CHAPTER 7
WATER RESOURCES

7.1 AFFECTED ENVIRONMENT

7.1.1 Introduction/Region of Influence

Water resources include surface water and ground water resources. Surface water within the project area includes mainly the waters of Monterey Bay. There are no permanent fresh water bodies (streams, lakes or ponds) in the project area. Rainfall, storm water drainage and discharge, and flooding are also addressed under the heading of water resources. There is a good deal of interconnection in the coastal zone between geology and water resources. Coastal processes involving the formation of beaches, transport of sand, wave erosion of coastal bluffs, and the formation of waves are addressed under the heading of geological resources. This chapter focuses on issues related to water quality and quantity. Ground water is water that occurs below the earth's surface. The discussion of surface and ground water could range quite broadly, but the focus of the discussion in this chapter is on those conditions that may be affected by the various alternatives. This discussion includes short-term conditions that may occur during construction of the individual projects associated with the alternatives (main bluff protection structure, parkway development, and The Hook bluff protection structure), as well as long-term conditions that may occur.

The ROI includes the area from Pleasure Point to The Hook in which construction activity would occur, as well as the adjacent offshore and onshore areas where water occurrence or quality may be directly or indirectly affected by the various project actions outlined in Chapter 2.

7.1.2 Regulatory Considerations

MBNMS Water Quality Protection Program. A MBNMS Water Quality Protection Program is under development by federal, state, and local agencies, and public and private groups. Among the participating agencies are the City of Santa Cruz, Santa Cruz County, and the California Coastal Commission. Urban runoff is one of four priority water quality problem areas being addressed in the Water Quality Protection Program. A number of strategies have been identified to reduce nonpoint (stormwater) pollution of MBNMS.

Nonpoint Source Permit for Stormwater Discharges Associated with Construction Activity. All dischargers where construction activity disturbs more than five acres are required to develop and implement a Stormwater Pollution Prevention Plan (SWPPP) which specifies best management practices that would prevent all construction pollutants from contacting stormwater, with the intent of keeping all products of erosion from moving off site into receiving waters. Stormwater permit requirements are implemented and enforced by the Central Coast Regional Water Quality Control Board.

Santa Cruz County General Plan. Section 5.4 of the General Plan (Santa Cruz County 1994b) describes policies and programs regarding water quality in Santa Cruz coastal waters. These policies include wastewater discharge treatment requirements and prohibitions, including disturbances in coastal waters and wetlands and placement or discharge of pollutants and dredged material.

The County of Santa Cruz Erosion Control Ordinance requires preparation of an erosion control plan and compliance with other measures designed to protect the environment. These measures include the following:

- Maintain runoff rates at or below predevelopment levels;
- Retain on-site runoff by filtering it back into the soil whenever possible and always where percolation rates are two inches per hour or greater;
- If retention is not possible, detain runoff with detention basins or other runoff collection devices and release it in a controlled fashion, possibly into pipes or lined ditches;
- Direct released runoff flows into established vegetation, paved areas, or other adequate energy dissipaters, such as rock riprap;
- Keep sediment on-site by filtering runoff with gravel berms, vegetated filter strips, catch basins, or the like;
- Use berms or swales to divert runoff away from sensitive areas, such as unstable slopes; and
- Revegetate and protect exposed soils by October 15.

Santa Cruz County Local Coastal Program. The Santa Cruz County Local Coastal Program (LCP) is embodied as part of the County's General Plan. It fulfills requirements of the California Coastal Act, and consists of a land use plan, implementing ordinances, and any specific plans that may be adopted by the County for the Coastal Zone. Various ordinances adopted by the County implement policies of both the LCP and the remainder of the General Plan. Among the ordinances relevant to water resources are the County Grading Ordinance (Chapter 16.20 of the County Code) and the Erosion Control Ordinance (Chapter 16.22). The Grading Ordinance includes provisions for obtaining grading permits, eliminating hazardous conditions, excavations, and fills. The erosion control ordinance requires development of an erosion control plan and requires implementation of runoff controls.

7.1.3 Climate

Santa Cruz County has warm summers and mild winters, with mean daily maximum summer temperatures of 70 to 75 degrees Fahrenheit (°F) and mean daily minimum winter temperatures of 35 to 40 °F. Rainfall generally increases with elevation. Mean annual rainfall in the project area is about 28 inches, while parts of the Santa Cruz Mountains receive up to 90 inches in wet years.

