creek watershed. Excavation in this area would vary and range from less than 1.0 foot to several feet in depth to create depressional features with various ponding depths. The second is that, if the Levee Road culvert was replaced through adaptive restoration, the existing bridge over the Bear Valley Creek outlet would need to be replaced with either a pedestrian causeway along Levee Road or a new bridge closer to Lagunitas Creek. As with the old bridge, the new bridge or causeway would be within approximately 125 feet of the San Andreas Fault trace.

Possible Additional Mitigation Measures: No mitigation measures are proposed.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: As was discussed under the No Action Alternative, there is at least one project that could potentially cause cumulative impacts with the proposed project. The proposed Bear Valley Creek Watershed Enhancement Project would replace undersized or otherwise hydraulically limiting stream crossing infrastructure in the middle and upper portions of the watershed. Changes in erosion or sedimentation patterns resulting from this project could have cumulative effects on topographic resources through changing sediment transport patterns in the subwatershed, patterns of deposition and erosion. Should the Bear Valley Creek project increase sediment transport to the lower reaches of Bear Valley Creek, subsidence within Olema Marsh induced by oxidation could be tempered to some degree. Because of the flat gradient through lower Bear Valley Creek and Olema Marsh, the Bear Valley Creek project is unlikely to increase erosion rates. Therefore, cumulative impacts on topographic resources under Alternative C from the Bear Valley Creek Watershed Enhancement Project would be considered to be beneficial and minor to moderate in intensity. Other than the Bear Valley Creek project, there are no currently proposed or reasonably foreseeable projects that would have the potential to cause cumulative impacts in the Giacomini Ranch should Alternative C be implemented.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in

enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Impacts under Alternative C would be generally similar to those under Alternative B, with a few exceptions. Similar to Alternatives A and B, Alternative C would have no impacts on unique geologic resources, and there would be potential minor adverse impacts on public safety related to geologic hazards associated with construction and/or operation of public access structures and facilities in known hazard zones within the Project Area. The most apparent change in Alternative C relative to Alternative B is the appreciable increase in areal extent of changes in topographic conditions, as well as the extent of area that would be subjected to more intensive excavation and fill activities (> 1.0 foot). Most of this increase would come from changes in Olema Marsh, which would subside as a result of improved hydraulic connectivity and drainage of waters afforded by the proposed restoration activities, as well as possible construction of levees to protect private property. The adaptive restoration approach proposed could result in anywhere form 0.66 to 3 feet of surface elevation lowering or subsidence from oxidation and decomposition of extensive peat material present in Olema Marsh. This alternative would affect bluffs through removal of invasive vegetation, but slopes would be revegetated with native vegetation, so these activities would not develop bluffs or violate the bluff-related policies in the LCP Plan. Therefore, this alternative would have only a negligible/minor/moderate effect on coastal bluff stability.

Alternative D

Analysis: Alternative D would generally have very similar impacts to Alternative C, except for potential impacts to public safety associated with surface fault rupture (Table 35).

Geologic Hazards: This alternative would have no potential impacts to public safety associated with geologic hazards such as surface fault rupture, because no bridge would be constructed along the southern perimeter of the Giacomini Ranch as part of the public access component. There would be no potential changes in topographic resources associated with public access, because there would be no through-trail component on the eastern perimeter or future extension of the southern perimeter trail to Inverness Park. Visitation rates could increase slightly in White House Pool County park, simply because of public interest in viewing the restoration project, but these increases would be low enough that they would probably not be detectable.

Topographic Resources: Potential impacts to existing topographic resources would still be characterized as moderate for restoration and public access components in the Giacomini Ranch East and West Pastures and Olema Marsh. The largest change in Alternative D relative to Alternative C is some limited grading in the southwestern portion of the East Pasture to bring the higher elevation areas down to intertidal elevations that would be affected by tides either daily or on higher high tides.

Under this alternative, the extent of area affected by changes in existing topographic contours would increase slightly from approximately 90 percent under Alternative C to approximately 95 percent under Alternative D (Table 36). Changes in existing topographic contours would average slightly higher than Alternative C, but still be less, on average, than 0.5 feet (Table 36). The extent of area affected by intensive excavation and fill (> 1.0 foot) activities would remain similar under Alternative D to Alternative C, because, while the areal extent of excavation would increase, the revised approach under the FEIS/EIR involves less changes to existing topographic contours with excavation depth not to exceed more than 1 foot. As with Alternatives B and C, there would still be the potential for construction of a levee or levees around lower-elevation private properties on the east side of Sir Francis Drake Boulevard in Inverness Park as a possible flood control–related mitigation measure (see Public Health and Safety – Flooding). Because restoration actions focus on removing fill and other legacies of 60 years of agricultural management, changes in topographic resources proposed under this alternative are characterized as beneficial.

Possible Additional Mitigation Measures: No additional mitigation measures would be proposed.

Effectiveness of Possible Additional Mitigation Measures: Not applicable.

Cumulative Impacts: Cumulative impacts would the same as discussed under Alternative C.

Conclusions: Alternative D would generally have very similar impacts to Alternative C, except for potential impacts to public safety associated with surface fault rupture (Table 35). Similar to Alternative C, this alternative would have no impact on unique geologic resources; negligible/minor/moderate impacts on coastal

bluff stability; beneficial moderate effects on topographic resources, and potential minor adverse impacts to public safety associated with geologic hazards such as groundshaking and liquefaction. The most substantial change in Alternative D relative to Alternative C is the removal of the bridge under the public access component, which reduces, if not eliminates, potential threats to public safety from geologic hazards such as surface fault ruptures. The other change is the excavation of the southeastern portion of the East Pasture to intertidal elevations, which causes a slight increase in areal extent and average depth of fill or excavation relative to Alternative C.

Soil Resources

Laws, Regulations, Policies, and Criteria Guiding Impact Analysis

Soils are regulated either as a unique resource or a possible source of contamination. Soils that are believed to have high value for agriculture are seen as a unique resource and are subject to the federal Farmland Protection Policy Act (FPPA). Highly publicized efforts to clean up Superfund sites and landfills over the past 30 years underscore how soils can also become a source of contamination and a hazard to public health. In general, sediment contamination is linked for regulatory purposes to water quality under Section 401 and Section 303(d) of the Clean Water Act. The San Francisco RWQCB has standards for turbidity or the amount of suspended sediment in waters, and suspended sediment often is bound to nutrients, pathogens, and contaminants such as mercury. The Basin Plan (RWQCB 1995a) requires that the suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

In addition, "controllable water quality factors shall not cause a detrimental increase in the concentrations of toxic pollutants in sediments or aquatic life" (RWQCB 1995a). Should soil contamination reach high enough levels, federal legislation such as the Resource Conservation and Recovery Act (42 U.S.C. 6901 et seq. --

1976) and Comprehensive Environmental Response, Compensation, and Liability Act (42 (U.S.C. 9601 et seq. -- 1980), also known as Superfund, are triggered, which regulate transport and disposal of hazardous waste and require clean-up of toxic areas. While not directly regulated, soils can also become a contaminant source through uptake of extremely high levels of nutrients from activities such as concentrated cattle or horse grazing or manure spreading. These nutrients can later be potentially released from soils to surface or ground waters through erosion, resuspension of bound forms back into solution, and/or release of nitrogen through volatilization to the atmosphere.

Significance criteria developed by the state and county for CEQA mainly focus on the potential for erosion or siltation through wind and water forces, the latter of which is addressed under Water Resources.

General Assumptions and Methodologies

- Impacts to Prime and Unique Farmland Resources are evaluated under the Land Use and Planning – Agricultural Land Use section.
- Potential water quality impacts in the Project Area or watershed associated with erosion of soils or flux of nutrient or contaminants from soils into overlying surface waters during and shortly after construction, as well as over the long-term, are evaluated under Water Resources – Water Quality focused impact topic.
- Changes in the quality of sediments in the Project Area associated with implementation of the proposed project are assessed separately for 1) nutrients (assumed to be a combination of nitrates, ammonium, and phosphates) and 2) contaminants (principally metals).
- Short-Term under this impact topic refers to a period of approximately 10 years.

Described below are methodologies for impact indicators related to soils resources, including any specific assumptions or details on methodologies used to develop impact thresholds (Tables 34-35).

Sediment Quality – Nutrients: While nutrient dynamics in Tomales Bay is largely driven by loading from upstream portions of the watershed, the quality of the sediment in most of the Project Area is currently affected primarily by agricultural management practices such as cattle grazing and varying degrees of manure spreading within the pastures. With restoration, these soils could be subject to erosion and transported downstream into Lagunitas Creek and the southern portion of Tomales Bay. Because there are no specific regulations regarding nutrient concentrations in sediment despite its potential to affect water quality through

erosion or release or flux of nutrients from soils into overlying waters, analysis relies on establishing a relatively broad range of impact thresholds in sediment quality conditions using baseline data collected on sediments in the Project Area (NPS, unpub. data; Table 37). Impact thresholds are based on the natural range of variability in nutrient concentrations (specifically total organic and inorganic nitrogen or TKN) observed in baseline or reference wetlands, lightly managed pastures with cattle grazing but no manure spreading, heavily managed pastures with higher levels of cattle grazing and light manure spreading, and pastures repeatedly subjected to heavy manure spreading. TKN (inorganic and organic nitrogen) was selected as the representative nutrient parameter, because TKN does not vary as widely over short time scales as do other nutrient parameters such as nitrates (J. Callaway, wetlands ecology professor, University of San Francisco, *pers. comm*.).

Changes in soil nutrient concentrations were not modeled for the proposed project, so impact thresholds are intended to provide a very rough semi-quantitative tool for assessing relative degree of impact. Projected future changes in sediment nutrient concentrations under the various alternatives are estimated using qualitative assumptions on the rate of decline in existing nutrient loads due to removal of cattle in addition to expected future nutrient loading from creek or fluvial sediment transport processes such as overbank flooding, estuarine sediment transport processes, and use of the Project Area by wildlife.

TABLE 37. SEDIMENT QUALITY - NUTRIENTS

Source: RWQCB Basin Plan Nature: Beneficial, Adverse Context: Project Area, Watershed Duration: Short-Term, Long-Term	
No Impact	There would be no change in nutrient concentrations within sediment in the Project Area.
Negligible	Estimated changes in the concentration of nutrients (i.e., TKN) within sediment would be negligible and remain within the range of natural variability in natural wetlands (± 50 percent relative to baseline concentrations).
Minor	Estimated changes in the concentration of nutrients (i.e., TKN) within sediment would be minor (± 51 -100 percent relative to baseline concentrations). For adverse impacts, change would be roughly equivalent to introducing light grazing to natural wetland.
Moderate	Estimated changes in the concentration of nutrients (i.e., TKN) within sediment would be moderate (± 101 - 200 percent relative to baseline concentrations). For adverse impacts, change would be roughly equivalent to introducing heavy grazing and manure disposal to natural wetland.
Major or Substantial	Estimated changes in the concentration of nutrients (i.e., TKN) within sediment would be major (± > 200 percent relative to baseline concentrations). For adverse impacts, change would be roughly equivalent to converting into manure disposal area.

Sediment Quality – Contaminants: Tomales Bay has not been impacted by the number of contaminants and degree of contamination as has highly urbanized watersheds such as San Francisco Bay, but it still has been affected by contamination, principally by metals. Within the Project Area and southern portion of Tomales Bay, the contaminants of concern appear largely to be mercury from the Gambonini mine in the Walker Creek watershed; lead from decades of hunting within and adjacent to the Project Area; and contaminants from possible leaching of the now-closed West Marin Landfill in the Tomasini Creek watershed directly upstream of the Project Area (Parsons and Allen 2004a). Through restoration of hydrologic connectivity, the proposed project has the potential to affect concentration and/or distribution of contaminants in the Project Area, as well as outside of the Project Area.

Impact thresholds are based on semi-quantitatively estimating the potential for change in average concentrations for any contaminants of concern identified for the Project Area and vicinity. The analysis takes into account known or estimated existing or baseline contaminant concentrations in the Project Area and immediate vicinity, including any localized "hotspots," as well as anticipated changes in the future through potential influx of contaminants from flooding and creek or fluvial sediment transport processes, as well as from estuarine sediment transport processes. Impact thresholds are based on several sediment quality guidelines that have been developed, including the Effects Range sediment quality guidelines by the National Oceanic and Atmospheric Administration.

The Effects Range sediment quality guidelines identify which concentrations of contaminants have been associated with biological effects in laboratory, field, or modeling studies. Effects Range-Low (ERL) is "rarely" associated with adverse effects, while Effects Range-Median (ERM) is "occasionally" associated with adverse effects: those above the ERM are "frequently" associated with adverse effects. Some metals are naturally high in the San Francisco Bay region due to the presence of certain minerals and ultramafic rocks such as

serpentine (Hornberger et al. 1999)with background (pre-industrialization) concentrations actually exceeding thresholds of the Effects Range guidelines (Gandesbery et al. 1999). An Ambient Sediment Criteria (ASC) has been developed for the San Francisco Bay region to reflect these regional anomalies (Gandesbery et al. 1999). The standardized percent change used in the impact threshold criteria (±80 percent) represents roughly the mean or average percent change between the different standards: 1) ASC or background/regional ambient conditions, 2) ERL, and 3) ERM concentrations for all the contaminants of concern (e.g., lead, mercury, cadmium; Table 38). Because changes in sediment contaminant concentrations were not modeled using computers, impact thresholds are intended to provide only a very rough semi-quantitative tool for assessing the relative degree of change or impact.

TABLE 38. SEDIMENT QUALITY – CONTAMINANTS

Source: RWQCB Basin Plan, RCRA Nature: Beneficial, Adverse Context: Project Area, Watershed Duration: Long-Term	
No Impact	There would be no change in contaminant concentrations within sediment in the Project Area.
Negligible	Estimated changes in the concentration of contaminants of concern within sediment would be negligible (± 80 percent relative to baseline conditions). For natural, relatively unpolluted wetlands, there would be a barely detectable change in concentrations, with concentrations remaining within the range of ambient sediment concentrations or ASC.
Minor	Estimated changes in the concentration of contaminants of concern within sediment would be minor (± 81 -160 percent relative to baseline conditions). For adverse impacts to natural, relatively unpolluted wetlands, there would be a measurable change that would increase concentrations, but levels would be maintained below the ERL.
Moderate	Estimated changes in the concentration of contaminants of concern within sediment would be moderate (± 161-240 percent relative to baseline conditions). For adverse impacts to natural, relatively unpolluted wetlands, there would be an appreciable change that would increase concentrations above the ERL, but maintain below the ERM.
Major or Substantial	Estimated changes in the concentration of contaminants of concern within sediment would be moderate (± > 240 percent relative to baseline conditions). For adverse impacts to natural, relatively unpolluted wetlands, there would be a highly striking change that would increase concentrations above the ERM.

Impact Analysis

TABLE 39. INTENSITY, NATURE, TYPE, DURATION, AND CONTEXT OF IMPACTS FOR SOIL RESOURCES

All impacts are analyzed for the Project Area and Watershed. Potential watershed effects are analyzed under Water Resources – Water Salinity and Quality.

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Impact Indicator	*Intensity, Nature, Type, Duration, and Context of Impact*				
Sediment Nutrients – Project Area Short-Term	Beneficial – Negligible	Beneficial – Negligible	Beneficial – Negligible	Adverse - Negligible	Adverse - Negligible
Long-Term	Beneficial – Minor	Beneficial – Moderate	Beneficial – Moderate	Beneficial – Moderate	Beneficial – Moderate
Sediment Nutrients – Watershed Short-Term	No Impact	Beneficial – Negligible	Beneficial – Negligible	Beneficial – Negligible	Beneficial - Negligible
Long-Term	Beneficial – Negligible/ Minor	Beneficial – Negligible/ Minor	Beneficial – Negligible/ Minor	Beneficial – Negligible/ Minor	Beneficial – Negligible/ Minor
Sediment Contaminants – Project Area	Adverse - Negligible	Adverse - Negligible	Adverse - Negligible	Adverse - Minor	Adverse - Minor
Sediment Contaminants – Watershed Short-Term	No Impact	Beneficial – Negligible	Beneficial – Negligible	Beneficial – Negligible	Beneficial - Negligible
Long-Term	Beneficial – Negligible	Beneficial – Negligible	Beneficial – Negligible	Beneficial – Negligible	Beneficial – Negligible

No Action Alternative

Analysis: The impacts of the No Action Alternative on soil resources would generally range from have negligible to minor effects on soil resources in the Project Area (Table 39). Under the No Action Alternative, levees, tidegates, and culverts in the Giacomini Ranch are not breached or removed, except for the 11-acre wetland restoration area in the northeastern corner of the East Pasture. (The Park Service is required under its existing agreement with CalTrans to restore wetlands as mitigation for impacts caused by CalTrans to aquatic habitat from a road repair on State Route 1 in Marin County in exchange for the Park Service receiving monies to purchase and restore the Giacomini Ranch.) The remainder of the levee would not be deconstructed, although there would be no levee maintenance. Under the terms of the existing purchase agreement, the Project Area will convert from a dairy in early 2007 to lands that would be largely managed as open space, although there is a potential for leased grazing for dairy heifers (young cows) or beef cattle through a separate environmental review process. When the dairy closes in 2007, most of the agricultural management practices associated with dairying will cease, including light and intensive spreading of manure; irrigation; and annual mowing.

Nutrients: Under this alternative, changes in soil nutrient conditions would be expected primarily in the Giacomini Ranch, with any change in Olema Marsh expected to remain within the range of natural variability. Over the short-term, the reduced scale of agricultural operations and management would be expected to have only negligible beneficial effects on sediment nutrient concentrations, because, while there may be some short-term fluctuations in levels of nitrates, ammonium, or phosphates, the nutrient "pool" within sediments is generally stable from year-to-year and responds slowly to change. Any changes within the first 10 years following closure of the dairy would be expected to fall within the rather large range of natural variability characteristic of sediments in wetland and agricultural areas. Olema Marsh is not grazed by cattle, so the nutrient cycle within this portion of the Project Area is affected more by nutrient loading from upstream sources and limitations on nutrient processing once nutrients have entered the marsh, with the lack of oxygen within the permanently impounded sediment hampering breakdown of organic matter and conversion to inorganic nutrients.

Over the long-term, this alternative would be expected to result in minor beneficial effects on soil nutrients in the Giacomini Ranch through the reduction in grazing intensity typically associated with beef cattle or heifer grazing and elimination of agricultural management practices such as light or heavy application of manure to pastures. Grazing dairy cattle can generate as much as 0.65 to 0.9 pounds of nitrogen in excreted waste per day depending upon the amount of time that cattle are kept in pastures (Van Horn et al. 1999 *in* (Downing 2001). Because no effort would be made to remove manure disposal areas in the Giacomini Ranch East Pasture, nutrient levels in this 13-acre area would be expected to decrease, but remain high relative to natural wetland and even to moderately grazed lands for the foreseeable future. Currently, manure disposal areas have Total Nitrogen levels that are roughly six (6) times that of the heavily grazed or managed pastures in the Giacomini Ranch (NPS, unpub. data). In general, if leased grazing were approved, nutrient concentrations within the currently more highly managed East Pasture would be expected to decrease over time, dropping slightly to levels consistent with lightly managed agricultural lands such as the West Pasture. Ambient nutrient concentrations in the East Pasture would be slightly more than double that of the West Pasture (NPS, unpub. data). Nutrient concentrations within the lightly managed West Pasture would be expected to remain stable. Nutrient concentrations, on the other hand, in sediments of Lagunitas Creek within the Project Area would be expected to drop substantially due to the elimination of cattle from Lagunitas Creek. Dairy cattle currently access the West Pasture by crossing the creek just downstream of White House Pool. Should grazing be removed entirely, the amount of reduction in sediment nutrient concentrations within the Giacomini Ranch would be expected to increase slightly over the long-term, although manure disposal areas or pastures would remain high for the foreseeable future.

Within the East Pasture, the rate of change might be highest in the 11-acre restored area in the northwestern corner of the East Pasture. This area would be restored through removing the existing levees and reestablishing a tidal connection for the now hydrologically isolated northern end of the East Pasture Old Slough. (A new levee would be constructed at the southern end of the 11-acre restoration area.) Through levee removal and hydrologic reconnection, the potential for influxes of nutrients from both fluvial/creek and tidal sources would increase exponentially, particularly during periods of flooding and extreme high tides. Natural wetlands are believed to remove as much as 50 percent of ammonium, 50 percent of Total Nitrogen, 20- 45 percent of Total Phosphates, and more than 90 percent of fecal coliform from municipal wastewaters or stormwaters or from natural waters with high concentrations of nutrients, pathogens, and contaminants (Kadlec and Knight 1996; van der Lee et al. 2004) CH2M Hill *in* Kadlec and Knight 1996). These nutrients are

uptaken by plants, stored long-term in sediment, or, for nitrogen, potentially released to the atmosphere through volatilization. Based on water quality sampling in the adjacent portion of Lagunitas Creek, the potential for substantial nutrient influxes to this relatively small portion of the Project Area would be extremely negligible.

Contaminants: Changes in sediment contaminant concentrations in the Project Area under this alternative would be expected to be extremely negligible, with the only real potential for impact in the 11-acre restored area. A sediment screening evaluation was conducted as part of baseline studies for the Project Area, with the potential contaminants of concern being lead shot from decades of hunting on the Giacomini Ranch and mercury from redistribution of contaminated sediments near the outer portion of Tomales Bay eventually into the southern portion of the watershed. The only contaminant detected in the Project Area was cadmium, which actually occurred outside the Giacomini Ranch in Tomasini Creek directly upstream of Mesa Road (Parsons and Allen 2004a). Mercury, methylated mercury, and lead were not detected in the Project Area – even, in the case of methylated mercury, with extremely low detection limits. However, mercury, in particular, continues to be a concern, because of its longevity in the environment, its propensity to be transformed in wetlands soils to an even more toxic form (methylmercury), and its ability to move within aquatic environments through frequent sediment suspension and redistribution. Studies conducted in Tomales Bay in the 1990s showed that mercury concentrations followed somewhat of a bell curve distribution, with the lowest concentrations occurring at the furthest northern and southern ends of the Bay (D. Whyte, RWQCB, *pers. comm*.).

Changes to sediment contaminants in the Project Area under this alternative would be considered to be extremely negligible, because this alternative would involve very limited levee removal for the 11-acre mitigation area, leaving the rest of the Giacomini Ranch and Olema Marsh isolated from Lagunitas Creek. In addition, there would be no change in the channel alignment or flow pattern of Tomasini Creek that would increase its influence on the Giacomini Ranch. Currently, Tomasini Creek only tops its levees and floods into the East Pasture during large flood events such as the late 2005 30-year flood event, although the creek is known to have at least one connection with the East Pasture via a culvert that allows high tide waters to flood into the shallowly flooded area that attracts moderate numbers of waterfowl and shorebirds during the winter. The potential risk for contaminant influx into the Project Area could increase over the long-term because of levee degradation and the increased connectivity between the Giacomini Ranch and potential contaminant sources in bay and creek waters. It could also increase, because of increased tidal inundation within the Project Area due to sea level rise, which appears to be increasing at a much higher rate than originally predicted based on recently published studies (Overpeck et al. 2006).

Watershed: From a watershed perspective, the No Action Alternative would have no impacts to very negligible beneficial effects on sediment nutrient and contaminant concentrations over the short-term. The levees effectively keep most, if not all, of the nutrients and contaminants present in the Giacomini Ranch on-site, while also preventing influx of nutrient and contaminants from upstream sources onto floodplains during flood events that could improve downstream water quality. Over the long-term, degradation of the levees could increase the ability of the Giacomini Ranch to improve the quality of downstream sediment resources in the southern portion of Tomales Bay by retaining many of the nutrients, contaminants, and other pollutants present in flood flows from Lagunitas, Olema, and Tomasini Creeks. This subject is discussed in more detail under Water Resources. If so, this alternative could ultimately have a negligible to minor beneficial effect on sediment nutrients and contaminants within the southern portion of the watershed.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: There is only one project that would potentially have a cumulative impact should the No Action alternative be implemented. The proposed Bear Valley Creek Watershed Enhancement Project would replace undersized or otherwise hydraulically limiting stream crossing infrastructure in the middle and upper portions of the watershed. Changes in erosion or sedimentation patterns resulting from this project could have cumulative effects on soil resources through changing sediment transport patterns in the subwatershed and patterns of deposition and erosion, leading to possible changes in levels of sediment nutrients and contaminants in both Olema Marsh and Lagunitas Creek. Changes in erosion or sedimentation patterns resulting from this project could have cumulative effects on nutrients in sediments, because nutrients

and contaminants are often bound to sediment. Because of the flat gradient through lower Bear Valley Creek and Olema Marsh, the Bear Valley Creek project is unlikely to increase erosion rates. Therefore, cumulative impacts on soil resources would be considered to be potentially adverse, though minor in intensity.

Other than the Bear Valley Creek project, there are no currently proposed or reasonably foreseeable projects that would have the potential to cause cumulative impacts in the Giacomini Ranch should the No Action Alternative be implemented. The RWQCB instituted a clean-up of the Gambonini mine that dramatically reduced the potential for additional mercury to enter Tomales Bay, but it did not address mercury that had already entered the Bay and that is being stored and redistributed in estuarine sediments. The RWQCB had also been attempting to force the owners of the West Marin Landfill in the Tomasini Creek watershed to perform some remedial clean-up that would decrease documented problems with leaching of landfill materials into the creek, but a Marin County judge dismissed the case (D. Elias, RWQCB, *pers. comm*.). Enforcement action is reportedly being pursued by another agency.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The impacts of the No Action Alternative on soil resources would range from negligible adverse to beneficial minor in the Project Area and from no impact to beneficial negligible in the watershed. The shift from a dairy to either leased grazing and/or open space lands that would occur as part of the Park Service's existing agreement with the Giacomini Trust would result in a long-term minor to moderate reduction in nutrients, because the intensity of any agricultural uses that would be approved through a separate environmental process in the future would be of a much lesser scale and intensity than the current dairy operation, The current dairy operation often disposes of manure through concentrated application in certain pastures with light application elsewhere in the East Pasture. Sediment contaminant concentrations, which appear to be very low currently (Parsons and Allen 2004a), might increase negligibly from removal of levees in the 11-acre mitigation that would be performed in the northwestern portion of the East Pasture to satisfy the Park Service's existing mitigation agreement with CalTrans. Over the long-term, levee degradation would increase both fluvial/creek and tidal influences and thereby potentially increase exposure to contaminants such as mercury that occur in the outer portion of Tomales Bay currently and that is known to actively move within watersheds through sediment resuspension and redistribution. This would be compounded by increased tidal inundation caused by sea level rise.

Alternative A

Analysis: The impacts of Alternative A on soil resources in the Project Area and watershed would generally range from negligible adverse to moderate beneficial (Table 39). Under Alternative A, the East Pasture would be restored. There would be no restoration in the West Pasture or Olema Marsh. The levees along and tidegate/culvert in the West Pasture and Tomasini Creek would be retained. In the East Pasture, restoration would involve breaching of levees in the East Pasture along Lagunitas Creek, and excavation of new tidal channels.

Nutrients: As with the No Action Alternative, changes in soil nutrient conditions would be expected primarily in the Giacomini Ranch, with any change in Olema Marsh expected to remain within the range of natural variability. Soil nutrient conditions would be expected to change in the heavily managed East Pasture, which is being actively restored, but they would also change in the more lightly managed West Pasture through passive removal related to removal of cows. Olema Marsh is not grazed by cattle, so the nutrient cycle within this portion of the Project Area is affected more by nutrient loading from upstream sources and limitations on nutrient processing once nutrients have entered the marsh. The lack of oxygen within the permanently impounded sediment hampers breakdown of organic matter and conversion to inorganic nutrients.

Over the short-term, the conversion from heavily and lightly managed agricultural operations to open space lands would be expected to have only negligible effects on sediment nutrient concentrations, because, while there may be some short-term fluctuations in levels of nitrates, ammonium, or phosphates, the nutrient "pool" within sediments is generally stable from year-to-year and responds slowly to change. Therefore, generally, any change within the first 10 years following closure of the dairy would be expected to be within the rather large range of natural variability observed in sediment in the Project Area and vicinity. There would be some immediate improvement with excavation of 1.5 to 3 feet of the soil surface within the 13-acre manure disposal area, which would be hauled off locally to fill in the manure disposal ponds near the dairy facility. As will be

discussed in greater detail under Water Resources – Hydrologic Processes, an increase in the frequency of flooding would bring new sediments that may act to effectively bury some of these high nutrient soils.

Over the long-term, this alternative would be expected to result in moderate beneficial effects on soil nutrient conditions in the Giacomini Ranch, largely because of removal of agricultural operations. Total nutrient concentrations would be expected to decrease relative to both baseline conditions of intensive agricultural management and the No Action Alternative, although the rate of change may remain roughly similar between the two alternatives. Under Alternative A, soil nutrient conditions would be expected to drop substantially over time, eventually reaching levels that are consistent with those observed in natural, undiked marsh soils. Excavation of the nutrient-laden surface soils in the manure disposal area or pasture should hasten reductions in nutrient loads to those observed in highly managed or intensively grazed areas, which can be approximately six (6) times lower than manure disposal areas in terms of Total Nitrogen (NPS, unpub. data). Nutrient concentrations in localized portions of Lagunitas Creek within the Project Area would be expected to drop substantially due to the elimination of Giacomini cattle from Lagunitas Creek, although upstream cattle influences outside of the Project Area would continue to exist. Dairy cattle from the Giacomini Ranch currently access the West Pasture by crossing the creek just downstream of White House Pool. Over time, nutrient concentrations in the East Pasture would be expected to drop to levels similar to those in the less intensively grazed and managed areas such as the West Pasture. Ambient nutrient concentrations in the East Pasture would be slightly more than double that of the West Pasture (NPS, unpub. data). Nutrient concentrations within the lightly managed West Pasture would be expected to decrease slightly.

While removal of cattle and manure would eliminate one large source of nutrients, breaching of levees and hydrologic reconnection of the East Pasture with Lagunitas Creek and Tomales Bay would introduce others -- nutrients carried by fluvial/creek and tidal waters in Lagunitas Creek. In terms of the amount of area exposed, the largest nutrient loading periods would occur during flooding and higher and extreme tide events, although intertidal areas below Mean High Water (MHW) would be exposed to nutrient influx from outside sources on a more regular basis. Water quality sampling conducted over the past four years at the upstream and downstream ends of Lagunitas Creek in the Project Area suggests that concentrations of nutrients such as nitrates within at least this section of the creek are normally moderate (mean concentrations < 1.0 mg/L and mean instantaneous loading <1 mg per second or mg/s), although instantaneous loading rates during a 2.25-year storm event in April 2006 storm climbed as high as approximately 220 mg per second (mg/s; Parsons, *in prep*.). During these types of smaller flood events, approximately 10 percent of Lagunitas Creek floodwaters, which carry sediment, nutrients, pathogens, and contaminants, could flow into the East Pasture (KHE 2006a). Natural wetlands are believed to remove as much as 50 percent of ammonium, 50 percent of Total Nitrogen, 20-45 percent of Total Phosphates, and greater than 90 percent of fecal coliforms from municipal wastewaters or stormwaters or natural waters with high nutrient, pathogen, or contaminant loads that flow onto floodplains or marshplains during flood events (Kadlec and Knight 1996, van der Lee et al. 2004, CH2M Hill *in* Kadlec and Knight 1996). Retention of nitrates in floodplains is considerably lower (~2- 3 percent) due to the fact that these nutrients are not bound to sediment and tend to be transported through floodplains unless waters are detained for a substantial amount of time (van der Lee et al. 2004).

Once deposited, these nutrients are uptaken by plants, stored long-term in sediment, or, for nitrogen, potentially released to the atmosphere as gasses through volatilization depending on soil conditions, particularly the amount of aeration or oxygen in the soils. Breaching of levees not only increases the potential for nutrient influx, but ultimately affects the fate of these newly deposited nutrients, sediments, and contaminants, as well as the rate and exact timeframe over which reductions in agriculturally-related nutrients and pathogens would occur. Nutrients are more efficiently processed in well-aerated soils than in soils that are low in oxygen due to permanent, semi-permanent, or even seasonal inundation or saturation. This is the mechanism by which wetland soils act as such efficient trappers or filters of nutrients and contaminants, with anoxic conditions often limiting processing or conversion and/or causing nutrients and contaminants to become strongly bound or “sorbed” to soils, metals, and minerals. In less frequently inundated areas such as the higher intertidal zones or upland areas, sediment-associated nutrients such as ammonium and organic nitrogen would tend to be released and rapidly converted into oxygenated forms of nitrates such as nitrates that would either be uptaken by plants or lost to the atmosphere as nitrogen gas. In more frequently inundated areas where soils remain anoxic, conversion to nitrates would be reduced, and nutrients such as ammonium would remain strongly sorbed to soils. Phosphorous follows a somewhat different trajectory than many other nutrients and contaminants, such that oxygenated soil conditions enhance retention of phosphorous. Soils where even the soil-water interface zone becomes anoxic or depleted of oxygen often release phosphorous into overlying waters. Some managed wetlands have pulses of phosphates during periods of high productivity such as the spring and summer, when oxygen in overlying waters drop to no or

very low levels at night because of high respiration or oxygen demand (Parsons and Martini-Lamb 2003). Former agricultural soils often show pulses of phosphorous in restoration situations where soils are either temporarily flooded or dried because of release of iron-bound phosphorous or conversion of organic to inorganic phosphorous, respectively (Aldous et al. 2005).

In certain areas of the Giacomini Ranch and certainly in Olema Marsh, inundation and saturation conditions have actually been exacerbated to varying degrees by the tendency of levees to impound waters. In addition, the Giacominis flood and spray irrigated most of the East Pasture during the summer, thereby prolonging the period of inundation or saturation. Without irrigation, some of the higher areas would actually become drier under undiked conditions. Based on estimates from hydraulic modeling, upland and higher intertidal elevations would represent approximately 86 percent of the West Pasture and 47 percent of the East Pasture (KHE 2006a). Therefore, breaching of levees may not only increase the potential for influx, but the potential for efflux through either more efficient processing of organic matter and inorganic nutrients or through release into overlying waters.

Contaminants: Changes in sediment contaminant concentrations under this alternative would be expected to be negligible, with the potential for change restricted to the 350-acre East Pasture. A sediment screening evaluation was conducted as part of baseline studies for the Project Area, with the potential contaminants of concern being lead shot from decades of hunting on the Giacomini Ranch and mercury from redistribution of contaminated sediments near the outer portion of Tomales Bay eventually into the southern portion of the watershed. The only contaminant detected in the Project Area was cadmium, which actually occurred outside the Giacomini Ranch in Tomasini Creek directly upstream of Mesa Road (Parsons and Allen 2004a). Mercury, methylated mercury, and lead were not detected in the Project Area – even, in the case of methylated mercury, with extremely low detection limits. However, mercury, in particular, continues to be a concern, because of its longevity in the environment, its propensity to be transformed in wetlands soils to an even more toxic form (methylmercury), and its ability to move within aquatic environments through frequent sediment suspension and redistribution. Studies conducted in Tomales Bay in the 1990s showed that mercury concentrations followed somewhat of a bell curve, with the lowest concentrations the furthest northern and southern ends of the Bay (D. Whyte, RWQCB, *pers. comm*.).

Changes to sediment contaminants under this alternative would be considered to be negligible, because potential exposure to Bay, or creek, sources of contaminants would be restricted largely to the breached East Pasture, and the risk that sediments within the East Pasture would become contaminated by mercury would appear at this time to be relatively minor. In addition, there would be no change in the channel alignment or flow pattern of Tomasini Creek that would increase its influence on the Giacomini Ranch. Currently, Tomasini Creek only tops its levees and floods into the East Pasture during large flood events such as the late 2005 30-year flood event, although the creek is known to have at least one connection with the East Pasture via a culvert that allows high tide waters to flood into the shallowly flooded area that attracts moderate numbers of waterfowl and shorebirds during the winter. The potential risk for contaminant influx into the Project Area could increase over the long-term because of increased tidal inundation within the Project Area due to sea level rise, which appears to be increasing at a much higher rate than originally predicted based on recently published studies (Overpeck et al. 2006).

Watershed: From a watershed perspective, Alternative A would have negligible to perhaps minor beneficial effects on sediment nutrient and contaminant concentrations. Over the short term, disturbance of sediments from construction activities may increase the influx of sediment-associated nutrients and contaminants to downstream waters, but as discussed earlier, removal of the levees would encourage Lagunitas Creek to overflow onto its historic East Pasture floodplains during flood events and thereby decrease the amount of nutrients, contaminants, and other pollutants that are carried downstream into the southern portion of Tomales Bay for eventual deposition into subtidal and intertidal sediments. (This subject is discussed in more detail under Water Resources.) While the magnitude of the effect of the proposed project on sediment resources in downstream portions of the watershed is hard to predict, it would be expected to remain within the relatively broad range of natural variability observed in these systems.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The impacts of Alternative A on soil resources in the Project Area and watershed would generally range from negligible adverse to moderate beneficial (Table 39). While changes in the Project Area would not be dramatic over the short-term, over the long-term, moderate reductions in nutrient concentrations within sediment of the Giacomini Ranch would be expected to be generated by the elimination of cattle and conversion to open space and potential changes in nutrient processing capabilities with breaching of levees and better drainage of soils. Hydrologic reconnection of the Giacomini Ranch to Lagunitas Creek would increase the potential for influxes of nutrient-laden waters from fluvial and tidal sources, including Lagunitas Creek. Sediment contaminant concentrations, which appear to be very low currently (Parsons and Allen 2004a), might increase negligibly from breaching of the East Pasture levees. Levee breaching and hydrologic reconnection would increase both fluvial/creek and tidal influences and thereby potentially increase exposure to contaminants such as mercury that occur in the outer portion of Tomales Bay currently and that are known to actively move within watersheds through sediment resuspension and redistribution. However, the potential risk of mercury contamination appears relatively negligible at this time based on recent sampling that showed that most of the mercury was concentrated in the outer Bay, with levels dropping off sharply towards the southern end of Tomales Bay. From a watershed perspective, this alternative would have negligible to perhaps minor beneficial effects on the quality of subtidal and intertidal sediments in Tomales Bay through a potential decrease in loading of nutrients, contaminants, and other pollutants from Lagunitas Creek due to increased connectivity of the creek with its historic floodplain on the Giacomini Ranch.

Alternative B

Analysis: Alternative B would have very similar effects to Alternative A in terms of effect on soil resource conditions in the Project Area and the watershed (Table 39). The primary differences between Alternative B and A relate to the fact that, in Alternative B, the East Pasture levees would be removed completely, and the West Pasture levees would be breached in several locations. In the East Pasture, the shift to full levee removal is expected to have relatively negligible effects on the amount and rate of reduction in soil nutrients or the potential for exposure to contaminants such as mercury. Levee breaching of the West Pasture might increase the amount and rate of nutrient reductions in soils or increase the potential for exposure to contaminants such as mercury, but the degree of change would be relatively minor, because this pasture is less intensively managed and grazed. In terms of contaminants, the West Pasture, which appeared to be relatively uncontaminated based on contaminant screening (Parsons and Allen 2004a), is already exposed to potential contaminants from sources in the bay through muted tidal flushing on Fish Hatchery Creek, which runs parallel to and is influenced to some degree by Lagunitas Creek. However, breaching of the levee along Lagunitas Creek would increase potential exposure to Bay, or creek, sources of contaminants, although the risk that sediments within the West Pasture would become contaminated by mercury would appear at this time to be relatively minor.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative B would have very similar effects to Alternative A in terms of effect on soil resources in the Project Area and the watershed (Table 39). The impacts of Alternative B would range from adverse negligible to beneficial moderate. The primary difference between Alternative B and Alternative A is that the East Pasture levee is removed completely and that the West Pasture is now included in the proposed project, with limited breaching of the levee. These changes would not be expected to have more than negligible effects on the overall amount and rates of soil nutrient reductions and the potential for exposure to

contaminants such as mercury.

Alternative C

Analysis: Alternative C would have very similar effects to Alternative B in terms of effect on soil resources in the Project Area and watershed, except for effects related to restoration of Olema Marsh and Tomasini Creek (Table 39). Under Alternative C, the East and West Pastures would be restored, along with Olema Marsh. Restoration would involve complete removal of levees in the East and West Pastures along Lagunitas Creek and excavation of even more new tidal channels. Tomasini Creek would be realigned into one of its historic alignments midway through the East Pasture. In Olema Marsh, an adaptive restoration approach would be undertaken, with initial excavation of a shallow berm and the Bear Valley Creek channel to improve hydraulic connectivity and drainage of currently impounded waters. Poor drainage has converted Olema Marsh into an extensive vegetated and open water pond with no stream gradient, and there is some evidence that water levels are continuing to increase over time (KHE 2006a). In future years, should these initial actions not appear to lead to the desired degree of restoration, the Park Service, CSLC, and Audubon Canyon Ranch (ACR) would consider replacement of the culverts at Levee Road or Bear Valley Road or both culverts.

Because excavation and/or culvert replacement would be expected to substantially improve hydraulic connectivity of Olema Marsh and Lagunitas Creek and increase drainage of ponded waters, water surface elevations within Olema Marsh would drop substantially, exposing the thick layer of peat or organic rich-soils to air. Aeration of the underlying peat materials would cause rapid decomposition or breakdown of organic materials. The expected range of water surface level change would range from as much as 4 feet with removal of the berm and shallow excavation of the channel up to 6 feet with replacement of the Levee Road culvert (KHE 2006b). The effect of these improvements in hydrologic connectivity would be eased by phasing the adaptive restoration components over time.

Nutrients: Oxidation of impounded soils, particularly peat soils or soils that were historically exposed to tidal influence, can dramatically affect nutrient conditions within soils. Rapid decomposition of peat and organic-rich mineral soils can generate a pulse in mineralization or production of inorganic nutrients, with pH often driving which nutrient forms are the most prevalent (DeLaune and Smith 1985; Anisfeld and Benoit 1997; Portnoy 1999; Sommer and Horwitz 2001; Parsons and Martini-Lamb 2003). Oxidation often results in a lowering in soil pH because of the production of humic acids and other types of acids, and these acids can shift the nutrient pathway away from nitrification or the production of nitrates from ammonium. In addition, introduction of saltwater can decrease binding of ammonium already present in soils through the higher ionic strength of saltwater relative to minerals or organic matter (Portnoy 1999). Nutrients produced through breakdown of organic matter or such as ammonium and phosphate can either remain in drained soils, or they can be flushed into overlying waters when soils are flooded again (Delaune and Smith 1985, Portnoy 1999). Often, these pulses are relatively short-lived, lasting a matter of weeks (Anisfeld and Benoit 1997, Parsons and Martini-Lamb 2003). Nutrient efflux into overlying waters may also be spatially variable, with areas exposed to tidal influence having higher rates of efflux because of cation exchange. The implications of the nutrient efflux for water quality are discussed in greater detail under Water Resources.

The pH in systems that are drained is often depressed further in saline or tidally influenced soils (pH ~ 3-4 with pH 7 considered normal) than in freshwater wetland ones (pH ~5.0), because oxidation of pyrite and other iron-sulfur compounds in tidally influenced soils leads to extensive production of additional acidic compounds (e.g., sulfuric acid and ferrous iron; Delaune and Smith 1985). The persistence of acidic conditions within soils depends to a large degree on the influx rate of waters high in carbonates such as seawater, groundwater, or streams, with acids typically quickly buffered in wetlands with some consistent source of water. The peat underlying Olema Marsh is expected to be relatively fresh or low salinity in nature, at least within surface layers, because tidal influences have been largely precluded or at least limited since construction of Levee Road in the late 1800s. However, estuarine-derived muds and peat probably underlie the peat at some unknown depth. Therefore, pHs generated by breakdown of organic matter would be expected to be closer to 5 than 3-4, and permanent Bear Valley Creek inflow, combined with persistent subsurface groundwater inflow from the Inverness Ridge, would be expected to buffer acids within a short time of being produced, although there could be some spatial variability within the marsh where lower pHs persist.