Storm runoff and direct impact by wind-driven rain contributes to bluff erosion. The amount of erosion is a function of the amount, the intensity, and the duration of the storm. Often, but not always, intense rainfall occurs in conjunction with high waves, so that wave erosion and erosion from rainfall and runoff work together.

7.1.4 Storm Waves

Of more relevance to the erosion of coastal bluffs is the frequency of extreme rainfall, wind, and waves. The historical record of major storms in Monterey Bay indicates that major storms hit the Monterey Bay Area on average about once every year and a half (Bixby 1962; R. E. Johnson & Associates 1984). However, the most severe storms seem to be those associated with El Niño, which occurs on a long-term cycle of about once every seven years. Since the destructive El Niño of 1982-1983, there have been five El Niño years, in 1986-1987, 1991-1992, 1993, 1994 and 1997-1998, illustrating that there is no guarantee that an El Niño year would be followed by seven years of non-El Niño conditions.

El Niño conditions tend to generate storm waves that approach the coast from the southwest, where they are unobstructed by land until they reach the project area. Waves from the northwest (the predominant direction of winds) lose some of their energy when they are refracted around points of land, including the outer coast of Monterey Bay and Soquel Point. Therefore, the most destructive storms tend to come from the southwest, and only very severe storms from the northwest cause major erosion at the project area. Nevertheless, waves generated by smaller and more frequent storms, of a size that may occur several times per year, are capable of chronically scouring and undercutting the bedrock supporting the bluff, and of spraying and even occasionally washing up against the terrace deposits (as when these storms correspond with a high tide).

Haro, Kasunich and Associates (HKA) (1998) performed a wave runup analysis for the project area. Wave runup calculations include two principal components: the still water level, which is the elevation of the water surface if all waves were removed, and the height above the still water level that waves of different types will reach as they travel onto the shore. The still water level itself consists of several components, including high tidal levels, storm surge, wave setup, and long-term sea level rise. HKA used a still water range of 6.0 to 8.0 feet NGVD in their calculations of the maximum wave runup for design of the soil nail structure.[1] This is a conservative value, because the "maximum" wave runup has a very low probability of occurring.

[1]NGVD refers to the National Geodetic Vertical Datum of 1929, which is used as the elevation datum throughout this report, unless otherwise noted. It is often taken as synonymous with mean sea level and is the land elevation datum typically used on USGS topographic maps. Other elevation data such as mean lower low water (MLLW), are often applied to elevations of the sea bottom, in part because this datum is of greater interest to navigation.

In order to better understand the likelihood that waves will achieve a given elevation relative to the bluffs at East Cliff Drive, it is useful to evaluate the heights of wave runup under conditions with different recurrence intervals. Recurrence intervals are the average time intervals, in years, between events of a given size. They are based on analysis of historical records, and they are probabilistic. The Federal Emergency Management Agency (FEMA 1986) estimated the still water elevations for 10-year, 50-year, 100-year, and 500-year conditions at selected locations on the Santa Cruz County coastline. These are conditions that have a recurrence interval (probability of occurring) once in 10, 50, 100, or 500 years. For New Brighton Beach, the nearest location estimated by FEMA, the still water elevations corresponding to these recurrence intervals were estimated to be 4.6, 4.8, 5.0, and 5.3 feet NGVD, respectively.

The amount of wave runup is a function of the wave height, direction, and velocity and of the characteristics of the shore. In order to accurately predict wave runup, it is necessary to examine historical records of waves to determine the probabilities of waves of various heights, directions, and velocities (called wave spectra) and then to model the way in which the waves interact with the particular bottom geometry and bluff geometry at the project area. To achieve a high level of accuracy would require a large amount of data and is not usually considered necessary for design purposes, so long as conservative estimates are made. HKA (1998) conservatively estimated that the maximum wave runup in the project area would be 34 feet NGVD, using a standard methodology developed by the US Army Corps of Engineers (the Corps). The Corps had previously estimated the maximum wave runup in the area at 30 feet NGVD. Because the still water elevation assumed by HKA was one to three feet higher than the 100-year still water elevation estimated by FEMA, the lower wave runup estimate by the Corps probably better reflects the 100-year runup elevation for the project area but is still conservative. These results were used not only to determine the wave runup elevation, but also to estimate the magnitude of the wave forces that the soil nail structure would need to be designed to resist.

FEMA (1986) estimated wave runup heights for selected locations east of the project area. These results provide some indication of the relative magnitudes of wave runup of different probabilities, as well as of the variability in wave runup between locations. The estimates took into account the probabilities of waves approaching from different quadrants and with different velocities, based on historical wave data. The estimated 10-year wave runup elevations at sites east of the project area ranged from 15.2 feet to 28.5 feet; 50-year wave runup elevations ranged from 16.5 feet to 30.2 feet; 100 year wave runup elevations ranged from 17 feet NGVD to 31 feet NGVD; and 500-year wave runup elevations ranged from 21.5 feet to 32.4 feet. Based on these data, it appears that the estimate of 30 feet of wave runup is at the high end of the 100-year runup values for the vicinity, and that even the lowest 10-year value calculated by FEMA would be above the elevation of the top of the Purisima Formation in the project area.

7.1.5 Surface Water Features and Drainage (Onshore)

Current Conditions

Most of the rain that falls on the west-facing slope of the Santa Cruz Mountains is collected in streams that discharge to the sea. Because rainfall generally increases with elevation, the upper watersheds tend to capture most of the rainfall. As a result, these are areas of very active erosion, supplying large amounts of sediment to the streams that then flow out across the Pleistocene marine terrace. Some of the rainfall infiltrates through the stream channels or soils and recharges the groundwater aquifers beneath the coastal terraces. Unless captured by wells, the groundwater also eventually discharges to the sea. In developed urban areas, a large proportion of the ground surface is covered by pavement, buildings, and other impermeable surfaces and is directed to stream channels through the urban stormwater collection system.

In urban areas stormwater also picks up and transports pollutants from streets and other surfaces. The storm drainage system in Santa Cruz, like most urban storm sewer systems, is separate from the sanitary sewer system and discharges through outfall pipes along stream channels or the shore of the sea. At the project area, all stormwater collected from streets and roads is discharged at outfalls to the sea, and the storm drainage area includes mainly streets and homes. In response to concerns about the impacts of nonpoint source pollution on water quality in Monterey Bay, the County of Santa Cruz has begun installing systems to treat stormwater at some outfalls. (Non-point source pollution includes pollutants that are not released into the environment from a fixed location. Non-point source pollutants are typically picked up and concentrated by storm water runoff, which transports the pollutants to receiving waters such as the ocean, a stream, or to ground water). These stormwater remediation systems are typically designed to separate oily substances, which float, from the water, before the water is discharged to Monterey Bay. A small percentage of the runoff falls outside the collection area and runs off directly overland to the sea, across the bluffs. Under normal conditions the volume of water that drains directly over the bluffs is so small that it causes very little erosion.

Under extreme conditions of intense rainfall, the rate of rainfall may exceed the capacity of the stormwater collection system, and then the excess runoff has the potential to flood streets, overtop curbs, and flow directly over the bluffs to the sea. Intense storms that cause significant overland flow have the potential to contribute to bluff erosion. Generally, stormwater outfalls are intended to direct storm flows in such a way that the flows do not cause erosion. However, when the outfalls are in poor condition, leak, or discharge directly onto the bluff face, they can contribute to bluff erosion. The stormwater collection system is discussed further in Chapter 14, Utilities.

7.1.6 Surface Water Quality

As described above, stream water quality in the project area vicinity is affected largely by nonpoint sources of pollutants, which are contributed by runoff from streets. The quantity of these nonpoint pollutants is a function of the types of activities that occur within the urban portions of the watershed and the size of the urban storm sewer collection area. Point sources also contribute to the pollutant load, but discharges from point sources are controlled by discharge permits issued by the Regional Water Quality Control Board, which places limits on the quantity and concentration of pollutants and requires monitoring of the wastewater discharge.

The quantity of pollutants from point sources tend to remain constant over time and are independent of rainfall and stream flow. The quantity of pollutants from nonpoint sources vary over time and depend on rainfall. The largest quantities of nonpoint source pollutants enter the streams during the first large rains of the year, which usually occur in October and November. Later in the wet season the nonpoint pollutant loadings are lower because the streets already have been washed, and pollutant concentrations are also lower because the pollutants are diluted in the large volumes of stormwater runoff. However, the large storms transport greater amounts of sediment, including new sediment that is washed into the stream channels from hill slopes, and sediment that was already in the stream channels is transported farther downstream by high flows.