The reintroduction of tidal influence into Olema Marsh after many decades of absence may have other effects on the chemistry of its soils. An influx of sulfates, which are naturally high in ocean waters, would occur during daily tidal flows, and these sulfates would typically be reduced in the low or no oxygen environment of

wetland soils to its reduced form, sulfides. Abundant sulfides in the root zone can be toxic to plants. In many marshes, this toxicity is avoided through binding of sulfides with iron, which neutralizes its effect on plants. Tidally influenced marshes with low iron content and/or stagnant water conditions are likely to have higher sulfide concentrations within soils. Sustained high sulfide concentrations were observed in diked marshes that had been historically waterlogged with freshwater from improper drainage when seawater was reintroduced, because of the low levels of iron (Portnoy 1999). Some studies in San Francisco Bay have shown lower iron concentrations in brackish/freshwater marshes than salt marshes (Goman 2005). A sediment screening study conducted in the Project Area revealed very high concentrations of iron in all sediment samples high despite that some of the areas had been diked for decades and isolated from tidal influence. Iron is naturally high in the Tomales Bay and other San Francisco Bay watershed and is detected regularly in creek and groundwater (NMWD, unpub. data). The permanent Bear Valley Creek flow, as well as subsurface groundwater inflow from the Inverness Ridge, would be again to be expected to buffer Olema Marsh against negative of seawater reintroduction by maintaining iron concentrations in the peat, which is known to strongly bind iron (Syrovetnik and Neretnieks 2002).

Over time, subsidence would be expected to reach some kind of equilibrium with water surface levels, but while subsidence can occur relatively rapidly, the long-term effects of drainage on sediment nutrient pools and fluxes can persist for some time, with effects noted in some marshes even 10 years after marshes had been drained (Portnoy 1999). For the purposes of this evaluation, analysis of short-term effects takes into account the longer time horizons needed for resources that are typically relatively stable over time to reach post-restoration equilibrium conditions and assumed to be at least 10-15 years. During this intermediate period, a tremendous shift would be expected, at least in surficial soils, from organic nutrient forms (peat) to inorganic forms such as ammonium and phosphate, with a possible efflux of nutrients out of the soils (Portnoy 1999). For this reason, short-term effects of this alternative in Olema Marsh nutrient pools would be characterized as minor to moderate and probably, although not necessarily, adverse. From an overall project perspective, both Giacomini Ranch and Olema Marsh would be expected to experience at least negligible to minor reductions in nutrients over the short-term, with effects becoming more pronounced (moderate) for the Giacomini Ranch over the long-term. For Olema Marsh, on the other hand, the degree of change would be expected to decrease appreciably in the long-term as the marsh came into equilibrium with changed water surface level conditions. While reductions in nutrient concentrations in Giacomini Ranch soils can easily be interpreted as beneficial, in Olema Marsh, the changes in soil nutrients over the long-term are harder to characterize. However, impoundment of waters could be interpreted as having created artificially high nutrient pools in the form of inorganic nutrients (peat and organic matter), with restoration beneficial in reestablishing more natural and balanced soil nutrient concentration and processing conditions characteristic of conditions prior to diking in the late 1800s.

Contaminants: These same biogeochemical processes have implications for contaminants, as well as nutrients. Under oxidized conditions, many marsh soils will release sediment-bound contaminants into overlying waters. Oxidation in and of itself does not necessarily lead to release of metals, but oxidation combined with a sharp decrease in pH as is often observed in saline soils can encourage a “pulse” of formerly sediment-complexed metals into the water column. Studies have documented releases of a variety of metals, including silver, aluminum, cadmium, chromium, copper, iron, manganese, nickel, lead, selenium, and zinc (DeLaune and Smith 1985; Soukup and Portnoy 1986; Gambrell et al. 1991; Anisfeld and Benoit 1997). Release of contaminants such as metals appears to be higher from saline or saltwater wetland soils than freshwater wetland ones, probably because of the lower pHs often present in oxidized tidally influenced soils (pH ~3-4) than in freshwater wetland ones (~5.1; Delaune and Smith 1985). Soils high in humic acids or organic carbon also tend to bind metals (Syrovetnik and Neretnieks 2002), as well as organic contaminants such as DDT and other pesticides, as well as chlorinated benzenes.

As noted earlier, the peat underlying Olema Marsh is expected to be relatively fresh or low salinity in nature, at least within surface layers, with historic estuarine-derived muds and peat some distance below the surface due to extensive build-up of the peat during the last 100 years. The potential for a pulse in metal or organic contaminants into overlying waters following draining and oxidation of Olema Marsh soils would appear relatively minor given the relatively low probability of any historic or current exposures to organic contaminants or metals, even metals such as nickel, chromium, and valanium that are naturally high in the ultramafic or serpentine soils found in the Franciscan Formation, which is prevalent in the San Francisco Bay region, including eastern Tomales Bay (Hornberger et al. 1999) The sediment screening survey conducted in the Project Area in 2003 did show ubiquitously high levels of nickel and chromium in the Project Area, except in Fish Hatchery Creek (Parsons and Allen 2004a). The upper portions of Fish Hatchery Creek, as well as Bear Valley Creek, drain completely off the Inverness Ridge, which is dominated by granitic rock such as quartz-

diorite and granodiorite that probably contains low levels of metals relative to the Franciscan Formation (G. Kamman, KHE, *pers. comm*.).

Within the Giacomini Ranch, the potential for exposure to contaminants would increase, because Tomasini Creek would be rerouted to connect with one of its historic alignments and move through the East Pasture. During high flow events that result in scour of the channel bed upstream of the Project Area, sediment-bound contaminants that may have originated from the now-closed West Marin Landfill could be remobilized and eventually deposited within the new channel or floodplain of Tomasini Creek. Because of the increase in exposure to contaminants – or conditions that could release contaminants such as those potentially occurring in Olema Marsh – effects of Alternative C on sediment contaminant conditions within the Project Area were characterized as adverse – minor. The potential risk for contaminant influx into the Project Area could increase over the long-term because of increased tidal inundation within the Project Area due to sea level rise, which appears to be increasing at a much higher rate than originally predicted based on recently published studies (Overpeck et al. 2006).

Watershed: From a watershed perspective, Alternative C would be expected to have negligible to minor beneficial effects on sediment nutrient and contaminant concentrations. Over the short term, disturbance of sediments from construction activities may increase the influx of sediment-associated nutrients and contaminants to downstream waters, but removal of the levees would encourage Lagunitas Creek to overflow onto its historic floodplains during flood events and thereby decrease the amount of nutrients, contaminants, and other pollutants that are carried downstream into the southern portion of Tomales Bay for eventual deposition into subtidal and intertidal sediments. (This subject is discussed in more detail under Water Resources.) The magnitude of this effect is expected to be slightly greater than under Alternative A, because of the inclusion of the West Pasture and the removal of levees on Tomasini Creek, which would act to direct more of the nutrient and contaminant load carried by high flows in this subwatershed into the Project Area rather than out into the bay.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable.

Cumulative Impacts: As discussed under the No Action Alternative, there is at least one project that could potentially cause cumulative impacts with the proposed project under Alternative C-- the proposed Bear Valley Creek Watershed and Fishery Enhancement Project. Changes in erosion or sedimentation patterns resulting from this project could have cumulative effects on nutrients in sediments, because nutrients and contaminants are often bound to sediment. Depending upon the duration of the transitional phase for Olema Marsh, the Bear Valley Creek project could cause influxes of nutrients to increase temporarily, which could end up having a temporary moderate adverse cumulative impact with the proposed project if decomposition of organic matter was still generating higher than normal levels of nutrients. This impact would be expected to dissipate with time as both the upper and lower systems come into equilibrium with changed conditions, reducing cumulative effects over the long-term to very negligible or even beneficial in nature. Contaminants are less of a concern in this watershed. Overall, then, cumulative impacts on sediment nutrients and contaminants in Olema Marsh would be considered to be adverse and negligible over the long-term, with adverse moderate effects possible over the short-term due to elevated nutrient levels. The potential for this project to affect sediment nutrient and contaminants in the Giacomini Ranch is considered extremely negligible.

Other than the Bear Valley Creek project, there are no currently proposed or reasonably foreseeable projects that would have the potential to cause cumulative impacts in the Giacomini Ranch should Alternative C be implemented. The RWQCB instituted a clean-up of the Gambonini mine that dramatically reduced the potential for additional mercury to enter Tomales Bay, but it did not address mercury that had already entered the Bay and that is being stored and redistributed in estuarine sediments. The RWQCB had also been attempting to force the owners of the West Marin Landfill in the Tomasini Creek watershed to perform some remedial clean-up that would decrease documented problems with leaching of landfill materials into the creek, but a Marin County judge dismissed the case (D. Elias, RWQCB, *pers. comm*.). Enforcement action is reportedly being pursued by another agency.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative C would have very similar effects to Alternative B in terms of effect on soil resources in the Project Area and watershed, with the intensity of impacts ranging from minor adverse to beneficial moderate (Table 39). The largest differences between Alternative C and Alternative B come from the inclusion of Olema Marsh and the rerouting of Tomasini Creek into one of its historic alignments in the East Pasture. Under this alternative, hydrologic connectivity and drainage of excessively impounded waters would be improved by excavation of berms and channel flow paths and potentially replacement of culverts at Levee Road and Bear Valley Road. These restoration actions would potentially decrease water surface levels from 4 to 6 feet over time through a phased approach to adaptive restoration. Decreases in water surface levels would expose flooded peat soils to air and cause rapid compaction through accelerated rates of organic matter decomposition that would have appreciable effects on soil nutrient pools. These changes would be expected to have minor short-term adverse impacts on soil nutrient conditions, but long-term effects would be considered beneficial as nutrient levels and rates of nutrient processing began to approach conditions more characteristic of natural undiked marshes.

In addition to its effect on nutrients, oxidation of waterlogged peat and saline soils can be accompanied by decreases in pH that often result in releases of sediment-bound contaminants to overlying waters. This effect is less pronounced in freshwater wetlands (Delaune and Smith 1985), and this, combined with the naturally low levels of contaminants expected from anthropogenic sources in this subwatershed, would suggest that the risk of contaminant release from oxidation of peat soils in Olema Marsh would be negligible. A higher potential for exposure to contaminants would probably come from rerouting of Tomasini Creek into one of its historic alignments through the East Pasture, thereby increase exposure of creek channels and adjacent floodplains to potential contaminant sources in Tomasini Creek that may have originated from the now-closed West Marin Landfill.

Alternative D

Analysis: Alternative D would have the same effects on soil resources in the Project Area and watershed as Alternative C (Table 39). Under Alternative D, Tomasini Creek would be rerouted completely into one of its historic alignments, but this difference is not expected to change its potential effects on soil nutrient and contaminant levels in the Project Area or watershed.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts for Alternative D would be the same as Alternative C.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative D would have the same effects on soil resources in the Project Area and watershed as Alternative C. Under Alternative D, Tomasini Creek would be rerouted completely into one of its historic alignments, but this difference is not expected to change its potential effects on soil nutrient and contaminant levels in the Project Area or watershed.

Air Resources – Air Quality

Laws, Regulations, Policies, and Criteria Guiding Impact Analysis

The Seashore and north district of the GGNRA are classified as a Class I area under the Clean Air Act (42 USC 7401 et seq.). The Act requires land managers of Class I areas to protect air quality and related values, including visibility, plants, animals, soils, water quality, cultural and historic structures, and visitor health from the effects of air pollution.

The Clean Air Act (CAA) charges the Environmental Protection Agency (EPA) with identifying national ambient

air quality standards to protect public health and welfare. A more detailed description of laws, regulations, and policies governing air quality can be found in Chapter 3 under Air Resources. Under the Clean Air Act, standards have been set for seven pollutants: ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter less than 10 microns (PM10), very fine particulate matter less than 2.5 microns in diameter (PM2.5), and lead (Pb). The air pollutants of greatest concern in the SFBAAB are O3, CO, and PM10. A description of these pollutants and standards can be found in Chapter 3 under Air Resources and in Tables 5-6. The federal government has ceded responsibility and authority to establish more stringent air quality standards and regulations to states, which are required to develop state implementation plans (SIP) to achieve and maintain federal air quality standards. The California Air Resources Board (CARB) has set stricter ambient air quality standards than national standards (Table 6 in Chapter 3 under Air Resources). Under the 1988 California Clean Air Act, air basins were designated as attainment, non-attainment, or unclassified for the state standards. The Bay Area Air Basin is classified as a California non-attainment area for ozone and particulate matter and a federal non-attainment area for ozone (Table 6 in Chapter 3 under Air Resources).

The Bay Area Air Quality Management District (BAAQMD) is the air quality management district for the Project Area and has primary responsibility for control of air pollution. State air quality agencies and other federal agencies are required to demonstrate conformity of actions to national air quality standards or, in the case of federal agencies, applicable SIPs developed by state air quality agencies. BAAQMD has prepared SIPs to address nonattainment and maintenance issues related to the national ozone standards and the national carbon monoxide standard and is in the process of revising the ozone SIP in collaboration with the Association of Bay Area Governments and MTC. The USEPA had been expected to issue a final action on the SIP revision, the *San Francisco Bay Area Transportation Air Quality Conformity Protocol*, in spring 2007, however, on December 22, 2006, the U.S. Court of Appeals for the District of Columbia Circuit vacated USEPA's Phase new 8-hour ozone implementation rule. The USEPA is currently analyzing impacts of this decision on its regulation of ozone.

The USEPA has developed criteria and procedures for determining the conformity of federal actions to the applicable SIPs. The Transportation Conformity rule (40 CFR parts 51 and 93) and the General Conformity rule (40 CFR parts 51 and 93) apply to nonattainment areas and maintenance areas covered by an approved attainment or maintenance plan. Under either conformity rule, conformance with an applicable SIP is demonstrated by showing that expected emissions are consistent with the emissions budget for the area or air quality basin. Certain types of federal projects, including trail construction, are considered to have the potential for only *de minimis* impacts and are not required to demonstrate conformance. Federal actions cannot cause or contribute to new violations, increase the frequency or severity of any existing violation, interfere with timely attainment or maintenance of a standard, delay emission reduction milestones, or contradict the State Implementation Plan. Certain types of federal projects, including trail construction, are considered to have the potential for only *de minimis* impacts and are not required to demonstrate conformance. Therefore, all Park Service areas are required to comply with state laws on these matters regardless of the type of legal jurisdiction that applies to other activities within the Park Service unit.

Significance criteria developed by the state and county under CEQA focus on the potential for the proposed project to conflict with or obstruction of implementation of Bay Area Air Quality Plan; violate air quality standards; contribute substantially to existing or projected air quality violation for the Basin; contribute cumulatively to a net increase of any pollutant that the Bay Area Air Quality Basin is not in attainment with; expose sensitive receptors to substantial pollutant concentrations such as fumes or dust; or create objectionable odors.

General Assumptions and Methodologies

- Potential impacts to air quality from the proposed project would result primarily from construction equipment operated during the construction period and any potential increase in vehicular trips associated with visitors and residents either coming to view the restored Project Area or using public access facilities.
- BAAQMD has established thresholds of significance under CEQA for construction and project operations-related impacts. These thresholds are used as a basis for establishing impact thresholds for impact indicators related to construction and short-term/long-term project-related on air quality and are used to determine whether the proposed project would be in conformance with the Bay Area Air Quality Plan and with the General Conformity rule (40 CFR parts 51 and 93) for ozone and CO under the relevant SIPs.

Described below are methodologies for impact indicators related to air quality resources, including specific

assumptions or details on methodologies.

Air Quality-Construction-Related Impacts. The BAAQMD has established thresholds of significance under CEQA for construction impacts. According to BAAQMD, fine particulate matter (PM10) is the pollutant of greatest concern with respect to construction activities (BAAQMD 1999). (BAAQMD noted that construction equipment do emit CO and other ozone precursors such as ROG, however, these emissions are included in the emission inventory that is the basis for regional air quality plans and would not generally be expected to impede attainment or maintenance of ozone and carbon monoxide standards in the Bay Area.) BAAQMD has identified a set of feasible control measures for minimizing production of PM10 through construction activities, including Basic Measures for all construction sites and Enhanced Measures for larger construction sites (> 4 acres; BAAQMD 1999). If all of the control measures are implemented as appropriate for the size of the construction site, then BAAQMD has deemed that emissions from construction activities would be considered less than significant under CEQA.

Should control measures be not or only partially implemented, potential emissions of PM10 and other air pollutants emitted in the exhaust of construction equipment would need to be either estimated using area or gallon-based factors developed by BAAQMD (Table 8; BAAQMD 1999) or quantified based on the type and horsepower of equipment, number of days of operation or truck trips, number of control measures to be implemented, and average trip length, etc. Demolition of buildings also generates PM10 emissions, which BAAQMD notes can be estimated using the following emission factor: 0.00042 lbs PM10 per cubic feet of building volume (South Coast Air Quality Management District 1993 *in* BAAQMD 1999).

For the proposed project, impact thresholds were developed that incorporate both the potential for avoiding significant impacts through implementation of the appropriate control measures, as well as the potential for estimating air quality impacts through use of cubic yard-based estimation factors developed by BAAQMD (1999; Table 40). Park Service NEPA regulations require that impacts be analyzed within the context of a broad range of potential impact intensities (i.e., Negligible, Minor, Moderate, as well as Major or Substantial). The BAAQMD thresholds of significance are established for CEQA and, therefore, incorporate only a single threshold for those emission impacts that would be considered potentially "substantial" or "significant." To accommodate the broader context of impact evaluation in this document, thresholds of significance established by BAAQMD for project operations (see Project Operations – Carbon Monoxide and Total Emissions, Table 43 below) were divided by 3 to allow for characterization of Negligible, Minor, and Moderate, as well as Major or Substantial impacts from construction on air quality resources.

Table 46 presents the detailed results of potential estimated construction emissions from the various components of the proposed project, including restoration, public access, and Olema Marsh adaptive restoration. Based on the new anticipated construction schedule (see Chapter 2), emissions were calculated separately for each year of restoration implementation. While public access is anticipated to take two (2) years in most cases to construct, emissions are summed for total anticipated number of days, because a construction schedule has not been developed. As funding has not yet been secured, the public access component would most likely be constructed after restoration is completed. The elements of the Olema Marsh component that would be anticipated to be constructed at some point in the future as potential adaptive restoration options are also broken out from those anticipated to be potentially constructed as part of the initial restoration construction (e.g., Olema Creek frog ponds). As impact thresholds between the different pollutants were not necessarily similar, impacts are presented in Table 46, when necessary, as the range of impact intensity estimated for individual pollutants, as well as the median – or midpoint value – intensity.

Conformance with SIP ozone standards during construction is addressed through meeting BAAQMD standards for precursors that are most linked to formation of ozone at ground level – CO and ROG, with CO also independently considered a SIP maintenance pollutant in the SFAAB. Activities that do not cause levels of these pollutants to exceed BAAQMD significance thresholds are considered to be in conformance with the SIP. In addition, activities in which potentially significant or major emissions might occur, but they are mitigated to a less-than-significant or major level using approved BAAQMD mitigation measures, are also considered to be in conformance with the SIP.

TABLE 40. AIR QUALITY – ALL POLLUTANTS RELATED TO CONSTRUCTION EMISSIONS

Source: BAAQMD, Park Service Management Policies, Marin CWP
Nature: Beneficial, Adverse
Context: Local Community, Regional (Marin Coast, Bay Area Air Basin)
Duration: Construction

TABLE 40. AIR QUALITY – ALL POLLUTANTS RELATED TO CONSTRUCTION EMISSIONS

No Impact	There would be no potential for impact to air quality associated with implementation of the proposed project.
Negligible	There would be potential for impact, because implementation would involve use of construction equipment and vehicles used to transport personnel to and from the Project Area, however, impacts would be barely detectable, because: 1) all the appropriate control measures recommended by BAAQMD would be implemented; *OR* 2) estimated emissions from construction equipment would NOT exceed the following thresholds based on pounds per day: 1) PM10 (<27); 2) CO (<183); 3) ROG[1] (<27), 4) NOX (<27), and 5) SOX (<27).
Minor	There would be potential for measurable impact, because implementation would involve use of construction equipment and vehicles used to transport personnel to and from the Project Area, however, impacts would be relatively small, with estimated emissions from construction equipment falling in the following ranges based on pounds per day generated: 1) PM10 (27-53); 2) CO (183-367); 3) ROG (27-53), 4) NOX (27-53), and 5) SOX (27-53).
Moderate	There would be potential for impact, because implementation would involve use of construction equipment and vehicles used to transport personnel to and from the Project Area, and impacts would be appreciable, with estimated emissions from construction equipment falling in the following ranges based on pounds per day generated: 1) PM10 (54-80); 2) CO (368-550); 3) ROG (54-80), 4) NOX (54-80), and 5) SOX (54-80).
Major or Substantial	There would be potential for impact, because implementation would involve use of construction equipment and vehicles used to transport personnel to and from the Project Area, and impacts would be substantial or major, with estimated emissions from construction equipment exceeding the following thresholds based on pounds per day generated: 1) PM10 (>80); 2) CO (>550); 3) ROG (>80), 4) NOX (>80), and 5) SOX (>80).

Air Quality – Project-Related Impacts. The BAAQMD has also established thresholds of significance under CEQA for impacts related to project operation. The Thresholds of Significance established by BAAQMD assume that, for most of the proposed projects, motor vehicles traveling to and from the projects represent the primary source of air pollutant emissions associated with project operation (BAAQMD 1999). Project-related Thresholds of Significance have been developed for the following pollutants or combination of pollutants:

- Local Carbon Monoxide,
- Total Emissions (includes ROG, NOX, and PM10),
- Odors,
- Toxic Air Contaminants,
- Accidental Releases/Acutely Hazardous Air Emissions, and
- Cumulative Impacts.

These BAAQMD thresholds and the specific methodologies and assumptions developed for the proposed project are discussed in more detail below.

- ***The proposed project would not have any potential for Toxic Air Contaminants or Accidental Releases/Acutely Hazardous Air Emissions, so these criteria are not discussed further***.

Localized Carbon Monoxide Concentrations (BAAQMD 1999): Localized carbon monoxide concentrations should be estimated for projects in which: 1) vehicle emissions of CO would exceed 550 lb./day, 2) project traffic would impact intersections or roadway links operating at Level of Service (LOS) D, E or F **or** would cause LOS to decline to D, E or F, or 3) project traffic would increase traffic volumes on nearby roadways by 10 percent or more unless the increase in vehicle traffic volume is less than 100 vehicles per hour. A project contributing to CO concentrations exceeding the State Ambient Air Quality Standard of 9 parts per million (ppm) averaged over 8 hours and 20 ppm for 1 hour would be considered to have substantial and therefore significant impact under CEQA.

Because potential air quality impacts posed by the proposed project would largely be related to increased visitation of the restored wetland and enhanced public access opportunities, traffic volumes were used as the criterion for impact thresholds, with the BAAQMD threshold divided by 3 to establish a broader range of impact thresholds for analyzing the intensity of the impact as required by Park Service NEPA regulations (Table 42). Estimated vehicle trips was generated by projecting future maximum or peak visitation to the Project Area based on the types of public access and public access structures, facilities, and uses and/or

[1] ROG=Reactive Organic Gas

attractions under the various alternatives relative to existing visitation rates to other major visitation areas within the park. Maximum or peak visitation was divided by 1.3 to reflect the assumption that approximately 70 percent of all visitors to the Project Area would be driving alone. A more complete description of these methodologies can be found in Chapter 3 under Visitor and Resident Experience. Maximum peak visitation assumed that all maximum numbers might potentially occur on the same day to ensure that a conservative estimate of impact is generated, but it is highly unlikely that maximum peak visitation for all facilities would occur simultaneously.

TABLE 41. AIR QUALITY – CARBON MONOXIDE – PROJECT-RELATED

Source: BAAQMD, Park Service Management Policies, Marin CWP Nature: Beneficial, Adverse Context: Local Community, Regional (Marin Coast, Bay Area Air Basin) Duration: Long-Term	
No Impact	There would be no potential for impact to air quality from carbon monoxide associated with implementation of the proposed project.
Negligible	The proposed project would have negligible or barely measurable impact on air quality associated with carbon monoxide, because traffic volume on nearby roadways would NOT increase by more than 3 percent, and/or the increase would be less than 33 vehicles per hour.
Minor	The proposed project would have a small or slightly measurable impact on air quality associated with carbon monoxide, because the increase in traffic volume on nearby roadways would be greater than 3 percent, but less than 6 percent, and/or the increase would be between 33-66 vehicles per hour.
Moderate	The proposed project would have a moderate or measurable impact on air quality associated with carbon monoxide, because the increase in traffic volume on nearby roadways would be greater than 6 percent, but less than 9 percent, and/or the increase would be between 66-99 vehicles per hour.
Major or Substantial	The proposed project would have major or substantial impacts on air quality associated with carbon monoxide, because traffic volume on nearby roadways would increase by 10 percent or more, and the increase would be ≥ 100 vehicles per hour.

Total Emissions (BAAQMD 1999): Totals emissions from project operations need to be compared to the BAAQMD thresholds provided in Table 42, unless it meets some of the screening criteria identified below.

TABLE 42. BAAQMD CEQA THRESHOLDS OF SIGNIFICANCE FOR TOTAL EMISSIONS RESULTING FROM PROJECT OPERATIONS

Pollutant	ton/year	lb/day	kgm/day
ROG	15	80	36
NOX	15	80	36
PM10	15	80	36

To enable project proponents to determine whether a project may exceed the threshold of significance under CEQA for total emissions from project operations, BAAQMD has developed project screening criteria that are based on the threshold of significance for NOX (80 lbs/day). The criteria list screening thresholds for trip generation rate or size of project for various housing, retail, office, and other commercial and residential development projects. ***Generally, BAAQMD "does not recommend a detailed air quality analysis for projects generating less than 2,000 vehicle trips per day, unless warranted by the specific nature of the project or project setting***" (BAAQMD 1999). However, BAAQMD stresses that the screening criteria ***only address one threshold of significance and does not include other air quality issues such as carbon monoxide, odors, toxics, and cumulative impacts*** (BAAQMD 1999). Impact thresholds for this impact indicator are based on both the potential for the proposed project to generate less than 2,000 vehicle trips per day or on the project generating less than "substantial" or major amounts of ROG, NOX, and PM10 in pounds per day.

To establish a broad range of impact thresholds for evaluating the intensity of the impact as required Park Service NEPA regulations, projects with less than 2,000 vehicle trips per day were characterized as having negligible or minor impacts (Table 43). For moderate and major/substantial impacts, only BAAQMD total emissions criteria was used. As with other BAAQMD criteria, emissions thresholds for ROG, NOX, and PM10 were divided by 3 to develop a broader range of impact thresholds. Estimated vehicle trips was generated by projecting future maximum or peak visitation to the Project Area based on the types of public access and public access structures, facilities, and uses and/or attractions under the various alternatives relative to

existing visitation rates to other major visitation areas within the park. Maximum or peak visitation was divided by 1.3 to reflect the assumption that approximately 70 percent of all visitors to the Project Area would be driving alone. A more complete description of this methodology can be found in Chapter 3 under Visitor and Resident Experience. Maximum peak visitation assumed that all maximum numbers might potentially occur on the same day to ensure that a conservative estimate of impact is generated, but it is highly unlikely that maximum peak visitation for all facilities would occur simultaneously.

TABLE 43. AIR QUALITY – TOTAL EMISSIONS EFFECTS – PROJECT-RELATED

Source: BAAQMD, Park Service Management Policies, Marin CWP Nature: Beneficial, Adverse Context: Local Community, Regional (Marin Coast, Bay Area Air Basin) Duration: Long-Term	
No Impact	There would be no potential for impact to air quality from total emissions associated with implementation of the proposed project.
Negligible	The proposed project would have a negligible or barely measurable effect on air quality associated with total emissions, because the number of trips generated would not exceed 1,000 vehicle trips per day; *OR* estimated vehicle-generated emissions would NOT exceed the following thresholds based on pounds per day generated: 1) PM10 (<27); 2) ROG (<27), and 3) NOX (<27).
Minor	The proposed project would have a minor or small impact on air quality associated with total emissions, because the number of trips generated would not exceed 2,000 vehicle trips per day; *OR* estimated vehicle-generated emissions would fall in the following ranges based on pounds per day generated: 1) PM10 (27-53); 2) ROG (27-53), and 3) NOX (27-53).
Moderate	The proposed project would have moderate impacts on air quality associated with total emissions, with estimated vehicle-generated emissions falling in the following ranges based on pounds per day generated: 1) PM10 (54-80); 2) ROG (54-80), and 3) NOX (54-80).
Major or Substantial	The proposed project would have substantial to major impacts on air quality associated total emissions, with estimated vehicle-generated emissions exceeding the following thresholds based on pounds per day generated: 1) PM10 (>80); 2) ROG (>80), and 3) NOX (>80).

Odors (BAAQMD 1999): Under CEQA, any project with the potential to frequently expose members of the public to objectionable odors would be deemed to have a significant impact. According to BAAQMD, odor impacts on residential areas and other sensitive receptors warrant the closest scrutiny, but consideration should also be given to other land uses where people may congregate, such as recreational facilities, worksites and commercial areas. BAAQMD requires that potential odor impacts should be evaluated for both of the following situations: 1) sources of odorous emissions being located near existing receptors, and 2) receptors such as housing developments being located near existing odor sources. The proposed project would have the potential to create or increase a source of odors, primarily odors associated with wetlands.

BAAQMD recommends that certain types of operations constructed within a set distance from sensitive receptors using establishing screening level distance criteria be subject to a more detailed analysis, including contacting BAAQMD regarding potential odor complaints (BAAQMD 1999). Most of these facilities for which screening level distances have been established are operations such as wastewater treatment plants, sanitary landfills, and petroleum refineries. There are no established screening level distances for wetlands, restoration projects, or agricultural activities in the BAAQMD guidelines (BAAQMD 1999). As of 2002, there was only one large stationary source of odors in West Marin for which complaints had been received, which appeared to be associated with the now closed West Marin landfill (Illingworth & Rodkin and Nichols Berman 2002). Members of the local community have voiced objections during the scoping period and afterwards to the smell of manure emanating from the Giacomini Ranch dairy facility: any formal complaints regarding this may have been lodged with County of Marin rather than BAAQMD. BAAQMD provides no quantitative or qualitative thresholds of significance under CEQA for odors. Because odors are difficult to quantify, impact thresholds attempt to qualitatively estimate the potential impact of the proposed project on nearby sensitive receptors (Table 44).

TABLE 44. AIR QUALITY – ODORS

Source: BAAQMD, Marin CWP Nature: Beneficial, Adverse Context: Local Community Duration: Construction, Short-Term, Long-Term	
No Impact	There would be no potential for impact to air quality from odors associated with the proposed project.
Negligible	The proposed project would generate odors that would be barely detectable by sensitive receptors (e.g., adjacent residential and commercial development and park visitors).
Minor	The proposed project would generate odors that would be noticeable by sensitive receptors (e.g., adjacent residential and commercial development and park visitors), but not objectionable.
Moderate	The proposed project would generate odors that would be noticeable by sensitive receptors (e.g., adjacent residential and commercial development and park visitors) and slightly objectionable.
Major or Substantial	The proposed project would generate odors that would be major and strikingly apparent by sensitive receptors (e.g., adjacent residential and commercial development and park visitors) and moderately to highly objectionable such that a complaint is lodged with BAAQMD or the County of Marin.

Cumulative Air Quality Impacts (BAAQMD 1999): BAAQMD provides some additional guidance on evaluating cumulative air quality impacts under CEQA. Any proposed project that individually has a significant air quality impact on the Bay Area Air Basin would also be considered by BAAQMD to have a cumulatively significant air quality impact under CEQA. Those projects that do not individually have significant impacts would be considered to not cumulatively have significant impacts if the proposed project is consistent with the local general plan **and** the general plan of the regional air quality plan, in this case, the Clean Air Plan (BAAQMD 1999). The local general plan for the appropriate city or county must be consistent with the Clean Air Plan for this guideline to apply (BAAQMD 1999). The Marin CWP is consistent with the Clean Air Plan (Illingworth & Rodkin and Nichols Berman 2002).

Impact Analysis

TABLE 45. INTENSITY, NATURE, TYPE, DURATION, AND CONTEXT OF IMPACTS FOR AIR QUALITY RESOURCES

All impacts would be considered Adverse (unless otherwise noted) and Regional and are separately analyzed for Construction and Short-Term/Long-Term, with the exception of Odors, which would be considered a Local Community impact and is analyzed for Short- and Long-Term. Entries with a slash refer to range of impact intensities estimated for individual pollutants, with median boldfaced.

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Impact Indicator	Intensity, Nature, Type, Duration, and Context of Impact				
Air Pollutants – Construction Emissions	Negligible	Negligible/ Moderate (Yr 1)*	Negligible/ Minor*	Negligible/ Moderate* - Minor**	Negligible/ Moderate (Yr 1)* / Major (Yr 2)* -MInor **
NEPA: Intensity Following Mitigation					Moderate (Yr 2)*
CEQA: Significance Following Mitigation					Less than Significant (Yr 2)*
Air Pollutants – Project-Generated Carbon Monoxide Emissions	Negligible	Minor	Minor	Negligible	Negligible
Air Pollutants – Project-Generated Total Emissions	Negligible	Negligible	Negligible	Negligible	Negligible
Odors – Construction/Short-Term	Beneficial - Minor	Adverse - Negligible	Adverse - Negligible	Adverse- Moderate	Adverse- Moderate
Odors – Long-Term	Beneficial - Minor	Beneficial - Minor	Beneficial - Minor	Beneficial - Minor	Beneficial - Minor

* NOX production
** CO production

Project has been separated into construction years where a preliminary scheduling of construction activities has been conducted.

No Action			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	3,738	***Grams***	8,223.60	515,844.00	34,389.60	158,491.20	17,194.80
		Pounds	18.09	1,134.86	75.66	348.68	37.83
Construction Days	57	***Lbs/Day***	0.32	19.91	1.33	6.12	0.66
		Impact	Negligible	Negligible	Negligible	Negligible	Negligible
Alternative A - Yr 1			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	52,543	***Grams***	115,594.60	7,250,934.00	483,395.60	2,227,823.20	241,697.80
		Pounds	311.01	15,952.05	1,063.47	4,901.21	531.74
Construction Days	90	***Lbs/Day***	3.46	177.25	11.82	54.46	5.91
		Impact	Negligible	Negligible	Negligible	Moderate	Negligible
Alternative A - Yr 2			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	40,063	***Grams***	88,138.60	5,528,694.00	368,579.60	1,698,671.20	184,289.80
		Pounds	193.90	12,163.13	810.88	3,737.08	405.44
Construction Days	184	***Lbs/Day***	1.05	66.10	4.41	20.31	2.20
		Impact	Negligible	Negligible	Negligible	Negligible	Negligible
Alternative A - Public Access			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	16,833	***Grams***	37,032.60	2,322,954.00	154,863.60	713,719.20	77,431.80
		Pounds	81.47	5,110.50	340.70	1,570.18	170.35
Construction Days	270	***Lbs/Day***	0.30	18.93	1.26	5.82	0.63
		Impact	Negligible	Negligible	Negligible	Negligible	Negligible
Alternative B - Yr 1			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	46,906	***Grams***	103,193.20	6,473,028.00	431,535.20	1,988,814.40	215,767.60
		Pounds	283.73	14,240.66	949.38	4,375.39	474.69
Construction Days	90	***Lbs/Day***	3.15	158.23	10.55	48.62	5.27
		Impact	Negligible	Negligible	Negligible	Minor	Negligible
Alternative B - Yr 2			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	98,718	***Grams***	217,179.60	13,623,084.00	908,205.60	4,185,643.20	454,102.80
		Pounds	477.80	29,970.78	1,998.05	9,208.42	999.03
Construction Days	184	***Lbs/Day***	2.60	162.88	10.86	50.05	5.43
		Impact	Negligible	Negligible	Negligible	Minor	Negligible
Alternative B - Public Access			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	1,792	***Grams***	3,942.40	247,296.00	16,486.40	75,980.80	8,243.20
		Pounds	8.67	544.05	36.27	167.16	18.14
Construction Days	270	***Lbs/Day***	0.03	2.02	0.13	0.62	0.07
		Impact	Negligible	Negligible	Negligible	Negligible	Negligible
Alternative C - Yr 1			*PM10 (gm/yd3)*	*CO (gm/yd3)*	*ROG (gm/yd3)*	*NOX (gm/yd3)*	*SOX (gm/yd3)*
Earthmoving	58,222	***Grams***	128,088.40	8,034,636.00	535,642.40	2,468,612.80	267,821.20
		Pounds	338.49	17,676.20	1,178.41	5,430.95	589.21
Construction Days	90	***Lbs/Day***	3.76	196.40	13.09	60.34	6.55
		Impact	Negligible	Minor	Negligible	Moderate	Negligible
Alternative C - Yr 2			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	147,979	***Grams***	325,553.80	20,421,102.00	1,361,406.80	6,274,309.60	680,703.40
		Pounds	716.22	44,926.42	2,995.09	13,803.48	1,497.55
Construction Days	184	***Lbs/Day***	3.89	244.17	16.28	75.02	8.14
		Impact	Negligible	Minor	Negligible	Moderate	Negligible
Alternative C - Olema Marsh			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	5,142	***Grams***	11,312.40	709,596.00	47,306.40	218,020.80	23,653.20
		Pounds	24.89	1,561.11	104.07	479.65	52.04
Construction Days	75	***Lbs/Day***	0.33	20.81	1.39	6.40	0.69
		Impact	Negligible	Negligible	Negligible	Negligible	Negligible
Alternative C - Public Access			*PM10 (gm/yd3)*	*CO (gm/yd3)*	*ROG (gm/yd3)*	*NOX (gm/yd3)*	*SOX (gm/yd3)*
Earthmoving	1,235	***Grams***	2,717.00	170,430.00	11,362.00	52,364.00	5,681.00
		Pounds	5.98	374.95	25.00	115.20	12.50
Construction Days	270	***Lbs/Day***	0.02	1.39	0.09	0.43	0.05
		Impact	Negligible	Negligible	Negligible	Negligible	Negligible
Alternative D - Yr 1			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	60,757	***Grams***	133,665.40	8,384,466.00	558,964.40	2,576,096.80	279,482.20
		Pounds	350.76	18,445.83	1,229.72	5,667.41	614.86
Construction Days	90	***Lbs/Day***	3.90	204.95	13.66	62.97	6.83
		Impact	Negligible	Minor	Negligible	Moderate	Negligible
Alternative D - Yr 2			*PM10 (gm/yd3)*	*CO (gm/yd3)*	*ROG (gm/yd3)*	*NOX (gm/yd3)*	*SOX (gm/yd3)*
Earthmoving	194,426	***Grams***	427,737.20	26,830,788.00	1,788,719.20	8,243,662.40	894,359.60
		Pounds	941.02	59,027.73	3,935.18	18,136.06	1,967.59
Construction Days	214	***Lbs/Day***	4.40	275.83	18.39	84.75	9.19
		Impact	Negligible	Minor	Negligible	Major	Negligible
Alternative D - Olema Marsh			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	5,142	***Grams***	11,312.40	709,596.00	47,306.40	218,020.80	23,653.20
		Pounds	24.89	1,561.11	104.07	479.65	52.04
Construction Days	75	***Lbs/Day***	0.33	20.81	1.39	6.40	0.69
		Impact	Negligible	Negligible	Negligible	Negligible	Negligible
Alternative D - Public Access			PM10 (gm/yd3)	CO (gm/yd3)	ROG (gm/yd3)	NOX (gm/yd3)	SOX (gm/yd3)
Earthmoving	975	***Grams***	2,145.00	134,550.00	8,970.00	41,340.00	4,485.00
		Pounds	4.72	296.01	19.73	90.95	9.87
Construction Days	270	***Lbs/Day***	0.02	1.10	0.07	0.34	0.04
		Impact	Negligible	Negligible	Negligible	Negligible	Negligible

No Action Alternative

Analysis: The No Action Alternative would generally have negligible effects on air quality both during construction and after the proposed project was implemented and would be in conformance with the applicable SIPs for ozone and CO (Table 45; Table 46). Under the No Action Alternative, levees, tidegates, and culverts in the Giacomini Ranch are not breached or removed, except for the 11-acre wetland restoration area in the northeastern corner of the East Pasture. (The Park Service is required under its existing agreement with CalTrans to restore wetlands as mitigation for impacts caused by CalTrans to aquatic habitat from a road repair on State Route 1 in Marin County in exchange for the Park Service receiving monies to purchase and restore the Giacomini Ranch.) The remainder of the levee would not be deconstructed, although there would be no levee maintenance. Olema Marsh is also not restored, and there would be no construction of new public access facilities. With closure of the dairy in 2007 as specified in the Park Service's purchase agreement with the Giacomini family, agricultural management would largely be discontinued, although there would be a possibility for leased grazing through a separate environmental review process.

Emissions-Construction: The minor amount of grading that would be conducted as part of the 11-acre wetland restoration component would result in only negligible amounts of particulate matter (PM10), carbon monoxide (CO), sulfur dioxide (SOX), reactive organic gasses (ROG), and nitrogen dioxide (NOX) being generated from emissions of earthmoving equipment, with all pollutants considerably below threshold levels (Table 46). Recent monitoring by the Park Service found no exceedances for ozone at the Seashore under either the California or federal standard (Sullivan et al. 2001). In fact, visibility at the Seashore improved during the period of 1996 to 1999 primarily due to a decrease in nitrate particulates, a major component of visibility blocking material in coastal California. Particulate nitrate is formed from nitrogen oxide and hydrocarbon gases emitted into the atmosphere from fires, diesel engines, and other sources (Malm 2000).

Emissions-Project Implementation: After construction is completed, pollutant production would be limited to emissions associated with personal vehicles used by visitors and residents to access existing public access facilities; earthmoving equipment used to dredge some of the Inverness Ridge drainages to maintain hydraulic capacity for flood control purposes; and, should leased grazing be approved in the future, trucks used to haul cattle to and from the Giacomini Ranch. The post-project implementation actions would be expected to have negligible effects on carbon monoxide (CO) and other emission pollutants, with estimated hourly maximum or peak traffic volume estimated at less than the 33 vehicles-per-hour and 1,000 vehicles—per-day thresholds established for negligible. These maximum or peak volume traffic estimates represent conservative or cautious estimates that err on the side of overestimating impacts such that the maximum or peak for each of the public access facilities is assumed to occur simultaneously, which is unlikely.

Odors: In terms of odor, this alternative would have a minor beneficial effect on odors, because land use would switch from an intensively managed dairy to open space and/or leased grazing, which would be expected to have less odors in both the short- and long-term. As noted earlier, members of the local community have voiced objections during the scoping period and afterwards to the smell of manure emanating from the Giacomini Ranch dairy facility.

Conformity: The No Action Alternative would be considered to be in conformity with SIPs for ozone and CO. Emissions of ROG and CO would be negligible during both construction and project implementation.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable.

Cumulative Impacts: There are only three (3) currently proposed or reasonably foreseeable projects that would have the potential to cause cumulative impacts should the No Action alternative be implemented. These would be the proposed land exchange between the Park Service and the Giacomini family, Sir Francis Drake Boulevard Repaving Project, and the Culvert Cleaning near Olema Marsh, all of which are proposed for implementation in fall 2007. As part of the proposed land exchange, buildings would be removed from the Dairy facility: these removal efforts would generate additional emissions. It is likely that the proposed building removal would be conducted prior to implementation of restoration, however, in the event that removal efforts are delayed, the construction emissions numbers in Table 46 have been adjusted to take into account emissions generated from building removal. The County has tentatively planned to schedule the road

repaving project after hauling for the proposed project would be completed (M. Madayag, County of Marin Department of Public Works, *pers. comm*.), so it is likely that construction schedules would be staggered to some degree and not directly overlap. Should the culvert cleaning move forward in fall 2007, it is unlikely that the scale of the proposed cleaning efforts would raise cumulative emissions above the negligible level.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The No Action alternative would result generally in negligible air quality impacts from construction and project implementation and would represent a minor beneficial effect on odors in the local community with conversion from the dairy to either open space and/or leased grazing uses. It would be in conformance with the General Conformity Rule in that it would not exceed emissions thresholds established under SIPs for improvement of ozone and maintenance of CO in the Bay Area Air Basin, even with implementation of other small-scale projects in the vicinity. The only construction would be a small restoration component that is required under the Park Service's existing mitigation agreement with CalTrans, and project-related effects would be limited to vehicles and trucks associated with visitors and residents using existing public access facilities, flood control-related maintenance, and livestock transport.

Alternative A

Analysis: The effects of Alternative A on air quality would generally range from negligible to moderate during construction and negligible to minor effects after implementation and would be in conformance with the applicable SIPs for ozone and CO (Table 45, Table 46). Under Alternative A, restoration occurs in the East Pasture of the Giacomini Ranch, with construction of new public access facilities limited to the eastern and southern perimeters of the East Pasture. There are no restoration or public access components in the West Pasture or Olema Marsh, except for the potential future extension of the southern perimeter trail to Inverness Park.

Emissions-Construction: Construction activities for both restoration and public access in the East Pasture would be estimated to involve approximately more than 110,000 cubic yards of earthmoving (Table 46). Since release of the DEIS/EIR, construction schedules have changed, such that construction of the restoration component is now anticipated to take two (2) construction seasons. The first construction season would involve moving of approximately 52,550 cubic yards of earth and would be conducted during approximately a 90-day period. During this first construction season, approximately 5,000 cubic yards of building materials may be moved as part of a separate Park Service project, the land exchange (Residential Home Development; C Street, Point Reyes Station; Table 46). The second construction season would involve moving of approximately 40,100 cubic yards of earth and would be conducted during approximately a 184-day period. The public access component would be constructed after restoration is completed and is estimated to take two (2) construction seasons. It would generate approximately 17,000 cubic yards of earthmoving. In addition, there is a potential for the future trail extension to Inverness Park under this alternative, which could be constructed by either widening the Sir Francis Drake Boulevard road berm or by placing a boardwalk in the West Pasture. The former would require some earthmoving. Excavation, fill, and grading actions would result in only negligible amounts of particulate matter (PM10), reactive organic gasses (ROG), sulfur dioxide (SOX), and carbon monoxide (CO), and negligible (Year 2) to moderate (Year 1) amounts of nitrogen dioxide (NOX) being generated from emissions of earthmoving equipment. Moderate amounts of NOX generated during Year 1 would come from implementation of the more earthmoving-intensive operation such as shallow excavation of the concentrated manure disposal pasture and filling of the manure storage ponds.

Emissions-Project Implementation: After construction is completed, pollutants would be produced primarily from emissions associated with personal vehicles used by visitors and residents to access existing public access facilities and, to a much lesser extent, earthmoving equipment used to dredge some of the Inverness Ridge drainages to maintain hydraulic capacity for flood control purposes. These actions may have minor effects on carbon monoxide (CO), with estimated hourly maximum or peak traffic volumes associated less than 66 vehicles per hour. These maximum or peak volume traffic estimates represent conservative or cautious estimates that err on the side of overestimating impacts such that the maximum or peak for each of the public access facilities is assumed to occur simultaneously, which is unlikely. This alternative may have a negligible effect on Total Emissions, with maximum or peak daily vehicular traffic below 1,000 vehicles per day.

Conformity: Alternative A would be considered to be in conformity with SIPs for ozone and CO. Emissions of ROG and CO would be negligible during both construction and project implementation.

Odors: In terms of odor, this alternative would have a minor beneficial effect on odors, because land use would switch from an intensively managed dairy to open space, which would be expected to have fewer odors over the long-term. As noted earlier, members of the local community have voiced objections during and after the scoping period to the smell of manure emanating from the Giacomini Ranch Dairy facility. During construction and over the short-term, there may be a negligible adverse impact associated with disturbance of wetland and agricultural soils. At least one of the odors associated with wetlands is a "rotten egg" smell produced by hydrogen sulfides, but this is typically a localized smell that occurs when sediments are disturbed by people walking or digging in the mud. However, it is possible that, during the construction period, when wet soils are excavated, these types of odors might be magnified at least temporarily. In addition, excavation and grading related to removal of agricultural wastes such as manure may also temporarily increase agricultural odors in the Project Area vicinity.

Possible Additional Mitigation Measures: Based on the revised construction schedule, construction activities during restoration would potentially generate only negligible to at most moderate (NOX) amounts of emissions from earthmoving equipment. Therefore, mitigation would not be required, although many of the mitigation measures proposed previously in the DEIS/EIR under Alternatives A-C to reduce emissions below Major or Substantial levels would be implemented anyways because of mitigation measures proposed to reduce the impacts of noise to sensitive receptors in sensitive construction zones during construction (See Air Resources – Noise and Soundscapes). In addition, PM10 emissions would be minimized by watering down construction areas and hauling routes, where feasible, and washing tires of hauling trucks before they exit Project Area. No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: No formal mitigation measures would be proposed under this alternative.

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The effects of Alternative A on air quality during construction and after implementation would generally range from negligible to moderate. It would be in conformance with the General Conformity Rule in that it would not exceed emissions thresholds established under SIPs for improvement of ozone and maintenance of CO in the Bay Area Air Basin, even with implementation of other small-scale projects in the vicinity. Under this alternative, the East Pasture of the Giacomini Ranch would be restored, with construction of new public access facilities limited to the eastern and southern perimeter of the East Pasture. Project-related effects would involve primarily emissions from vehicles and trucks associated with visitors and residents using existing public access facilities, as well as, to a lesser degree, flood control-related maintenance. Based on the number of maximum or peak vehicles projected on an hourly or daily basis, these effects would be negligible (total emissions) to minor (carbon monoxide). This alternative would have a long-term minor beneficial effect on odors in the local community with conversion from the dairy to either open space or grazed lands, although there may be some negligible adverse effects during construction and over the short-term associated with disturbance of wetland soils and soils with high concentrations of manure.

Alternative B

Analysis: The effects of Alternative B on air quality during construction and after implementation would generally range from negligible to major or substantial and would be in conformance with the applicable SIPs for ozone and CO (Table 42; Table 46). Under Alternative B, restoration occurs in both the East and West Pastures of the Giacomini Ranch, with most of the construction of new public access facilities limited to the eastern and southern perimeters of the East Pasture.

Emissions-Construction: Construction activities for both restoration and public access would be estimated to involve more than approximately 142,000 cubic yards of earthmoving (Table 46). Since release of the DEIS/EIR, construction schedules have changed in terms of the order in which components would be

constructed during certain seasons. The first construction season would involve moving of approximately 47,000 cubic yards of earth and would be conducted during approximately a 90-day period. During this first construction season, approximately 5,000 cubic yards of building materials may be moved as part of a separate Park Service project, the land exchange (Residential Home Development; C Street, Point Reyes Station; Table 46). The second construction season would involve moving of approximately 100,000 cubic yards of earth and would be conducted during approximately a 184-day period. The public access component would be constructed after restoration is completed and is estimated to take two (2) construction seasons. It would generate approximately 1,800 cubic yards of earthmoving. In addition, there is still potential for the future trail extension to Inverness Park under this alternative, which could be constructed by either widening the Sir Francis Drake Boulevard road berm or by placing a boardwalk in the West Pasture. The former would require some earthmoving. In general, earthmoving associated with public access would be reduced under Alternative B relative to Alternative A, because the eastern perimeter trail would involve construction of a boardwalk rather than importation of fill for a culverted dirt trail.

Relative to the construction schedule proposed under the DEIS/EIR, the new construction schedule actually reduces the intensity of impacts. Excavation, fill, and grading actions would result in only negligible amounts of most emissions being generated by earthmoving equipment, although there would be the potential for minor NOX emissions. The intensity of NOX emissions would be reduced relative to Alternative A, because excavation and disposal of the concentrated manure disposal pasture soils would be conducted in Year 2 rather than Year 1, and there would be less overlap of this earthmoving-intensive element with other earthmoving activities.

Emissions-Project Implementation: Alternative B would have very similar effects to Alternative A on air quality after project implementation. The minimal amount of public access-related vehicle trips and maintenance-related use of earthmoving equipment would have only negligible effects on carbon monoxide (CO) and Total Emissions of other pollutants.

Odors: In terms of odor, this alternative would have a minor beneficial effect on odors similar to Alternative A, because land use would switch from an intensively managed dairy to open space, which would be expected to have fewer odors over the long-term.

Conformity: Alternative B would be considered to be in conformity with SIPs for ozone and CO. Emissions of ROG and CO would be negligible during both construction and project implementation.

Proposed Mitigation Measures: Based on the revised construction schedule, construction activities during restoration would potentially generate only negligible to at most minor (NOX) amounts of emissions from earthmoving equipment. Therefore, mitigation would no longer be required, although many of the mitigation measures proposed previously in the DEIS/EIR under this alternative to reduce emissions below Major or Substantial levels would be implemented anyways because of mitigation measures proposed to reduce the impacts of noise to sensitive receptors in sensitive construction zones during construction (See Air Resources – Noise and Soundscapes). In addition, PM10 emissions would be minimized by watering down construction areas and hauling routes, where feasible, and washing tires of hauling trucks before they exit Project Area.

Effectiveness of Proposed Mitigation Measures: No formal mitigation measures would be proposed under this alternative.

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The effects of Alternative B on air quality during construction and after implementation would range generally from negligible to minor (NOX). It would be in conformance with the General Conformity Rule in that it would not exceed emissions thresholds established under SIPs for improvement of ozone and maintenance of CO in the Bay Area Air Basin, even with implementation of other small-scale projects in the vicinity. Relative to the construction schedule proposed under the DEIS/EIR, the new construction schedule actually reduces the intensity of impacts. Excavation, fill, and grading actions would result in only negligible amounts of most emissions being generated by earthmoving equipment, although there would be the potential for minor NOX emissions. The intensity of NOX emissions would be reduced relative to Alternative A,

because excavation and disposal of the concentrated manure disposal pasture soils would be conducted in Year 2 rather than Year 1, and there would be less overlap of this earthmoving-intensive element with other earthmoving activities. Because of the reduction in impacts with the revised schedule, mitigation would no longer be required, although many of the mitigation measures proposed previously in the DEIS/EIR under this alternative to reduce emissions below Major or Substantial levels would be implemented anyways because of mitigation measures proposed to reduce the impacts of noise to sensitive receptors in sensitive construction zones during construction (See Air Resources – Noise and Soundscapes).

Project-related effects would involve primarily emissions from vehicles and trucks associated with visitors and residents using existing public access facilities, as well as, to a much lesser degree, flood control-related maintenance. Based on the number of maximum or peak vehicles projected on an hourly or daily basis, effects would be negligible for both carbon monoxide and total emissions. This alternative would have a long-term minor beneficial effect on odors in the local community with conversion from the dairy to either open space or grazing land, although there may be some negligible adverse effects during construction and over the short-term after implementation associated with disturbance of wetland and heavily manured soils.

Alternative C

Analysis: Alternative C would have similar, generally negligible to minor effects on air quality during construction and after implementation as Alternative B. Under Alternative C, restoration occurs in the East and West Pastures of the Giacomini Ranch and Olema Marsh. As with the other alternatives, most of the construction of new public access facilities is limited to the eastern and southern perimeters of the East Pasture, although the amount of public access on the eastern perimeter is scaled back. Because of the increase in restoration efforts, the intensity of construction-related NOX and CO emissions could increase from minor and negligible, respectively, under Alternative B to moderate and minor under Alternative C (Table 42; Table 46). Conversely, the intensity of project-related CO emissions would generally be expected to decrease from minor to negligible. However, odors during construction and over the short-term following implementation could increase under Alternative C from negligible (Alternative B) to moderate, because of restoration efforts in Olema Marsh.

Emissions-Construction: Construction activities for both restoration and public access would be estimated to involve more than approximately 220,000 cubic yards of earthmoving (Table 46). Since release of the DEIS/EIR, estimates of earthmoving and construction schedules have been refined to take into account improved designs for the Olema Marsh component, as well as changes in the order in which components would be constructed during each of the two (2) construction seasons. The first construction season would involve moving of approximately 59,000 cubic yards of earth and would be conducted during approximately a 90-day period. This season incorporates construction of Olema Creek frog ponds as part of the Olema Marsh adaptive restoration component. In addition, during this first construction season, approximately 5,000 cubic yards of building materials may be moved as part of a separate Park Service project, the land exchange (Residential Home Development; C Street, Point Reyes Station; Table 46). The second construction season would involve moving of approximately 150,000 cubic yards of earth and would be conducted during approximately a 184-day period. The public access component would be constructed after restoration is completed and is estimated to take two (2) construction seasons. It would involve approximately 1,200 cubic yards of earthmoving. In addition, there is still potential for the future trail extension to Inverness Park under this alternative, which could be constructed by either widening the Sir Francis Drake Boulevard road berm or by placing a boardwalk in the West Pasture. The former would require some earthmoving. In general, earthmoving associated with public access would be reduced under Alternative C relative to Alternative B, because there would be no through trail construction on the eastern perimeter. Most of the Olema Marsh restoration component is designed as an adaptive restoration approach and so would, therefore, be phased to occur at some point in the future after – and if – some of the initial restoration elements are implemented. Implementation of some of these future adaptive restoration elements would result in approximately 5,150 cubic yards of earthmoving.

Relative to the construction schedule proposed under the DEIS/EIR, the new construction schedule actually reduces the intensity of impacts despite the increase in earthmoving estimates. Excavation, fill, and grading actions would result in only negligible amounts of most emissions being generated by earthmoving equipment, although there would be the potential for minor CO and moderate NOX emissions during both construction years. The intensity of NOX emissions in Year 1 would increase relative to Alternative B, because of construction of the Olema Creek frog ponds and other potential Olema Marsh restoration elements.

Emissions-Project Implementation: Alternative C would have very similar effects to Alternative B on air quality after project implementation. After construction is completed, pollutants would be produced primarily from emissions associated with personal vehicles used by visitors and residents to access existing public access facilities and, to a much lesser extent, earthmoving equipment used to dredge some of the Inverness Ridge drainages to maintain hydraulic capacity for flood control purposes. These actions may have negligible effects on both carbon monoxide (CO) and emissions of other pollutants. Hourly maximum or peak volume traffic is estimated at approximately 23 vehicles per hour or approximately 230 vehicles per day, below the 33 vehicle-per-hour and 1,000 vehicle-per-day thresholds for negligible under carbon monoxide and other emissions impact indicators, respectively. These maximum or peak volume traffic estimates represent conservative or cautious estimates that err on the side of overestimating impacts such that the maximum or peak for each of the public access facilities is assumed to occur simultaneously, which is unlikely.

Odors: In terms of odor, this alternative would have a minor beneficial effect on odors over the long-term, because land use would switch from an intensively managed dairy to open space, which would be expected to have fewer odors over the long-term. Members of the local community have voiced objections during and after the scoping period to the smell of manure emanating from the Giacomini Ranch dairy facility. During construction and over the short-term, there may be a moderate adverse impact associated with disturbance of wetland and agricultural soils in Giacomini Ranch and Olema Marsh. In addition to the potential odors generated by excavation of wetland and heavily manured soils in the Giacomini Ranch discussed under Alternative A, the Olema Marsh restoration component also has the potential to generate adverse odors during construction and over the short-term after implementation, because lowering of water surface levels within the impounded marsh would cause oxidation of peat soils and breakdown of organic matter. The decaying organic matter, combined with odors generated by chemical reactions within the soil such as hydrogen sulfides, may cause noticeable and slightly objectionable odors in the vicinity of the marsh until the marsh comes into equilibrium with new water surface level conditions. Phasing of the project through adaptive restoration would help to ameliorate the severity of odor problems by staggering periods of major drainage and organic matter decomposition.

Conformity: Alternative C would be considered to be in conformity with SIPs for ozone and CO. While there would be minor emissions of CO during both construction seasons, ROG emissions would remain negligible. These emissions would not be expected to be out of conformance with SIP or to cause the Bay Area Air Basin to become out of compliance with the SIPs.

Proposed Mitigation Measures: Based on the revised construction schedule, construction activities during restoration would potentially generate only negligible to moderate (NOX) amounts of emissions from earthmoving equipment. Therefore, mitigation would no longer be required, although many of the mitigation measures proposed previously in the DEIS/EIR under this alternative to reduce emissions below Major or Substantial levels would be implemented anyways because of mitigation measures proposed to reduce the impacts of noise to sensitive receptors in sensitive construction zones during construction (See Air Resources – Noise and Soundscapes). Specifically, contractors would be required to: 1) minimize idling time to 5 minutes; 2) maintain properly tuned equipment; and 3) limit the hours of operation of heavy duty equipment or the number of pieces of equipment operating simultaneously. In addition, PM10 emissions would be minimized by watering down construction areas and hauling routes, where feasible, and washing tires of hauling trucks before they exit Project Area.

Effectiveness of Proposed Mitigation Measures: No formal mitigation measures would be proposed under this alternative.

Cumulative Impacts: Cumulative impacts would generally be the same as described under the No Action Alternative. Based on the estimated pounds of emissions generated per day under construction Year 1 (Table 46), concurrent implementation of any of the three (3) relatively small proposed or reasonably foreseeable projects discussed under the No Action Alternative would not have the potential to cumulatively contribute to an increase in NOX emissions that would exceed BAAQMD's thresholds for substantial or significant impacts, particularly as the numbers in Table 46 have been adjusted to take into account emissions generated from building removal as part of the proposed land exchange between the Park Service and the Giacomini family.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The effects of Alternative C on air quality during construction and after implementation would generally be similar to Alternative B, with the intensity of effects ranging from negligible to moderate, although CO and NOX emissions and short-term odors could increase in intensity. This alternative would be in conformance with the General Conformity Rule in that it would not exceed emissions thresholds established under SIPs for improvement of ozone and maintenance of CO in the Bay Area Air Basin, even with implementation of other small-scale projects in the vicinity. Relative to the construction schedule proposed under the DEIS/EIR, the new construction schedule actually reduces the intensity of impacts, even though estimates for the total amount of earthmoving increased relative to those generated in the DEIS/EIR. These changes resulted from refinement in earthmoving estimates, as well as for designs for the Olema Marsh restoration component. Excavation, fill, and grading actions would result in only negligible amounts of most emissions being generated by earthmoving equipment, although there would be the potential for minor CO and moderate NOX emissions during both construction years and more odor over the short-term from construction in Olema Marsh. NOX emissions during Year 1 would increase relative to Alternative B because of construction of the Olema Creek frog ponds. Because of the reduction in impacts with the revised schedule, mitigation would no longer be required, although many of the mitigation measures proposed previously in the DEIS/EIR under this alternative to reduce emissions below Major or Substantial levels would be implemented anyways because of mitigation measures proposed to reduce the impacts of noise to sensitive receptors in sensitive construction zones during construction (See Air Resources – Noise and Soundscapes).

Project-related effects would involve primarily emissions from vehicles and trucks associated with visitors and residents using existing public access facilities, as well as, to a much lesser degree, flood control-related maintenance. Based on the number of maximum or peak vehicles projected on an hourly or daily basis, effects would be negligible for both carbon monoxide and Total Emissions. This alternative would have a long-term minor beneficial effect on odors in the local community with conversion from the dairy to either open space or grazing land. However, there may be some moderate adverse effects during construction and over the short-term after implementation associated with excavation-related disturbance of wetland and heavily manured soils in the Giacomini Ranch and drainage-related decomposition of organic matter and related chemical changes of Olema Marsh soils.

Alternative D

Analysis: Alternative D would generally have similar negligible to minor effects on air quality during construction and after implementation as Alternative C, although NOX emissions could increase in intensity during the second year of construction. Under Alternative D, restoration occurs in the East and West Pastures of the Giacomini Ranch and Olema Marsh, with expanded restoration efforts in the East Pasture. As with the other alternatives, most of the construction of new public access facilities is limited to the eastern and southern perimeters of the East Pasture, although the amount of public access on the eastern and southern perimeters is scaled back considerably. Because of the increase in restoration efforts, the intensity of NOX emissions could increase from moderate under Alternative B to major or substantial under Alternative C during Year 2 of restoration implementation (Table 42; Table 46). The “substantial” amount of NOX potentially emitted, which was estimated from the amount of cubic yards of earth moved during the second year of construction, would represent a significant impact under CEQA according to BAAQMD CEQA guidelines (1999), however, these impacts would be mitigated to less-than-significant under CEQA and moderate under NEPA using mitigation measures proposed by BAAQMD (1999). With implementation of these BAAQMD-approved mitigation measures, this alternative would be expected to be in conformance with the General Conformity Rule in that it would not exceed emissions thresholds established under SIPs for improvement of ozone and maintenance of CO in the Bay Area Air Basin, even with implementation of other small-scale projects in the vicinity.

Emissions-Construction: Construction activities for both restoration and public access would be estimated to involve more than approximately 270,000 cubic yards of earthmoving (Table 46). Since release of the DEIS/EIR, estimates of earthmoving and construction schedules have been refined to take into account improved designs for the Olema Marsh component, as well as changes in the order in which components would be constructed during each of the two (2) construction seasons.

The first construction season would involve moving of approximately 61,000 cubic yards of earth and would be conducted during approximately a 90-day period. This season incorporates construction of Olema Creek frog ponds as part of the Olema Marsh adaptive restoration component. In addition, during this first construction season, approximately 5,000 cubic yards of building materials may be moved as part of a separate Park

Service project, the land exchange (Residential Home Development; C Street, Point Reyes Station; Table 46). The second construction season would involve moving of approximately 195,000 cubic yards of earth and would be conducted during approximately a 210-day period, with construction starting a month earlier than under Alternative C to enable completion of all restoration components. The public access component would be constructed after restoration is completed and is estimated to take two (2) construction seasons. It would involve approximately 1,000 cubic yards of earthmoving, including earthmoving for an ADA-compliant trail that was incorporated into this alternative in the FEIS/EIR. In addition, unlike Alternative D as proposed in the DEIS/EIR, there is still potential for the future trail extension to Inverness Park under this alternative, which could be constructed by either widening the Sir Francis Drake Boulevard road berm or by placing a boardwalk in the West Pasture. The former would require some earthmoving. In general, earthmoving associated with public access would be reduced under Alternative D relative to Alternative C, because there would be no through trail construction on the southern perimeter and only one spur trail on the eastern perimeter. Most of the Olema Marsh restoration component is designed as an adaptive restoration approach and so would, therefore, be phased to occur at some point in the future after – and if – some of the initial restoration elements are implemented. Implementation of some of these future adaptive restoration elements would result in approximately 5,150 cubic yards of earthmoving. Replacement of the Tomasini Creek culvert would also most likely occur after restoration is implemented, but would be expected to generate less than 800 cubic yards of earthmoving.

Relative to the construction schedule proposed under the DEIS/EIR for Alternative D, the new construction schedule does not greatly alter the intensity of impacts despite the increase in earthmoving estimates. Excavation, fill, and grading actions would result in only negligible amounts of most emissions being generated by earthmoving equipment, although there would be the potential for minor CO emissions during both years of construction and moderate NOX emissions during Year 1, with potentially major or substantial NOX emissions during Year 2. The intensity of NOX emissions in Year 2 increased relative to Alternative C, because of implementation of the some additional restoration elements that are proposed under Alternative D, including shallow excavation of pasture to marshplain and floodplain elevations. The "substantial" amount of NOX potentially emitted would represent a major or substantial impact and, therefore, a potentially significant impact under CEQA according to BAAQMD CEQA guidelines (1999). This impact would be mitigated would be mitigated to less than significant under CEQA and moderate under NEPA using mitigation measures recommended by BAAQMD described below.

Emissions-Project Implementation: Alternative D would have very similar effects to Alternative C on air quality after project implementation. The minimal amount of public access-related vehicle trips and maintenance-related use of earthmoving equipment would have only negligible effects on carbon monoxide (CO) and Total Emissions of other pollutants.

Odors: In terms of odor, this alternative would have identical effects to Alternative C, with a minor beneficial effect over the long-term and a moderate adverse effect potentially during construction and over the short-term due to excavation and drainage-related disturbances to wetland and heavily manured soils in the Giacomini Ranch and organic matter decomposition and related chemical changes in Olema Marsh.

Conformity: Alternative D would be considered to be in conformity with SIPs for ozone and CO. While there would be minor emissions of CO during both construction seasons, ROG emissions would remain negligible. These emissions would not be expected to be out of conformance with SIP or to cause the Bay Area Air Basin to become out of compliance with the SIPs.

Proposed Mitigation Measures: Construction activities during the second construction year would potentially generate major or substantial amounts of nitrogen dioxide (NOX) from emissions of earthmoving equipment. This would be considered a significant impact under CEQA based on BAAQMD CEQA guidelines (1999). The Park Service and CSLC propose to mitigate this impact to a less-than-significant level under CEQA and a moderate impact under NEPA through instituting the following Best Management Practices advocated by BAAQMD (1999). Specifically, contractors would be required to: 1) minimize idling time to 5 minutes; 2) maintain properly tuned equipment; and 3) limit the hours of operation of heavy duty equipment or the number of pieces of equipment operating simultaneously. In addition, PM10 emissions would be minimized by watering down construction areas and hauling routes, where feasible, and washing tires of hauling trucks before they exit Project Area.

Effectiveness of Proposed Mitigation Measures: Mitigation measures proposed by the Park Service and CSLC are ones recommended specifically by BAAQMD for mitigating impacts of pollutant emission from

earthmoving equipment during construction and would, therefore, be considered to proven, effective mitigation measures.

Cumulative Impacts: Cumulative impacts would similar to those described for Alternative C.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The effects of Alternative D on air quality during construction and after implementation would generally be very similar to Alternative C, with the intensity of effects for most air pollutants ranging from negligible to minor, although NOX emissions during Year 2 of construction could increase in intensity to major or substantial. Relative to the construction schedule proposed under the DEIS/EIR, the new construction schedule maintains a similar intensity of impacts, even though estimates for the total amount of earthmoving increased relative to those included in the DEIS/EIR. Changes in total amount of earthmoving resulted from refinement in earthmoving estimates, as well as for designs for the Olema Marsh restoration component. Excavation, fill, and grading actions would result in only negligible amounts of most emissions being generated by earthmoving equipment, although there would be the potential for minor CO emissions during both years of construction, moderate NOX emissions during Year 1 of construction, and major NOX emissions during Year 2. The intensity of NOX emissions in Year 2 increased relative to Alternative C, because of implementation of the some additional restoration elements that are proposed under Alternative D, including shallow excavation of pasture to marshplain and floodplain elevations. The "substantial" emissions of NOX would be considered a significant impact under CEQA. The Park Service and CSLC propose to mitigate this impact to a less-than-significant level through construction-related Best Management Practices (see Proposed Mitigation Measures above) recommended by BAAQMD (1999). With implementation of these BAAQMD-approved mitigation measures, this alternative would be expected to be in conformance with the General Conformity Rule in that it would not exceed emissions thresholds established under SIPs for improvement of ozone and maintenance of CO in the Bay Area Air Basin, even with implementation of other small-scale projects in the vicinity.

In terms of project implementation, the minimal amount of public access-related vehicle trips and maintenance-related use of earthmoving equipment would have only negligible effects on carbon monoxide (CO) and Total Emissions of other pollutants. This alternative would have a long-term minor beneficial effect on odors in the local community with conversion from the dairy to either open space, although there may be some moderate adverse effects during construction and the short-term associated with excavation- and drainage-related disturbance of wetland and heavily manured soils in the Giacomini Ranch and Olema Marsh.

Air Resources - Noise and Soundscapes

Laws, Regulations, Policies, and Criteria Guiding Impact Analysis

The Park Service is directed to preserve, to the greatest extent possible, the natural soundscapes of parks and to protect natural soundscapes from degradation due to noise, defined as "undesirable human-caused sound" (NPS 2006, Section 4.9). The Park Service policy is considered a more stringent standard than set by the federal Noise Control Act of 1972, which was established to promote an environment free of the noise that can jeopardize public health or welfare. A number of federal, state, and local agencies have established policies regarding the maximum amplitude or peak pressure of the sound wave, which are measured in decibels. The U.S. Department of Housing and Urban Development (HUD) established 24-hour period thresholds for noise impacts on residential projects, with 65 decibels over 24-hour period (dB-Ldn) or less considered acceptable, 66-75 dB-Ldn normally unacceptable, and 75 db-Ldn or greater as unacceptable. Ldn refers to noise averaged over a 24-hour period or the Day-Night Equivalent Sound Level. The California Department of Health Services (DHS) has published guidelines for use in developing in local general plans, which range from less than 65 dB-Ldn for low-density residential uses and conditionally acceptable levels as less than or equal to 70 dB-Ldn.

In 1994, the Marin County Noise Element mandated that residences, public spaces, and institutions not be subjected to noise levels above an average of 60 decibels (dB) over a 24-hour period or 60 dB-Ldn. Many planning agencies use a 24-hour average of noise intensity, with a 10 dB "penalty" added for nighttime noise

(10:00 p.m. to 7:00 a.m.) to account for the greater intrusiveness of loud noises during this time of the day (California Code of Regulations 1988).

The County has also developed noise criteria under its CEQA guidelines (Marin County Community Development Agency 1994). These criteria generally characterize noise impacts as significant if the project would generate noise that 1) conflicts with countywide or state noise standards; 2) substantially increases noise levels in areas of sensitive receptors; or 3) is not compatible with baseline or ambient noise levels. Sensitive noise receptors include schools, residences, child care centers, health facilities, and convalescent centers. Unlike some counties such as Napa, the County of Marin has not established separate noise criteria for construction: The County of Napa has established 75 dBA[2] as the maximum allowable sound levels during construction. However, in 2005, the County did recently expand the loud and unnecessary noise ordinance to include guidelines on acceptable hours of operation for "loud noise-generating construction-related equipment (e.g., backhoes, generators, jackhammers)" as Monday through Friday, 8 a.m. to 5 p.m., with some exceptions, including construction projects of City, County, State, other public agency, or other public utility (Marin County Board of Supervisors, Ordinance No. 3431).

General Assumptions and Methodologies

- The proposed project has the potential to impact soundscapes and noise through operation of construction equipment and haul trips to local quarries to dispose of excess excavated sediment, as well as vehicles used to transport construction personnel to and from the Project Area. Following completion of construction, noise would be generated primarily through an increase in vehicles of visitors who might come to view the restored wetland or use the public access facilities.
- Noise levels have been studied in a few areas in the vicinity of the Project Area by the County of Marin (State Route 1) and by proponents of other projects (selected areas in Point Reyes Station). Most of these are outside the Seashore and the GGNRA north district. No ambient noise levels are available for the Seashore.
- To estimate ambient noise conditions for several roads in and near the Project Area that have not been surveyed, an approach from HUD's noise assessment guidelines in its *Noise Guidebook* (HUD 2004) was used that estimates average ambient noise levels based on vehicular traffic counts.
    - Noise levels were estimated using average daily traffic data collected in traffic surveys conducted by BRW and Lee Engineering in 1998. These roads included Bear Valley Road, Sir Francis Drake Boulevard, Pierce Point Road, and State Route 1 north of Point Reyes Station.
    - While the BRW and Lee Engineering (1998) study projected that park visitation and vehicle trips would climb 1 percent annually through 2010, park visitation has dropped overall since 1998 and, in 2005, was 27 percent lower than BRW and Lee Engineering projections. Therefore, these numbers could slightly overestimate ambient noise conditions on roads, although they do not take into account ancillary sources (e.g., construction at adjacent houses, etc.) that contribute to ambient noise levels along road corridors.
- For this analysis, the maximum threshold for ambient noise conditions is established as 60 dB–Ldn or 60 dBA over a 24-hour period, which is mandated by county ordinance. There may be noises during the daytime that exceed 60 dBA, which reflects the fact that the Project Area is bordered by several heavily traveled roads, including Sir Francis Drake Boulevard, Levee Road, Bear Valley Road, and State Route 1. However, noise levels are averaged over a 24-hour period, with nighttime noise conditions projected to average 45 dBA, so there can be temporary periods in which noises reach as high as 75 dBA without violating county ordinance.
- Sensitive receptors in the Project Area are represented almost exclusively by residences (Figure 40). The closest residences to the Project Area are three homes along Sir Francis Drake Boulevard in Inverness Park, which are contiguous with and at roughly the same elevation as the West Pasture of the Giacomini Ranch. There are approximately 12 parcels on Levee Road, which are across Lagunitas Creek from the southern portion of the East Pasture of the Giacomini Ranch, are also at roughly the same elevation as the pastures. The nearest sensitive receptors are a childcare center at the Dance Palace and a senior housing project on Mesa Road in Point Reyes Station, approximately 800 to 400 feet, respectively, away from the Project Area.

Described below are methodologies for impact thresholds related to soundscape and noise resources, including specific assumptions or details on methodologies.

[2] dBA=decibels adjusted or decibels as measured on a frequency range similar to the human ear (1 kHz to 4 kHz).

Noise and Soundscapes – Construction-Related: The impact thresholds for construction-related noise are based on thresholds established by the county and CEQA guidelines, which discourages exposure to noise levels that would exceed county ordinances and other federal and state laws and policies, as well as noise that would result in a substantial increase in temporary and periodic noise exceeding ambient noise levels (Table 47). The County of Marin has established 24-hour noise thresholds of 60 dB-Ldn associated with operation of a completed project, but it has not established specific thresholds for construction. It should be noted that the 24-hour noise threshold for agricultural and industrial areas is 70dB-Ldn. The threshold established by Marin CWP of 60dB-Ldn pertains to a 24-hour average noise level, including the assignment of a 10dB penalty for noise occurring at night between 10 p.m. and 7 a.m. The noise associated with construction is different from operational noises, because it is louder, but usually short-term or more intermittent and does not occur in the evening or nighttime hours. While the Counties of Napa and Solano have established thresholds of 75 dBA on construction activities at 50 feet, Marin County does not have a construction noise ordinance.

The existing use of the Project Area is an agricultural operation. Proposed actions will return the area to a more natural condition, but for the purpose of this analysis, the construction activities will be considered consistent with the agricultural 24-hour threshold of 70 dB-Ldn. Noise surveys have shown that maximum levels for temporary and periodic noise often exceed 75 dBA in towns such as Point Reyes Station, reaching as high as 87 dBA (EDAW Inc. 2001). The hours of construction for the proposed project within sensitive receptor zones would be 7am to 6pm during weekdays. Any work exceeding these hours or occurring on the weekends within sensitive receptor zones would be short-term and would require approval by the Park Service, CSLC, and possibly the county. The absence of project-related construction noise during the evening and night hours means that noise during night hours would not exceed low-level ambient or background conditions for town and rural areas (~45 dBA). Therefore, construction-related noise that does not exceed 75 dBA during the hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, would meet the 24-hour noise thresholds of 60 dB-Ldn established by the County of Marin.

Impact thresholds for the construction period, then, incorporate a range of potential construction-related changes to ambient noise conditions, with levels exceeding 75dBA considered major under NEPA and substantial and significant under CEQA. CalTrans and the Federal Highway Administration have published criteria relating to the intensity of impacts from changes in ambient noise levels. According to these guidances, increases in ambient noise conditions of 5 dBA is considered "possibly significant," and increases of 6 – 10 dBA in urban areas and ≥ 10 dBA in rural areas -- or exceedances of local noise ordinances -- are considered generally significant under CEQA. Changes in ambient noise of less than 3 dBA are assumed to be negligible due to the fact that human ear can barely detect changes of this magnitude.

Noise produced by construction equipment depends upon a number of variables. These variables include: 1) the type of equipment (e.g., excavator, jackhammer, bulldozer, sheet pile driver, dump truck, etc.), 2) period of operation of equipment, 3) number of pieces of equipment operated simultaneously, 4) distance from the receiver to construction equipment, and 5) effects of topography and other factors (e.g., sound walls, wind direction, thick, dense vegetation) on noise propagation or attenuation. The number of pieces of construction equipment operating simultaneously can vary considerably during the construction period, but it can be assumed that several pieces of equipment might be operating simultaneously. Based on the conceptual design approach, it is anticipated that anywhere from one to four pieces of construction equipment would be operating on specific construction tasks during each construction year or years (2007 or 2007 and 2008) depending on the particular alternative. Construction noise can also include multiple haul trips made by dump trucks or trucks used to either bring construction materials to the Project Area or to transport materials such as excavated sediment to disposal locations, which can increase noise along roadway corridors.

For the purposes of this analysis, the maximum number of potential pieces of construction equipment, including 3 dump trucks, will be assumed to be operating simultaneously to provide a conservative or cautious estimate of impact, although it is unlikely that all equipment would be operating simultaneously. The number of necessary construction personnel will also be estimated, with a person-to-vehicle ratio of 1.3 assumed. Changes in noise levels generated by dump trucks and construction personnel vehicles along roadway corridors were estimated using HUD noise assessment guidelines (HUD 2004) that estimate average 24-hour noise conditions from average daily traffic volume. Under most alternatives, construction activities would be concentrated to some degree in focal areas (Figure 40). Noise generated by maximum number of simultaneously operating construction equipment in these construction focus areas will be evaluated relative to the distance to the nearest sensitive receptors, which are almost exclusively private residences. Scaling factors used to adjust noise emissions from equipment will be attenuation of noise with distance, with noise produced by construction equipment expected to decrease about 6 dB for every doubling of distance. In

Figure 40

addition, noise barriers, which can include embankments, walls, and thick, dense vegetation at least 100 feet in width (Federal Highway Administration 2001) also attenuate sound.

TABLE 47. NOISE AND SOUNDSCAPES – CONSTRUCTION-RELATED EFFECTS

Source: Park Service Management Policies, HUD, Marin CWP Nature: Beneficial, Adverse Context: Local Community Duration: Construction	
No Impact	There would be no potential for impact to noise and soundscape resources associated with construction of the proposed project.
Negligible	The proposed project would generate construction-related noise that would be barely detectable (change of ≤ 3 dBA) by sensitive receptors from existing conditions (adjacent residences) and within the range of ambient or background noise conditions.
Minor	The proposed project would generate construction-related noise that would have a minor effect on ambient noise levels (change of ≤ 5 dBA) and would be detectable by sensitive receptors beyond existing conditions (adjacent residences). Maximum noise levels during construction would not exceed 75 dBA as perceived by the nearest sensitive receptor.
Moderate	The proposed project would generate construction-related noise that would have a moderate effect on ambient noise levels (change of ≤ 10 dBA) and be apparent and appreciable to sensitive receptors beyond existing conditions (adjacent residences). Maximum noise levels during construction may exceed 75 dBA as perceived by the nearest sensitive receptor for short periods of time, without construction noise mitigation measures.
Major or Substantial	The proposed project would generate construction-related noise that would have a substantial effect on ambient noise levels (change of > 9 dBA) and highly apparent to sensitive receptors beyond existing conditions (adjacent residences). Maximum noise generated during construction would potentially exceed 75 dBA as perceived by the nearest sensitive receptor.

Noise and Soundscapes – Project-Related: Impacts to noise and soundscapes from implementation or operation of the proposed project would result primarily from the potential increase in the number of visitors, residents, and vehicles coming to view the restored wetland or use the public access facilities. Estimates of the change in visitors and vehicles within the Project Area are based on projected increases in overall park visitation in the future, as well as on evaluation of the number of public access-related structures, facilities, and attractions/uses provided by each of the various alternatives. These semi-quantitative ranking systems are discussed in greater detail under Chapter 3.

To qualitatively or semi-quantitatively estimate noise generated by visitors, residents, and vehicles, the estimated maximum number/range of visitors and residents and associated vehicles that would visit or use each of the facilities in the Project Area was used as the basis for analysis. It would be expected that the highest visitation would occur on weekends, when visitation to the local community and parks are naturally highest. The evaluation also assumed that peak visitation would occur simultaneously on weekends for all of the public access facilities proposed under the various alternatives. Approximately 70 percent of the visitors were assumed to be driving alone, while the other 30 percent were assumed to be paired in vehicles. In addition to vehicle noise, visitors would generate additional noise through conversation: people talking normally generate noise levels in the range of approximately 50 to 70 dB, with normal conversation in the range of 60 – 65 dB. However, for the purposes of this analysis, the relative contribution of conversation to changes in ambient noise levels was considered negligible. This approach was considered to provide a conservative or cautious estimate of impacts such that it would err on the side of over-estimating the total number of people and vehicles that might be present at any one time.

The impact thresholds for project-related noise were based on thresholds established by the county and CEQA guidelines, which discourage exposure to noise levels that would exceed county ordinances and other federal and state laws and policies, as well as noise that would ***substantially*** and permanently increase ambient noise levels above existing levels (Table 48). CalTrans and the Federal Highway Administration have published criteria relating to the intensity of impacts from changes in ambient noise levels. According to these guidances, increases in ambient noise conditions of 5 dBA is considered "possibly significant," and increases of 6 – 10 dBA in urban areas and ≥ 10 dBA in rural areas -- or exceedances of local noise ordinances -- are considered generally significant under CEQA. In addition, changes in ambient noise conditions that would increase noise levels above 60 dB-Ldn, the threshold established by the County, would be considered major under NEPA and substantial and significant under CEQA. Based on a night-time average ambient noise condition of 45 dBA, which is reasonable for a rural area, daytime averages would need to exceed 75 dBA to

exceed the 60 dB-Ldn thresholds established by the county noise ordinance. Because the proposed project will both potentially increase and decrease the number of noise sources (e.g., agricultural operations), impact thresholds incorporate the potential for both increases and decreases in ambient noise conditions (assumed to be 60 dB-Ldn) for areas adjacent to the Project Area), with changes in ambient noise of < 3 dBA assumed to be negligible due to the fact that human ear can barely detect changes of this magnitude.

TABLE 48. NOISE AND SOUNDSCAPES – PROJECT-RELATED EFFECTS

Source: Park Service Management Policies, HUD, Marin CWP Nature: Beneficial, Adverse Context: Local Community Duration: Long-Term	
No Impact	There would be no potential for impact to noise and soundscape resources associated with implementation of the proposed project.
Negligible	The proposed project would generate an undetectable or barely detectable change (generally ≤ 3 dBA) in ambient noise conditions in the local community. Changes in ambient noise conditions would not exceed the 60 dB-Ldn 24-hour average noise level threshold established by county ordinance.
Minor	The proposed project would generate a small, but detectable change (generally ≤ 5 dBA) in ambient noise conditions in the local community. Changes in ambient noise conditions would not exceed the 60 dB-Ldn 24-hour average noise level threshold established by county ordinance.
Moderate	The proposed project would generate an apparent or appreciable change (≤ 10 dBA) in ambient noise conditions in the local community. However, changes in ambient noise conditions would not exceed the 60 dB-Ldn 24-hour average noise level threshold established by county ordinance.
Major or Substantial	The proposed project would generate a major or substantial change (> 10 dBA) in ambient noise conditions in the local community; OR Would exceed County of Marin noise ordinance of 60 dB-Ldn or 60 dBA over a 24-hour period.