Water quality monitoring programs have been established by public agencies and by non-governmental organizations. The USGS collects water quality data at stream gages on the San Lorenzo River and Soquel Creek. The data is intended mainly for evaluating sediment erosion rates and the concentrations of mineral constituents, as part of ongoing studies of streams throughout the country. Santa Cruz County monitors water quality in selected stream locations and at public beaches for public health purposes. The County Health Department is primarily interested in microbial pollutants and issues public health warnings or site closures when microbial levels exceed public health standards.

The MBNMS also is concerned with water quality within the sanctuary's boundaries and has a water quality action plan that encourages public participation to meet water quality goals. The emphasis of the program is on prevention and management of nonpoint sources.

7.1.7 Hydrodynamics and Circulation (Monterey Bay and Nearshore)

The general circulation pattern of the waters of Monterey Bay is controlled by the dominant northwesterly wind and wave system, which produces a clockwise current within Monterey Bay. Superimposed on this dominant system are local wind-generated waves, as well as waves generated by distant storms from other directions. These waves and currents tend to produce rapid mixing and to aerate the waters of Monterey Bay. The natural circulation pattern in Monterey Bay works both chemically and physically to prevent pollutants or sediment from accumulating in the bay.

Offshore, the California Current transports subarctic water of relatively low temperature and salinity and high dissolved oxygen and nutrients off the coast of California toward the equator (Hickey 1979). Currents near the coast are affected by a variety of forces and boundary conditions, including local winds, upwelling currents (that bring deep waters to the surface), lateral and vertical mixing, tides, freshwater inflow, solar heating, changes in depth, and El Niño episodes. Coastal currents are primarily forced by local winds.

Within Monterey Bay, surface flow is dominated by a counterclockwise circulation, with speeds of about 4 inches per second (10 centimeters per second (cm/s)). Surface flow patterns extend to 66 feet (20 meters [m]) depth in the summer and to 164 feet (50 m) in the fall. Underlying this, at depths of 82 to 492 feet (25 to 150 m), is a clockwise flow, with speeds of approximately 2 inches per second (5 cm/s). There may be a third layer of deep counterclockwise flow below 656 to 984 feet (200 to 300 m), with speeds of a few inches per second, mostly in a shoreward direction, indicating the overall influence of the Monterey Submarine Canyon on subsurface flows.

When northerly winds relax, a warm clockwise eddy (circular current) moves shoreward, bringing cold oceanic water into the Monterey Bay (Bolin and Abbott 1963; Breaker and Broenkow 1989; Farrell et al. 1990; Tracy 1990). A period of upwelling occurs almost continuously between

March and October. After upwelling stops, there is a short period when the California Current is still the dominant current pattern but water conditions change slightly. This so-called oceanic period is marked by the absence of upwelling and a warming of the surface water temperature to more than 55°F. As the surface waters are moved offshore and replaced by the cold nutrient-rich waters from below the resultant upwelling introduces the nutrients (nitrates, phosphates, and silicates) that are essential for high phytoplankton production in the surface waters. These events are responsible for the highly productive waters of Monterey Bay (NOAA 1992).

Water quality in Monterey Bay is protected by natural processes and also by regulations. The MBNMS prohibits most activities that could endanger water quality and monitors those that cannot be prohibited. For example, most large ship traffic is routed outside the boundaries of the sanctuary, and oil exploration is prohibited within the sanctuary. Permits are required for any major construction or development that could involve the discharge of pollutants.

7.1.8 Groundwater Occurrence and Movement

Description of Regional Aquifer System

The Purisima Formation is the principal regional groundwater aquifer (geologic unit capable of yielding significant quantities of water to a well) in the Santa Cruz-Aptos area. The City of Santa Cruz Water Department pumps groundwater for municipal use from the Purisima Formation from wells within the Live Oak area. The Soquel Creek Water District relies on its wells in the Purisima Formation in mid-county to supply domestic water to most of its customers in Soquel, Capitola, and Aptos. The water-bearing zones within the Purisima Formation consist of fine well-sorted sands. The uppermost water-bearing zone tapped by municipal wells occurs at a depth of about 100 to 130 feet below the ground surface. Above this depth, the Purisima Formation does not yield sufficient water for pumping. Instead, the upper portion of the formation has a relatively low permeability and acts as an aquitard (a geologic layer that resists ground water flow), preventing downward movement of groundwater. Most of the recharge to the aquifer occurs in the foothills of the Santa Cruz Mountains.