Impact Analysis

TABLE 49. INTENSITY, NATURE, TYPE, DURATION, AND CONTEXT OF IMPACTS FOR AIR RESOURCES – SOUNDSCAPES

*All impacts would be considered Adverse (unless otherwise noted) and Local Community and are separately analyzed for Construction and Short-Term/Long-Term. **Slashed entries refer to the range in intensity of impacts for specific components under impact indicators: bold-faced entries refer to the average impact intensity.***

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Impact Indicator	Intensity, Nature, Type, Duration, and Context of Impact				
Noise and Soundscapes – Construction-Related Effects	Negligible/ Minor	Negligible/ Major or Substantial*	Negligible/ Major or Substantial*	Negligible/ Major or Substantial*	Negligible/ Major or Substantial*
NEPA: Intensity Following Mitigation		Moderate	Moderate	Moderate	Moderate
CEQA: Significance Following Mitigation		Less than Significant	Less than Significant	Less than Significant	Less than Significant
Noise and Soundscapes – Project-Related Effects	Beneficial - Minor	Adverse-Minor	Adverse-Minor	Adverse-Negligible	Beneficial-Negligible

* Conclusion limited to Specific Sensitive Receptor Areas near Levee Road, C Street, and/or Sir Francis Drake Boulevard in Inverness Park.

No Action Alternative

Analysis: The effects of the No Action Alternative on ambient noise in the local community during construction and after implementation would generally range from negligible to minor (Table 49). Under the No Action Alternative, levees, tidegates, and culverts in the Giacomini Ranch are not breached or removed, except for the 11-acre wetland restoration area in the northeastern corner of the East Pasture. (The Park Service is required under its existing agreement with CalTrans to restore wetlands as mitigation for impacts caused by CalTrans to aquatic habitat from a road repair on State Route 1 in Marin County in exchange for the

Park Service receiving monies to purchase and restore the Giacomini Ranch.) The remainder of the levee would not be deconstructed, although there would be no levee maintenance. Olema Marsh and the West Pasture are not restored, and there would be no construction of new public access facilities.

Construction: The wetland restoration/mitigation component would be located more than 2,000 feet from any sensitive noise receptors. The largest source of noise associated with construction would come from an increase in truck traffic along primary roadway corridors associated with hauling of excavated sediments to local quarries. Approximately 200 truck trips would be required to dispose of approximately 3,800 cubic yards of sediment. For this analysis, three trucks were assumed to be running simultaneously for a short, concentrated period of time, with the total number of daily truck trips not exceeding exceed 25 roundtrips or 50 single trips. This analysis also took into account vehicular traffic associated with commuting of construction personnel to the Project Area.

Because the wetland restoration is located in the northwestern corner of the East Pasture, trucks hauling sediment would be traveling through Point Reyes Station and then would likely use Sir Francis Drake Boulevard to the primary quarry disposal locations in the Seashore located near Pierce Point Road (Figure 7). In rural areas, ambient noise levels typically range from 40 to 50 dBA. In urban areas or in rural areas adjacent to roads and highways such as Point Reyes Station, noise levels typically range from 60 to 70 dBA. Ambient noise levels on State Route 1 south of Point Reyes Station averaged 65 decibels in 2001 (County of Marin 2004). In the town of Point Reyes Station, average ambient noise levels were slightly higher (69 dB), with maximum and minimum levels of 87 and 43 dB, respectively (EDAW Inc. 2001). Traffic on local roads and State Route 1 constitutes the dominant noise source (EDAW Inc. 2001). Based on an approach that estimates average ambient noise levels from traffic survey data, noise levels for non-surveyed roads could average 70.8 dBA for State Route 1 north of Point Reyes Station; 69.5 dBA for Bear Valley Road and Sir Francis Drake Boulevard; and 66.5 dBA for Pierce Point Road.

As these numbers would suggest, most of the local and regional roadways such as Sir Francis Drake Boulevard are already somewhat noisy because of the relatively high volume of car and truck traffic associated with residents, park visitors and staff, and dairy and ranching-associated businesses. Agricultural operations in the Olema Valley and Point Reyes Peninsula generate a considerable number of truck trips within the local community, including twice daily runs of milk trucks and periodic runs of hay trucks and other suppliers. Increased truck traffic along these already busy local and regional roadways would cause only a negligible increase (≤ 3 dBA) in noise levels in Point Reyes Station and along Sir Francis Drake Boulevard. However, the lower volume of traffic on Pierce Point Road, combined with its steeper gradient, may increase the relative effect of these truck trips on noise conditions, causing a minor change in ambient noise levels in this area with the increase estimated at approximately 4 dBA.

Project Implementation: After construction is completed, noise levels would not be expected to increase relative to baseline conditions, because there would be no new public access structures or facilities. This alternative would potentially have a beneficial minor effect on soundscapes in that it would generate a small, but detectable decrease in noise associated with intensive agricultural operations such as dairies. Dairies often produce loud or sharp temporary noises from operation of milk trucks, backhoes, All-Terrain Vehicles (ATV), and other mechanized farm equipment that have peak noise levels ranging from 100 to 122 dBA at 0-5 feet (Depczynski et al. 2002). While the dairy will close in spring 2007 due to the expiration of the existing Reservation of Use Agreement with the Giacomini Trust, there is a potential for leased grazing of dairy heifers or beef cattle under the No Action Alternative through separate environmental review process. Even if leased grazing is approved, noise intensity would still be expected to be lower than those of the dairy operations and would be limited largely to the periodic or infrequent use of livestock trucks to trailer animals on and off the Giacomini Ranch. In addition, there may be occasional noise generated by earthmoving equipment performing maintenance on the property. Overall, the No Action Alternative would be expected to result in a minor beneficial effect in noise conditions for the local community after implementation, particularly for residents along 3rd and C Streets and possibly for downtown Point Reyes Station.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: There are only three currently proposed or reasonably foreseeable projects that would have the potential to cause cumulative impacts should the No Action alternative be implemented.

These would be the proposed land exchange between the Park Service and the Giacomini family, Sir Francis Drake Boulevard Repaving Project, and the Culvert Cleaning near Olema Marsh, all of which are proposed for implementation in fall 2007. As part of the proposed land exchange, buildings would be removed from the Dairy facility: these removal efforts would generate noise. However, it is likely that the proposed building removal would be conducted prior to implementation of restoration. The County has tentatively planned to schedule the road repaving project after hauling for the proposed project would be completed (M. Madayag, County of Marin Department of Public Works, *pers. comm*.), so it is likely that construction schedules would be staggered to some degree and not directly overlap. Should the culvert cleaning move forward in fall 2007, it is unlikely that the scale of the proposed cleaning efforts would raise cumulative ambient noise levels along and in the vicinity of Levee Road above the negligible level.

Once the Giacomini Dairy closes, lands along C Street would be available for other uses. These parcels are primarily zoned Coastal Residential (CRAB-2) and could potentially at some point be developed into as many as 8-10 homes (including parcels already owned by the Giacomini family). For the local community as a whole, residential development would constitute a negligible to minor adverse impact, although the impacts to nearby residents could possibly be constructed as appreciable or moderate. As with the proposed project, the analysis of impacts from this potential project would need to take into account existing or baseline ambient noise generated along C Street by operation of the dairy, including twice-daily milk truck runs, hay trucks, and use of earthmoving equipment for maintenance and ATVs. Because the No Action would be expected to have minor beneficial, effects on ambient noise following implementation, cumulative impacts would be considered adverse negligible at most. Most of the other medium- to large projects that might be constructed during the same timeframe are distant enough that there would be no cumulative effects on ambient noise, except for the Bear Valley Creek Watershed and Fishery Enhancement Project. However, there is no definitive timeframe for construction of this project.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The effects of the No Action Alternative on ambient noise in the local community would generally range from adverse negligible/minor to beneficial minor. The only construction would be a small restoration component that is required under the Park Service's existing mitigation agreement with CalTrans, which would have negligible effects on sensitive receptors except for along Pierce Point Road. Hauling of excavated sediments to quarries in the Pierce Point Road vicinity would generate a minor increase in ambient noise levels during construction. This alternative would actually have a minor beneficial effect on ambient noise conditions after implementation, because loud and sharp noises associated with intensive agriculture such as dairying would be discontinued when the dairy closes in spring 2007 in accordance with the expiration of the Park Service's existing Reservation of Use Agreement with the Giacomini Trust. Potential future maintenance and agricultural uses such as leased grazing would be expected to produce only very infrequent or periodic loud noises from use of earthmoving equipment and trucks to trailer animals on and off the Giacomini Ranch.

Alternative A

Analysis: The effects of Alternative A on ambient noise in the local community during construction and after implementation would range from negligible to major (Table 49). Under this alternative, the East Pasture of the Giacomini Ranch would be restored, with new public access structures and facilities largely located on the eastern and southern perimeters of the East Pasture. The West Pasture and Olema Marsh would not be restored, although there is a potential for a future extension of the southern perimeter trail to Inverness Park either through widening of the Sir Francis Drake Boulevard berm or a boardwalk that would run through the West Pasture.

<u>*Construction*</u>: Most of the effects of construction on sensitive noise receptors or residences in the vicinity of the East Pasture would be attenuated either through distance or natural barriers such as road embankments, elevation differences, or thick, dense vegetation. There are at least two areas identified as a sensitive construction zones (southeastern portion of East Pasture and Sir Francis Drake Boulevard corridor) where sounds would not naturally be attenuated to the degree needed to keep noise levels below 75 dBA during daytime hours (Figure 40). Under this alternative, most of the construction in the southern portion of the East Pasture occurs in the western quadrant near White House Pool: creek banks would be regraded to a more

stabile profile, and a prefabricated bridge would be installed. These areas appear distant enough from residences that noise levels would not increase substantially.

However, grading and finishing of the southern perimeter trail across from the homes on Levee Road and homes on 3rd and C Streets would potentially elevate noise to 84 to 86 dBA for very short periods of time. Homes on Levee Road are approximately 130 to 150 feet from the East Pasture levee, and those at the corner of 3rd and C Street are approximately 80 feet away. The latter would be more affected by trail construction activities. Grading would be required to construct the trail, but this activity would occur only for a very short period, and other trail-related construction activities (e.g., fence installation, installation of trail tread) in this zone would otherwise appear to generate minimal noise. The other sensitive construction zone would occur along the Sir Francis Drake Boulevard corridor and would be associated with the potential future extension of the southern perimeter trail to Inverness Park. While this trail would be designed and constructed through a separate environmental review process jointly conducted with the county, it would possibly involve either widening of the Sir Francis Drake Boulevard road berm through placement of fill or construction of a boardwalk in the West Pasture. Both of these approaches would possibly generate construction-related noise that would exceed 75 dBA.

Because earthmoving and other construction activities would generate noise at levels that may exceed 75 dBA for nearby sensitive receptors, impacts under this alternative would be characterized as be major under NEPA and substantial and significant under CEQA. These impacts would be localized and very short term and would be mitigated to less than significant under CEQA and moderate under NEPA using Best Management Practices identified below.

Other than earthmoving, the largest source of noise associated with construction would come from an increase in noise along local and regional roadway corridors associated with hauling of excavated sediments to local quarries. Under this alternative, approximately 52,550 cubic yards of excess sediment excavated would be hauled to quarries within the Seashore for disposal, which would result in an increase in the number of potential single truck trips from approximately 200 under the No Action Alternative to 2,600 under Alternative A. This analysis assumed that two (2) to four (4) 20 cubic-yard trucks would be running simultaneously for a longer period of time relative to the No Action Alternative, with the maximum total number of daily truck trips not exceeding exceed 32 roundtrips or 64 single trips. (E. Polson, Polson Civil Engineering, *pers. comm*.). As with the No Action Alternative, it also took into account vehicle-related noise associated with commuting of construction personnel to the Project Area.

Because this alternative focuses on the East Pasture, trucks hauling sediment would be traveling through Point Reyes Station from either the Mesa Road or C Street access points and then would likely use Sir Francis Drake Boulevard to reach the primary disposal locations in the Seashore located near Pierce Point Road (Figure 7). Most of the local and regional roadways such as Sir Francis Drake Boulevard are already somewhat noisy because of the relatively high volume of car and truck traffic associated with residents, park visitors and staff, and dairy and ranching-associated businesses. Agricultural operations in the Olema Valley and Point Reyes Peninsula generate a considerable number of truck trips within the local community, including twice daily runs of milk trucks and periodic runs of hay trucks and other suppliers.

Increased truck traffic would cause only a negligible increase (≤ 3 dBA) in noise levels in Point Reyes Station and along Sir Francis Drake Boulevard. The intensity of impact would be minimized to some degree by the extended timeframe over which construction would occur: restoration would occur over two construction seasons, with construction of public access expected to occur over two construction seasons following implementation of restoration. However, the lower volume of traffic on Pierce Point Road, combined with its steeper gradient, may increase the effect of hauling relative to Sir Francis Drake Boulevard. In this area, truck trips would cause a minor short-term, localized change in ambient noise levels estimated at approximately 4 dBA. Taking into account the length of travel on each of the roads, truck hauling during construction would be expected to result in no more than an overall adverse negligible effect on ambient noise conditions along local and regional roadways.

Project Implementation: After implementation, effects on soundscape resources or ambient noise conditions would result primarily from changes in visitation and the number of vehicles traveling to and from the Project Area, because of the expansion in public access-related structures, facilities, and attractions/uses. In addition, there may be occasional noise generated by earthmoving equipment performing maintenance on the property. As discussed under the No Action Alternative, this alternative would potentially have a beneficial effect on soundscapes in that it would generate a small, but detectable decrease in noise associated with

intensive agricultural operations such as dairies. Dairies often produce loud or sharp temporary noises from operation of milk trucks, backhoes, All-Terrain Vehicles (ATV), and other mechanized farm equipment that have peak noise levels ranging from 100 to 122 dBA at 0-5 feet (Depczynski et al. 2002).

In general, the potential increase in noise associated with visitation and use of public access facilities in the Project Area would not be expected to result in more than a negligible to minor adverse effect on ambient noise conditions. The largest potential for a change in ambient noise conditions would occur for sensitive receptors on Levee Road, near 3rd and C Street, and directly north of the worker housing along Tomasini Creek on the west side of Mesa Road in Point Reyes Station. The southern perimeter trail that would be constructed in the vicinity of these sensitive receptors would be used by a higher number of visitors than the informal path that currently exists, thereby increasing the number of vehicles relative to baseline conditions. The higher number of visitors relative to baseline conditions would increase noise levels both from vehicles and from people conversing with each other. In addition to noise from traveling vehicles, residences near 3rd and C Streets in Point Reyes Station would be affected by sounds associated with engine starting and acceleration and deceleration of vehicles traveling to and from new or expanded public access structures and facilities, because they would be located in the vicinity of designated trailheads. Noise from engine starting and vehicle acceleration and deceleration are louder than those generated by a traveling vehicle.

Other sensitive receptors that could possibly be affected by construction or enhancement of public access facilities are residences on the Point Reyes Mesa above the eastern perimeter trail and homes along Sir Francis Drake Boulevard adjacent to the possible future extension of the southern perimeter trail to Inverness Park. Currently, there is no public access along the eastern perimeter of the East Pasture except at the terminus of the Tomales Bay Trail. Therefore, construction of the eastern perimeter trail, which would connect to the Tomales Bay Trail, would introduce a new source of noise for residences along the Point Reyes Mesa, however, visitation-related increases in ambient noise levels would be expected to represent no more than a minor adverse impact in this area. Noise generated near homes along Sir Francis Drake Boulevard by the possible future extension of the southern perimeter trail to Inverness Park would be largely masked by the roadway noise and would have no more than a negligible adverse effect on ambient noise relative to baseline conditions.

The intensity of these impacts must be balanced with the fact that these areas are currently subject to higher ambient levels of noise due to operation of the dairy, worker housing, and the existing informal path on the East Pasture levee. Noise associated with the dairy facility on C Street includes twice daily milk truck stops; hay truck and other truck deliveries; operation of backhoes, dump trucks, and other construction equipment; and vehicle and conversation noise of ranch workers. In addition, a certain amount of noise is already generated in this area by people using the informal path that currently exists on the levee, who usually park near 3rd and C Streets. On Mesa Road, noise is generated by ranch workers living in housing on the north side of Tomasini Creek, as well as by earthmoving equipment used by the Giacominis for ranch maintenance activities in the East Pasture.

Under Alternative A, noises associated with dairy operations would be eliminated, while noise associated with visitation and use of public access facilities would either be considered an increase relative to public access-related noise generated under baseline conditions (southern perimeter trail) or a new source of noise (eastern perimeter trail). Because public access-related noise would increase relative to baseline conditions and would be more constant than the agricultural-related noise eliminated by close of the dairy, this alternative may have an overall minor adverse effect on ambient noise conditions that would not violate the county noise ordinance of 60 dB-Ldn.

Proposed Mitigation Measures: To reduce noise levels to the maximum extent practicable in sensitive construction zones, the construction contractor shall employ the following noise-reducing Best Management Practices (BMP). Construction would be limited to the hours of 8 a.m. and 6 p.m. Monday through Saturday in sensitive construction zones, with weekends permissible only under special authorization from the Park Service and CSLC. All equipment would have sound control devices that are no less effective than those provided by the original equipment and would have muffled exhaust. In addition, contractor would be required to maintain properly tuned equipment and limit idling time to 5 minutes, limit the number of concurrently operating pieces of construction equipment within the Sensitive Noise Receptor Area, notify adjacent residences in advance of construction, and potentially reschedule construction activities.

Effectiveness of Proposed Mitigation Measures: Implementation of the proposed mitigation measures

would reduce the intensity of impacts in sensitive construction zones to less-than-significant levels under CEQA.

Cumulative Impacts: There are only three currently proposed or reasonably foreseeable projects that would have the potential to cause cumulative impacts should Alternative A be implemented. These would be the proposed land exchange between the Park Service and the Giacomini family, Sir Francis Drake Boulevard Repaving Project, and the Culvert Cleaning near Olema Marsh, all of which are proposed for implementation in fall 2007. Cumulative impacts would be expected to be similar to those discussed under the No Action Alternative, particularly as barn removal proposed as part of the land exchange between the Park Service and the Giacominis would be expected to occur prior to restoration activities.

Once the Giacomini Dairy closes, lands along C Street would be available for other uses. These parcels are primarily zoned Coastal Residential (CRAB-2) and could potentially at some point be developed into as many as 8- 10 homes (including parcels already owned by the Giacomini family). For the local community as a whole, residential development would probably constitute a negligible to minor adverse impact, although the impacts to nearby residents could be considered moderate. As with the proposed project, the analysis of impacts from this potential project would need to take into account existing or baseline ambient noise generated along C Street by operation of the dairy, including twice-daily milk truck runs, hay trucks, and use of earthmoving equipment for maintenance and ATVS. Because Alternative A would be expected to have minor adverse effects on ambient noise after implementation, project-related cumulative impacts would be considered adverse minor to moderate at most.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The effects of Alternative A on ambient noise in the local community during construction and after implementation would generally range from negligible adverse to major or substantial adverse, with substantial adverse effects mitigated to less-than-significant levels under CEQA and moderate levels under NEPA. Under Alternative A, restoration and construction of new public access structures and facilities would occur primarily in the East Pasture, although there is a potential to extend the southern perimeter trail to Inverness Park. In general, construction would have only negligible to minor effects on noise along local and regional roadways associated with hauling of excavated sediments and negligible effects on most of the sensitive receptors or residences near the Project Area because of attenuation of noise with distance and natural sound barriers. However, the close proximity of homes on Levee Road, 3rd and C Streets in Point Reyes Station, and Sir Francis Drake Boulevard to two major construction areas would potentially result in temporary, short-term noise levels exceeding 75 dBA. This would be considered a substantial and significant impact under CEQA. While these impacts cannot be eliminated, they have been reduced to a less-than-significant level under CEQA and moderate levels under NEPA through adoption of noise-reducing construction management practices.

The primary effects of this alternative on ambient noise conditions following project implementation may be associated largely with increases in visitation and traffic due to construction or expansion of public access structures, facilities, and attractions/uses. Projected increases in vehicle volume associated with higher numbers of visitors would have a barely detectable or very negligible impact on state, regional, and local roadways. However, impacts may be higher in certain areas such as 3rd and C Streets and directly north of the worker housing near Mesa Road in Point Reyes Station, where trailheads would be located due to noise from engine starting and vehicle acceleration and deceleration. In addition, potential construction of homes along C Street could also contribute cumulatively to an increase in ambient noise levels, although these impacts would not be expected to exceed minor to moderate at most. Construction of the eastern perimeter trail would also introduce a new source of noise for residents on the Point Reyes Mesa. Ultimately, the increase in public access-related noise associated with expansion or construction of public access facilities would be offset to some degree by the elimination of noises associated with operation of the dairy, although visitation and use of public access facilities would be expected to generate a more constant level of noise than the intermittent or periodic loud and sharp noises produced by milk trucks, hay trucks, and earthmoving equipment used for maintenance. Therefore, overall, project implementation would be expected to potentially have a minor adverse effect on ambient noise conditions for at least certain areas within the local community, although ambient noise conditions would not exceed the county noise ordinance of 60 dB-Ldn.

Alternative B

Analysis: The effects of Alternative B on ambient noise in the local community would be very similar to Alternative A, generally ranging from negligible adverse to major or substantial (Table 49). Under this alternative, the East and West Pastures of the Giacomini Ranch would be restored, with most of the new public access structures and facilities still largely located on the eastern and southern perimeters of the East Pasture as they would be in Alternative A. The amount of construction in the sensitive construction zones in the southeastern portion of the East Pasture would be increased, and two other zones would be added in the West Pasture, where levees would be breached or berms or levees would potentially be constructed. Construction in these areas would have the potential to generate noise localized, short-term noise levels exceeding 75 dBA, which would constitute a major impact under NEPA and a substantial and significant impact under CEQA. These effects would be mitigated to a less-than-significant level under CEQA and a moderate level under NEPA using the mitigation measure BMPs described under Alternative A.

Construction: Under this alternative, approximately 72,567cubic yards of excess sediment excavated would be hauled to quarries within the Seashore for disposal (Figure 7). There are at least two areas identified as sensitive construction zones (southeastern portion of East Pasture; Sir Francis Drake Boulevard corridor; southern portion of West Pasture) where construction sounds would not naturally be attenuated to the degree needed to keep noise levels below 75 dBA (Figure 40). Because of this, the number of potential truck trips would climb from approximately 200 under the No Action Alternative and 2,000 under Alternative A to 3,625 under Alternative B. Despite this, impacts to noise levels along local and regional roadways would still be estimated to be negligible, because of the moderate to high existing ambient noise conditions along these busy road corridors and the extended timeframe over which hauling would occur. This alternative would be constructed over three (3) to four (4) construction seasons, with the public access component anticipated to take two years for construction after restoration is completed. The only noticeable increase in estimated noise from hauling occurred along Pierce Point Road, where the lower overall traffic volume on this road, combined with the steeper road gradient, would cause a minor short-term, localized change in ambient noise levels estimated at approximately 4 dBA. Taking into account the length of travel on each of the roads, truck hauling during construction would be expected to result in no more than an overall adverse negligible effect on ambient noise conditions along local and regional roadways.

Project Implementation: After implementation, effects on soundscape resources or ambient noise conditions would result largely from changes in visitation and the number of vehicles traveling to and from the Project Area, because of the expansion in public access structures, facilities, and attractions/uses. In general, the effects of Alternative B on ambient noise after implementation would be almost identical to those of Alternative A, because the public access components are very similar with a few exceptions. The magnitude of a potential increase in visitation and visitor-related traffic would be expected to result in no more than a negligible to minor adverse effect on ambient noise conditions.

The intensity of these impacts must be balanced with the fact that these areas are currently subject to higher ambient levels of noise due to operation of the dairy, worker housing, and the existing informal path on the East Pasture levee. Under both Alternatives A and B, noises associated with dairy operations would be eliminated, while noise associated with visitation and use of public access facilities would either be considered an increase relative to public access-related noise generated under baseline conditions (southern perimeter trail) or a new source of noise (eastern perimeter trail). Because public access-related noise would increase relative to baseline conditions and would be more constant than the agricultural-related noise eliminated by close of the dairy, this alternative would have an overall minor adverse effect on ambient noise conditions that would not violate the county noise ordinance of 60 dB-Ldn.

Proposed Mitigation Measures: Proposed measures to reduce noise levels to the maximum extent practicable in sensitive construction zones would be the same as under Alternative A.

Effectiveness of Proposed Mitigation Measures: Implementation of the proposed mitigation measures would reduce the intensity of impacts in sensitive construction zones to less-than-significant levels under CEQA and moderate levels under NEPA.

Cumulative Impacts: Cumulative impacts would be the same as described under Alternative A.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Despite increases in the extent and degree of restoration, Alternative B would have very similar project-related and cumulative effects as Alternative A on ambient noise in the local community that would range from negligible adverse to major or substantial, with substantial construction-related effect on sensitive receptors reduced to less-than-significant levels under CEQA and to a moderate level under NEPA through incorporation of noise-reducing construction management practices. Following implementation, this alternative would have an almost identical minor adverse effect to Alternative A on ambient noise conditions in the local community that would not violate the county noise ordinance of 60 dB-Ldn. While noise associated with the dairy would be eliminated with its closure, noise associated with increased visitation to new or expanded public access facilities would increase slightly relative to baseline conditions and would be more constant than noise generated by milk trucks, hay trucks, earthmoving equipment used for dairy maintenance, and other agricultural activities. In addition, potential construction of homes along C Street could also contribute cumulatively to an increase in ambient noise levels, although these impacts would not be expected to exceed minor to moderate at most.

Alternative C

Analysis: Alternative C would have very similar effects on ambient noise in the local community during construction and after implementation as Alternative B, with the intensity of effects ranging from negligible adverse to major or substantial adverse (Table 49). Under this alternative, the scope of restoration is expanded to include Olema Marsh and the adjacent Olema Creek watershed, as well as the East and West Pastures of the Giacomini Ranch. The degree of active restoration within the East Pasture and West Pasture is increased, as well. The extent of public access along the eastern perimeter of the East Pasture would be scaled back to include two spur trails or spur trail extensions, with the Mesa Road spur trail becoming an ADA-compliant trail.

Construction: As with the other alternatives, most of the effects of construction on sensitive noise receptors or residences in the vicinity of the East and West Pastures would be attenuated either through distance or natural barriers such as road embankments, elevation differences, or thick, dense vegetation. Similar to Alternative B, there are at least three areas identified as sensitive construction zones (southeastern portion of East Pasture; Sir Francis Drake Boulevard corridor; southern portion of West Pasture) where construction sounds would not naturally be attenuated to the degree needed to keep noise levels below 75 dBA (Figure 40). However, under this alternative, the intensity of restoration in at least two of these sensitive construction areas would increase with the addition of shallow grading or scraping of a 40-acre pasture to eliminate weeds in addition to levee removal, creek bank regrading, and trail construction in the East Pasture and complete removal of the levee in the West Pasture (Figure 40). Also, there would still be the potential for future expansion of the southern perimeter trail to Inverness Park and construction of levees around lower-elevation private properties on the east side of Sir Francis Drake Boulevard (Sir Francis Drake Boulevard corridor; Figure 40). Because earthmoving and other construction activities may generate noise at levels that would potentially exceed 75 dBA for nearby sensitive receptors in these areas, impacts under this alternative would be characterized as be major under NEPA and substantial and significant under CEQA. These impacts would still be localized and very short term, although the duration of impacts would be slightly longer than under Alternative B. These effects would be mitigated to a less-than-significant level under CEQA and a moderate level under NEPA using the mitigation measure BMPs described under Alternative A.

Other than earthmoving, the largest source of noise associated with construction would come from an increase in noise along local and regional roadway corridors associated with hauling of excavated sediments to local quarries. Under this alternative, approximately 125,250 cubic yards of excess sediment excavated would be hauled to quarries within the Seashore for disposal, which would result in an increase in the number of potential truck trips from approximately 200 under the No Action Alternative and 3,600 under Alternative B to approximately 6,275 under Alternative C. This analysis assumed that two (2) to four (4) 20 cubic-yard trucks would be running simultaneously for a longer period of time relative to Alternative B (E. Polson, Polson Civil Engineering, *pers. comm*.), with the total number of daily truck trips not exceeding exceed 32 roundtrips or 64 single trips. As with the other alternatives, it also took into account vehicle-related noise associated with commuting of construction personnel to the Project Area. Under this alternative, trucks hauling sediment from the East Pasture would be traveling through Point Reyes Station from either the Mesa Road or C Street

access points and then would likely use Sir Francis Drake Boulevard to reach the primary disposal locations in the Seashore located near Pierce Point Road (Figure 7). Trucks hauling sediment from Olema Marsh and the West Pasture would primarily be using Sir Francis Drake Boulevard and, for Olema Marsh, either Bear Valley or Levee Roads.

Despite the increase in trips relative to Alternative B, truck traffic would still be expected to cause only a negligible increase (≤ 3 dBA) in noise levels in Point Reyes Station and along Sir Francis Drake Boulevard. Impacts would be slightly higher on Pierce Point Road, because the lower volume of traffic, combined with its steeper gradient, would magnify the effects of hauling on noise conditions relative to Sir Francis Drake Boulevard. In this area, truck trips would cause a minor short-term, localized change in ambient noise levels estimated at approximately 4 dBA. Taking into account the length of travel on each of the roads, truck hauling during construction would be expected to result in no more than an overall adverse negligible effect on ambient noise conditions along local and regional roadways. As discussed under the previous alternatives, the intensity of impact would be minimized to some degree by the high levels of ambient noise that currently exist along these busy road corridors and the extended timeframe over which construction would occur. Construction would occur over an estimated five to seven construction seasons, because it includes construction of public access facilities and restoration of Olema Marsh, which would be restored under an adaptive approach that would phase restoration over time.

Project Implementation: After implementation, effects on ambient noise would result primarily from changes in visitation and the number of vehicles traveling to and from the Project Area, because of the expansion in public access-related structures, facilities, and attractions/uses. In addition, there may be occasional noise generated by earthmoving equipment performing maintenance on the property. Relative to Alternative B, the potential increase in noise associated with visitation and use of public access facilities in the Project Area would be lower, because of changes to or scaling back of the southern and eastern perimeter trails. Therefore, this alternative would still be expected to have barely detectable or very negligible impacts on ambient noise conditions along local and regional road corridors.

The largest potential for a change in ambient noise conditions would occur for sensitive receptors on Levee Road and near 3rd and C Street and in the Point Reyes Mesa area in Point Reyes Station. Under Alternative C, Mesa Road becomes an ADA-compliant spur trail that leads to a viewing near the Giacomini Hunt Lodge on the edge of Tomasini Creek. Access from Point Reyes Station to the southern perimeter trail changes to the Green Bridge, with access point at the corner of 3rd and C Street eliminated. This change in trailhead location decreases potential effects to sensitive receptors near 3rd and C Streets from noise associated with engine starting and vehicle acceleration and deceleration, although noise from users of the adjacent trail system might still be detectable relative to existing conditions. (Noise from engine starting and vehicle acceleration and deceleration are louder than those generated by a traveling vehicle.)

Residences in the Point Reyes Mesa area – particularly those directly north of Tomasini Creek near Mesa Road – would potentially become more affected by sounds associated with engine starting and acceleration and deceleration of vehicles traveling to and from new or expanded public access structures and facilities, because the Mesa Road spur trail would be converted to an ADA-compliant facility. However, any increase in visitation relative to Alternative B due to restructuring of these facilities would be expected to be negligible. Other sensitive receptors that could possibly be affected by construction or enhancement of public access facilities are residences along Sir Francis Drake Boulevard adjacent to the possible future extension of the southern perimeter trail to Inverness Park. However, noise generated near homes along Sir Francis Drake Boulevard by the possible future extension of the southern perimeter trail to Inverness Park would be largely masked by the roadway noise and would have no more than a negligible adverse effect on ambient noise relative to baseline conditions.

The intensity of public access-related impacts to ambient noise must be balanced with the fact that these areas are currently subject to higher ambient levels of noise due to operation of the dairy, worker housing, and the existing informal path on the East Pasture levee. As discussed under the No Action Alternative and Alternative A, this alternative would potentially have a beneficial effect on soundscapes in that it would generate a small, but detectable decrease in noise associated with intensive agricultural operations such as dairies, twice daily milk truck stops; hay truck and other truck deliveries; operation of backhoes, dump trucks, and other construction equipment; and vehicle and conversation noise of ranch workers. In addition, a certain amount of noise is already generated in this area by people using the informal path that currently exists on the levee, who usually park near 3rd and C Streets. On Mesa Road, noise has been generated by ranch

workers living in housing on the north side of Tomasini Creek, as well as by earthmoving equipment used by the Giacominis for ranch maintenance activities in the East Pasture.

Under Alternative C, noises associated with dairy operations would be eliminated, while noise associated with visitation and use of public access facilities would either be considered an increase relative to public access-related noise generated under baseline conditions (southern perimeter trail) or a new source of noise (two spur trails on eastern perimeter). Because public access-related noise would increase relative to baseline conditions and would be more constant than the agricultural-related noise eliminated by close of the dairy, this alternative would still have an overall adverse effect on ambient noise, although impacts would be reduced relative to Alternative B to negligible rather than minor. As with other alternatives, changes in noise levels would not violate the county noise ordinance of 60 dB-Ldn.

Proposed Mitigation Measures: Proposed measures to reduce noise levels to the maximum extent practicable in sensitive construction zones would be the same as described under Alternative A.

Effectiveness of Proposed Mitigation Measures: Implementation of the proposed mitigation measures would reduce the intensity of impacts in sensitive construction zones to less-than-significant levels under CEQA.

Cumulative Impacts: Cumulative impacts would be the same as described under Alternative A.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The effects of Alternative C on ambient noise in the local community during construction and after implementation would generally range from negligible adverse to major or substantial adverse, with substantial adverse effects mitigated to less-than-significant levels under CEQA and moderate under NEPA. Under Alternative C, the extent and degree of restoration would be expanded to include Olema Marsh and more active restoration actions in the Giacomini Ranch. Construction or expansion of public facilities would be scaled back relative to Alternatives A and B, although there is still a potential to extend the southern perimeter trail to Inverness Park and construct a small levee around lower-elevation private properties on the east side of Sir Francis Drake Boulevard. In general, construction would have only negligible to minor effects on noise along local and regional roadways associated with hauling of excavated sediments and negligible effects on most of the sensitive receptors or residences near the Project Area because of attenuation of noise with distance and natural sound barriers. However, the close proximity of homes on Levee Road, 3rd and C Streets in Point Reyes Station, and Sir Francis Drake Boulevard to three major construction areas would potentially result in temporary, short-term noise levels exceeding 75 dBA. This would be considered a major impact under NEPA and a substantial and significant impact under CEQA. While these impacts cannot be eliminated, they have been reduced to a less-than-significant level under CEQA and a moderate level under NEPA through adoption of noise-reducing construction Best Management Practices.

The primary effects of this alternative on ambient noise conditions after implementation would be associated largely with increases in visitation and traffic due to construction or expansion of public access structures, facilities, and attractions/uses. Projected increases in visitation and related increases in vehicle traffic would be lower than those under Alternatives A and B and would, therefore, still have barely detectable or very negligible impacts on ambient noise conditions along local and regional road corridors. However, impacts may be higher in areas located next to trailheads due to noise from engine starting and vehicle acceleration and deceleration. Under this alternative, the Point Reyes Station trailhead for the southern perimeter trail is moved from 3rd and C Streets to the Green Bridge, and the ADA-compliant component on this trail is eliminated and switched to the Mesa Road spur trail. This change should decrease impacts to sensitive receptors near 3rd and C Streets, although it may increase impacts slightly to those near the Mesa Road spur trail relative to Alternative B. In addition, potential construction of homes along C Street could also contribute cumulatively to an increase in ambient noise levels for homes along 3rd and C Streets, although these cumulative impacts would not be expected to exceed minor at most. Ultimately, the increase in public access-related noise associated with expansion or construction of public access facilities and potential construction of homes would be offset to some degree by the elimination of noises associated with operation of the dairy, although visitation and use of public access facilities would be expected to generate a more constant level of noise than the intermittent or periodic loud and sharp noises produced by milk trucks, hay trucks, and

earthmoving equipment used for maintenance. Therefore, overall, project implementation would still be expected to potentially have a negligible adverse effect on ambient noise conditions for at least certain areas within the local community, although noise levels would not exceed the county noise ordinance of 60 dB-Ldn.

Alternative D

Analysis: The effects of Alternative D on ambient noise in the local community would be similar to Alternative C with some exceptions, generally ranging from negligible beneficial to major or substantial adverse (Table 49). Under this alternative, restoration actions would be expanded in the East Pasture to include replacement of the Tomasini Creek culvert at Mesa Road. The public access component would be scaled back considerably, with elimination of the bridge on the southern perimeter trail and the Mesa Road spur trail. While distance and barriers would attenuate most of the construction noise to minimal levels, the amount of construction in the three sensitive construction zones would remain similar to that under Alternative C. Therefore, construction in these areas would have the potential to generate noise localized, short-term noise levels exceeding 75 dBA, which would constitute a major impact under NEPA and a substantial and significant impact under CEQA. These effects would be mitigated to a less-than-significant level under CEQA and a moderate level under NEPA using the mitigation measure BMPs described under Alternative A.

Construction: Under this alternative, approximately 147,218 cubic yards of excess sediment excavated would be hauled to quarries within the Seashore for disposal (Figure 7). Because of this, the number of potential truck trips would climb from approximately 200 under the No Action Alternative and 6,275 under Alternative C to 7,400 under Alternative D. This analysis assumed that two (2) to five (5) 20 cubic-yard trucks would be running simultaneously for a longer period of time relative to Alternative B (E. Polson, Polson Civil Engineering, *pers. comm*.), with the total number of daily truck trips not exceeding exceed 40 roundtrips or 80 single trips. As with the other alternatives, it also took into account vehicle-related noise associated with commuting of construction personnel to the Project Area. Under this alternative, trucks hauling sediment from the East Pasture would be traveling through Point Reyes Station from either the Mesa Road or C Street access points and then would likely use Sir Francis Drake Boulevard to reach the primary disposal locations in the Seashore located near Pierce Point Road (Figure 7). Trucks hauling sediment from Olema Marsh and the West Pasture would primarily be using Sir Francis Drake Boulevard and, for Olema Marsh, either Bear Valley or Levee Roads.

Despite this increase in the estimated total number of truck trips, impacts to noise levels along local and regional roadways would still be estimated to be negligible, because of the moderate to high existing ambient noise conditions along these busy road corridors and the extended timeframe over which hauling would occur. This alternative would be constructed over six to seven construction seasons, because it includes the Tomasini Creek culvert, public access, and Olema Marsh, which would be restored under a phased, adaptive approach. As with the other alternatives, the only noticeable increase in estimated noise from hauling occurred along Pierce Point Road, where the lower overall traffic volume on this road, combined with the steeper road gradient, would cause a minor short-term, localized change in ambient noise levels estimated at approximately 4 dBA. Taking into account the length of travel on each of the roads, truck hauling during construction would still be expected to result in no more than an overall adverse negligible effect on ambient noise conditions along local and regional roadways.

Project Implementation: After implementation, effects on soundscape resources or ambient noise conditions would result largely from changes in visitation and the number of vehicles traveling to and from the Project Area, because of the expansion in public access structures, facilities, and attractions/uses. In general, the effects of Alternative D on ambient noise after implementation would be much lower than the other alternatives, because of the considerable scaling back of the public access component. The magnitude of a potential increase in visitation and visitor-related traffic would be expected to result in no more than a very negligible effects on ambient noise along local and regional road corridors and negligible adverse effects on ambient noise conditions for sensitive receptors near trails or trailheads. As with Alternative C, the Point Reyes Station trailhead for the southern perimeter spur trail would originate at the Green Bridge rather than at 3rd and C Streets, thereby decreasing impacts to these residences. The elimination of the bridge also decreases the number of potential trail users, reducing the potential impact for noise impacts to residents on Levee Road. The addition of an ADA-compliant trail in White House Pool County park to Alternative D in the FEIS/EIR would not be expected to have more than a negligible adverse effect on ambient noise levels. Elimination of the Mesa Road spur trail would decrease the potential for impacts to residences on the Point Reyes Mesa.

The intensity of these impacts is reduced even further by the fact that these areas are currently subject to higher ambient levels of noise due to operation of the dairy, worker housing, and the existing informal path on the East Pasture levee. As with the other alternatives, noises associated with dairy operations such as milk trucks, hay trucks, earthmoving equipment used for dairy maintenance and ATVs would be eliminated. Ultimately, this alternative would have an overall negligible beneficial effect on ambient noise conditions, because noises associated with dairy would be eliminated, and public access-related noise would be expected to be much lower than under the other alternatives and only slightly higher than under baseline conditions.

Proposed Mitigation Measures: Proposed measures to reduce noise levels to the maximum extent practicable in sensitive construction zones would be the same as described under Alternative A.

Effectiveness of Proposed Mitigation Measures: Implementation of the proposed mitigation measures would reduce the intensity of impacts in sensitive construction zones to less-than-significant levels under CEQA.

Cumulative Impacts: Cumulative impacts would be the same as described under Alternative A.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Despite increases in the extent and degree of restoration, Alternative D would have very similar project-related and cumulative effects on ambient noise in the local community during construction and after implementation as Alternative C, with effects ranging from negligible beneficial to major or substantial adverse. Substantial impacts of construction-related effect on sensitive receptors would be reduced to less-than-significant levels under CEQA and moderate levels under NEPA through incorporation of noise-reducing construction Best Management Practices. Other construction-related noise impacts would generally range from negligible to minor. Following implementation, this alternative would be expected to have a negligible beneficial effect on ambient noise. Noise associated with the dairy such as milk trucks, hay trucks, earthmoving equipment used for dairy maintenance, ATVs, and other agricultural operations would be eliminated with its closure, while noise associated with visitation to new or expanded public access facilities would be much lower than under other alternatives and only slightly higher than under baseline conditions.

Water Resources – Hydraulics and Hydrologic Processes

Laws, Regulations, Policies, and Criteria Guiding Impact Analysis

In recent decades, more local, state, and federal agencies have adopted policies regarding hydrologic processes, specifically the need to minimize hydrologic alterations and maintain natural hydrologic processes for improved water quality, viable fish and wildlife populations, and ecologically healthy fish and wildlife habitats. In its 2006 Management Policies, the Park Service urges parks to re-establish natural functions and processes altered by changes to hydrologic patterns and sediment transport, acceleration of erosion and sedimentation, floodplains, and disruption of natural processes to conditions characteristic of the surrounding environment (NPS 2006, Sections 4.1.5 and 4.6.4). Local agencies and plans also promote preservation and restoration of natural hydrologic processes and functions and have established policies restricting impoundments, diversions, channelization, and removal of riparian habitat or buffer. These policies and plans are discussed in more detail under Water Resources in Chapter 3.

Significance criteria developed by the county and CEQA for water resources pertaining to hydraulics and hydrologic processes include 1) substantial changes in absorption rates, drainage patterns (including alteration of the course of a stream or river), or the rate and amount of surface runoff; 2) substantial changes in drainage patterns that would result in substantial erosion and siltation on- or off-site; and 3) substantial changes in the flow of surface water or ground waters, including currents, rate of flow, and the course or direction of water movement. The DOI has mandated that federal agencies in DOI must address actions that would have adverse or beneficial impacts to floodplains.

General Assumptions and Methodologies

- The purpose of the proposed project is to restore natural hydrologic processes and functions, with the degree of restoration varying among proposed alternatives.
- The extent to which processes and functions can be restored within the Project Area and immediate vicinity is constrained to some degree by the need to maintain existing public services and safety (e.g., county roads, not increase potential for flooding of homes and roads, minimize saltwater intrusion into local municipal groundwater supplies), as well as provide opportunities for public access and enjoyment of the restored wetland.
- Some aspects relating to sediment transport processes are evaluated in other sections of this chapter, specifically potential changes to water quality relating to transport of suspended sediment (Water Resources – Water Quality) and potential changes in aggradation or erosion of Lagunitas Creek channel bed (Public Health and Safety – Flooding).

Listed below are methodologies for impact thresholds related to hydrologic processes, including specific assumptions or details on methodologies.

Changes in Surface Tidal Processes: Impact thresholds focus on changes in the area subject to surface tidal processes relative to baseline conditions, in which surface tidal processes have either been eliminated or reduced as a result of levee and road construction and installation of tidegates and culverts (Table 50). Changes in surface tidal processes represent estimates of the area subject to daily tidal action during Mean High Water (MHW) tide events under the various alternatives (KHE 2006a). Daily tidal action to MHW is used to represent tidal prism, where mean high water is 4.64 feet MLLW. No construction or short-term impacts to surface tidal hydrologic processes would be anticipated.

TABLE 50. SURFACE TIDAL HYDROLOGIC PROCESSES

Source: Park Service Management Policies, Marin CWP Nature: Beneficial, Adverse Context: Project Area, Watershed Duration: Long-Term	
No Impact	There would be no potential for impact to surface tidal processes associated with the proposed project.
Negligible	There would be a negligible change (≤ 10 percent) in the extent of area subject to surface tidal hydrologic processes during daily tides.
Minor	There would be a minor change (≤ 25 percent) in the extent of area subject to surface tidal hydrologic processes during daily tides.
Moderate	There would be a moderate change (≤ 50 percent) in the extent of area subject to surface tidal hydrologic processes during daily tides.
Major or Substantial	There would be a substantial or major change (> 50 percent) in the extent of area subject to surface tidal hydrologic processes during daily tides.

Changes in Surface Freshwater Hydrologic Processes: Impact thresholds for surface freshwater hydrologic processes focus on changes in the number of infrastructure facilities (e.g., tidegates, culverts, dams, roads, levees, wells or pumps) or management practices (e.g., creek dredging, creek straightening or realignment) that affect fluvial processes and related properties, such as sediment transport, frequency and pattern of flood flows, channel movement or migration, water residence time, etc. (Table 51). Because changes in surface area affected by increases or decreases in infrastructure or creek management practices occur relatively infrequently when flood flows are able to overtop creek bank or levees, surface area was not considered the best overall indicator of potential change in freshwater processes, although changes in floodplain capacity is evaluated later in this section.

To evaluate how the proposed project would affect freshwater hydrologic processes, the number of existing structures, facilities, or management practices for each freshwater system or subwatershed in the Project Area was compared between baseline or existing conditions (See Table 8 in Chapter 3) and the various alternatives. For each alternative, the number of structures or facilities removed, maintained, or installed – some alternatives include installation of a bridge or public access infrastructure -- was evaluated along with the number of management practices that would be discontinued, maintained, or initiated. A partially weighted scoring system that takes into account the relative degree of change (e.g., breached versus completely removed) and the number of hydrologic or geomorphic processes or conditions that might be affected by each

type of structure, facility, or management practice was used in analysis. To represent what effect the proposed project might have on watershed function, this analysis also evaluates the effect of the proposed project relative to constraints on freshwater hydrologic processes within each of the respective subwatersheds. (Only the mainstems of Lagunitas Creek and Bear Valley Creek are incorporated.) In addition, temporary effects on freshwater hydrologic processes associated with construction are also evaluated. These could include coffer dams used to dewater aquatic areas to allow for improved construction access.

TABLE 51. SURFACE FRESHWATER HYDROLOGIC PROCESSES

Source: Park Service Management Policies, CCC/LCP Zone II, Marin CWP, Community Plan Nature: Beneficial, Adverse Context: Project Area, Watershed Duration: Long-Term	
No Impact	There would be no potential for impact to fluvial or surface freshwater hydrologic processes associated with the proposed project.
Negligible	There would be a negligible change (≤ 10 percent) in the number of infrastructure, facilities, and management practices affecting fluvial or surface freshwater hydrologic processes. Changes would have a barely detectable effect on the overall number of infrastructure, facilities, and management practices (≤ 5 percent) affecting freshwater hydrologic processes within the overall subwatersheds.
Minor	There would be a minor change (±11 - 25 percent) in the number of infrastructure, facilities, and management practices affecting fluvial or surface freshwater hydrologic processes. Changes would have a measurable effect on the overall number of infrastructure, facilities, and management practices (≤ 10 percent) affecting freshwater hydrologic processes within the overall subwatersheds.
Moderate	There would be a moderate change (± 26 - 50 percent) in the number of infrastructure facilities and management practices affecting surface freshwater hydrologic processes. Changes would have an appreciable effect on the overall number of infrastructure, facilities, and management practices (≤ 25 percent) affecting freshwater hydrologic processes within the overall subwatersheds.
Major or Substantial	There would be a major or substantial change (> 50 percent) in the number of infrastructure facilities and management practices affecting surface freshwater hydrologic processes. Changes would have a striking effect on the overall number of infrastructure, facilities, and management practices (> 25 percent) affecting freshwater hydrologic processes within the overall subwatersheds.

Changes in Hydrologic Functions - Floodplains: Impact thresholds focus on changes in floodplain storage or cumulative volume of inundated waters in cubic feet that are stored or move through Lagunitas, Fish Hatchery Creek, and Tomasini Creek floodplains during the 2- and 100-year flood events relative to existing or baseline conditions (Table 52). These particular flood events were chosen for analysis, because levees have reduced the frequency of and area available for storage during flooding or periods when creek waters overtop banks and spill onto adjacent floodplains and marshplains, particularly for floods with recurrence intervals ≤ 3.5 years. Cumulative floodwater storage volume was estimated using computerized hydraulic models developed for the various alternatives and simulating floods of all the flood recurrence intervals, including the 2- and 100-year flood events (KHE 2006a). Cumulative volume takes into consideration not only peak total storage capacity, but the total volume of water that moves through off-channel storage areas during an entire storm event, which may include several peaks in flood flow depending on the intensity and pattern of rainfall. Hydraulic models include extreme storm tide conditions as freshwater flooding and extreme tides often coincide, thereby increasing the volume of floodwaters (KHE 2006a). No construction or short-term impacts to surface tidal hydrologic processes would be anticipated.

TABLE 52. HYDROLOGIC FUNCTIONS - FLOODPLAINS AND FLOODWATER RETENTION

Source: Park Service Management Policies, CCC/LCP Zone II, Marin CWP Nature: Beneficial, Adverse Context: Project Area, Watershed Duration: Long-Term	
No Impact	There would be no potential for impact to floodplains or floodplain storage associated with the proposed project.
Negligible	There would be a negligible change (±10 percent) in floodplain storage or cumulative volume of floodwaters in Lagunitas Creek during the 2- and 100-year flood events associated with the proposed project.
Minor	There would be a minor change (±11 - 25 percent) in floodplain storage or cumulative volume of floodwaters in Lagunitas Creek during the 2- and 100-year flood events associated with the proposed project.

TABLE 52. HYDROLOGIC FUNCTIONS - FLOODPLAINS AND FLOODWATER RETENTION

Moderate	There would be a moderate change (± 26 - 50 percent) in floodplain storage or cumulative volume of floodwaters in Lagunitas Creek during the 2- and 100-year flood events associated with the proposed project.
Major or Substantial	There would be a major or substantial change (> 50 percent) in floodplain storage or cumulative volume of floodwaters in Lagunitas Creek during the 2- and 100-year flood events associated with the proposed project.

Changes in Hydrologic Processes – Sediment Transport Dynamics: Impact thresholds focus on changes in deposition of suspended sediment onto floodplains or marshplains during the 2-year flood event (Table 53). Sediment transport rates for different stream discharge or flow rates were derived from sediment yield rating curves for suspended sediment at the Lagunitas Creek near Point Reyes Station gauge (USGS Station 11460600) developed by H. Esmaili & Associates (1980) for Marin Municipal Water District. The mainstem of Lagunitas Creek at the Point Reyes gauge demonstrated the highest rates (if not total loads) of sediment transport at lower flows (streamflows < 1,000 cfs), thereby making the 2-year flood event the most appropriate modeled flow for analysis.

The potential movement of sediment onto floodplains in the Project Area is restricted by poor connectivity between creeks and floodplains during smaller and more frequent flood events (< 10-year flood events). Smaller flow events such as these often constitute the "dominant discharge" streamflows at which most of the sediment transport within many systems occurs, at least on average. During the 1979-1980 study, the rate of sediment transport in the lower portions of Lagunitas Creek just upstream of the Project Area showed signs of declining at the 1-year flood event, although the total load continued to increase with streamflow at a slower rate, with some of the most extensive sedimentation in recent decades observed after the 100-year flood event in 1982 (H. Esmaili and Associates 1980; Anima et al. 1988). Based on the sediment rating curve developed by H. Esmaili & Associates (1980), approximately 50,000 tons per day of suspended sediment would potentially move through the Project Area during a 2-year flood event.

This analysis assumes that the bedload being transported in Lagunitas Creek largely remains within the creek channel and that most of the sediment that would be deposited on floodplains and marshplains would be suspended sediment such as fines (silts, clays) and medium-grained sands (Dunne and Leopold 1978). Only a portion of floodwaters carrying sediment during flood events end up on the floodplains or marshplains, with some being deposited in lower elevation off-channel features such as oxbows and secondary channels or within the active channel itself (Heimann 2001). Sediment yield for the stream discharge associated with the 2-year flood event (3,531cfs; KHE 2006a) at the Point Reyes Station gauge on Lagunitas Creek was then factored by the percentage of cumulative flood volume of waters moving through the East and West Pasture floodplains under the various alternatives to estimate the proportion of sediment in tons per day likely to be deposited on floodplains during overbank flooding. As with bedload sediment transport, suspended sediment loads are likely to be variable both vertically and horizontally within floodwater flows, however, for the purposes of this analysis, suspended sediment was assumed to be relatively uniformly distributed throughout the water column. In some systems, sediment deposition on floodplains has shown a strong linear relationship with both cumulative suspended sediment load and cumulative streamflow, with these variables explaining up to 82 percent of the variability in floodplain sediment deposition (Heimann and Roell 2000). No construction or short-term impacts to surface tidal hydrologic processes would be anticipated.

TABLE 53. HYDROLOGIC PROCESSES – SEDIMENT TRANSPORT

Source: Park Service Management Policies, Marin CWP Nature: Beneficial, Adverse Context: Project Area/Watershed Duration: Long-Term	
No Impact	There would be no potential for impact to sediment deposition rates in the Project Area or sedimentation within the southern portion of the Tomales Bay watershed.
Negligible	There would be a negligible change (±5 percent) in sediment deposition rates in the Project Area and delivery of sediment by Lagunitas Creek to the southern portion of the Tomales Bay watershed.
Minor	There would be a minor change (±6-10 percent) in sediment deposition rates in the Project Area and delivery of sediment by Lagunitas Creek to the southern portion of the Tomales Bay watershed.
Moderate	There would be a moderate change (± 11- 25 percent) in sediment deposition rates in the Project Area and delivery of sediment by Lagunitas Creek to the southern portion of the Tomales Bay watershed.
Major or Substantial	There would be a major or substantial change (> 25) in sediment deposition rates in the Project Area and delivery of sediment by Lagunitas Creek to the southern portion of the Tomales Bay watershed.

Impact Analysis

TABLE 54. INTENSITY, NATURE, TYPE, DURATION, AND CONTEXT OF IMPACTS FOR WATER RESOURCES –HYDRAULICS AND HYDROLOGIC PROCESSES

All impacts would be considered Project Area and are separately analyzed for Construction and Short-Term/Long-Term.

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Impact Indicator	Intensity, Nature, Type, Duration, and Context of Impact				
Surface Tidal Hydrologic Processes	Beneficial-Negligible	Beneficial-Moderate	Beneficial-Moderate	Beneficial-Moderate	Beneficial-Moderate
Surface Freshwater Hydrologic Processes (Project Area/ Watershed)	Beneficial-Minor/ Negligible	Beneficial-Minor/ Minor	Beneficial-Moderate/ Minor	Beneficial-Moderate/ Moderate	Beneficial-Moderate/ Moderate
Hydrologic Functions – Floodplains and Floodwater Retention	Beneficial –- Negligible	Beneficial - Moderate	Beneficial - Major	Beneficial - Major	Beneficial - Major
Hydrologic Processes – Sediment Transport (Project Area/ Watershed)	Beneficial-Negligible/ Negligible	Beneficial-Major/ Minor	Beneficial-Major/ Moderate	Beneficial-Major/ Moderate	Beneficial-Major/ Moderate

TABLE 55. ESTIMATION OF CHANGES IN HYDRAULIC AND HYDROLOGIC PROCESSES FOR THE GIACOMINI WETLAND RESTORATION PROJECT.

	Existing Conditions	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Surface Tidal Hydrologic Processes						
Extent of Area Inundated by MHW (Acres)	10.9	20.9	200.0	210.4	231.4	252.3
(Percent Change)						
Surface Freshwater Hydrologic Processes						
Estimated Percent Change in the Number of Infrastructure, Facilities, and Management Practices						
Project Area		12	19	37	39	44
(Watershed)		(5)	(10)	(10)	(15)	(17)
Hydrologic Functions – Floodplains and Floodwater Retention						
Cumulative Floodwater Volume – 2-year event (acre-feet)						
Project Area	101	101	1085	1873	2049	2079
Lagunitas Creek	*9972*	*9972*	*8971*	*8104*	*7999*	*7973*
Hydrologic Processes – Sediment Transport						
Estimated Sediment Deposition from Lagunitas Creek (tons/day) – 2-year event						
Project Area	0	0	4,768	8,896	9,397	9,521
Tomales Bay	*50,000*	*50,000*	*45,232*	*41,104*	*40,603*	*40,479*

No Action Alternative

Analysis: The No Action Alternative would generally have negligible to minor beneficial effects on water resources and hydrologic processes and functions (Table 54).

Under the No Action Alternative, levees in the Giacomini Ranch are not breached or removed, except for the 11-acre wetland restoration area in the northeastern corner of the East Pasture. The Park Service is required under its existing agreement with CalTrans to restore wetlands as mitigation for impacts caused by CalTrans to aquatic habitat from a road repair on State Route 1 in Marin County in exchange for the Park Service receiving monies to purchase and restore the Giacomini Ranch. The remainder of the levee would remain, although there would be no levee maintenance. Olema Marsh is also not restored, and there would be no new public access facilities. There would be only a negligible change in surface tidal hydrologic processes or areas exposed to daily tidal action, floodplain area and the volume of water moving through floodplains, and sediment deposition on floodplains relative to baseline or existing conditions, at least in the immediate long-term future.

Under the No Action Alternative, there is a potential for leased grazing of dairy heifers or beef cattle on the Giacomini Ranch lands in the future, which would be in accordance with the parks' GMP. Leasing would undergo a separate environmental review process, but it is likely that, if lease or leases were approved, that the Seashore would institute restrictions on resource setbacks or setbacks from creeks and certain wetland areas, as well as the intensity, duration, and timing of grazing. In addition, certain creeks in the West Pasture would continue to be dredged to eliminate flood risks to adjacent private residences.

Levees would continue to act as constraints on floodplains and floodwater retention, although these constraints are limited to smaller flood events such as the 2- to 10-year floods. Without maintenance, levees would be expected to degrade over time, thereby increasing the potential for greater change in these processes and functions, however, the rate of degradation is difficult to predict and location of breaching and flooding would be clustered around large scale storm events. During this same time frame, long-term trends in sea level rise could also cause an increase in the potential extent of area inundated by tides, especially on upstream reaches of Tomasini Creek and Olema Marsh. Levees and tidegates would generally restrict the potential for surface tidal inundation in the East and West Pastures, however, recently published studies suggest that sea level rise rates may be much greater than predicted, with water levels rising as much as 3 feet by 2100 (Overpeck et al. 2006).. This sea level rise, when combined with levee degradation, could lead to intrusion of tidal influence into large portions of the Giacomini Ranch pastures, particularly areas below 4 ft NAVD88.

Under the existing purchase agreement with the Giacomini Trust, the Giacomini Ranch dairy had a 7-year Reservation of Use agreement that allowed the Giacomini family to continue dairying until the agreement expires in spring 2007. At that time, the dairy will close, and agricultural management practices associated with dairying will cease. These management practices include crossing of Lagunitas Creek by Giacomini Ranch dairy cows; infrequent discharge of waters in East Pasture ditch system to Lagunitas Creek; periodic maintenance of levees and creek crossings; dredging of creeks for improved pasture drainage; disposal of sediments; and diversion of waters from Lagunitas Creek and Fish Hatchery Creek for pasture irrigation and livestock watering purposes. The Park Service will also dedicate appropriative irrigation water right to beneficial instream uses. These changes will have a beneficial effect on both tidal and surface water hydrologic processes, resulting in a 12 percent decrease in the number of infrastructure, facilities, and management practices that affect surface freshwater hydrologic processes relative to existing conditions (Table 55).

Tidal Prism: Through the limited wetland mitigation component, the extent of area inundated by daily tidal action (Mean High Water) and available floodplain within the East Pasture would be increased by 10 acres or approximately 2 percent (Table 55). The tidegate/flashboard dam structure on Tomasini Creek would not be removed, but would be left in place to maintain subtidal conditions during low tides for the federally endangered fish species, tidewater goby (*Eucyclogobius newberryi*). The tidegate/flashboard dam structure currently does not function properly, allowing the full extent of high tides into the diked portion of Tomasini Creek. The structure prevents complete outflow during low tides, controlling a residual base water level at least 1- to 2 feet above the deepest part of the channel (KHE 2006a). Peak high tides within the diked portion of Tomasini Creek reach 7 feet NAVD88 and are not attenuated significantly as distance from the tidegate increases (KHE 2006a). Estuarine circulation patterns and salinities would continue to be dampened by the appreciable amount of groundwater inflow that comes from the Point Reyes Mesa, maintaining brackish water

salinities for most of the summer and fall despite the strength of tidal influence. During high tides, there would still continue to be some muted tidal action in the shallowly flooded sparsely vegetated flats in eastern portion of the East Pasture from Tomasini Creek waters flowing through a culvert in the Tomasini Creek berm.

Tidegates which facilitate the existing muted tidal regime in the northern portion of the West Pasture would also remain on Fish Hatchery Creek. The existing condition has been documented to cause seasonal spikes in salinity in the large freshwater marsh adjacent to Sir Francis Drake Boulevard. The West Pasture tidegate mutes the tidal regime to fluctuate between 3.4 and 5.25 ft NAVD88. Circulation patterns and salinities in the West Pasture would continue to be strongly influenced by perennial freshwater flow from Fish Hatchery Creek, as well as several other small drainages. In Olema Marsh, the box culvert at Levee Road would continue to act as a grade control structure that limits tidal exchange into a very limited portion of the marsh to tides exceeding 4.5 ft NAVD88 (KHE 2006a).

Floodplain/Floodwater Retention: Under this alternative, levees would continue to act as constraints on floodplains and floodwater retention, although these constraints are limited to smaller flood events such as the 2- to 10-year floods. Under these smaller flow events, floodplains for Lagunitas and Tomasini Creeks within the Project Area are limited to the channel and narrow fringes of marshplain on the outboard of the levees. At its upstream end, the East Pasture would flood during 3.5-year flood events or during storms that occur, on average, every 3.5 years, which is reflected in the relatively low cumulative volume of floodwaters that move through the East Pasture and Tomasini Creek under a 2-year event (~97 acre-feet; KHE 2006a). Almost all of that water comes from Tomasini Creek, which is hydrologically disconnected from the adjacent East Pasture by a levee. Overtopping of the creek bank in the East Pasture downstream of White House Pool would occur less frequently (7-year flood event). On larger floods, the entire pasture would be inundated, with cumulative floodwater volume during a 100-year event climbing to approximately 19,000 acre-feet (KHE 2006a). Tomasini Creek would only reach levels sufficient to overbank flood onto floodplains during some of the larger flood events (KHE 2006a). Under this alternative, inundated area in the East Pasture would range from 1.8 acres under the 2-year flood event, with the entire 350-acre East Pasture flooded during a 50-year event (KHE 2006a). Once flooded, floodwaters in the East Pasture would be expected to become impounded – the bathtub effect -- for days or even weeks in the lower elevation northern portions of the East Pasture just as they do now, because drainage outflow is restricted by the levees, concrete spillway, and undersized or poorly functioning tidegates.

Flooding of the West Pasture by Lagunitas Creek would not occur generally until stream discharge reached levels comparable to a 12-year flood event, although the numerous Inverness Ridge drainages that flow into the West Pasture would continue to cause flooding problems for residents adjacent to Sir Francis Drake Boulevard (KHE 2006a). An analysis of the effect of the proposed project on flooding issues related to public health and safety are discussed later in this Chapter. The inundation area in the West Pasture would be larger (76 acres) than the East Pasture under the 2-year event because of flooding from Fish Hatchery Creek and the other Inverness Ridge drainages, with the entire 200 acres completely flooded by the 500-year event (KHE 2006a). However, the cumulative volume of floodwaters in the West Pasture would be much lower, ranging from approximately 4 to 610 acre-feet (KHE 2006a). As with the East Pasture, the West Pasture also tends to impound waters in its northern portions because of levees, concrete spillway, and limited drainage outflow through the tidegate, although the degree of impoundment is considerably reduced. For Olema Marsh, the problem would continue to be levees and culverts holding water in, not keeping waters out. Under a 2-year flood event, the lack of hydraulic connectivity and inadequate drainage caused by the Levee Road culvert would maintain inundated area at 49 acres, with the extent of the 500-year flood event climbing only slightly to 67 acres (KHE 2006a). The only change in floodplains and floodwater storage would come from restoration of the 11-acre wetland, and this would be expected to have an extremely negligible effect on flooding patterns and storage, resulting in no change in the total volume of floodwaters moving through the Giacomini Ranch during a 2-year event relative to existing conditions (~101 acre-feet; Table 55).

Stream Power and Sediment Transport Patterns: The potential movement of sediment onto floodplains in the Project Area would continue to be restricted by poor connectivity between creeks and floodplains during smaller and more frequent flood events (< 10-year flood events). Smaller flow events such as these often constitute the “dominant discharge” streamflows at which most of the sediment transport within many systems occurs, at least on average. During the 1979-1980 study, the rate of sediment transport in the lower portions of Lagunitas Creek just upstream of the Project Area already showed signs of declining at the 1-year flood event, although the total load continued to increase with streamflow at a slower rate, with some of the most extensive sedimentation in recent decades observed after the 100-year flood event in 1982 (H. Esmaili and Associates 1980; Anima et al. 1988). Based on the sediment rating curve developed by H. Esmaili &

Associates (1980), approximately 50,000 tons per day of suspended sediment would potentially move through the Project Area during a 2-year flood event, with only negligible amounts potentially being deposited on Project Area floodplains. The only potential change in sediment deposition patterns on the Giacomini Ranch floodplains relative to baseline conditions would be negligible and would come from the 11-acre restored wetland in the northeastern portion of the East Pasture, which is unlikely to receive much in the way of sediment.

The potential movement of sediment onto floodplains would occur under higher flood flow events, although, at the higher flow velocities, a higher percentage of sediment may be transported through rather than deposited onto floodplains. During higher flood flows (~3.5- to 7-year flood events), floodwaters within Lagunitas Creek would crest the levee and flow into the East Pasture. Based on hydraulic modeling, stream power would drop sharply once floodwaters crest the levee, causing most, if not all, of the sediment to deposit in the southern portion of the pasture (KHE 2006a). This is the same sediment deposition pattern that exists now, although the Giacominis have preferentially directed flood flows to the southwestern corner of the East Pasture by removing or lowering levees in this area (KHE 2006a). Stream power would decrease appreciably under all flooding conditions in the northern portion of the East Pasture due to impoundment of floodwaters by the levee, concrete spillway, and tidegates/culverts (G. Kamman, KHE, *pers. comm*.). Similar to baseline conditions, stream power would remain extremely low throughout Olema Marsh, although transport capacity increases considerably near the Levee Road culvert outlet (KHE 2006a). In Lagunitas Creek, stream power during a 2-year flood event would be similar to baseline conditions and remain sufficient to maintain transport capacity of fine sediments, coarse sands, and fine gravels throughout the Project Area (KHE 2006a). Stream power would be even lower in the West Pasture than the East Pasture, with hydraulic modeling suggesting that there would be little to no sediment deposition under even higher flood flows (KHE 2006a).

The potential movement of sediment onto floodplains would occur under higher flood flow events, although, at the higher flow velocities, a greater percentage of sediment may be transported through rather than deposited onto floodplains. During higher flood flows (~3.5- to 7-year flood events), floodwaters within Lagunitas Creek would crest the levee and flow into the East Pasture. Based on hydraulic modeling, stream power would drop sharply once floodwaters crest the levee, causing most, if not all, of the sediment to deposit in the southern portion of the pasture (KHE 2006a). This is the same sediment deposition pattern that exists now, although the Giacominis have preferentially directed flood flows to the southwestern corner of the East Pasture by removing or lowering levees in this area (KHE 2006a). Stream power would decrease appreciably under all flooding conditions in the northern portion of the East Pasture due to impoundment of floodwaters by the levee, concrete spillway, and tidegates/culverts (G. Kamman, KHE, *pers. comm*.). Similar to baseline conditions, stream power would remain extremely low throughout Olema Marsh, although transport capacity increases considerably near the Levee Road culvert outlet (KHE 2006a). In Lagunitas Creek, stream power during a 2-year flood event would be similar to baseline conditions and remain sufficient to maintain transport capacity of fine sediments, coarse sands, and fine gravels throughout the Project Area (KHE 2006a). Stream power would be even lower in the West Pasture than the East Pasture, with hydraulic modeling suggesting that there would be little to no sediment deposition under even higher flood flows (KHE 2006a).

Tidal Power and Sediment Transport Patterns: Sediment can also be moved through estuarine sediment transport processes. Hydraulic modeling of tidal velocities during an average tidal month suggests that tidal velocities do not exceed 1.3 feet per second (ft/s) except in between White House Pool and the cattle crossing location (KHE 2006a). These velocities are typically insufficient to move loose sandy clay, much less the denser alluvial sands and gravels that primarily comprise the Lagunitas Creek streambed in the Project Area (KHE 2006a). The tidegate/culvert on Fish Hatchery Creek also appears to have reduced tidal velocities in the West Pasture, with velocities rarely exceeding 0.3 ft/s. In Olema Marsh, tidal velocities may exceed 2.6 ft/s, but tidal influence only extends into Bear Valley Creek and the marsh outlet for a very short distance (~60 feet; KHE 2006a). There is no tidal influence currently in the East Pasture, and the wetland mitigation/restoration would be expected to have only a very negligible effect, if any, on tidal velocities.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: There are at least two currently proposed projects that would have the potential to cause cumulative impacts should the No Action alternative be implemented, the Bear Valley Creek Watershed Enhancement Project and replacement of the Rift Zone Trail culvert. The Rift Zone Trail culvert would be

replaced in the summer of 2006 with a bridge. The Bear Valley Creek Project proposes to replace failing or underperforming hydrologic infrastructure at a number of locations on Bear Valley Creek within the Seashore boundaries. There is no definitive timeframe for construction of this project, but preliminary design for this project would be expected to have a cumulatively beneficial effect through improvement of hydrologic and ecological processes and functions in the upper portions of the Bear Valley Creek subwatershed, upstream of Olema Marsh. This effect would be appear to be negligible to minor for the proposed project as a whole, but it would be a major or substantial beneficial effect on the Bear Valley Creek subwatershed.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The No Action alternative would generally result in generally negligible to minor beneficial effects on hydrologic processes. The restoration would add approximately 10 acres intertidal habitat and would have only negligible effects on floodplains and floodwater storage and sediment transport processes. The No Action Alternative would have minor beneficial effects on fluvial or surface freshwater hydrologic processes in the Project Area, largely because of the elimination of intensive agricultural management practices. Should leasing grazing be approved after the Reservation of Use agreement expires in 2007, there would continue to be cattle grazing, but the Seashore would institute restrictions that would establish resource setbacks, grazing intensity, duration, and timing. These and the other changes would have minor beneficial effects on hydrologic processes in the Project Area, but only negligible beneficial effects on watershed function.

Alternative A

Analysis: Alternative A would have minor to major beneficial effects on water resources and hydrologic processes and functions (Table 54). Under Alternative A, only the East Pasture would be restored, with new public access facilities limited to the eastern and southern perimeters of the East Pasture. Restoration would involve breaching of levees in the East Pasture along Lagunitas Creek, and excavation of new tidal channels. Streambank armoring in the southwestern corner of the East Pasture creek bank would be removed and the banks regraded to a more stabile profile. Most of the actions under this alternative focus on removal agricultural infrastructure such as filling of ditches, ripping of compacted roads, fence removal, and removal of pumps, pipelines, and concrete spillways. The West Pasture and Olema Marsh would not be restored, and there would be no levee maintenance in the West Pasture.

Fluvial and Freshwater Processes: As with the No Action Alternative, the tidegate/flashboard dam structure on Tomasini Creek would not be removed, but would be left in place to maintain subtidal conditions during low tides for the federally endangered fish species, tidewater goby (*Eucyclogobius newberryi)*. Tidegates would also remain on Fish Hatchery Creek, preserving the muted tidal regime that currently exists in the northern portion of the West Pasture and causing seasonal spikes in salinity in the large freshwater marsh adjacent to Sir Francis Drake Boulevard. The West Pasture tidegate attenuates both the upper and lower portions of the tidal range, maintaining water levels between 3.4 and 5.25 ft NAVD88. Salinities in the West Pasture would continue to be strongly influenced by perennial freshwater flow from Fish Hatchery Creek and groundwater inflow from Inverness Ridge, as well as several other small drainages. In Olema Marsh, the box culvert at Levee Road would continue to act as a grade control structure that limits tidal exchange into a very limited portion of the marsh to tides exceeding 4.5 ft NAVD88 (KHE 2006a).

Under the existing purchase agreement with the Giacomini Trust, the Giacomini Ranch dairy has a 7-year Reservation of Use agreement that allows the Giacomini family to continue dairying until the agreement expires in spring 2007. At that time, the dairy will close, and agricultural management practices associated with dairying will cease. These management practices include crossing of Lagunitas Creek by Giacomini Ranch dairy cows; infrequent discharge of waters in East Pasture ditch system to Lagunitas Creek; periodic maintenance of levees and creek crossings; dredging of creeks for improved pasture drainage; disposal of sediments; and diversion of waters from Lagunitas Creek and Fish Hatchery Creek for pasture irrigation and livestock watering purposes. In addition, the infrastructure described above would be removed. The Park Service would also be redesignating the appropriative water right purchased with the Giacomini Ranch that has been used for irrigation for beneficial instream uses. However, certain creeks in the West Pasture would need to continue to be dredged to eliminate flood risks to adjacent private residences.

As part of the public access, the southern perimeter trail would include a prefabricated bridge across Lagunitas Creek, near the old summer dam location across from White House Pool County Park, The bridge would be designed to have no footings in the active channel or floodplain, thereby reducing effects on hydrologic processes. Future extension of the southern perimeter trail, in collaboration with the County of Marin, would connect White House Pool County park with a path along Sir Francis Drake that would either run alongside Sir Francis Drake Boulevard or move off the road at the southern end of the unrestored West Pasture onto a low-elevation boardwalk that would join back with Sir Francis Drake Boulevard in Inverness Park. The other infrastructure that would be constructed under Alternative A would be a culverted berm through trail on the eastern perimeter of the East Pasture that would be expected to have minor adverse effects on conveyance of the considerable surface water run-off from the Point Reyes Mesa that flows into Tomasini Creek. All of these actions would still be expected, however, to reduce constraints on surface freshwater hydrologic processes within the Project Area by almost 20 percent (Table 55).

Tidal Prism: Breaching of East Pastures would result in a moderate beneficial effect on the extent of area inundated twice daily by tides. Area inundated daily by tides in the East Pasture would be increased to approximately 189 acres, thereby also dramatically increasing available floodplain (Table 55). A considerable portion of the 350-acre East Pasture falls above intertidal topographic elevations and would not be subject to normal tidal flooding. These areas appear to be high either because of historic sediment deposition and/or past fill and grading events. Over the long-term, however, sea level rise could cause an increase in the potential extent of area inundated by tides, particularly in the East Pasture. Recently published studies suggest that sea level rise rates may be much greater than originally predicted, with water levels rising as much as 3 feet by 2100 (Overpeck 2006). This rate sea level rise could lead to regular inundation of large portions of the East Pasture below 4 ft NAVD88.

Floodwater/Floodplain Retention: Under this alternative, the East Pasture would flood more frequently during smaller (1.5- to 2-year) flood events (KHE 2006a). However, Tomasini Creek flood flows would remain largely confined to the narrow channel and fringing marshplain along the East Pasture's perimeter. At its upstream end, the East Pasture would flood during 2-year events as compared to 3.5-year flood events under baseline or existing conditions (KHE 2006a). Lowering of the levee downstream of White House Pool would increase the frequency of flooding in this portion from a 7-year to a 1.5-year flood event (KHE 2006a). Cumulative floodwater volume during the 2-year flood event would increase from approximately 96 acre-feet under baseline or existing conditions to approximately 1,080 acre-feet under restored conditions (KHE 2006a). Almost all of the flood volume under baseline conditions comes from Tomasini Creek, which is hydrologically disconnected from the adjacent East Pasture by a levee.

As more water spills onto the floodplain, cumulative floodwater volume in Lagunitas Creek would drop from approximately 9,975 acre-feet to 8,970 acre-feet, a decrease of 10 percent (Table 55). Floodwater volume in the Project Area would climb from 101 acre-feet under the No Action Alternative (Fish Hatchery Creek and surface run-off volume) to 1,085 acre-feet during a 2-year event, all of which results from an increase in storage volume in the East Pasture (KHE 2006a; Table 55). Cumulative floodwater volume in the East Pasture during a 100-year event would nearly double from approximately 19,000 acre-feet to 35,000 acre-feet (KHE 2006a). Tomasini Creek would still continue to only reach levels sufficient to overbank flood onto floodplains during some of the larger flood events (KHE 2006a). Under this alternative, inundated area in the East Pasture would increase from 1.8 acres under the 2-year flood event to 298 acres, with the entire 350-acre East Pasture flooded during a 50-year event (KHE 2006a). Total inundated area in the Giacomini Ranch during a 2-year event would increase slightly from 78 acres under existing conditions (with the West Pasture drainages accounting for 76 acres and surface runoff the remainder) to approximately 374 acres under Alternative A. Floodwaters would be expected to move through the East Pasture more rapidly with removal of levees, concrete spillway, and undersized or poorly functioning tidegates, which may account for the dramatic increase in cumulative floodwater volume during the 100-year event when the East Pasture would be flooded, as well, under baseline or existing conditions.

As with the No Action Alternative, flooding of the West Pasture by Lagunitas Creek would not occur generally until stream discharge reached levels comparable to a 12-year flood event, although the numerous Inverness Ridge drainages that flow into the West Pasture would continue to cause flooding problems for residents adjacent to Sir Francis Drake Boulevard (KHE 2006a). An analysis of the effect of the proposed project on flooding issues related to public health and safety are discussed later in this Chapter. The inundated area in the West Pasture would be larger (76 acres) than the East Pasture under the 2-year event because of flooding from Fish Hatchery Creek and the other Inverness Ridge drainages, with the entire 200 acres completely flooded by the 500-year event (KHE 2006a). However, the cumulative volume of floodwaters in the West Pasture would be much lower than the East Pasture, ranging from approximately 4 to 610 acre-feet during the

2- and 100-year events (KHE 2006a). The West Pasture would continue to impound waters to some degree in its northern portions because of levees, concrete spillway, and limited drainage outflow through the tidegate, although the degree of impoundment is considerably reduced. For Olema Marsh, the problem would continue to be levees and culverts holding water in, not keeping waters out. Under a 2-year flood event, the lack of hydraulic connectivity and inadequate drainage caused by the Levee Road culvert would maintain inundated area at 49 acres, with the extent of the 500-year flood event climbing only slightly to 67 acres (KHE 2006a).

Stream Power and Sediment Transport Patterns: The potential movement of sediment onto floodplains in the Project Area would increase relative to baseline conditions in the East Pasture with breaching of the Lagunitas Creek levees, particularly during smaller and more frequent flood events (< 10-year flood events). Based on the sediment rating curve developed by H. Esmaili & Associates (1980), approximately 50,000 tons/day of suspended sediment would potentially move through the Project Area during a 2-year flood event. Under Alternative A, approximately 10 percent of this or almost 5,020 tons/day would potentially be diverted from Lagunitas Creek and flow through the East Pasture. The percentage of material deposited on floodplains versus transported through depends on a number of factors, but trapping efficiency is often higher under smaller floods such as 5-year events than larger ones such as 25-year events, because flood flow velocities on the floodplain are lower (Heimann 2001). A study on 11 natural (versus constructed) wetlands in the United States yielded a median trapping or removal efficiency rate for Total Suspended Solids (TSS; suspended sediment and other materials) of 76 percent, with a maximum removal rate up to 95 percent (Strecker et al. 1992) *in* Kadlec and Knight 1996).

Based on hydraulic modeling, stream power during average and maximum flood conditions in the East Pasture would be considerably higher under Alternative A relative to baseline conditions, but still not high enough to increase transport capacity across the floodplain (KHE 2006a). As with No Action Alternative, stream power would drop sharply once floodwaters crest the levee, causing most of the sediment to deposit in the southern portion of the pasture (KHE 2006a). This is the same sediment deposition pattern that exists now, although the Giacominis have preferentially directed flood flows to the southwestern corner of the East Pasture by removing or lowering levees in this area (KHE 2006a). These results would suggest that trapping efficiency, at least under the modeled flows, would be closer to the higher end of the range quoted earlier, with perhaps as much as approximately 4,770 tons/day potentially being deposited rather than transported through the East Pasture floodplain (Table 55). Sediment delivery to Tomales Bay could be reduced under Alternative A by almost 9.5 percent, which would be expected to have a minor beneficial effect (Table 55). Stream power in the West Pasture would remain similar to the No Action Alternative, because there would be no restoration activities in the West Pasture under Alternative A, with stream power similar to or slightly higher under maximum flooding to the East Pasture (KHE 2006a). Stream power in Lagunitas Creek would continue to be very similar to baseline conditions and sufficient to maintain transport capacity of fine sediments, coarse sands, and fine gravels throughout most of the Project Area, although there would be a slight decrease in stream power downstream of the cattle crossing (KHE 2006a).

Sediment deposition during floods can, over time, lead to net aggradation within floodplain areas and, ultimately, decrease trapping efficiency as vertical elevation of the floodplain rises. This trend tilts the evolutionary trajectory within wetland systems towards establishment of uplands, but within naturally dynamic systems such as estuaries, these trends are often counterbalanced by sea level rise (discussed above under Tidal Prism) and subsidence (either compaction- or fault-associated) that act to maintain or regenerate wetlands even within depositional environments.

Tidal Power and Sediment Transport Patterns: Sediment conveyance onto floodplains would have implications for the long-term sustainability of tidal channels created in the East Pasture, with sediment deposition tending to silt in channels and decrease drainage areas that maintain channel capacity. These forces would be counteracted to some degree by the energy of tidal flows, although, over the long-term, channels would be expected to decrease in size over time relative to constructed conditions to dimensions that can be maintained by the available drainage area and tidal currents. Hydraulic modeling showed that tidal velocities (~6.6 ft/s) during an average tidal month would be sufficient in the hydrologically reconnected East Pasture Old Slough to erode or maintain created channels at least in the northern portion of the East Pasture through mobilization of sediment with bulk densities as high as compact sandy clay, including potentially sediment deposited during overbank flooding (KHE 2006a). Tidal velocities in the West Pasture would remain low (< 0.5 ft/s) due to muting of tidal inflow and below the threshold for mobilization of loose sandy clay material (KHE 2006a). In Lagunitas Creek, tidal velocities would be almost identical to those under baseline conditions and the No Action Alternative, suggesting that there would not likely be any net changes in channel conditions (KHE 2006a).

With maintenance of existing tidal velocities in Lagunitas Creek, the influence of estuarine sediment transport processes such as gravitational circulation that involves resuspension of sediment along channel bottoms through strong tidal currents would likely remain negligible in the Project Area, because tidal currents are not sufficient to move the alluvial sands and gravels that comprise most of the streambed. However, tides and currents would continue to strongly influence circulation patterns within this reach of Lagunitas Creek such as gravitational circulation or density- or salinity-based stratification of waters that could at least create, particularly in areas where bathymetry changes abruptly such as shoals, zones where suspended sediment concentrations would reach a peak or maximum and preferentially fall out of suspension in the creek channel. While this could contribute to reductions in sediment delivery to Tomales Bay, the dominance of fluvial forces in this part of the estuary would suggest that fluvial sediment transport processes governing transport and deposition within in-stream and off-stream storage areas such as floodplains would largely dictate sediment delivery rates to the Bay, at least within the Project Area.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable.

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative A would result in minor to major beneficial effects on hydrologic processes. Under Alternative A, only the East Pasture would be restored, and most of the new public access infrastructure and facilities, including a bridge, would be located along the perimeter of the East Pasture and southwestern portion of the West Pasture. Breaching of the levees would restore tidal inundation to approximately 189 acres in the East Pasture, resulting in moderate beneficial impacts. Alternative A would have minor beneficial effects on fluvial or surface freshwater hydrologic processes in the Project Area, largely because of levee breaches and elimination of agricultural infrastructure and management practices. Some of the largest benefits would come from the moderate beneficial effects on floodplains and floodwater storage and sediment transport processes. Both the cumulative amount of floodwater and the amount of suspended sediment that potentially is deposited onto the East Pasture would increase dramatically under this alternative. The potential for increased sediment deposition on East and West Pasture floodplains would mean that flood flows could potentially reduce delivery of sediment to the southern portion of Tomales Bay by up to 9.5 percent or 4,770 tons/day during 2-year events, which would suggest that this alternative might have at least a minor beneficial effect on sedimentation patterns in southern portion of the watershed.

Alternative B

Analysis: Alternative B would have similar impacts to Alternative A on water resources and hydrologic processes, resulting in beneficial effects that range from minor to major (Table 54). Under Alternative B, the East and West Pastures would be restored, but not Olema Marsh. Most of the new public access facilities would continue to be limited to the eastern and southern perimeters of the East Pasture, including construction of the pedestrian access bridge across Lagunitas Creek near the old summer dam, and a planning area for continuation of the southern perimeter trail to Inverness Park. On the West Pasture north levee, a viewing area would replace the informal existing trail. Restoration would involve complete removal of levees in the East Pasture along Lagunitas Creek and excavation of even more new tidal channels. Breaches would be created in the West Pasture levee, including removal of the north levee. The southern East Pasture creek bank would be restored through removal of rip-rap bank stabilization and regraded, where needed, to a more stabile profile. Some connection would be established between the East Pasture and Tomasini Creek through lowering of levees to allow overflow during flood events. As with Alternative A, this alternative would involve removal or restoration of agricultural infrastructure and discontinuation of agricultural management practices.

Fluvial or Freshwater Processes: Alternative B would have very similar effects to Alternative A on fluvial or surface freshwater hydrologic processes in the Project Area, with impacts characterized as minor and beneficial. This alternative would expand the amount of levee breaching and removal, remove the Fish Hatchery Creek tidegate, and eliminate of agricultural infrastructure and management practices from both the

East and West Pastures. As with Alternative A, the tidegate/flashboard dam structure on Tomasini Creek would remain to maintain subtidal conditions during low tides for the federally endangered fish species, tidewater goby (*Eucyclogobius newberryi*). Under this alternative, a small berm would potentially be constructed to reduce flooding of lower-elevation private properties on the east side of Sir Francis Drake Boulevard: while this would reduce fluvial influences of Lagunitas Creek on this property, it could potentially at least temporarily increase inundation or flooding of the property from surface flow and run-off from the Inverness Ridge. Approximately 5 acres of freshwater marsh would be created in the East Pasture Tomasini Triangle as alternate breeding habitat for the California red-legged frog, as removal of the Fish Hatchery Creek tidegate/culvert at the West Pasture north levee would increase tidal intrusion into the freshwater marsh that serves as its primary breeding habitat in the Giacomini Ranch currently. Creation of this marsh would constrain sheet flow of surface run-off and groundwater emerging from the base of the Point Reyes Mesa through berms constructed to prolong ponding of waters for creation of breeding California red-legged frog habitat and minimize potential tidal intrusion during extreme high or storm tides.

As with Alternative A, the southern perimeter trail would include a prefabricated bridge across Lagunitas Creek, near the old summer dam location across from White House Pool County Park, The bridge would be designed to have no footings in the active channel or floodplain, thereby reducing effects on hydrologic processes. Future extension of the southern perimeter trail, in collaboration with the County of Marin, would connect White House Pool County park with a path along Sir Francis Drake that would either run alongside Sir Francis Drake Boulevard or move off the road at the southern end of the unrestored West Pasture onto a low-elevation boardwalk that would join back with Sir Francis Drake Boulevard in Inverness Park. In addition, under Alternative B, the east perimeter trail would be constructed as a boardwalk trail (rather than culverted berm) to allow more of the surface water run-off from the Point Reyes Mesa to flow into Tomasini Creek unimpeded. All of these actions would still be expected to reduce constraints on surface freshwater hydrologic processes within the Project Area by almost 37 percent (Table 55).

Tidal Prism: Complete removal of the East Pasture levee would result in benefits similar to those described under Alternative A, restoring daily tidal flooding (up to MHW) to approximately 189 acres (KHE 2006a). Breaching of the West Pasture levee would have only a small effect on the extent of area inundated by daily tides, which would increase from 10.9 acres to 21.3 (KHE 2006a). Area inundated during daily tides within the Project Area would increase from approximately 200 acres under Alternative A to approximately 210 acres under Alternative B (KHE 2006a; Table 55). Breaching of the levees would primarily influence the extent of high tides (above MHW). Under current conditions, the tide gate facility creates a muted tidal regime with tides fluctuating between 3.4 and 5.25 ft NAVD88. While only limited new areas would be inundated at MHW, areas flooded during extreme high tides in the West Pasture would increase dramatically under Alternative B from 7.1 acres to 98.9 acres (KHE 2006a). This increase in tidal influence would be expected to increase tidal flooding of the freshwater marsh adjacent to Sir Francis Drake Boulevard, which supports breeding California red-legged frog (*Rana aurora draytonii*), a federally threatened species. Generally, this would result in a reduction in area of the marsh, not complete loss of this important freshwater habitat. This issue is discussed in more detail under Wildlife Resources.

Floodplain/Floodwater Retention: Under this alternative, both the West and East Pastures would flood more frequently during smaller (1.5- to 2-year) flood events (KHE 2006a). However, Tomasini Creek flood flows would typically remain confined to the narrow channel and fringing marshplain along the East Pasture's perimeter, except when flows are high to overtop the lowered section of levee. As with Alternative A, the East Pasture would continue to flood during 1.5- to 2-year events relative to the 3.5- to 7-year flood events required under baseline conditions to overtop levees (KHE 2006a). Cumulative floodwater volume during the 2-year flood event would increase from approximately 96 acre-feet under baseline or existing conditions to approximately 1,873 acre-feet, almost double the volume under Alternative A (1,085 acre-feet; KHE 2006a; Table 55). Almost all of the flood volume under baseline conditions comes from Tomasini Creek, which is hydrologically disconnected from the adjacent East Pasture by a levee. As more water spills onto the floodplain, cumulative floodwater volume in Lagunitas Creek would drop from approximately 9,972 acre-feet under existing conditions to 8,100 acre-feet, a decrease of 19 percent and nearly twice the reduction provided by Alternative A (Table 55). Cumulative floodwater volume during a 100-year event would still double relative to baseline conditions from approximately 19,000 acre-feet to 39,200 acre-feet, but the increase between Alternatives A and B is not nearly as great (KHE 2006a). Under this alternative, inundated area in the East Pasture would remain similar to that under Alternative A (~300 acres) under the 2-year flood event, increasing from 1.8 acres under baseline conditions (KHE 2006a). During a 50-year event, the entire 350-acre East Pasture would be flooded (KHE 2006a). Floodwaters would be expected to move through the East Pasture more rapidly with removal of levees, concrete spillway, and undersized or poorly functioning

tidegates, which may account for the dramatic increase in cumulative floodwater volume during the 100-year event relative to baseline or existing conditions.

Under Alternative B, flooding of the West Pasture by Lagunitas Creek would become more frequent, dropping from a 12-year recurrence interval to a 2-year recurrence interval (KHE 2006a). A certain percentage of floodwaters within the West Pasture would continue to be generated by the numerous Inverness Ridge drainages that flow into the West Pasture, which cause flooding problems for residents adjacent to Sir Francis Drake Boulevard (KHE 2006a). An analysis of the effect of the proposed project on flooding issues related to public health and safety is discussed later in this Chapter. The inundated area in the West Pasture under the 2-year event would actually decrease slightly from 76 acres to 70 acres, probably because removal of the concrete spillway, levees, and tidegate/culvert would decrease impoundment of waters. The entire 200 acres would be completely flooded by the 500-year event (KHE 2006a). The discrepancy between pastures in total inundation (50-year versus 500-year flood event) is reflected in the much lower cumulative floodwater volume in the West Pasture, which ranges from approximately 5 to 3,200 acre-feet during the 2- and 100-year events (KHE 2006a). For Olema Marsh, existing levees and culverts maintain a ponded water condition. Under a 2-year flood event, the ponded condition in the Olema Marsh would maintain inundated area at 49 acres, with the extent of the 500-year flood event climbing only slightly to 67 acres (KHE 2006a).

Stream Power and Sediment Transport Patterns: The potential movement of sediment onto floodplains in the Project Area would continue to increase under this alternative relative to baseline conditions with complete removal of the East Pasture levees and breaching of the West Pasture ones, particularly during smaller and more frequent flood events (< 10-year flood events). Under Alternative B, the percentage of suspended sediment from Lagunitas Creek moving through the East Pasture would increase from approximately 10 percent or 5,020 tons/day under Alternative A to 18.7 percent or 9,341 tons/day under Alternative B (KHE 2006a). Conversely, the percentage that would be diverted into the West Pasture would be much lower -- approximately 23 tons/day (KHE 2006a). The percentage of material deposited versus transported through depends on a number of factors, but often more deposition occurs under smaller floods such as 5-year events than larger ones such as 25-year events, because flood flow velocities on the floodplain are lower (Heimann 2001). A study on 11 natural (versus constructed) wetlands in the United States yielded a median trapping or removal efficiency rate for Total Suspended Solids (TSS; suspended sediment and other materials) of 76 percent, with a maximum removal rate up to 95 percent (Strecker et al. 1992 *in* Kadlec and Knight 1996)

Based on hydraulic modeling, stream power for the East Pasture would be almost identical to that under Alternative A, with trapping efficiency, at least under smaller flows, totaling approximately 8,875 tons/day (Table 55). Stream power would increase considerably in the West Pasture with breaching of levees, although transport capacity would still be too low to move sediment further than the edge of the floodplain (KHE 2006a). Sediment delivery to Tomales Bay could be reduced considerably under Alternative B from 9.5 percent (~4,770 tons/day) under Alternative A to 17.8 percent (~8,900 tons/day) under Alternative B (Table 55). This reduction would be expected to have a moderate beneficial effect on sediment and pollutant delivery to the Bay (Table 55).

While removal of the levees and increased off-channel storage of flood flows might be expected to decrease stream power in Lagunitas Creek channel and increase deposition or aggradation of sediment in this reach, hydraulic modeling suggests that, during 2-year flood events or typical channel-forming flows, the creek would continue to maintain transport capacity at least in the reach upstream of White House Pool (KHE 2006a). Downstream of White House Pool, stream power would drop measurably, enough to potentially decrease transport capacity of silt and fine sand, although the magnitude of these change would not be anticipated to appreciably alter channel geometry or bed-form conditions (KHE 2006a).

Tidal Power and Sediment Transport Patterns: Hydraulic modeling showed that tidal velocities (~6.6 ft/s) during an average tidal month would be sufficient in the hydrologically reconnected East Pasture Old Slough to erode or maintain created channels at least in the northern portion of the East Pasture through mobilization of sediment with bulk densities as high as compact sandy clay, including potentially sediment deposited during overbank flooding (KHE 2006a). Conversely, tidal velocities in the West Pasture may be much lower (~1.2 ft/s) than the East Pasture and below the threshold for mobilization of loose sandy clay material, although they would be higher than under baseline conditions (KHE 2006a). In Lagunitas Creek, tidal velocities would be almost identical to those under baseline conditions and Alternatives A and B, suggesting that there would not likely be any net changes in channel conditions (KHE 2006a).

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this

alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative B would have similar minor to major beneficial effects on hydrologic processes as Alternative A. Under this alternative, both the West and East Pasture would be restored, although most of the new public access infrastructure and facilities, including a bridge, would be located along the perimeter of the East Pasture. Complete removal of the East Pasture levees and breaching of the West Pasture levees would result in moderate beneficial effect on the extent of tidal inundation. This alternative would have moderate beneficial effects on freshwater hydrologic processes in the Project Area through expanded removal and breaching of levees, removal of the Fish Hatchery Creek tidegate, and discontinuation or deconstruction of agricultural practices and infrastructure in both the West and East Pastures, although, from a watershed perspective, the beneficial effects would be relatively minor. There would be the potential for construction of small levees to protect lower-elevation properties on the east side of Sir Francis Drake Boulevard. As with Alternative A, some of the largest benefits would come from the major or substantial beneficial effects on floodplains and floodwater storage and sediment transport processes. Both the cumulative amount of floodwater and the amount of suspended sediment that moves through the Project Area floodplains would increase substantially under this alternative, potentially decreasing the amount of sediment that is delivered by Lagunitas Creek to southern Tomales Bay by up to 17.8 percent or 8,900 tons/day during 2-year events. Based on these results, the project would result in potentially moderate beneficial effects on sedimentation patterns in southern portion of Tomales Bay.

Alternative C

Analysis: Alternative C would have very similar impacts to Alternative B on water resources and hydrologic processes, with beneficial effects ranging from minor to major (Table 54). Under Alternative C, the East and West Pastures would be restored, along with Olema Marsh. Most of the new public access facilities would continue to be limited to the eastern and southern perimeters of the East Pasture, although access along the eastern perimeter would be scaled back through removal of the through-trail component. The southern perimeter trail would include construction of the pedestrian access bridge across Lagunitas Creek near the old summer dam, and a planning area for continuation of the southern perimeter trail to Inverness Park. Restoration would involve complete removal of levees in the East and West Pastures along Lagunitas Creek and excavation of even more new tidal channels. A small tidal channel would be initiated off Lagunitas Creek, as well as in the interior of the East Pasture. Tomasini Creek would be realigned into one of its historic alignments midway through the East Pasture. In Olema Marsh, an adaptive restoration approach would be undertaken, with initial excavation of a shallow berm and the Bear Valley Creek channel to improve hydraulic connectivity and improve drainage of currently impounded waters. As with the other alternatives, this alternative would involve removal or restoration of agricultural infrastructure and discontinuation of agricultural management practices.

As with the other alternatives, the tidegate/flashboard dam structure on what would become the former Tomasini Creek would not be removed, but would be left in place to maintain subtidal conditions during low tides for the federally endangered fish species, tidewater goby (*Eucyclogobius newberryi*). During high tides, there would still continue to be some muted tidal action in the shallowly flooded sparsely vegetated flats in eastern portion of the East Pasture from Tomasini Creek waters flowing through a culvert in the Tomasini Creek berm. As discussed under Alternative B, the increase in tidal influence would be expected to increase salinities within the freshwater marsh adjacent to Sir Francis Drake Boulevard, which supports breeding California red-legged frog (*Rana aurora draytonii*). This issue is discussed in more detail under Wildlife Resources. Circulation patterns and salinities in the West Pasture would continue to be strongly influenced by perennial freshwater flow from Fish Hatchery Creek and groundwater flow from the Inverness Ridge, as well as several other small drainages. As with Alternative B, this alternative would also eliminate the borrow ditch directly north of the West Pasture levee and reconnect the tidal slough in the undiked marsh with the remnant one in the West Pasture, which persists as a shallow, frequently flooded depressional feature.

Fluvial or Freshwater Processes: Alternative C would expand upon restoration actions in Alternative B and would, therefore, appear to have moderate rather than minor beneficial effects on fluvial or surface freshwater hydrologic processes in the Project Area. Under this alternative, the West Pasture levee would be completely removed, and portions of several small channels would be realigned to more natural channel patterns or morphology from the unnaturally straight alignment created by repeated ditching efforts. The major effects that this would have on Lagunitas Creek floodplains and floodplain capacity and fluvial sediment deposition on floodplains are analyzed and discussed separately below. As with Alternative B, a small berm would potentially be constructed to reduce flooding of lower-elevation private properties on the east side of Sir Francis Drake Boulevard: while this would reduce fluvial influences of Lagunitas Creek on this property, it could potentially at least temporarily increase inundation or flooding of the property from surface flow and run-off from the Inverness Ridge.

Approximately two-thirds of the downstream portion of Tomasini Creek in the Giacomini Ranch would be removed from its leveed channel and realigned into one of its historic channel alignments, the East Pasture Old Slough. This slough would be realigned to mimic more natural tidal marsh channel patterns, as it was ditched for storage of irrigation water some time after the 1940s. This would potentially affect localized channel morphology, fluvial sediment transport and delivery, channel avulsion and meandering, and floodplains and influence hydraulic characteristics such as flow velocity and the erosive power of flood flows. The existing Tomasini Creek channel would remain as a backwater slough, with a low berm or levee placed between it and the new channel to allow some flood overflow from the new channel into the old one during flood events. Circulation patterns within would not be expected to change with disconnection of the semi-permanent freshwater flow of Tomasini Creek from its old channel, with generally well-mixed conditions continuing to exist, although salinities may increase. Groundwater inflow from the Point Reyes Mesa, however, would be expected to continue to moderate salinity concentrations of tidal waters from Tomales Bay during the summer and fall, when bay salinities increase to almost marine concentrations.

Excavation of hydrologic impediments and replacement of culverts on Levee and Bear Valley Roads in the Olema Marsh would dramatically improve hydraulic connectivity between upstream portions of Bear Valley, the marsh, and Lagunitas Creek through dramatically decreasing water levels, which appear to have been increasing generally in recent years, perhaps since the 1998 flood event. Prior to 1998, Bear Valley Creek drained from Olema Marsh through two culverts, with most of the channel flow apparently preferentially flowing to the westernmost one near White House Pool County Park (KHE 2006b). During the 1998 flood event, the main outflow for Bear Valley Creek in Olema Marsh, however, became the easternmost culvert, with huge amounts of sediment from Inverness Ridge debris flows apparently blocking the westernmost culvert. The easternmost culvert is not only smaller, but constructed at a higher elevation, which, combined with the loss of the westernmost one, has considerably reduced creek outflow from the marsh (KHE 2006b). In addition, past fill events have created a low sediment berm in the marsh near the easternmost culvert that acts almost as a funnel to creek flow, limiting the amount of water that can reach the culverts. The effect of these impediments can be seen in the fact that water levels in the marsh are consistently 4 feet above the culvert invert, and there is some evidence that water levels are continuing to rise, as only in the 1990s, one researcher described the water surface as being below the Bear Valley Road culverts, but these culverts are consistently submerged now (KHE 2006b). With a reduction in water levels in Olema Marsh, water surface levels within the Bear Valley Creek Marsh directly upstream of Bear Valley Road would be expected to decrease, as well, through improvements in hydraulic connectivity and drainage, although the degree of reduction is uncertain.

Under the adaptive restoration approach, the first step would be to remove the berm and to excavate a shallow, better defined flow path for Bear Valley in the currently vegetation-choked channel. The success of these initial restoration measures would be assessed over time, before a decision is made as to whether to proceed with replacement of one or both culverts. As discussed above, water surface levels could drop as much as 4 feet to the elevation of the culvert invert following removal of the berm and improvement in flow conditions (KHE 2006b). Replacement of the Levee Road culvert with a bridge installed at a lower elevation would potentially lower water surface levels another 1-2 feet (KHE 2006b). A decrease in water surface level would greatly improve hydraulic connectivity of the Bear Valley Creek system with Lagunitas Creek, which would have benefits for species such as salmon. The implications of this dramatic decrease in water surface levels for wildlife and other resources such as topography, soils, water quality, and vegetation are analyzed in other sections of this chapter.

As with Alternatives A and B, the only increase in infrastructure would come from installation of a prefabricated bridge near the old summer dam location across from White House Pool County Park, but the bridge would be designed to have no footings in the active channel or floodplain, thereby reducing effects on

hydrologic processes. Creation of a freshwater marsh in the East Pasture Tomasini Triangle would constrain sheet flow of surface run-off and groundwater emerging from the base of the Point Reyes Mesa through berms constructed to prolong ponding of waters for creation of breeding California red-legged frog habitat and minimize potential tidal intrusion during extreme high or storm tides. In addition, there may be some minor adverse affects during construction from temporary installation of coffer dams needed to dewater construction areas such as Fish Hatchery Creek, Tomasini Creek, and areas along the East Pasture creek bank sufficiently to complete construction, but these would be largely offset by the numerous benefits this alternative would have on hydrologic processes and functions. In fact, all of these actions would be expected to reduce constraints on surface freshwater hydrologic processes by almost 37 percent (Table 55). From a watershed perspective, the expanded amount and degree of restoration under this alternative would increase its benefits to watershed function and processes relative to the other alternatives from minor to moderate.

Tidal Prism: Complete removal of East and West Pasture levees would result in a moderate beneficial effect on the extent of area inundated twice daily by tides relative to baseline conditions, but would not increase tidally inundated acreage relative to Alternative B despite continuing to increase the extent of tidal channels in the East Pasture (189.1 acres in the East Pasture and 21.3 acres in the West Pasture; KHE 2006a; Table 55). However, areas inundated during daily tides within the Project Area would increase under Alternative C, because of restoration efforts in Olema Marsh, with acreage increasing from approximately 210 under Alternative B to 231 acres under Alternative C (Table 55). These areas represent elevations that would be flooded at MHW. However, topographic surveys show additional extensive acreage would be subject to tidal inundation at tidal levels between MHW and MHHW. Over the long-term, however, sea level rise could cause an increase in the potential extent of area inundated by tides, particularly in the East Pasture. Recently published studies suggest that sea level rise rates may be much greater than originally predicted, with water levels rising as much as 3 feet by 2100. This rate sea level rise could lead to regular inundation of large portions of the East and West Pastures below 4 ft NAVD88.

In Olema Marsh, excavation of the berm and a more defined creek flow path would result in improved drainage through the marsh, and reduction of static marsh water level as described above. Dewatering and potential subsequent subsidence of peat soils would considerably expand the meager amount of existing tidal influence into the marsh, increasing the extent of area affected by daily tidal action up to 20 acres with a tidal prism ranging from 21 to 32 acre-feet depending on the adaptive restoration components implemented (KHE 2006a).

Floodplain/Floodwater Retention: Under this alternative, both the West and East Pastures would continue to be flooded more frequently by Lagunitas Creek during smaller (1.5- to 2-year) flood events just as in Alternative B (KHE 2006a). However, under Alternative C, Tomasini Creek flood flows would now be routed through the East Pasture, as well. Under Alternative C, cumulative floodwater volume modeled for the 2-year flood event relative would climb approximately 6 percent from 1,873 acre-feet under Alternative B to 2,050 acre-feet (KHE 2006a; Table 55). As water spills onto the floodplain, cumulative floodwater volume in Lagunitas Creek would drop from approximately 9,972 acre-feet under existing conditions to 8,000 acre-feet under Alternative C (KHE 2006a; Table 55). This reduction would represent a decrease of 20 percent relative to baseline conditions, but only 1 percent relative to Alternative B, and may support that most of the increase in cumulative floodwater volume under this alternative comes from Tomasini Creek. Cumulative floodwater volume during a 100-year event would increase only negligibly to approximately 39,200 acre-feet between Alternatives B and C, but would still represent more than 100 percent increase from baseline conditions (KHE 2006a). Under this alternative, inundated area in the East Pasture would remain roughly similar to that under Alternatives A and B (~300 acres) under the 2-year flood event, increasing from 1.8 acres under baseline conditions (KHE 2006a). During a 50-year event, the entire 350-acre East Pasture would be flooded (KHE 2006a). Floodwaters would be expected to move through the East Pasture more rapidly with removal of levees, concrete spillway, and undersized or poorly functioning tidegates, which may account for the dramatic increase in cumulative floodwater volume during the 100-year event relative to baseline or existing conditions.

Under Alternative C, complete removal of the levee would result in a minor increase in the extent of inundated area in the West Pasture under the 2-year event, with acreage increasing from 70 to 83 acres (KHE 2006a). Under Alternative C, cumulative floodwater volume under the 2-year event increases dramatically from approximately 4 acre-feet under baseline conditions and 5 acre-feet under Alternative B to 50 acre-feet under Alternative C. For the 100-year event, cumulative floodwater volume would climb from 610 acre-feet under existing conditions to approximately 5,000 acre-feet under Alternative C, a 5 percent increase over Alternative B (KHE 2006a). As discussed under Alternative B, the discrepancy between pastures in total inundation (50-

year versus 500-year flood event) is reflected in the much lower cumulative floodwater volume in the West Pasture, even under fully restored conditions.

For Olema Marsh, this alternative would act to decrease floodwater retention – or at least persistent impoundment – and increase transport of floodwaters from the Bear Valley Creek system. For this reason, inundated area under the 2- to 500-year flood events would change negligibly, if at all (KHE 2006a). Inundated volume would drop from approximately 202 acre-feet under baseline conditions to 185 acre-feet under Alternative C, with the degree of reduction fairly consistent among all flood events up to the 500-year flood (KHE 2006a). This decrease in inundated volume during flood events is reflected in slightly lower maximum floodwater elevations within the marsh, which drop from approximately 11.2 to 10.7 feet NAVD88 under a 2-year event (KHE 2006a).

Stream Power and Sediment Transport Patterns: The potential movement of sediment onto floodplains in the East Pasture would increase even more under Alternative C with removal of not only the Lagunitas Creek levees, but realignment of Tomasini Creek into the East Pasture. Based on the sediment rating curve developed by H. Esmaili & Associates (1980), approximately 50,000 tons/day of suspended sediment would potentially move through the portion of Lagunitas Creek in the Project Area during a 2-year flood event. Under Alternative C, the percentage of suspended sediment from Lagunitas Creek potentially moving through the East and West Pastures would increase from 10 percent or approximately 5,020 tons/day under Alternative A to 19.8 percent or approximately 9,900 tons/day under Alternative C, with only a slight increase (< 1 percent) relative to Alternative B. Based on flood flow volume, almost 98 percent of this sediment (~ 9,650 tons/day) would move through or end up in the East Pasture rather than the West Pasture.

Based on hydraulic modeling, stream power in the East Pasture under a 2-year flood event would be almost identical to that under Alternative B, with transport capacity lost relatively quickly on the floodplains (KHE 2006a). The sudden loss in stream power would suggest that trapping efficiency, at least under smaller flows, would be high and could result in approximately 9,400 tons/day of sediment being deposited on the Giacomini Ranch floodplains under Alternative C (Table 55). Increased rates of floodplain deposition could have a moderate beneficial effect on the Bay by reducing sediment and potentially pollutant delivery by as much 18.8 percent, compared to 17.8 percent (~8,900 tons/day) under Alternative B (Table 55).

The primary difference for the East Pasture would continue to be restored conditions versus baseline ones, which are affected by the presence of levees, spillways, culverts, and other infrastructure that limit outflow capacity and decrease velocities. In the West Pasture under Alternative C, there would be a general increase in stream power, relative to both baseline conditions and Alternative B with the complete removal of the levees, tidegates, and spillway (KHE 2006a). Stream power would drop sharply once waters crest the creek bank, causing most of the fines to be deposited close to Lagunitas Creek (KHE 2006a). Stream power would remain extremely low throughout Olema Marsh during both baseline and restored conditions, although transport capacity increases considerably near the Levee Road culvert outlet (KHE 2006a). While removal of the levees and increased off-channel storage of flood flows might be expected to decrease stream power in Lagunitas Creek channel and increase deposition or aggradation of sediment in this reach, hydraulic modeling suggests that, during 2-year flood events the creek would continue to maintain transport capacity at least in the reach upstream of White House Pool (KHE 2006a). Similar to Alternative B, stream power would drop measurably downstream of White House Pool, enough to potentially decrease transport capacity of silt and fine sand, although the magnitude of these change would not be anticipated to appreciably alter channel geometry or bed-form conditions (KHE 2006a).

Sediment deposition during floods can, over time, lead to net aggradation within floodplain areas and, ultimately, decrease trapping efficiency as vertical elevation of the floodplain rises. This trend tilts the evolutionary trajectory within wetland systems towards establishment of uplands, but within naturally dynamic systems such as estuaries, these trends are often counterbalanced by sea level rise (discussed above under Tidal Prism) and subsidence (either compaction- or fault-associated) that act to maintain or regenerate wetlands even within depositional environments.

Tidal Power and Sediment Transport Patterns: Similar to Alternative B, hydraulic modeling showed that tidal velocities (~6.6 ft/s) during an average tidal month would be sufficient in the hydrologically reconnected East Pasture Old Slough to erode or maintain created channels -- at least in the northern portion of the East Pasture -- through mobilization of sediment with bulk densities as high as compact sandy clay, including potentially sediment deposited during overbank flooding (KHE 2006a). In Olema Marsh, tidal velocities would increase considerably relative to baseline conditions, with velocities even higher than the East Pasture (~ 9 ft/s), although tidal influence would drop off sharply approximately 150 feet from Levee Road (KHE 2006a).

Tidal velocities in the West Pasture would continue to be much lower (~1.2 ft/s) than the East Pasture and below the threshold for mobilization of loose sandy clay material, although they would be higher than under baseline conditions (KHE 2006a). In Lagunitas Creek, tidal velocities would be almost identical to those under baseline conditions and Alternatives A and B, suggesting that there would not likely be any net changes in channel conditions (KHE 2006a).

With maintenance of existing tidal velocities in Lagunitas Creek, the influence of estuarine sediment transport processes such as gravitational circulation that involves resuspension of sediment along channel bottoms through strong tidal currents would likely remain negligible in the Project Area, because tidal currents do not have sufficient power to move the alluvial sands and gravels that comprise most of the streambed. However, tides and currents would continue to strongly influence circulation patterns within this reach of Lagunitas Creek such as gravitational circulation or density- or salinity-based stratification of waters that could at least create, particularly in areas where bathymetry changes abruptly such as shoals, zones where suspended sediment concentrations would reach a peak or maximum and preferentially fall out of suspension in the creek channel. While this could contribute to reductions in sediment delivery to Tomales Bay, the dominance of fluvial forces in this part of the estuary would suggest that fluvial sediment transport processes governing transport and deposition within in-stream and off-stream storage areas such as floodplains would largely dictate sediment delivery rates to the Bay, at least within the Project Area.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be the same as described for the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative C would have similar minor to major beneficial effects on hydrologic processes as Alternative B. Complete removal of the East and West Pasture levees and adaptive restoration of Olema Marsh would have a moderate beneficial effect on surface tidal and freshwater hydrologic processes, with effects on some processes and functions such as floodplains and floodplain capacity and fluvial sediment deposition on floodplains characterized as major beneficial effects. As with Alternative B, there would still be the potential for construction of a small levee to protect lower-elevation properties on the east side of Sir Francis Drake Boulevard.

Complete removal of East and West Pasture levees and adaptive restoration of Olema Marsh would result in a moderate beneficial effect on the extent of area inundated twice daily by tides relative to baseline conditions and an increase relative to Alternative B (KHE 2006a). These areas represent elevations that would be flooded at MHW, however, additional extensive acreage would be subject to tidal inundation at tidal levels between MHW and MHHW.

The expanded amount of restoration under this alternative increases its value to watershed restoration efforts.. As with Alternatives A and B, some of the largest benefits would come from the major or substantial beneficial effects on floodplains and floodwater storage and sediment transport processes. Alternative C would result in major beneficial impacts associated with increased floodplain function and floodwater retention. In addition, the amount of suspended sediment that moves through the Project Area floodplains would increase under this alternative, potentially decreasing the amount of sediment that is delivered by Lagunitas Creek to southern Tomales Bay by as much as 18.8 percent or 9,400 tons/day. As a result, Alternative C would have major beneficial impacts on sediment transport within the Project Area and potentially minor beneficial effects on sediment deposition within the southern end of Tomales Bay.

Alternative D

Analysis: Alternative D would have very similar impacts to Alternative C on water resources and hydrologic processes, with beneficial effects ranging from minor to major (Table 54). Under Alternative D as with Alternative C, the East and West Pastures would be completely restored, along with Olema Marsh. Almost all

of the differences between Alternative D and C relate to excavation of a limited portion of the East Pasture to intertidal elevations, complete realignment of Tomasini Creek into one of its historic alignments, replacement of the Tomasini Creek Mesa Road culvert with a bridge or arch culvert, and further scaling back of new public access facilities through elimination of the bridge across Lagunitas Creek and one of the spur trails on the eastern perimeter. In addition, there would be excavation of even more new tidal channels in the East Pasture. Tomasini Creek would be realigned into one of its historic alignments just downstream of Mesa Road and would run through the constructed freshwater marsh area just north of the Giacomini Ranch dairy facility. There would be no change in restoration approach in the West Pasture from Alternative C, and the same adaptive management approach would be undertaken in Olema Marsh, with initial excavation of a shallow berm and the Bear Valley Creek channel to improve hydraulic connectivity and improve drainage of currently impounded waters. As with the other alternatives, this alternative would involve removal or restoration of agricultural infrastructure and discontinuation of agricultural management practices.

Fluvial or Freshwater Processes: Under this alternative, Tomasini Creek would be completely moved out of its leveed channel into one of its historic alignments just downstream of Mesa Road and would run through the newly created freshwater marsh in the Tomasini Triangle. Low berms would be used to ensure that the creek would not drain the marsh, which is being constructed as breeding habitat for California red-legged frog. Low berms would constrain to some degree the potential for channel avulsion or meandering, sediment deposition, and floodplain connectivity, although functionality would still be improved relative to existing leveed conditions. Replacement of the Tomasini Creek culverts at Mesa Road would increase hydraulic connectivity between upstream and downstream reaches and potentially decrease any backwater flooding effects from undersized infrastructure.

The existing Tomasini Creek channel would remain as a backwater slough, with a low berm placed between it and the new channel to allow some flood overflow from the new channel into the old one during flood events. Tidal action in the old Tomasini Creek channel would continue to be controlled by the tidegate/flashboard dam structure, maintaining subtidal conditions in the backwater slough, until such time that the marsh and marsh channels have developed to offer alternate habitat for the tidewater goby. As under Alternative C, circulation patterns within would not be expected to change with disconnection of the semi-permanent freshwater flow of Tomasini Creek from its old channel, with generally well-mixed conditions continuing to exist, although salinities may increase. Groundwater inflow from the Point Reyes Mesa, however, would be expected to continue to moderate salinity concentrations of tidal waters from Tomales Bay during the summer and fall, when bay salinities increase to almost marine concentrations.

Under Alternative D, there would be no installation or construction of infrastructure such as bridges or culverted trails that would impede hydrologic process. Creation of a freshwater marsh in the East Pasture Tomasini Triangle would constrain sheet flow of surface run-off and groundwater emerging from the base of the Point Reyes Mesa through berms constructed to prolong ponding of waters for creation of breeding California red-legged frog habitat and minimize potential tidal intrusion during extreme high or storm tides. There may be some minor adverse effects during construction from temporary installation of coffer dams needed to dewater construction areas such as Fish Hatchery Creek, Tomasini Creek, and areas along the East Pasture creek bank sufficiently to complete construction, but these would be largely offset by the numerous benefits this alternative would have on hydrologic processes and functions.

Tidal Prism: The only change in tidal hydrologic processes relative to Alternative C would come from the slightly expanded extent of area in the East Pasture inundated twice daily by tides, with acreage increasing from 189.1 acres under the other action alternatives to 195 acres under Alternative D. This increase in inundated area would come from lowering of the southwestern corner of the East Pasture to intertidal elevations. Areas inundated during daily tides within the Project Area would increase, then, under Alternative D from approximately 231 under Alternative C to 252 acres under Alternative D (Table 55). As with the other alternatives, a rise in sea level over the long-term could cause an increase in the potential extent of area inundated by tides, particularly in the East Pasture. Recently published studies suggest that sea level rise rates may be much greater than originally predicted, with water levels rising as much as 3 feet by 2100 (Overpeck et al. 2006). This rate of sea level rise could lead to regular inundation of large portions of the East and West Pastures below 4 ft NAVD88.

Fluvial or Freshwater Processes: As with Alternative C, Alternative D would expand upon restoration actions in Alternative B and would, therefore, also appear to have moderate rather than minor beneficial effects on fluvial or surface freshwater hydrologic processes in the Project Area. Tomasini Creek would be fully realigned in one of its historic channels, and the Tomasini Creek Mesa Road culvert would be replaced. These actions would further reduce constraints on surface freshwater hydrologic processes by almost 44 percent, a 5

percent increase over Alternative C (Table 55). From a watershed perspective, the expanded amount and degree of restoration under this alternative would increase its benefits to watershed function and processes relative to the other alternatives from minor to moderate. The major effects that this would have on Lagunitas Creek floodplains and floodplain capacity and fluvial sediment deposition on floodplains are analyzed and discussed separately below.

Floodplain/Floodwater Retention: Under this alternative, both the West and East Pastures would continue to be flooded more frequently by Lagunitas Creek during smaller (1.5- to 2-year) flood events just as in Alternative C (KHE 2006a). However, under Alternative D, Tomasini Creek flood flows would now be routed through a larger portion of the East Pasture. Cumulative floodwater volume in the East Pasture during the 2-year and 100-year flood events would not differ appreciably from that under Alternative C, with volume estimated at 2,030 acre-feet during the 2-year event (KHE 2006a). Floodwater volume in the Project Area would climb slightly from 2,049 acre-feet under Alternative C to 2,079 acre-feet under Alternative D during a 2-year event, all of which results from an increase in flows from Tomasini Creek and storage volume in the East Pasture (KHE 2006a; Table 55). Cumulative floodwater volume in Lagunitas Creek during a 2-year event would be very similar to Alternative C, with volume dropping from approximately 8,000 acre-feet under Alternative C to approximately 7,975 acre-feet under Alternative D (KHE 2006a; Table 55). The reduction in cumulative floodwater volume during a 2-year event would represent roughly a 20 percent decrease relative to baseline conditions. As noted earlier, there would be no additional restoration in the West Pasture and Olema Marsh so flood frequency, cumulative floodwater volume, and inundated area would be as described under Alternative C.

Stream Power and Sediment Transport Patterns: Based on cumulative floodwater volume, the percentage of suspended sediment from Lagunitas Creek potentially moving through the East and West Pastures would account for 20 percent or approximately 9,830 tons/day, which would be double the sediment load transported under Alternative A (4,880 tons/day; KHE 2006a). Almost 98 percent of this sediment (~ 9,600 tons/day) would move preferentially into the East Pasture rather than the West Pasture. The sudden loss in stream power suggested by hydraulic modeling once floodwaters crest the levees would suggest that trapping efficiency, at least under smaller flows, would be high and could result in approximately 9,525 tons/day of sediment being deposited on the Giacomini Ranch floodplains under Alternative D compared to 9,400 tons/day under Alternative C (Table 55). Increased rates of floodplain deposition could have a moderate beneficial effect on the Bay by reducing sediment and potential pollutant delivery by as much as 19 percent, which is only slightly more than the 18.8 percent reduction that would be expected under Alternative C (Table 55).

Tidal Power and Sediment Transport Patterns: Tidal power conditions and estuarine sediment transport processes and patterns would be similar to those described in Alternative C.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be the same as described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative D would have similar minor to major beneficial effects on hydrologic processes as Alternative C. This alternative would expand restoration efforts by lowering more of the marshplain in the East Pasture to intertidal elevations, realigning almost the entire portion of Tomasini Creek within the Project Area into one of its historic alignments, and replacing the undersized culvert for Tomasini Creek at Mesa Road. These actions would have a moderate beneficial effect on surface tidal and freshwater hydrologic processes, with effects on some processes and functions such as floodplains and floodplain capacity and fluvial sediment deposition on floodplains characterized as major beneficial effects.

The only change in tidal hydrologic processes relative to Alternative C would come from the slightly expanded extent of area in the East Pasture inundated twice daily by tides, with acreage increasing from 189.1 acres under the other action alternatives to 195 acres under Alternative D. This increase in inundated area would

come from lowering of the southwestern corner of the East Pasture to intertidal elevations. As with Alternative C, the expanded amount of restoration under this alternative, which particularly focuses on restoration of Tomasini Creek, does increase its value to watershed restoration efforts, although the beneficial effects would still be relatively minor from an overall watershed perspective. As with the other action alternatives, some of the largest benefits would come from the major or substantial beneficial effects on floodplains and floodwater storage and sediment transport processes. Both the cumulative volume of floodwater and the amount of suspended sediment that moves through the Project Area floodplains would remain similar to that of Alternative C under this alternative, potentially decreasing the amount of sediment that is delivered by Lagunitas Creek to southern Tomales Bay by as much as 19 percent or 9,525 tons/day during 2-year flood events.

Water Resources –Water Quality

Laws, Regulations, Policies, and Criteria Guiding Impact Analysis

The Federal Water Pollution Control Act (Clean Water Act) and subsequent amendments of 1977 (33 USC §1251 et seq)provides for the restoration and maintenance of the physical, chemical, and biological integrity of the nation's waters, primarily through three sections – Section 404, Section 401, and Section 303(d). Federal, state, and local agencies are required to comply with the Clean Water Act, and most have developed their own policies regarding activities affecting water quality. The Park Service Management Policies (2006) mandates parks to "take all necessary actions to maintain or restore the quality of surface waters and groundwaters consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations" (Section 4.6.3; NPS 2006). Additional information on other federal, state, and local policies can be found in Chapter 3 under Water Resources – Water Salinity and Water Quality.

In California, authority for Section 401 and Section 303 has been delegated to the State Water Resources Control Board (SWRCB), which also is responsible for overseeing California's water quality law, the Porter Cologne Act. The water quality control plan for the San Francisco Bay region, including the entire Marin coastline, is the Water Quality Control Plan for the San Francisco Bay Basin (RWQCB 1995a), The Basin Plan (RWQCB 1995a) designates beneficial uses of water for specific water bodies, establishes specific water quality objectives to protect those uses, and provides a program to implement the objectives. For Lagunitas Creek, beneficial uses include contact and non-contact recreation, oyster production, municipal and domestic water supply, agricultural supply, cold freshwater habitat, fish migration, preservation of rare and endangered species, recreation, fish, spawning, and wildlife habitat. Under Section 303(d) of the Clean Water Act, the state and the nine regional boards are able to declare certain water bodies as "impaired" or unable to perform designated beneficial uses by specified contaminants. Lagunitas Creek and Tomales Bay have been declared impaired under Section 303(d) for sediment, nutrients, and pathogens.

The ranges or thresholds used to characterize the quality of waters and need for cleanup measures come from the Basin Plan (RWQCB 1995a; Table 9 in Chapter 3 under Water Resources – Water Salinity and Water Quality). There are two types of objectives: narrative and numerical: Narrative objectives present general descriptions of water quality that must be attained and serve as the basis for the development of detailed numerical objectives (RWQCB 1995a). Numerical objectives typically describe pollutant concentrations, physical/chemical conditions of the water itself, and the toxicity of the water to aquatic organisms. Numerical water quality objectives in the Basin Plan build upon national water quality standards established by the U.S. Environmental Protection Agency (USEPA). Additional guidelines have been established for characterizing nutrient concentrations in natural, unpolluted waters of estuaries and freshwater streams by AWWA (1990).

General Assumptions and Methodologies:

- Water quality objectives for Tomales Bay are currently contained in the Basin Plan (RWQCB 1995a), which applies to all waters in the San Francisco Bay area Basin. Many of the objectives in the Basin Plan have components or sub-objectives that are very specific to the San Francisco Bay estuary or certain locations within the estuary. For these objectives, the most applicable sub-objective has been chosen for comparison with Project Area and Tomales Bay waters.
- Basin Plan water quality objectives cover at least 19 different water quality parameters, including bacteria, bioaccumulation, biostimulatory substances, color, dissolved oxygen, floating material, oil and grease, pH, radioactivity, salinity, sediment, settleable material, sulfide, suspended material, taste and odors,

temperature, toxicity, turbidity, and unionized ammonia. USEPA objectives include standards for nitrates and nitrites.

- The Tomales Bay watershed has been declared impaired by the RWQCB under Section 303(d) of the Clean Water Act for nutrients, sediment, pathogens, and mercury. Lagunitas Creek has been declared impaired for sediment, nutrients, and pathogens. The RWQCB has adopted criteria for the Pathogen TMDL, which identifies ambient water concentrations for fecal coliform in the watershed streams (200MPN/100ml[log mean]), at the Green Bridge (95 MPN/100ml[log mean]) and in Tomales Bay (14 MPN/100ml [median value]).
- The purpose of the proposed project is to restore natural hydrologic functions and processes, such as water quality improvement. One of the objectives of the project is to take a watershed-based approach to restoration such that restoration efforts maximize not only the opportunity to improve water quality within the Project Area, but within the entire Tomales Bay watershed.
- Changes in water quality conditions were not conducted as part of the hydrodynamic modeling, with the exception of salinity, but modeling results and other hydrologic information collected can be used to qualitatively predict changes in water quality conditions.
- Because changes in salinity conditions are generally considered a neutral effect and not an impact in and of itself, any evaluation of potential impacts related to changes in salinity in the Project Area will be assessed relative to specific impact topics (e.g., California red-legged frog under Wildlife Resources).
- Changes in functional capacity for the Project Area to intercept and filter pollutants in flood flows from upstream portions of the watershed are evaluated under Water Resources – Hydraulics and Hydrologic Resources, Hydrologic Functions – Floodplains.

Listed below are methodologies for significance criteria related to water quality, including specific assumptions or details on methodologies.

Changes in Water Quality Conditions – Project Area: Impact thresholds focus on change in overall water quality conditions in the Project Area, including changes in the number or frequency of exceedances of water quality objectives during, immediately after, and some time after construction (Table 56). Evaluation of exceedances of Basin Plan or USEPA water quality objectives focuses on potential changes in the number of objectives that are violated on a regular or consistent basis in the East Pasture, West Pasture, Lagunitas Creek, Tomasini Creek, and Olema Marsh.

Exceedance is determined based on recorded values from Park Service or other data exceed Basin Plan or USEPA objectives. Objectives are defined as being infrequently (≤ 25 percent of values), occasionally (≤ 50 percent of values), regularly (≤ 75 values), or consistently (>75 percent) exceeded (see Table 9 in Chapter 3 under Water Resources – Water Salinity and Water Quality). This impact indicator specifically focuses on changes in water quality conditions that result from the proposed project.

For certain nutrients, there are either no objectives or very high ones aimed specifically at human health concerns. For example, for nitrates, USEPA objectives for human health are high enough (>10 mg/L) that measurable change would also be masked. There are no Basin Plan or USEPA objectives for dissolved phosphates or ammonia, except for toxic forms of nitrogen such as unionized ammonia and nitrites. The RWQCB, however, is proposing to develop a TMDL for nutrients, which can, in excess, cause ecological impacts, in addition to being harmful to human health. Nutrients that do not have objectives such as ammonia and phosphates are also analyzed in this section.

Potential changes are semi-quantitatively evaluated using an understanding of current water quality conditions; sources of current water quality problems (e.g., dairy, septic, non-point source surface run-off, and physical factors such as long water residence time, etc.); expected changes in loading with implementation of the proposed project; rate of decline in various pollutants with time; and the potential for future loading of pollutants with overbank flooding during storms and tidal flushing. In addition, the number of exceedances or overall ambient concentrations of water quality parameters within other Tomales Bay reference wetlands was also used in analysis.

TABLE 56. WATER QUALITY – PROJECT AREA

Source: RWQCB Basin Plan, Park Service Management Policies, Marin CWP, Community Plan
Nature: Beneficial, Adverse
Context: Project Area
Duration: Construction, Short-Term, Long-Term

TABLE 56. WATER QUALITY – PROJECT AREA

No Impact	There would be no potential for impact to water quality associated with the proposed project.
Negligible	*Beneficial*: The proposed project would result in a negligible or barely detectable improvement in water quality conditions such that the frequency of exceedance of Basin Plan and USEPA objectives in the Project Area would decrease slightly (≤ 10 percent) relative to existing conditions. *Adverse*: The proposed project would result in a negligible or barely detectable deterioration in water quality conditions such that the frequency of exceedance of Basin Plan and USEPA objectives in the Project Area would increase slightly (≤ 10 percent) relative to existing conditions.
Minor	*Beneficial*: The proposed project would result in a minor improvement in the water quality conditions such that the frequency of exceedance of Basin Plan and USEPA objectives in the Project Area would decrease measurably (> 10 and ≤25 percent) relative to existing conditions. *Adverse*: The proposed project would result in a minor deterioration in water quality conditions such that the frequency of exceedance of Basin Plan and USEPA objectives in the Project Area would increase measurably (> 10 and ≤25 percent) relative to existing conditions.
Moderate	*Beneficial*: The proposed project would result in a moderate improvement in water quality conditions such that the frequency of exceedance of Basin Plan and USEPA objectives in the Project Area would decrease appreciably (> 25 and ≤50 percent) relative to existing conditions. *Adverse*: The proposed project would result in a moderate deterioration in water quality conditions such that the frequency of exceedance of Basin Plan and USEPA objectives in the Project Area would increase appreciably (> 25 and ≤50) relative to existing conditions.
Major or Substantial	*Beneficial*: The proposed project would result in a major improvement in water quality conditions such that the frequency of exceedance of Basin Plan objectives in the Project Area would decrease strikingly (>50 percent) relative to existing conditions. *Adverse*: The proposed project would result in a major deterioration in water quality conditions such that the frequency of exceedance of Basin Plan objectives in the Project Area would increase appreciably (> 50 percent) relative to existing conditions.

Changes in Water Quality Conditions in Watershed: This impact indicator focuses on potential change in water quality conditions in the southern portion of the Tomales Bay watershed with construction or implementation of the proposed project. Changes in water quality downstream of the Project Area would result from changes in the quality of water flowing out of Project Area and changes in the functional capability of the Project Area to receive waters from upstream portions of the watershed and to filter and store or transform sediment, nutrients, and contaminants from these waters. This impact indicator does not attempt to assess whether water quality objectives or guidelines would be met through potential implementation, although these are used as a guide, along with conditions in natural wetlands, to assess which changes might be beneficial or adverse. This analysis represents a semi-quantitative estimation of changes expected under the various alternatives based on extensive baseline data, hydraulic modeling results, and professional judgment regarding the effect of any changes on water quality (Table 57). This analysis takes into account several pieces of information, including: 1) cumulative volume of floodwaters during a 2-year flood event as estimated through hydraulic modeling of the various alternatives; and 2) estimated loading rate of nutrients, pathogens, and sediment during flood events based on RWQCB pathogen study (RWQCB 2001) and literature-derived estimates of nutrient retention, uptake, and transformation (Kadlec and Knight 1996). Daily sediment yields and sediment deposition rates (tons/day) on floodplains as evaluated under Sediment Transport Processes under Water Resources – Hydrologic Processes.

TABLE 57. WATER QUALITY - WATERSHED

Source: RWQCB Basin Plan, Park Service Management Policies, Marin CWP, Community Plan Nature: Beneficial, Adverse Context: Project Area Duration: Construction, Short-Term, Long-Term	
No Impact	There would be no potential for impact to water quality downstream of the Project Area associated with the proposed project.
Negligible	A barely detectable change in water quality conditions would be expected downstream of the Project Area based on changes in conditions in Project Area waters and functional capacity. Changes would be in the range of natural variability for conditions in natural wetlands in Tomales Bay and surrounding watersheds.
Minor	A measurable change would be expected downstream of the Project Area based on changes in conditions in

TABLE 57. WATER QUALITY - WATERSHED

	Project Area waters and functional capacity. Change would be expected to exceed the range of natural variability by ≤ 10 percent. If adverse change occurs, water quality conditions would not exceed Basin Plan objectives.
Moderate	An apparent and measurable change would be expected downstream of the Project Area based on changes in conditions in Project Area waters and functional capacity. Change would exceed the range of natural variability by ≤ 20 percent. If an adverse change occurs, water quality conditions might exceed Basin Plan objectives.
Major or Substantial	A substantial and major change would be expected downstream of the Project Area based on changes in conditions in Project Area waters and functional capacity. Change would exceed the range of natural variability by > 20 percent. If an adverse change occurs, water quality conditions would probably exceed Basin Plan objectives.

Impact Analysis

TABLE 58. INTENSITY, NATURE, TYPE, DURATION, AND CONTEXT OF IMPACTS FOR WATER RESOURCES – WATER QUALITY
All impacts would be considered Project Area and are separately analyzed for Construction and Short-Term/Long-Term.

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Impact Indicator	Intensity, Nature, Type, Duration, and Context of Impact				
Project Area Water Quality					
Construction	Adverse - Negligible	Adverse - Negligible	Adverse - Negligible	Adverse - Negligible	Adverse - Negligible
Short-Term	Beneficial - Negligible	Beneficial – Minor	Beneficial - Minor	Beneficial - Negligible	Beneficial - Negligible
Long-Term	Beneficial - Minor	Beneficial - Moderate	Beneficial - Moderate	Beneficial - Major	Beneficial - Major
Watershed Water Quality					
Construction	Adverse - Negligible	Adverse - Negligible	Adverse - Negligible	Adverse - Negligible	Adverse - Negligible
Short-Term	Beneficial- Negligible	Beneficial- Negligible	Beneficial- Negligible	Beneficial- Minor	Beneficial- Minor
Long-Term	Beneficial- Negligible	Beneficial - Minor	Beneficial - Moderate	Beneficial - Moderate	Beneficial - Moderate

No Action Alternative

Analysis: The No Action Alternative would generally have negligible to minor effects on water quality in the Project Area and the southern portion of the Tomales Bay watershed (Table 58). Under the No Action Alternative, levees, tidegates, and culverts in the Giacomini Ranch are not breached or removed, except for the 11-acre wetland restoration area in the northeastern corner of the East Pasture. The remainder of the levees in the East Pasture and West Pasture would remain, although there would be no levee maintenance. Olema Marsh is also not restored, and there would be no new public access facilities. There would be no public access facilities.

Project Area-Overview: The No Action Alternative would have minor beneficial effects on water quality in the Project Area and negligible beneficial effects in the watershed, largely because of the elimination of intensive agricultural management practices. In Olema Marsh, where there is no agricultural use, conditions would be expected to remain fairly similar to baseline conditions.

Under the existing purchase agreement with the Giacomini Trust, the Giacomini Ranch dairy had a 7-year Reservation of Use agreement that allowed the Giacomini family to continue dairying until the agreement expires in spring 2007. At that time, the dairy will close, and agricultural management practices associated with dairying will cease. These management practices include crossing of Lagunitas Creek by Giacomini Ranch dairy cows; infrequent discharge of waters in East Pasture ditch system to Lagunitas Creek; periodic maintenance of levees and creek crossings; frequent dredging of ditches creeks for improved water conveyance and pasture drainage; and shallow and concentrated spreading of manure.

Under the No Action Alternative, there is a potential for leased grazing of dairy heifers or beef cattle on the

Giacomini Ranch lands in the future, which would be in accordance with the parks' GMP. Leasing would undergo a separate environmental review process, but it is likely that, if lease or leases were approved, that the Seashore would institute restrictions on resource setbacks or setbacks from creeks and certain wetland areas, as well as the intensity, duration, and timing of grazing. In addition, certain creeks in the West Pasture would continue to be dredged to eliminate flood risks to adjacent private residences.

Agricultural management practices have dramatically affected water quality conditions in the Project Area, particularly the East Pasture. Within the Project Area, monitoring has shown occasional, regular, or consistent exceedance of Basin Plan or USEPA objectives for fecal coliforms, unionized ammonia, nitrates, nitrites, dissolved oxygen, and pH. Water quality conditions within the Project Area are generally not eutrophic, but there are occasionally spikes in nutrients and toxic nutrients, and concentrations of pathogen indicators such as fecal coliform are consistently high. Certain ditches within the Giacomini Ranch have extremely poor water quality, with oxygen levels at levels low (<< 5 mg/L) enough to cause mortality to aquatic organisms. General mechanisms for delivery of pollutants from the Project Area to the Bay include the cattle crossing areas, pumping of ditches, and general outflow through leaky tide gate facilities.

Water quality conditions are generally most limited in the pasture ditches, which have been constructed to maintain drainage and groundwater level. Elimination of frequent ditching would decrease the production of organic matter whose breakdown generates the chronically low or almost non-existent levels of oxygen within waters of East Pasture ditches that causes consistent exceedance of Basin Plan dissolved oxygen objectives. Decomposition of organic matter may also be responsible for the occasional exceedances of oxygen objectives in the vegetation-choked, peat-rich substrates of Olema Marsh. As with natural wetlands, oxygen levels would be expected to infrequently drop into hypoxic (low) conditions during summer nights when warm temperatures during the day boosts phytoplankton and algal productivity within shallower water features, causing spikes in oxygen demand or respiration at night that temporarily reduces available oxygen. These periods of high productivity are often accompanied by sharp elevations in pH greater than 8.5 that would continue to cause infrequent exceedance of Basin Plan pH objectives. In addition, some of groundwater-fed drainages would probably continue as they do now to show slightly lower pH that infrequently dips below 6.5. In keeping with Basin Plan project-related objectives, this alternative would not be expected to cause change greater than 0.5 pH in any of the hydrologic units within the Project Area.

Project Area -Nutrients: With elimination of intensive dairying, infrequent pulses of nitrates, nitrites, and unionized ammonia in the East Pasture that exceed Basin Plan and USEPA objective would be eliminated or practically eliminated. The East Pasture had at least six instances where nitrates exceeded USEPA objectives of 10 mg/L, well above the ambient concentrations of most natural systems, even if slightly eutrophic (Parsons, *in prep*.). There were also five instances in the East Pasture where nitrites exceeded objectives for aquatic life of 0.5 mg/L, and at least one where nitrites exceeded USEPA objectives of 1 mg/L. The substantial reduction in nutrient source loading with elimination or reduction in grazing intensity, along with discontinuation of manure spreading practices, would be expected to eliminate exceedances of these objectives. Low oxygen levels in ditches caused by oxygen demand generated by frequent ditching and generation of decomposing organic matter probably played a role in infrequent exceedance of nitrite and unionized ammonia objectives (Parsons, *in prep*.). Extremely low levels or the absence of oxygen in waters can prohibit the conversion of nitrites to nitrates, allowing this typically very transient form of nitrogen to persist and potentially cause negative impacts on aquatic organisms. Increases in dissolved oxygen within East Pasture waters would be expected to practically eliminate, if not totally eliminate, violation of nitrite objectives. Even in reference or natural marshes, nitrites are occasionally detected due to temporary hypoxia, probably during the summer when large diel variations in oxygen production and demand play havoc with oxygen levels (Parsons, *in prep*.).

Low oxygen also affects the conversion of ammonia to nitrites, with low oxygen conditions favoring ammonia. While ammonia occurred at dramatically lower concentrations in the Project Area relative to nitrates and was often undetectable, the East Pasture had among the highest ammonia concentrations, which is undoubtedly due to the hypoxia prevalent in most of the ditches and ditched former sloughs (Parsons, *in prep*.). Under warm temperatures and high pH, ammonia converts to another toxic nutrient form, unionized ammonia. The East Pasture had one instance when unionized ammonia concentrations exceeded Basin Plan maximum objectives of 0.16 mg/L and four instances when concentrations exceeded the median objective of 0.025 mg/L (Parsons, *in prep*.). In addition, the downstream-most sampling location on Lagunitas Creek also had very high unionized ammonia concentrations on one occasion, which appeared to be related to the very infrequent episodes of pumping of East Pasture ditch waters into the creek (Parsons, *in prep*.). Based on nutrient concentrations and patterns in natural or undiked wetlands in Tomales Bay, these episodes would be

eliminated under the No Action Alternative through increased conversion of ammonia to nitrates through considerable increases in oxygen concentrations and a decrease in overall nutrient loading.

Discontinuation of intensive agricultural management practices would not eliminate all sources of nutrient loading to the Project Area. Even with levees largely disconnecting the Giacomini Ranch from Lagunitas Creek and Tomasini Creek, the West Pasture would continue to have influxes of nitrates from Inverness Ridge drainages such as Fish Hatchery Creek, which flow underneath Sir Francis Drake Boulevard and into the West Pasture. Fish Hatchery Creek is the largest tributary in the West Pasture and is not leveed, so it, therefore, frequently floods overbank into the pasture. A slightly smaller drainage, the 1906 creek, runs through one of the private properties before it flows into the extensive freshwater marsh in the northern portion of the West Pasture adjacent to Sir Francis Drake Boulevard. This marsh also receives hydrologic inputs from groundwater emerging at the base of the Inverness Ridge, as well at least one other small drainage. Nitrate concentrations in creeks regularly (> 50 percent) exceed 1 mg/L, the upper threshold established by the AWWA (1990) for moderate aquatic organism diversity and avoidance of algal blooms in estuaries. Maximum nitrate concentrations in these creeks reached as high as 6.7 mg/L (Parsons, *in prep*.). Nitrate concentrations in groundwater-fed areas infrequently (> 25 percent) exceed 1 mg/L, with concentrations ranging as high as 2.4 mg/L (Parsons, *in prep*.). Similar conditions exist in Olema Marsh, where nitrate concentrations regularly exceed 1 mg/L in portions of Bear Valley Creek directly upstream of the marsh (Parsons, *in prep*.). Because of levees and/or tidegates/culverts, most of the waters flowing into the Project Area are either retained entirely or, in the case of the West Pasture and Tomasini Creek, have longer residence times due to inefficient conveyance of waters through culverts.

While loading or total volume of nutrients flowing into the Project Area remains relatively low compared to larger creeks such as Lagunitas, these sources still represent the primary hydrologic contribution to the West Pasture, except during larger storms such as 12-year flood events when Lagunitas Creek flows are sufficient to crest the West Pasture levees and flow onto the currently diked floodplain. Even under grazed conditions and seemingly higher-than-normal nutrient loading from agricultural sources, nitrate concentrations and loading consistently decreased on Fish Hatchery Creek downstream of the sampling location located at the Project Area boundary, suggesting that nitrates were being retained either in the channel during lower flows or on the floodplain during higher flows. Nitrate concentrations decreased by an average of 1.0 mg/L, with the median reduction 0.75 mg/L (Parsons, *in prep*.). A similar trend was observed in Olema Marsh at upstream and downstream portions where Bear Valley Creek flowed into and out of the marsh. Nitrate concentrations decreased, on average, by 0.85 mg/L between the upstream and downstream portions of the marsh (Parsons, *in prep*.).

Research on other systems has shown that, while ammonia and total nitrogen have fairly high retention rates (~21 – 76 %) in a variety of aquatic systems from treatment wetlands to floodplains (Behrendt 1996; Kadlec and Knight 1996; De Witt 1999; Seitzinger et al. 2002; van der Lee et al. 2004), nitrates often have fairly low retention rates, at least on active floodplains and floodplain terraces, because they remain in solution rather than bound or sorbed to sediment particles as do other nutrients such as ammonium, organic nitrogen, and phosphates and therefore tend not to get “trapped” (van der Lee et al. 2004). Flattening of the Fish Hatchery Creek stream gradient as it flows into the West Pasture may decrease downstream velocities and increase the potential for nitrates to be assimilated by aquatic plants or phytoplankton in the stream channel or converted from nitrates to nitrogen gas. With removal or reductions in number of cattle, the efficiency of in-stream and possibly floodplain wetlands in decreasing the relatively small, but key, loading of nitrates from upstream sources should improve slightly under the No Action Alternative, but concentrations would probably still occasionally exceed 1 mg/L.

Under the No Action Alternative, the East Pasture remains largely hydrologically disconnected from any fluvial inputs from Lagunitas and Tomasini Creeks, with the exception of the 11-acre restored area in the northern portion described above. Primary hydrologic sources for the East Pasture, therefore, are limited to direct precipitation, surface run-off, emergent groundwater from the base of the Point Reyes Mesa terrace, non-point surface run-off from the town of Point Reyes Station, and irrigation waters during the summer. While cattle would still represent a source of nutrient loading, the intensity of grazing and management would decrease appreciably. Nutrients such as ammonium, nitrates, and phosphates, all of which are high under baseline conditions relative to other hydrologic units within the Project Area, would be affected less by continued influx of new nutrients in most of the East Pasture and more by the rate at which moderate to excessively high nutrients in waters and soils could be expected to decrease over time without active removal of “hot soils” or hydrologically reconnecting ditches and sloughs to flush them out. Certain portions of the East Pasture perimeter, however, would continue to receive influxes of nutrients from non-point source run-off from the

town of Point Reyes Station and septic-influenced groundwater. Nutrient loads would be expected to decrease in at least one of the run-off sources on the north end of Point Reyes Station that currently receives run-off from one of the Giacomini Ranch feedlots.

Few studies appeared to have addressed the issue of the timeframe over which nutrients and constituents of agriculturally managed soils and water such as fecal coliform decrease in response to removal or reduction in intensity of agriculture. In general, nutrients within the water column would be expected to transition relatively quickly into other nutrient forms or to be uptaken by plants and phytoplankton. However, flux out of soils into overlying waters could lengthen the timeframe over which nutrient concentrations would decrease within the East Pasture waters. Certain nutrients such as phosphates become soluble in soils and available for flushing into overlying waters when conditions become anaerobic or low in oxygen, which typically occurs during periods of persistent or repeated flooding or ponding. Other constituents such as metals are tightly bound under the reduced, slightly acidic to neutral pH conditions characteristic of flooded wetland soils.

With the exception of the drainage ditches and ditched sloughs, most of the East Pasture is only surface flooded temporarily or seasonally, although soil saturation in response to rainfall or receding surface often persists until early June (Parsons, *in prep*.). Some of these areas are subsequently flooded or spray irrigated in the summer. There are a few areas along the eastern perimeter of the East Pasture where soil saturation persists permanently or semi-permanently due to the emergence of groundwater flows. Through most of the pasture, soils would remain oxidized for a large portion of the year, which would encourage rapid breakdown of organic matter into oxidized inorganic nutrients such as nitrates and either subsequent assimilation of these nutrients by plants or conversion into nitrogen gas. Under oxidized conditions, the pool of undecomposed organic matter and inorganic nutrients is typically low, because it is expended quickly, as is evident from the comparatively low of organic matter in upland versus wetland soils. Within the East Pasture, it is likely most of these nutrients would be "lost" through plant uptake, with the moderately to excessively high nutrient load favoring establishment of weedy species that proliferate quickly under high nutrient conditions. This issue is discussed in more detail under the Vegetation Resources section of this chapter.

Project Area-Pathogens: Perhaps, the most pervasive issue or problem under baseline conditions is fecal coliform, which has been traditionally used an indicator of pathogen or bacterial contamination levels. Fecal coliform concentrations in all hydrologic units of the Project Area, including Olema Marsh, consistently (>75 percent) to regularly (> 50 percent) exceed TMDL objectives for Lagunitas Creek of 200 MPN/100 ml , as well as the 95 MPN/100 ml load-based allocation for Lagunitas Creek at the Green Bridge (established in 2005). Within the East Pasture, fecal coliform concentrations regularly surpass the 2,000 MPN/100 ml Non-Contact Recreational use threshold. As with nutrients, removal or reductions in the number of cattle would substantially decrease coliform loading. However, results of some limited testing in the Project Area for surfactants that are commonly incorporated into detergents would suggest that leaking septic systems, as well as cattle, may contribute to coliform or pathogen loading to the Project Area. Fluvial or creek water draining non-agricultural subwatersheds such as the Inverness Ridge, as well as groundwater from the Inverness Ridge and Point Reyes Mesa and non-point source run-off from Point Reyes Station, regularly to consistently exceed TMDL objectives for Lagunitas Creek of 200 MPN/100 ml. Another potential source is wildlife. Unlike nitrates, which decreased at the downstream end of Olema Marsh, fecal coliform generally increases from upstream to downstream, suggesting some localized contribution. These sources could include wildlife such as waterfowl that commonly use the marsh or leaking septic systems, as Olema Marsh also receives hydrologic inputs from small drainages and emergent groundwater off the Inverness Ridge. These sources would be expected to continue to influence the Project Area under the No Action (and other) Alternatives.

Unlike nutrients, which are typically rapidly assimilated or converted, bacteria can persist for an extended period of time in both water and soils. In one study, *E. coli* -- another bacteria that has become more popular as a pathogen indicator -- lived in lake waters for at least 6 to 7 days, but in nutrient-rich river water, *E. coli* survived in excess of 3 weeks and was believed to persist for as long as 2 months in sediment (Palmateer and Huber 1985; Huron County Science Committee 2005). Under these conditions, coliform concentrations would be expected to slowly decrease particularly in the East Pasture, although pathogens would not be eliminated due to the potential retention of at least limited grazing and septic-influenced hydrologic inputs. Over the long-term, the East Pasture would be expected to have lower coliform levels than the West Pasture due to the fact that it would still be leveed off from Lagunitas and Tomasini Creeks, which would have much higher loading rates than the seeps and non-point source run-off that currently drains into the pasture. While leveed off from Lagunitas Creek, the West Pasture would be more highly influenced by Fish Hatchery Creek and the other drainages, which have higher loading rates.

Pollutant Retention and Effects on Tomales Bay: Under flood flow conditions, nutrient- and pathogen-laden waters would flow into both the East and West Pastures. The East Pasture would flood during a relatively small to moderate-sized flood events (3.5 year – 7 year), while the West Pasture levee would require considerably more flow to overtop (12 year; KHE 2006a). Floodwaters would overtop levees and spill onto the floodplain, dropping a considerable amount of suspended sediment near the levees with the abrupt drop in stream power (KHE 2006a). These sediments are often associated with nutrients such as ammonium, organic nitrogen, and phosphate; pathogen indicators such as fecal coliform and *E. coli*; and contaminants such as metals. Research on rivers in Europe, where nitrates are the predominant form of nitrogen, has shown that nitrate retention on floodplains is extremely low, because it is not associated with sediment and tends to remain free in solution (van der Lee et al. 2004). While sediment and nutrient loading often show a linear relationship with streamflow or discharge, deposition of sediment and sediment-associated nutrients, pathogens, and contaminants onto floodplains appear to display more of a non-linear relationship in which at some specific threshold of flow velocities become high enough that most of the sediments, nutrients, pathogens, and contaminants are transported through floodplains rather than retained. In a study on Missouri creeks, Heimann (2001) found that more suspended sediment deposition occurred under smaller floods such as 5-year events than larger ones such as 25-year events, because flood flow velocities on the floodplain were lower.

The optimal flow at which trapping efficiency of the Giacomini Ranch floodplains is maximized is unknown. While nutrient and pathogen loading rates for a 3.5-year flood event – the smallest flood event capable of overtopping the Giacomini Ranch levees -- cannot be estimated from existing data, instantaneous loading on the falling limb (~5,000 cfs) of a 2.25-year flood event in 2006 was estimated at approximately 10 million MPN per second for fecal coliform in Lagunitas Creek at the Green Bridge, the upstream boundary of the Project Area (Parsons, *in prep*.). Calculated instantaneous loading rates during this same storm event totaled approximately 220 mg/s for nitrates, while those for phosphates totaled approximately 40 mg/s (Parsons, *in prep*.). Even with levees, then, some floodplain deposition of sediment, nutrients, pathogens, and contaminants would occur, but the frequency of these overbank flooding events would be substantially lower, because higher water levels would be required to initiate floodplain flooding, particularly in the West Pasture (~12-year flood event). At some probably much higher flow, increased velocities might begin to preclude deposition even if floodplains are flooded.

Because Lagunitas Creek would occasionally overflow into the Giacomini Ranch pastures, this alternative would be expected to have, over the long-term, at least a negligible beneficial effect on water quality downstream of the Project Area in southern Tomales Bay. Currently, overbank flooding during larger storm events may increase loading to the watershed due to the excessive amount of nutrients, pathogens, and manure present, at least in the East Pasture. A similar effect would potentially be expected over the short-term during larger storm events, with floodwaters moving through the Project Area and causing discharge of nutrient- and pathogen-laden waters to downstream areas of Lagunitas Creek. Relative to the other alternatives, it would longer under the No Action Alternative for the existing loads of nutrients and pathogens, particularly in the East Pasture, to dissipate to levels characteristic of other lightly grazed and/or open space areas. However, with a reduction or elimination of grazing and elimination of intensive agricultural management practices, overbank flooding would be expected over the long-term to contribute positively to the watershed by filtering sediment, nutrients, pathogens, and contaminants, which is one of the more functions that wetlands play. The degree that water quality conditions in the bay would be improved is tempered to some degree by the relative infrequency that the Giacomini Ranch would flood. There would be little interaction between Tomasini Creek and the East Pasture.

Possible Additional Mitigation Measures: No additional mitigation measures are proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: There are at least four (4) currently proposed projects that would have the potential to cause cumulative impacts should the No Action alternative be implemented, the Bear Valley Creek Watershed Enhancement Project, Chicken Ranch Beach Enhancement, the East Shore Wastewater Improvement Project, and the County of Marin's Culvert Cleaning Project, generally described in Table 25 of this chapter. The Bear Valley Creek Project proposes to replace failing or underperforming hydrologic infrastructure at a number of locations on Bear Valley Creek within the Seashore boundaries. There is no definitive timeframe for construction of this project, but preliminary design for this project would be expected to have a cumulatively beneficial effect through improvement of hydrologic and ecological processes and

functions in the upper portions of the Bear Valley Creek subwatershed, upstream of Olema Marsh. This project would have negligible effect to minor effects on water quality for the Bear Valley subwatershed and Project Area. The East Shore Wastewater Improvement Project would construct a community wastewater system to replace substandard and marginally operating septic systems for 91 properties along the east shore of southern Tomales Bay. Another creek and wetland restoration project is proposed for Chicken Ranch Beach, a small drainage on the western shore of Tomales Bay that consistently has high pathogen loading to the bay. The Tomales Bay Watershed Council is working with local agencies to identify and reduce sources of loading and restore the lower floodplain area, which has been negatively impacted by fill. The County of Marin Department of Public Works is proposing to clean out culverts on the northern edge of Olema Marsh in one of its former outlets that now serves primarily to convey Silver Hills Creek flows. This proposed project could cumulative contribute to increases in turbidity in adjacent waters such as Lagunitas Creek depending on the construction schedule, however, any cumulative effect would be expected to be no more than minor. Cumulatively, the proposed project, in combination with these other projects, would be expected to have a minor to perhaps even moderate beneficial effect on water quality within southern Tomales Bay.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: The No Action alternative would generally result in generally negligible to minor effects on water quality in the Project and the southern portion of the Tomales Bay watershed. The only changes under this alternative would be a small 11-acre wetland restoration component that is required under the Park Service's existing mitigation agreement with CalTrans, reduction in intensity or elimination of grazing, and the discontinuation of agricultural management practices that have had negative effects on water quality. Nutrient and pathogen loading in water would decrease slowly, because of the possible interaction between soil and water that could continue to introduce nutrients and pathogens into overlying waters. Direct loading of nutrients and pathogens associated with the active dairy operations would end, and generally improve water quality conditions within the Project Area. Source loading of nutrients and pathogens from other sources such as creeks and drainage and emergent groundwater potentially affected by leaking septic systems, non-point source run-off from the town of Point Reyes Station, and wildlife use of marsh areas could remain. In addition, there is potential under the No Action Alternative for leased grazing of dairy heifers or beef cattle through a separate environmental review process, although grazing would be expected to be lower in intensity and regulated more tightly in terms of minimizing resource impacts. During larger flood events ranging from 3.5- to 12-year flood events, floodwaters from Lagunitas Creek would reach levels high enough to overtop levees and flow onto floodplains, where sediment-associated nutrients, pathogens, and contaminants would probably be retained depending on velocity of waters. Over the short-term, loading to Lagunitas Creek during storm events where overbank flooding occurs may increase through floodwaters moving through the Project Area and causing discharge of the still nutrient- and pathogen-laden waters to downstream areas of Lagunitas Creek. However, over the long-term, overbank flooding onto floodplains would be expected to decrease nutrient and coliform loading to southern portions of the Tomales Bay watershed. While this would improve conditions in the bay, the effect would probably be relatively minor, with the frequency of flooding being relatively low (3.5- to 12-year events). Also, with Tomasini Creek still leveed off from the East Pasture, there would be little chance for reduction of loads from this source.

Alternative A

Analysis: Alternative A would generally have negligible to moderate effects on water quality in the Project Area and the southern portion of the Tomales Bay watershed. Under Alternative A, only the East Pasture would be restored, with new public access facilities limited to the eastern and southern perimeters of the East Pasture. The southern perimeter trail includes a bridge crossing of Lagunitas Creek near the old summer dam, and evaluation of a planning corridor in the West Pasture between White House Pool and Inverness Park. There would be no restoration in the Olema Marsh. The levees along and tidegate/culvert in the West Pasture and Tomasini Creek would be retained. In the East Pasture, restoration would involve breaching of levees in the East Pasture along Lagunitas Creek, and excavation of new tidal channels. The southwestern corner of the creek bank would be regraded to a more stabile profile. Most of the actions under this alternative focus on removal or restoration of agricultural infrastructure such as filling of ditches, ripping of compacted roads, fence removal, and removal of pumps, pipelines, and concrete spillways.

Project Area-Overview: During the short- and long-term, Alternative A would have minor to moderate beneficial effects on water quality in the Project Area and negligible to minor beneficial effects in the watershed, because of the elimination of intensive agricultural management practices. Discontinuation of agricultural operations and removal of dairy infrastructure, roads and ditches would reduce potential for exceedance of Basin Plan and USEPA water quality objectives from actions within the Project Area. In general, the breaching of levees in the East Pasture will increase the frequency of flooding into the area. One role this area will play in the watershed water quality condition is to expand potential areas for deposition and detention of pollutants. Under Alternative A, there is no potential for leased grazing, thereby eliminating another potential source of nutrients and pathogens to the Project Area and further reducing nutrient loading. Also, a 13-acre area in the East Pasture where manure has been heavily spread would be excavated, and the nutrient-laden soils would be used to fill in the manure ponds on the dairy mesa, which would eliminate another potential source of residual nutrients and possibly pathogens from the East Pasture.

Alternative A would involve removal of the one-way tidegate on the East Pasture Old Slough, but a berm blocking drainage of slough waters would also be removed. This would increase hydrologic connectivity with Lagunitas Creek. Road and ditch infrastructure in the East Pasture will be removed. Creation of tidal channels will convey tidal water into and through parts of the East Pasture, and minimizing stagnant conditions that can lead to poor water quality in terms of low oxygen in waters and high nutrients and even toxic nutrients. Some increase in ponding and water residence time would be expected along the eastern perimeter trail, where construction of a berm trail would likely cause ponding of surface run-off and emergent groundwater despite inclusion of culverts to improve conveyance. Impacts during construction would be characterized as negligible adverse, because BMPs would be instituted to reduce potential impacts associated with incidental fallback of sediment into the creek.

Project Area-Nutrients and Pathogens: Within the Project Area, removal of direct pollutant sources from the Project Area, and improved hydraulic connectivity through the Project Area would be expected to have a more dramatic effect on reduction in nutrients, including nitrates, and pathogen indicators such as fecal coliform than the No Action Alternative. Over the long-term, the East Pasture would still be expected to only occasionally (>25 percent and <50 percent) exceed AWWA nitrate objectives of 1 mg/L, however, unlike under baseline conditions, this would occur when nitrates rather than ammonia would be the prevalent form of nitrogen. In addition, additional efforts to remove sources of contamination would increase effects on coliform concentrations, which would be expected to only occasionally exceed TMDL objectives for Lagunitas Creek of 200 MPN/100 ml. In Olema Marsh, where there is no agricultural use, conditions would be expected to remain fairly similar to baseline conditions.

As discussed under the No Action Alternative, discontinuation of intensive agricultural management practices would not eliminate all sources of nutrient loading to the Project Area. Even with levees largely disconnecting the Giacomini Ranch from Lagunitas Creek and Tomasini Creek, the West Pasture would continue to have influxes of nitrates and pathogens from Inverness Ridge drainages such as Fish Hatchery Creek and the 1906 drainage and possible groundwater emerging from the base of the Inverness Ridge and flowing into the West Pasture. Under Alternative A, several breaches would be created in the East Pasture, which would increase hydrologic connectivity between Lagunitas Creek and its floodplain. In addition, the East Pasture would also be influenced by emergent groundwater from the base of the Point Reyes Mesa terrace and non-point surface run-off from the town of Point Reyes Station, both of which appear to have moderate- to high pathogen and nutrient loads.

Nitrate concentrations in creeks and groundwater-fed areas in the Giacomini Ranch and Olema Marsh regularly (> 50 percent) to infrequently (>25 percent) exceed 1 mg/L, the upper threshold established by the AWWA (1990) for moderate aquatic organism diversity and avoidance of algal blooms in estuaries. Fecal coliform concentrations in all hydrologic units of the Project Area, including Olema Marsh, consistently (>75 percent) to regularly (> 50 percent) exceed TMDL objectives for Lagunitas Creek of 200 MPN/100 ml, as well as the 96 MPN/100 ml load-based allocation for Lagunitas Creek at the Green Bridge.

Pollutant Retention and Effects on Tomales Bay: In the East Pasture, breaching of levees would increase the frequency of overbank flooding from 3.5- to 7-year events to 1.5- to 2-year events, thereby increasing the influence of Lagunitas Creek on the East Pasture and vice versa. During these storm events, floodwaters would overtop levees and spill onto the floodplain, dropping a considerable amount of suspended sediment near the levees with the abrupt drop in stream power. Relative to the No Action Alternative or baseline conditions, stream power appeared slightly higher, but still probably not strong enough to convey sediments more than a short distance from the creek banks (KHE 2006a). In addition to being a water quality pollutant

in and of itself – Tomales Bay has been declared impaired for sediment – suspended sediments are often associated with nutrients such as ammonium, organic nitrogen, and phosphate; pathogen indicators such as fecal coliform and *E. coli*; and contaminants such as metals.

The optimal flow at which trapping efficiency of the Giacomini Ranch floodplains is maximized is unknown. However, some estimates of potential instantaneous loading rates during smaller flood events can be derived from instantaneous loading rates calculated on the falling limb (~5,000 cfs) of a 2.25-year flood event in 2006. Because samples were collected in Lagunitas Creek at the Green Bridge, which is at the upstream boundary of the Project Area, these numbers do not include additional loading that would have occurred during this same event from Olema or Bear Valley Creeks, which are located downstream of the Green Bridge. During a storm event of this magnitude, approximately 50,000 tons/day of suspended sediment would be conveyed in Lagunitas Creek. Calculated instantaneous loading rates during this flood event totaled approximately 10 million MPN per second (MPN/s) for fecal coliform, 220 milligrams per second (mg/s) for nitrates, and 40 mg/s for total dissolved phosphates (Parsons, *in prep*.).

For the 2.25-year flood event, approximately 10 percent of Lagunitas Creek flood flows would be diverted into the East Pasture through overbank flooding. Through floodplain retention, suspended sediment loads within Lagunitas Creek could be reduced as much as 9.5 percent or approximately 4,770 tons/day. There are no definitive numbers for the percentage of pathogens likely to be retained on floodplains, but, as with sediments, estimates for coliforms generally appear to be high, with natural wetlands receiving untreated or partially treated municipal or stormwater discharges having a 94.2 to 99.9 percent removal rate, even with abundant use by wildlife (CH2MHill 1991 *in* Kadlec and Knight 1996). Retention efficiency generally exceeds 90 percent coliforms when influx concentrations are high (Kadlec and Knight 1996). During this storm, flows of approximately 5,000 cfs were sustained for at least one hour. Using an estimate of 90 percent retention on Giacomini Ranch floodplains (Kadlec and Knight 1996), instantaneous coliform loading rates in Lagunitas Creek could be reduced by as much as 8.6 percent or 860,000 MPN/s or 51.5 million MPN during just that one hour of flooding (Parsons, *in prep*.). In addition, using an estimate of 20 percent retention (Kadlec and Knight 1996), instantaneous phosphate loading rates in Lagunitas Creek could be reduced as much as 1.9 percent or 0.76 mg/s or 46 mg during just that one hour of flooding (Parsons, *in prep*.). Under this alternative, there would continue to be no overbank flooding into the West Pasture during a flood event of this size, so the East Pasture would continue to account for most of the pollutant reduction.

During the flood event described above, calculated instantaneous loading rates totaled approximately 220 mg/s for nitrates (Parsons, *in prep*.). However, nitrates may not be as readily retained by floodplains. Rather being sorbed to suspended sediment as are coliforms and phosphates, nitrates remain soluble and have, on some larger river systems, been found to have very low rates of retention (2 – 3%) on floodplains unlike other forms of nitrogen such as organic nitrogen and ammonia (van der Lee et al. 2004). The proportion of nitrogen removed from through a network of streams in an East Coast watershed ranged from 37 – 76 percent, but these numbers included ammonia and organic nitrogen (Seitzinger et al. 2002). Sampling has not been conducted on Lagunitas Creek for organic nitrogen, but ammonia is almost always below detection limit, as it is for almost all of the Project Area except for the East Pasture, suggesting that waters are generally well-oxidized, thereby converting ammonia to nitrates, and that the largest sources of these nutrients comes from some distance away. Ammonia often occurs in areas that are proximate to large sources of manure from livestock or fecal matter from wildlife, while nitrates are commonly associated with the influence of agricultural and residential fertilizers, septic systems, landfill leachate, commercial or industrial wastewater, and acid rain. Assuming a trapping efficiency rate of approximately 3 percent, the instantaneous loading rate of nitrate onto floodplains during the 2006 flood event would equate to roughly a 0.3 percent reduction in nitrate loads in Lagunitas Creek or a decrease of approximately 0.63 mg/s or a total of approximately 38 mg during that one hour of flooding.

Some nitrate retention does appear to occur with Project Area streams and associated wetlands. Even under grazed conditions and seemingly higher-than-normal nutrient loading from agricultural sources, nitrate concentrations and loading consistently decreased on Fish Hatchery Creek downstream of the sampling location at the Project Area boundary, suggesting that nitrates were being retained either in the channel during lower flows or on the floodplain during higher flows. Nitrate concentrations decreased by an average of 1.0 mg/L, with the median reduction 0.75 mg/L (Parsons, *in prep*.). A similar trend was observed in Olema Marsh at upstream and downstream portions where Bear Valley Creek flowed into and out of the marsh. Nitrate concentrations decreased, on average, by 0.85 mg/L between the upstream and downstream portions of the marsh (Parsons, *in prep*.). The average percent reduction was almost identical between these two systems – approximately 37 percent. The flat gradients present in both of these systems may increase residence time sufficiently to promote assimilation of nitrates by aquatic plants or phytoplankton in the stream

channel or conversion from nitrates to nitrogen gas through denitrification. Conversely, in Tomasini Creek, during approximately 50 percent of the sampling events, nitrate concentrations were higher downstream than upstream, and during 75 percent of the events, fecal coliform concentrations were also dramatically higher – on average, 544 percent -- downstream. These results point to a source of nitrates and coliforms being downstream of Mesa Road within the Project Area boundary. Dairy cattle rarely, if ever, cross over the levee to graze on the small fringing floodplain, so the source is believed to be leaking septic systems and other influences from residential development originating from either the worker housing or homes on the Point Reyes Mesa. Movement of these nutrients and pathogen indicators into the Project Area is enhanced by the existing seasonal to almost year-round groundwater and permeable gravel layers within this coastal marine terrace.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be identical to those described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Active restoration efforts under Alternative A, combined with discontinuation of intensive agricultural management and grazing throughout the Giacomini Ranch, would increase the benefits of this alternative on water quality in the Project Area relative to the No Action Alternative. Alternative A would be expected to have moderate beneficial effects over the long-term on water quality in both the East and West Pastures, however, there would be no to very negligible improvement in water quality conditions in Tomasini Creek. Increased overbank flooding in the East Pasture (reduced from 3.5 to 1.5 year flooding frequency) would increase floodplain detention and capture of many Bay pollutants. On floodplains, nutrients would be assimilated or uptaken by plants, converted to nitrogen gas, or would remain, as would most contaminants such as metals, within the sediment bound with varying degrees of strength to clays, silts, organic matter, and mineral complexes such as pyrite. Pathogens could persist in soils, but exposure to ultraviolet light can dramatically reduce pathogen levels (Palmateer et al. 1989).

As explained under the No Action Alternative, short-term effects would be less dramatic than long-term ones, because of the time expected to be required to bring water (and soil) conditions within the range characteristic of natural wetlands and grasslands. In addition, flooding of the East Pasture during storms may result in pulses of sediment, nutrients, and pathogens to downstream waters of Lagunitas Creek after construction is completed. These pulses would be expected to be transient in nature and not last more than 2- to 3 years. For this reason, short-term beneficial effects would be characterized as minor within the Project Area and negligible on a watershed scale. Negligible adverse effects may also occur during construction from temporary installation of coffer dams and accidental fallback of sediment into waters from excavation of levees along Lagunitas Creek. However, Best Management Practice (BMPs) would be instituted to minimize the effects of these actions on water quality within and downstream of the Project Area.

A much greater frequency of flooding by Lagunitas Creek of the East Pasture would be expected to have, over the long-term, a minor beneficial effect on water quality downstream of the Project Area in southern Tomales Bay. With elimination of grazing and elimination of intensive agricultural management practices, overbank flooding would be expected to contribute positively to the water quality of the southern portion of Tomales Bay by filtering sediment, nutrients, pathogens, and contaminants, which is one of the more functions that wetlands play. The extent to which this alternative could improve water quality conditions of the bay is restricted by the continued presence of levees, tidegates, and culverts in the West Pasture, Tomasini Creek, and Olema Marsh, as well as the continued influx of high loads of nutrients and pathogens from small creeks, drainages, and emergent groundwater into the Project Area. However, over the long-term, overbank flooding onto floodplains would be expected to have at least a minor beneficial effect on water quality within the southern portion of Tomales Bay by decreasing [of sediment, coliform, phosphate, and certain forms of nitrogen, with reductions in suspended sediment and instantaneous coliform loading estimated to be as high as 9.5 percent and 8.6 percent, respectively, during approximately 2-year flood events.

Alternative B

Analysis: As with Alternative A, Alternative B would generally have negligible to moderate effects on water quality in the Project Area and the southern portion of the Tomales Bay watershed (Table 58) Under Alternative B, the East and West Pastures would be restored, but not Olema Marsh. Most of the new public access facilities would continue to be limited to the eastern and southern perimeters of the East Pasture. The southern perimeter trail includes a bridge crossing of Lagunitas Creek near the old summer dam, and evaluation of a planning corridor in the West Pasture between White House Pool and Inverness Park. In addition, a viewing area would replace the informal existing trail on the West Pasture north levee, which would be removed. Restoration would involve complete removal of levees in the East Pasture along Lagunitas Creek and excavation of even more new tidal channels. Breaches would be created in the West Pasture levee. The southern East Pasture creek bank would be restored through removal of rip-rap bank stabilization and regraded, where needed, to a more stabile profile. Lowering of levees between the East Pasture and Tomasini Creek would allow overflow during flood events, but otherwise Tomasini Creek would remain in its current channel with tidegate/flashboard dam structure still in place. As with Alternative A, this alternative would involve removal of agricultural infrastructure and discontinuation of agricultural management practices.

Project Area-Overview: Alternative B would have very similar beneficial effects to Alternative A on water quality in the Project Area and watershed relating to the removal of agricultural infrastructure and features (e.g., manure disposal area) in the East Pasture and elimination of intensive agricultural management practices in both pasture. Infrastructure removal and elimination of agricultural management practices would reduce potential for water quality and exceedance of water quality objectives are discussed in detail under the No Action Alternative and Alternative A. However, under Alternative B, the West Pasture levee would be breached, and the tidegate and concrete spillway would be removed, which would increase hydrologic connectivity with Lagunitas Creek and downstream areas with the West Pasture. Breaches of levees in the West Pasture would increase turnover of waters and minimize stagnant conditions that can lead to poor water quality in terms of low oxygen in waters and high nutrients and even toxic nutrients. In addition, the eastern perimeter trail would be constructed as a boardwalk rather than as a culverted berm trail, which would decrease ponding of surface run-off and emergent groundwater flowing off the Point Reyes Mesa. Conversely, creation of a freshwater marsh in the Tomasini Triangle would increase considerably residence time of some surface waters and emergent groundwater within at least 5.4 acres of the East Pasture, however, sustained inundation through at least the summer is necessary to create conditions conducive to supporting breeding and rearing of California red-legged frog (*Rana aurora draytonii*), a federally threatened species.

Project Area-Nutrients and Pathogens: This alternative would be expected to have a greater reduction of nutrients, including nitrates, and pathogen indicators such as fecal coliform than Alternative A. The change is less dramatic under this alternative perhaps because the West Pasture was not as intensely managed from an agricultural perspective as the East Pasture and already had limited exchange of waters with downstream areas. Over the long-term, the East and West Pastures would be expected to continue to have occasional (>25 percent and <50 percent) exceedances of AWWA (1990) nitrate objectives of 1 mg/L. This is the frequency at which this objective has been exceeded during the past four years of monitoring some of the natural, undiked wetlands in Tomales Bay, including Walker Creek marsh, which is exposed – as would be the Project Area – to high nutrient and pathogen loading from creeks, drainages, and other sources (Parsons, *in prep*.). Even Limantour Marsh, which is not subject to some of the same negative influences from dairying or other forms of agriculture and leaking septic systems, infrequently exceeds the AWWA (1990) upper threshold on nitrates for maintaining non-eutrophic conditions within estuaries (Parsons, *in prep*.). Ultimately, the degree of change that can be effected in the Project Area in terms of water quality improvement will be constrained by conditions with source creeks and other hydrologic sources. Data collected by the Park Service on water quality within reference wetlands in the watershed suggests that, for many of the objectives such as pH, dissolved oxygen, turbidity, and pathogens regulated under the Basin Plan (RWQCB 1995a), the range of natural variability is large and approaches or – in the case of pathogens – exceeds the numerical thresholds or limits imposed by water quality objectives (Parsons, *in prep*.).

Given these constraints, the degree of change effected under Alternative B relative to Alternative A is also much less dramatic for pathogens. As discussed under the No Action Alternative and Alternative A, "natural" water quality conditions within source creeks such as Lagunitas, Bear Valley, Fish Hatchery, Tomasini, and other drainages upstream of the Project Area or groundwater emerging at the base of the Inverness Ridge and Point Reyes Mesa often already exceeds TMDL and Basin Plan objectives. This is particularly true for the Lagunitas Creek TMDL concentration objective of 200 MPN/100 ml, which is regularly (>50 percent) to consistently (>75 percent) exceeded during single time sampling events within hydrologic sources to the

Project Area at sampling locations that are upstream or at the perimeter of the Giacomini Ranch and Olema Marsh. The TMDL objective technically applies to a geometric mean for a series of samples collected within 30 days, while water quality monitoring was conducted quarterly during different seasons, as well as during storm events, to define ambient conditions. However, the geometric mean for all the samples collected in four years also exceeded the Lagunitas Creek TMDL objective.

Under this alternative and Alternative A, coliform loads in the East Pasture would drop from consistently exceeding the TMDL objective for Lagunitas Creek to perhaps only occasionally exceeding this objective. Within the West Pasture, coliform loads would decrease, but would still be expected to regularly exceed the TMDL objective. As with nitrates, the larger degree of improvement projected for the East Pasture relative to the West Pasture relates primarily to the relative influence of continued loading from creeks, groundwater, and other hydrologic sources. Waters within the West Pasture would continue to be affected by seasonal to year-round -- if relatively low in terms of overall loading rate -- influx of coliforms from Fish Hatchery Creek, the 1906 drainage, other small drainages, and groundwater from the Inverness Ridge. Tomasini Creek would remain isolated in its leveed channel that is hydrologically disconnected from the East Pasture would not effect conditions in the East Pasture. Most of the hydrologic sources to the East Pasture either have very low loading rates despite almost year-round flow or are high loading (Lagunitas Creek), but only flood the East Pasture, on average, every 2 years. However, retention of this levee would also prevent the East Pasture from improving water quality of Tomasini Creek before these waters are discharged to Tomales Bay.

Pollutant Retention and Effects on Tomales Bay: Some of the other major changes under Alternative B relative to Alternative A relate to the frequency of overbank flooding from Lagunitas Creek and the volume of Lagunitas Creek floodwater that could be diverted onto Giacomini Ranch floodplains. Breaching of the West Pasture levee would increase the frequency of overbank flooding from 12-year events to 2-year events, thereby increasing the influence of Lagunitas Creek on the West Pasture.
While levees would be completely removed on the East Pasture, the frequency of overbank flooding from Lagunitas Creek into the East Pasture would still be identical to that under Alternative A, ranging from 1.5- to 2-year flood events. However, the volume of floodwaters conveyed through the East Pasture would increase and thereby potentially increase the benefits of this alternative to water quality. Based on hydraulic modeling, cumulative floodwater volume from Lagunitas Creek conveyed into the East Pasture during a 2-year event would climb from approximately 10 percent under Alternative A to approximately 18.8 percent under Alternative B (KHE 2006a). The East Pasture accounts for more than 99 percent of the reduction in cumulative floodwater volume in Lagunitas Creek under a 2-year event (KHE 2006a).

During these storm events, floodwaters would overtop creek banks or remaining levees and spill onto the floodplain, dropping a considerable amount of suspended sediment near the creek bank or levees because of an abrupt drop in stream power (KHE 2006a). Little difference existed between Alternatives A and B in terms of reduction in stream power and likelihood for the East Pasture floodplain to be depositional in nature, however, relative to the No Action Alternative or baseline conditions, stream power appeared slightly higher, but still probably not strong enough to convey sediments more than a short distance from the creek banks (KHE 2006a). In addition to being a water quality pollutant, suspended sediments are often associated with nutrients such as ammonium, organic nitrogen, and phosphate; pathogen indicators such as fecal coliform and *E. coli*; and contaminants such as metals.

The optimal flow at which trapping efficiency of the Giacomini Ranch floodplains is maximized is unknown. However, some estimates of potential instantaneous loading rates during smaller flood events can be derived from instantaneous loading rates calculated on the falling limb (~5,000 cfs) of a 2.25-year flood event in 2006 are described under Alternative A. During 2-year flood events, estimated suspended sediment loads in Lagunitas Creek could be reduced by as much as 17.8 percent, with approximately 9,340 tons/day deposited on East Pasture floodplains and another 23.1 tons/day deposited on West Pasture floodplains, Using an estimate of 90 percent retention for coliforms on East Pasture floodplains, instantaneous coliform loading in Lagunitas Creek could be reduced at rate as high as 16 percent or 1.6 million MPN per second during this portion of the storm event. During this storm, flows of approximately 5,000 cfs were sustained for at least one hour at the time of sampling. If overbank flooding could have occurred, coliform loading in Lagunitas Creek could have been reduced by 96 million MPN during just this one hour. In addition, using an estimate of 20 percent retention (Kadlec and Knight 1996), instantaneous phosphate loading rates in Lagunitas Creek could be reduced as much as 3.6 percent or 1.4 mg/s or 85 mg during just that one hour of flooding (Parsons, *in prep*.). As noted earlier, most of the cumulative floodwater volume from overbank flooding of Lagunitas Creek would flow into the East Pasture. Under this alternative, much less than 1 percent of the cumulative floodwater volume would end up in the West Pasture (KHE 2006a).

During the flood event described above, calculated instantaneous loading rates totaled approximately 220 mg/s for nitrates (Parsons, *in prep*.). However, nitrates may not be as readily retained by floodplains. Assuming a trapping efficiency rate of approximately 3 percent, the instantaneous loading rate of nitrate in Lagunitas Creek during an approximately 2-year event would be reduced by 0.5 percent relative to 0.3 percent under Alternative A due to increased retention on floodplains in the East Pasture, resulting in a total reduction in instantaneous nitrate loading rates of 1.2 mg/s or 70 mg during a one-hour period. Contributions from overbank flooding of the West Pasture would be extremely negligible (<<< 0.1 mg/s) under this alternative.

As discussed under the No Action Alternative and Alternative A, some nitrate retention does appear to occur with Project Area streams and associated wetlands. The flat gradients present in the West Pasture and Olema Marsh may increase residence time sufficiently to promote assimilation of nitrates by aquatic plants or phytoplankton in the stream channel or conversion from nitrates to nitrogen gas through denitrification. Conversely, in Tomasini Creek, during approximately 50 percent of the sampling events, nitrate concentrations were higher downstream than upstream, and during 75 percent of the events, fecal coliform concentrations were also dramatically higher – on average, 544 percent -- downstream. This pattern in the data points to a localized source of nitrates and coliforms, downstream of Mesa Road. Under Alternative B, some of the relatively minor loading of nutrients and coliforms from non-point source run-off from the town of Point Reyes Station and emergent groundwater on the East Pasture perimeter just north of the dairy facility may be ameliorated by the proposed construction of a freshwater marsh (Tomasini Triangle freshwater marsh) to offset expected losses of the freshwater marsh in the West Pasture adjacent to Sir Francis Drake Boulevard from increased salinity intrusion.

Possible Additional Mitigation Measures: No mitigation measures would be proposed under this alternative.

Effectiveness of Possible Additional Mitigation Measures: Not applicable

Cumulative Impacts: Cumulative impacts would be identical to those described under the No Action Alternative.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: As with Alternative A, Alternative B would have much greater benefits to water quality in the Project Area than the No Action Alternative. Alternative B would be expected to have moderate beneficial effects on water quality in both the East and West Pastures, however, there would continue to be no to very negligible improvement in water quality conditions in Tomasini Creek. Increased overbank flooding from Lagunitas Creek would not be expected to reduce Project Area water quality, because most of these nutrients, pathogens, and contaminants would be deposited along with suspended sediment on the floodplains and not necessarily in Project Area waters and would be assimilated, converted, or remain bound to sediments. As explained under the No Action Alternative, short-term effects would be less dramatic than long-term ones, because of the time expected to be required to bring water (and soil) conditions within the range characteristic of natural wetlands and grasslands. In addition, flooding of the East Pasture during storms may result in pulses of sediment, nutrients, and pathogens to downstream waters of Lagunitas Creek after construction is completed. These pulses would be expected to be transient in nature and not last more than 2- to 3 years. For this reason, short-term beneficial effects would be characterized as minor as opposed to major. Negligible adverse effects may also occur during construction from temporary installation of coffer dams and accidental fallback of sediment into waters from excavation of levees along Lagunitas Creek. However, Best Management Practice (BMPs) would be instituted to minimize the effects of these actions on water quality within and downstream of the Project Area.

From a Lagunitas Creek perspective, the combination of the increased frequency of overbank flooding -- which occurs under Alternative A, as well – and the much greater cumulative floodwater volume routed through the East and West Pastures under Alternative B would increases the potential water quality benefits of this alternative to the watershed relative to Alternative A. Alternative B would be expected to have at least a minor beneficial effect on water quality downstream of the Project Area in southern Tomales Bay. With elimination of grazing and elimination of intensive agricultural management practices, overbank flooding

would be expected to contribute positively to the water quality of the southern portion of Tomales Bay by filtering sediment, nutrients, pathogens, and contaminants, which is one of the more functions that wetlands play. Over the long-term, overbank flooding onto floodplains would be expected to have at least a minor beneficial effect on water quality within the southern portion of Tomales Bay by decreasing loading of sediment, coliform, phosphate, and certain forms of nitrogen, with reductions in suspended sediment and instantaneous coliform loading estimated to be as high as 17.8 percent and 16 percent, respectively, during approximately 2-year flood events.

Alternative C

Analysis: Alternative C would have negligible to major effects on water quality in the Project Area and the southern portion of the Tomales Bay watershed (Table 58). Under Alternative C, the East and West Pastures would be restored, along with Olema Marsh. Most of the new public access facilities would continue to be limited to the eastern and southern perimeters of the East Pasture, although access along the eastern perimeter would be scaled back through removal of the through-trail component. The southern perimeter trail includes a bridge crossing of Lagunitas Creek near the old summer dam, and evaluation of a planning corridor in the West Pasture between White House Pool and Inverness Park. Restoration would involve complete removal of levees in the East and West Pastures along Lagunitas Creek and excavation of even more new tidal channels. A small tidal channel would be initiated off Lagunitas Creek, as well as in the interior of the East Pasture. Tomasini Creek would be realigned into one of its historic alignments midway through the East Pasture. In Olema Marsh, an adaptive restoration approach would be undertaken, with initial excavation of a shallow berm and the Bear Valley Creek channel to improve hydraulic connectivity and improve drainage of currently impounded waters. As with the other alternatives, this alternative would involve removal or restoration of agricultural infrastructure and discontinuation of agricultural management practices.

Project Area-Overview: Alternative C would have very similar beneficial effects to the other alternatives on water quality in the Giacomini Ranch portion of the Project Area. The numerous effects that infrastructure removal and elimination of agricultural management practices would have on water quality and exceedance of water quality objectives are discussed in detail under the No Action Alternative and Alternative A. The effects of most of the restoration efforts, which include partial or complete removal of levees, tidegates, and culverts and excavation of new tidal channels, are fully discussed under Alternative B. As with Alternative B, this alternative would be expected to have a minor to moderate effect on reducing frequency of exceedances of Basin Plan objectives for dissolved oxygen, nitrates, nitrites, unionized ammonia, and fecal coliform. Ultimately, the degree of change that can be effected in the Project Area in terms of water quality improvement will be constrained by conditions with source creeks and other hydrologic sources. Data collected by the Park Service on water quality within reference wetlands in the watershed suggests that, for many of the objectives such as pH, dissolved oxygen, turbidity, and pathogens regulated under the Basin Plan (RWQCB 1995a), the range of natural variability is large and approaches or – in the case of pathogens – exceeds the numerical thresholds or limits imposed by water quality objectives (Parsons, *in prep*.). New activities associated with the Tomasini Creek and Olema Marsh areas would result in potential impacts to water quality conditions.

Project Area-Tomasini Creek: Currently, Tomasini Creek is leveed to run along the edge of the Point Reyes Mesa until its outlet with Lagunitas Creek and southern Tomales Bay near Railroad Point. The creek has only a very narrow fringing floodplain on the inboard of the levee, with flooding from overtopping or breaching of levees into the East Pasture much less common than with Lagunitas Creek. Under this alternative, Tomasini Creek would be reconnected to its historic floodplains, with size of this new floodplain in the East Pasture estimated at 64 acres. The existing channel and the tidegate/flashboard dam structure that regulates low flows in Tomasini Creek would be retained, because the creek supports a federally endangered fish species. However, it would become more of a backwater slough that would only receive flood flows from Tomasini Creek during large storm events. Otherwise, this backwater slough would continue to be almost fully tidal, with the malfunctioning tidegate/flashboard dam structure only truncating low flows, and salinities would continue to be dampened by the persistent groundwater flow from the Point Reyes Mesa, thereby maintaining brackish conditions.

Rerouting of Tomasini Creek would have beneficial effects on not only water quality within the creek, but within the southern portion of Tomales Bay. Tomasini Creek was one of the few areas in which nitrate and pathogen loads were higher downstream in the Project Area than upstream of the Project Area. During approximately 50 percent of the water quality sampling events between 2002 and 2006, nitrate concentrations were higher downstream than upstream, and during 75 percent of the events, fecal coliform

concentrations were also dramatically higher – on average, 544 percent – downstream (Parsons, *in prep*.). These results point to a source of nitrates and coliforms being downstream of Mesa Road within the Project Area boundary. Dairy cattle rarely, if ever, cross over the levee to graze on the small fringing floodplain, so the source is believed to be leaking septic systems and other influences from residential development originating from either the worker housing or homes on the Point Reyes Mesa. Movement of these nutrients and pathogen indicators into the Project Area is enhanced by the existing seasonal to almost year-round groundwater and permeable gravel layers within this coastal marine terrace. Realigning Tomasini Creek near the Hunt Shack would most likely result in much lower loads of nutrients and pathogens being routed through the East Pasture, at least from the Point Reyes Mesa residential development, and would decrease the potential for these more polluted waters downstream of the Hunt Shack to be exchanged to Tomales Bay, because flood flows, which are more likely to convey nutrient loads to downstream sources, would be diverted into the East Pasture. Tidal action can also cause exchange of waters, but the retained tidegate/flashboard dam system tends to minimize outflow to some degree by truncating the lower part of the tidal range.

The quality of waters within the rerouted portion of Tomasini Creek would be improved through overbank flooding and related deposition of sediment, nutrients, pathogens, and contaminants onto the East Pasture floodplain. While Tomasini Creek has high concentrations of nutrients and coliforms just as do most of the other creeks and drainages, Tomasini Creek also is influenced by historic or potentially ongoing leakage from the now-closed West Marin Landfill, located upstream in the Tomasini Creek watershed. The landfill reputedly does not have the liner now required of all landfills and violates state regulations requiring a minimum of 5 feet between the bottom of the landfill and the groundwater table. The RWQCB documented the presence of leachates and cation/anion salts among other contaminants in Tomasini Creek more than one mile downstream from the landfill and just upstream of the Project Area boundary (David Elias, RWQCB, *pers. comm*.). A sediment screening study conducted in the Project Area in 2003 found detectable concentrations of cadmium within creek sediments just upstream of Mesa Road, the only detection of cadmium within the Project Area (Parsons and Allen 2004a). However, cadmium levels did not exceed standards associated with frequent or infrequent toxicity to aquatic organisms (Parsons and Allen 2004a). Rerouting of Tomasini Creek into the East Pasture would increase loading of not only nutrients and pathogens, but more toxic contaminants that are not typically a concern in rural areas such as Tomales Bay: the landfill reputedly accepted wastes for a while from other areas in the San Francisco Bay region. Without more data, it is difficult to predict the magnitude of the problem posed by the landfill. However, wetlands and their reduced or anaerobic soil environments are extraordinarily efficient in trapping and binding contaminants, as well as nutrients and pathogens, for long periods of time, as long as wetland conditions are not radically altered (e.g., dewatered). By routing flows onto East Pasture floodplains, these contaminant, nutrient, and pathogen loads are diverted from reaching Tomales Bay and decreasing water and sediment quality conditions in the southern portions of the watershed. In terms of minimizing impacts to aquatic life, floodplains are a more stable reservoir for contaminants than stream channels and bays, which are subject to more frequent erosion and redistribution of contaminated sediments.

Project Area-Olema Marsh: One of the other large changes that would occur under Alternative C comes with lowering of the water surface levels within Olema Marsh through improving hydraulic connectivity of Bear Valley Creek within Olema Marsh with Lagunitas Creek. As was discussed in detail under Soil Resources, the adaptive restoration approach proposed for Olema Marsh would result in a dramatic lowering of water surface levels in this highly impounded marsh. Water surface levels are currently perched almost 4 feet higher than the culvert invert for Bear Valley Creek at Levee Road for a number of reasons, including elimination of drainage from the western culvert, poor drainage from the eastern culvert due to low capacity and a berm near the outlet that acts as a funnel, and total submergence of the culverts at Bear Valley Road (KHE 2006b). The first phase of the adaptive restoration program would be to remove the berm and to shallowly excavate a more defined flow path for Bear Valley Creek within the marsh. These actions would lower water surface levels as much as 1- to 4 feet (KHE 2006b). As waters drain down, approximately the upper 1- to 2 feet of the marsh surface, which appear to be largely peat or undecomposed organic matter, would be dewatered and exposed to air. Through oxidation, the surface layer of these peat soils would begin to break down and decompose, causing a lowering of the marsh surface through subsidence or compaction. Subsidence rates are difficult to predict, but based on general elevations of the marsh soil surface from topographic surveys conducted, Olema Marsh could subside by approximately 0.7 to 1.7 feet.

Oxidation of peat and mineral soils triggers a range of biogeochemical reactions, some of which have important implications for water quality. Oxidation of impounded soils, particularly peat soils or soils that were historically exposed to tidal influence, can dramatically affect nutrient conditions within soils. Rapid decomposition of peat and organic-rich mineral soils can generate a pulse in mineralization or production of inorganic nutrients, with pH often driving which nutrient forms are the most prevalent (Delaune and Smith

1985, Anisfeld and Benoit 1997, Portnoy 1999, Sommer and Horwitz 2001, Parsons and Martini-Lamb 2003). Oxidation often results in a lowering in soil pH because of the production of humic acids and other types of acids, and these acids can shift the nutrient pathway away from nitrification or the production of nitrates from ammonia. In addition, introduction of saltwater can decrease binding of ammonium in soils through the higher ionic strength of saltwater (Portnoy 1999). Nutrients produced through breakdown of organic matter or such as ammonium and phosphate can either remain in drained soils, or they can be flushed into overlying waters when soils are flooded again (Delaune and Smith 1985, Portnoy 1999). Often, these pulses are very sharp, but relatively short-lived, lasting a matter of weeks (Anisfeld and Benoit 1997, Parsons and Martini-Lamb 2003). Nutrient efflux into overlying waters may also be spatially variable, with areas exposed to tidal influence having higher rates of efflux because of cation exchange.

In addition to nutrient pulses, inundation of recently dewatered or drained soils can cause pH within overlying waters to plummet, at least temporarily. The severity of this reduction in pH depends on the soil substrate and the degree of current or historic tidal influence. The pH in overlying waters often drops lower in saline or tidally influenced soils (pH ~2-4 with pH 7 considered normal or neutral) than in freshwater wetland or peat soils (pH ~5.0), because oxidation of pyrite and other iron-sulfur compounds in tidally influenced soils leads to extensive production of additional acidic compounds (e.g., sulfuric acid and ferrous iron; Delaune and Smith 1985). In freshwater wetlands, acidity is primarily produced by breakdown of peat into humic acids. The peat underlying Olema Marsh is expected to be relatively fresh or low salinity in nature, at least within surface layers, because tidal influences have been largely precluded or at least limited since construction of Levee Road in the late 1800s. However, estuarine-derived muds and peat probably underlie the peat at some unknown depth. Therefore, pHs generated by breakdown of organic matter would be expected to be closer to 5 than 2-4. The persistence of acidic conditions within overlying waters depends to a large degree on the influx rate of waters high in carbonates such as seawater, groundwater, or streams, with acids typically quickly buffered in wetlands with some consistent source of water. Low pHs typically persist for longer periods of time in systems with no to very low sources of inflowing water, because acid concentrations greatly exceed that of available carbonates. **Permanent Bear Valley Creek inflow, combined with persistent subsurface groundwater inflow from the Inverness Ridge, would be expected to buffer acids within a short time of being produced, although there could be some spatial variability within the marsh where lower pHs would persist.**

Decomposition of peat soils can also affect water quality by releasing soluble, partly decomposed organic matter into overlying waters, thereby increasing oxygen demand and decreasing dissolved oxygen levels (Anisfeld and Benoit 1997). A similar phenomenon was observed in the East Pasture drainage ditches: organic matter is constantly introduced into ditch waters by frequent dredging, which disturbs both rooted and floating vegetation and undecomposed organic matter in ditch soils. In ditches, dissolved oxygen levels rarely exceed 5 mg/L and are typically below 2 mg/L. Dissolved oxygen within Olema Marsh waters would be expected to drop in response to decomposition of peat soils, with effects being more prolonged than that for pH and possibly extending through the second year after restoration is completed.

These same biogeochemical processes have implications for contaminants, as well as nutrients. Under oxidized conditions, many marsh soils will release sediment-bound contaminants into overlying waters. Oxidation in and of itself does not necessarily lead to release of metals, but oxidation combined with a sharp decrease in pH as is often observed in saline soils can encourage a “pulse” of formerly sediment-complexed metals into the water column. Studies have documented releases of a variety of metals, including silver, aluminum, cadmium, chromium, copper, iron, manganese, nickel, lead, selenium, and zinc (Delaune and Smith 1985, Soukup and Portnoy 1986, Gambrell et al. 1991, Anisfeld and Benoit 1997). Release of contaminants such as metals appears to be higher from saline or saltwater wetland soils than freshwater wetland ones, probably because of the lower pHs often present in oxidized tidally influenced soils (pH ~3-4) than in freshwater wetland ones (~5.1; Delaune and Smith 1985). Soils high in humic acids or organic carbon also tend to bind metals (Syrovetnik and Neretnieks 2002), as well as organic contaminants such as DDT and chlorinated benzenes.

The potential for a pulse in metal or organic contaminants into overlying waters following draining and oxidation of Olema Marsh soils would appear relatively minor given the relatively low probability of any historic or current exposures to organic contaminants or metals, even metals such as nickel, chromium, and valanium that are naturally high in the ultramafic or serpentine soils found in the Franciscan Formation, which is prevalent throughout the San Francisco Bay region and the eastern side of Tomales Bay, including the Bolinas Ridge (Hornberger et al. 1999) The sediment screening survey conducted in the Project Area in 2003 did show ubiquitously high levels of nickel and chromium in the Project Area, except in Fish Hatchery Creek

(Parsons and Allen 2004a). The upper portions of Fish Hatchery Creek, as well as Bear Valley Creek, drain completely off the Inverness Ridge, which is dominated by granitic rock such as quartz-diorite and granodiorite that probably contains low levels of metals relative to the Franciscan Formation (G. Kamman, KHE, *pers. comm*.).

Over time, subsidence would be expected to reach equilibrium with water surface levels, but while subsidence can occur relatively rapidly, the long-term effects of drainage on sediment nutrient pools and fluxes into overlying waters can persist for some time, with effects noted in some marshes even 10 years after marshes had been drained (Portnoy 1999). Within the short-term, assumed to be at least 10- to 15 years for this impact indicator, a large degree of variability in water quality conditions would be expected, primarily in nutrient loading to overlying waters as surface soils in Olema Marsh adjust to being dewatered. Pulses of phosphates from soils would not necessarily violate any Basin Plan or USEPA objectives, because there are no phosphate objectives. Pulses of ammonia could cause exceedances of the unionized ammonia objective, although periods of low pH would restrict unionized ammonia production. Depending on oxygen levels, ammonia could also be rapidly converted to nitrates either within the marsh or downstream of the marsh in Lagunitas Creek. Sharp pulses in nitrates caused by conversion from ammonia could cause exceedance of the USEPA objectives for nitrate concentrations exceeding 10 mg/L. Low oxygen levels would favor ammonia or potentially production of nitrites, a typically transient form of nitrogen that is toxic to people and wildlife and is regulated by the USEPA.

Declines in pH would be expected to be a much more transient issue and unlikely to persist for more than a few weeks to a month, given the steady influx of carbonate-rich waters into the Olema Marsh capable of buffering acids produced. These temporary declines in pH would exceed Basin Plan objectives for pH both in terms of ambient pH objectives that specify a range of 6.5-8.5 and project-related objectives of not causing more than a 0.5 change in pH. While pH changes would not be expected to extend much outside Olema Marsh itself, nutrient spikes would affect both the marsh and Lagunitas Creek, at least temporarily increasing loading rates to southern Tomales Bay. For this reason, short-term effects of this alternative in Olema Marsh water quality would be characterized as minor to moderate and adverse. From an overall project perspective, these negative effects are buffered over the short-term by the marked improvement in water quality conditions in the Giacomini Ranch under all alternatives.

Over the long-term, the proposed actions would be expected to have a beneficial effect on water quality within Olema Marsh, as the marsh came into equilibrium with changed water surface level conditions. Currently, Olema Marsh occasionally (>25 percent and <50 percent) exceeds Basin Plan objectives for minimum oxygen levels within waters, with long residence times and high primary productivity apparently causing episodes of hypoxia or low oxygen, even during the day (Parsons, *in prep*.). As with Lagunitas Creek, Bear Valley Creek and Olema Marsh also regularly exceed AWWA (1990) standards for minimization of eutrophic conditions within estuaries, with nitrate concentrations exceeding 1 mg/L more than 50 percent of the time (Parsons, *in prep*.). As discussed under the other alternatives, nitrate concentrations decreased, on average, by 0.85 mg/L or 37 percent between the upstream and downstream portions of the marsh (Parsons, *in prep*.).

Fecal coliform patterns were more variable, with instantaneous loading rates sometimes increased at downstream sampling locations, which suggests localized contribution to coliform loads from waterfowl that commonly use the marsh or leaking septic systems. The flat or low topographic gradients present in this system may increase residence time sufficiently to promote assimilation of nitrates by aquatic plants or phytoplankton in the stream channel or conversion from nitrates to nitrogen gas through denitrification: floodplains have not necessarily been found in other systems to be very effective in trapping nitrates (van der Lee et al. 2004), with stream channels and floodplains most effective in trapping sediment-associated forms of nitrogen such as ammonia and organic nitrogen. While the proposed actions would change the structure of Olema Marsh, it would still be expected to remain largely a freshwater marsh with pockets of brackish marsh that would still be subject to flooding and therefore should continue to have beneficial effects on reducing nitrates. Ultimately, exceedance of AWWA nitrate standards would be expected to decrease in frequency to only occasionally exceeding these objectives. Fecal coliform concentrations would decrease slightly, but with major sources of coliforms present both upstream on Bear Valley Creek and potentially on the perimeter from small drainages and groundwater, the degree of reduction really possible is limited.

Pollutant Retention and Effects on Tomales Bay: Under Alternative C, the West Pasture levee would be completely removed, and tidal channel excavation would be increased in the East Pasture, which would increase conveyance and exchange of waters. While levees would be completely removed, the frequency of overbank flooding from Lagunitas Creek into the East Pasture would still be identical to that under Alternative B (2-year flood events). However, the volume of floodwaters from Lagunitas Creek conveyed through the

West Pasture would increase slightly, although the East Pasture still accounts for more than 99.9 percent of the reduction in cumulative floodwater volume in Lagunitas Creek under a 2-year event (KHE 2006a). Based on hydraulic modeling, cumulative floodwater volume from Lagunitas Creek conveyed into the West Pasture during a 2-year event would climb from much less than 1 percent under Alternative B to approximately 0.5 percent under Alternative B (KHE 2006a). Potential retention of suspended sediment on West Pasture floodplains during a 2.25-year flood event would increase from approximately 23 tons/day under Alternative B to 241 tons/day.

The reduction in sediment and potential pollutant delivery to the Bay would increase from 17.8 percent (8,900 tons/day) under Alternative B to 18.8 percent (9,400 tons/day) under Alternative C. Calculated fecal coliform loading rates on the Giacomini Ranch floodplains during this same flood event would increase slightly from Alternative B to 1.7 million MPN/s or 102 million MPN during a one-hour period, resulting in a 16.9 percent reduction in downstream loading. In addition, using an estimate of 20 percent retention (Kadlec and Knight 1996), instantaneous phosphate loading rates in Lagunitas Creek could be reduced as much as 3.8 percent or 1.5 mg/s or 90 mg during just that one hour of flooding (Parsons, *in prep*.). As discussed earlier, nitrates did not appear to be as readily retained by floodplains, however, assuming a trapping efficiency rate of approximately 3 percent, the instantaneous loading rate of nitrate in Lagunitas Creek during an approximately 2-year event would be reduced by 0.6 percent relative to 0.3 percent under Alternative A. This would result in a total reduction in instantaneous nitrate loading rates of 1.25 mg/s or 75 mg during a one-hour period.

Possible Additional Mitigation Measures: It should be noted that potential water quality impacts described for the Olema Marsh system would be transient and transitional. The continuous inflow of waters to the area from upland freshwater sources, as well as tidal influence, would buffer the potential pH variations and limit these to very localized, short-duration events. However, possible additional mitigation measures might also include actions that could be used to implement more gradual change in water surface levels in Olema Marsh. Through a gradual reduction in water surface levels, potential acute water quality impacts described above would be minimized. Currently, water level in the Olema Marsh is controlled by an extensive fill area or vegetated berm directly at outflow location under Levee Road. An initial treatment might be to cut through this sill and improve a flow path through the Project Area, but not to remove it entirely so that water levels would drop more gradually. In order to minimize some of the identified water quality impacts in the Olema Marsh, actions to remove established vegetation and initiate establishment of a flow path would be used to allow headcutting and channel downcutting over time. The reduction of water level in the marsh would be less predictable, but would occur over a longer period of time.

Effectiveness of Possible Additional Mitigation Measures: By instituting a more gradual reduction in water surface levels, some of the adverse effects associated with pulses in nutrients and acids that would further impact vegetation communities in Olema Marsh might be lessened or tempered to some degree. However, ultimately, the water quality conditions will be impacted to some degree with or without this mitigation measure. While slowing down the process might minimize potential poor water quality events, it may lengthen the time that it takes for a new equilibrium to be established. Because the identified impacts would be very localized and transient, the extent and duration of this potential measure may delay achievement of equilibrium conditions and improved water quality.

Cumulative Impacts: There are at least four (4) currently proposed projects that would have the potential to cause cumulative impacts should the No Action alternative be implemented, the Bear Valley Creek Watershed Enhancement Project, Chicken Ranch Beach Enhancement, the East Shore Wastewater Improvement Project, and the County of Marin's Culvert Cleaning Project, generally described in Table 25 of this chapter. Most of these projects were discussed in detail under Alternative A and would be expected to have cumulatively beneficial long-term effects, although, in the case of the culvert cleaning, there could be potentially some minor, short-term adverse effects, particularly in combination with short-term adverse effects predicted for Olema Marsh as part of the adaptive restoration. However, these conditions would be transient in nature and largely localized to the marsh itself. Cumulatively, the actions under Alternative C and other projects identified here would result in minor short-term benefits, and, as Olema Marsh reaches equilibrium conditions, moderate long-term cumulative benefits to water quality would be expected for the southern portions of Tomales Bay.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: As with Alternative B, Alternative C would have much greater benefits to water quality over the long-term in the Project Area than the No Action Alternative. Alternative C would be expected to have major beneficial effects over the long-term on water quality in both the East and West Pastures, as well as in Tomasini Creek and Olema Marsh. There would be some moderate adverse effects to water quality over the short-term in Olema Marsh from lowering of water surface levels within this highly impounded system and the associated biogeochemical reactions to dewatering and oxidation or breakdown of peat soils. In the case of nutrients, these short-term adverse effects would impact not only Olema Marsh, but Lagunitas Creek and southern portions of the watershed in the form of sharp spikes potentially in nutrient loading rates. However, these effects would be expected to be either very transient as in the case of declines in pH or to decline with time as in the case of nutrients as the marsh comes into equilibrium with its new conditions. From an overall project perspective, the impact of these adverse effects would be buffered by the steady improvement in water quality conditions within the Giacomini Ranch and Tomasini Creek. Negligible adverse effects may also occur during construction from temporary installation of coffer dams and accidental fallback of sediment into waters from excavation of levees along Lagunitas Creek. However, Best Management Practice (BMPs) would be instituted to minimize the effects of these actions on water quality within and downstream of the Project Area.

From a Lagunitas Creek perspective, the combination of the increased frequency of overbank flooding and the slightly greater cumulative floodwater volume routed through the East and West Pastures under Alternative C relative to Alternative B would increase the potential water quality benefits of this alternative to the southern portion of the watershed. In addition, the long-term improvement in water quality conditions in Tomasini Creek and Bear Valley Creek would also have positive impacts on watershed water quality. For this reason, Alternative C would be expected to have at least a moderate beneficial effect on water quality downstream of the Project Area in southern Tomales Bay. With elimination of grazing and elimination of intensive agricultural management practices, overbank flooding by Lagunitas and Tomasini Creeks onto the Giacomini Ranch floodplains would be expected to contribute positively to the water quality of the southern portion of Tomales Bay by filtering sediment, nutrients, pathogens, and contaminants, which is one of the more functions that wetlands play. The extent of improvement is limited to some degree by the continued influx of high loads of nutrients and pathogens from small creeks, drainages, and emergent groundwater into the Project Area. Over the long-term, overbank flooding from both Lagunitas Creek and Tomasini Creek onto floodplains would be expected to have at least a moderate beneficial effect on water quality within the southern portion of Tomales Bay by decreasing loading of sediment, coliform, phosphate, and certain forms of nitrogen, with reductions in suspended sediment and instantaneous coliform loading estimated to be as high as 18.8 percent and 16.9 percent, respectively, during approximately 2-year flood events.

Alternative D

Analysis: Alternative D would have identical negligible to major beneficial effects as Alternative C on water quality in the Project Area and the southern portion of the Tomales Bay watershed (Table 58). Under Alternative D as with Alternative C, the East and West Pastures would be completely restored, along with Olema Marsh. In terms of water quality, the only substantial difference would be the replacement of the Tomasini Creek Mesa Road culvert with a bridge or arch culvert, which may have some additional negligible beneficial effects on water quality in Tomasini Creek. Tomasini Creek would be completely realigned into one of its historic alignments just downstream of Mesa Road, which could eliminate potential contributions of nutrients and pathogens from the worker housing adjacent to Tomasini Creek just west of Mesa Road. In addition, there would be excavation of even more new tidal channels in the East Pasture, further increasing flow conveyance and exchange of waters with Tomales Bay. Cumulative floodwater volume would increase negligibly under this alternative in both the East and West Pastures, with negligible increases potentially in deposition of suspended sediment, pathogens, and other nutrients on Giacomini Ranch floodplains.

There would be no change in restoration approach in the West Pasture from Alternative C, and the same adaptive management approach would be undertaken in Olema Marsh, with initial excavation of a shallow berm and the Bear Valley Creek channel to improve hydraulic connectivity and improve drainage of currently impounded waters. As with the other alternatives, this alternative would involve removal or restoration of agricultural infrastructure and discontinuation of agricultural management practices.

Possible Additional Mitigation Measures: Possible mitigation measures to address potential impacts of actions in the Olema Marsh are described under Alternative C.

Effectiveness of Possible Additional Mitigation Measures: Same as Alternative C.

Cumulative Impacts: Cumulative impacts would be identical to those described under Alternative C.

Impairment Analysis: This alternative would not impair a resource identified in the Organic Act or as a goal in Park Service management policies or considered as necessary to fulfillment of purposes identified in enabling legislation or key to the natural or cultural integrity of the park.

Conclusions: Alternative D would have identical negligible to major beneficial effects as Alternative C on water quality in the Project Area and the southern portion of the Tomales Bay watershed (Table 58). Under Alternative D as with Alternative C, the East and West Pastures would be completely restored, along with Olema Marsh. In terms of water quality, the only substantial difference would be the replacement of the Tomasini Creek Mesa Road culvert with a bridge or arch culvert, which may have some additional negligible beneficial effects on water quality in Tomasini Creek. Tomasini Creek would be completely realigned into one of its historic alignments just downstream of Mesa Road, which could eliminate potential contributions of nutrients and pathogens from the worker housing adjacent to Tomasini Creek just west of Mesa Road. In addition, there would be excavation of even more new tidal channels in the East Pasture, further increasing flow conveyance and exchange of waters with Tomales Bay. Cumulative floodwater volume would increase negligibly under this alternative in both the East and West Pastures, with negligible increases potentially in deposition of suspended sediment, pathogens, and other nutrients on Giacomini Ranch floodplains. The reduction in sediment and fecal coliform delivery to Tomales Bay would climb slightly relative to Alternative C to 19 percent and 17.1 percent, respectively, thereby resulting in a moderate beneficial effect on downstream water quality.

Vegetation Resources

Laws, Regulations, Policies, and Criteria Guiding Impact Analysis

Many native vegetation communities within the United States have been adversely impacted by introduction of non-native plant species, as well as a host of other anthropogenic factors such as commercial, residential, and agricultural development, and resource extraction. These activities have affected all vegetation communities, but the most highly publicized and pervasive threats are perhaps those to wetland and riparian communities. Because of the important functions wetlands and riparian areas provide to plants, wildlife, and humans, these habitats are often subject to oversight from federal, state, and local agencies.

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 through discharge of fill or dredged material are minimized. In addition, wetlands are also regulated under other federal and state statutes and policies, including Section 401 of the Clean Water Act, the federal and California Coastal Act, the Porter-Cologne Act, and Park Service Management Policies. Some of these interpret impacts to include a much broader range of actions, including placement of material in upland areas that could affect wetlands, groundwater withdrawals, and livestock grazing. Riparian areas may or may not be considered wetlands under Section 404, but they are often regulated through establishment of “buffers” or non-development areas by other regulations and policies, including the Local Coastal Program (LCP) and California Coastal Commission (CCC) in the Coastal Zone, California Department of Fish and Game (CDFG) under Lake and Streambed Alteration Agreements, and the Point Reyes Station Community Plan. A more complete description of these policies can be found in Chapter 3 under Vegetation Resources.

Wetlands and other native vegetation communities provide habitats for native plant species, some of which have decreased dramatically in numbers or range because of development and threats from non-native species. In recognition of these threats, federal and state agencies have moved to protect individual plant species under federal and state Endangered Species Acts (ESA). The federal ESA of 1973, as amended, requires federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) before taking actions that could jeopardize the continued existence of any federally listed plant or animal species (i.e., listed as threatened or endangered) or species proposed for listing. Threats to state-listed species require consultation with CDFG. Park Service policies require parks to not only avoid impacts to threatened and endangered species, but to look for opportunities to restore these habitats for these species (NPS 2006; Section 4.4.2.3). The U.S. Department of the Interior (DOI) NEPA significance criteria mandates that any