Saltwater intrusion is a concern when pumping from any coastal aquifer, and the City of Santa Cruz has installed monitoring wells near the coast to track water levels and chloride concentrations. According to the data from these wells, the Purisima Formation is approximately 700 feet thick and dips to the south or southwest beneath the Live Oak area. The formation contains a number of water-bearing zones separated from each other to varying degrees by less permeable zones, with the effect that not all parts of the formation yield significant quantities of water. Most of the ground water is contained in aquifer zones that are below sea level (Fugro West 2001).

One monitoring well site is near 41st Avenue and consists of three separate wells placed in one boring. The nested wells, called the "Pleasure Point Monitoring Wells," were installed in 1988 (City of Santa Cruz 1988). The boring was drilled to a total depth of 422 feet. The shallowest well in the set is screened in the interval from 110 to 130 feet below the ground surface and taps ground water in the uppermost sandy water-bearing unit of the Purisima Formation in this area, which is designated the "B-Zone." Above this depth, the Purisima Formation consists of generally fine-grained, low permeability sediments that act as a confining layer.

Groundwater from local sources of recharge tends to perch on the top of the Purisima Formation, unable to penetrate the fine sediments at the top of the Purisima Formation. Rather than continue to move downward, the perched groundwater drains laterally, with the direction of its movement controlled by the slope or shape of the top of the Purisima. Locally, the perched ground water tends to move toward the south, and seeps from the face of the bluff. Seepage or springs can be seen in the bluff face near the interface between the terrace deposits and the Purisima Formation indicating areas where perched groundwater discharges.

7.2 ENVIRONMENTAL CONSEQUENCES

Impact Methodology

Water resources include both surface water and groundwater resources. Surface water resources include both terrestrial and saltwater resources. The topic of water resources includes both water quantity and water quality issues, and issues related to the movement of water (currents and waves, rainfall and runoff, groundwater movement) to the extent that these are related to water quantity and quality. Erosion processes, littoral transport, beach-forming processes, and other processes involving the interaction between water and geologic resources are addressed in the context of geological resources, in Chapter 6.

The ROI of the project area includes the region within the boundaries of the three projects in which construction would occur, as well as adjacent areas. In general, the boundaries of the ROI for water resources impacts would vary depending on the nature of the impact. Most water resources impacts would tend to occur within the immediate vicinity of the project area or in the direction of water movement (for example, downstream or down-current).

This section identifies all potential impacts on water resources from the proposed project alternatives and includes a discussion of each of these impacts relative to their magnitude or significance, both qualitatively and quantitatively.

Thresholds of Significance

In this analysis, an alternative is considered to have a significant impact on water resources if during or after construction it would result in any of the following:

- Degrade water quality such that the existing or future beneficial uses of the water would be reduced;
- Reduce the availability of, or accessibility to, one or more of the beneficial uses of a water resource;
- Alter the existing pattern of movement of water, such that the existing uses of the water within or outside the project area would be adversely affected;
- Cause existing or proposed water quality standards to be exceeded or would require an exemption from existing permit requirements in order for the alternative to proceed; or
- Increase the hazard of flooding or the amount of damage that could result from flooding.

Impacts from the proposed projects are compared against both current conditions and conditions expected after construction is completed (sometime between 2007 and 2010) and the long-term effects of the projects are evaluated over their 100-year expected lifespans.

7.2.1 Full Bluff Armoring (Alternative 1)

Significant Impacts

There are no significant impacts related to water resources under this alternative.

Nonsignificant Impacts

Hazard of Flooding

The hazard of flooding in the project area derives mainly from wave runup, rather than from stormwater runoff. The project area does not lie within the 100-year floodplain of any stream, and the storm drainage system is expected to effectively prevent flooding in 100-year storms.

The 100-year wave runup elevation in the project area has been estimated (see also Sections 6.1.11 and 7.1.4). The elevation of the bluff top in the project area is within the range of the 100-year runup elevations calculated by FEMA for nearby sites. The potential for flooding of the project area due to wave runup would increase over time, due to long-term sea level rise. Storm waves overtopping the bluffs could damage the parkway. The force of high waves could damage structures within the project area. However, impacts from flooding alone would be localized and would be similar to impacts from intense rainfall. Storm drainage systems are expected to accommodate the excess runoff generated by overtopping waves. Because the soil nail structure would generally mimic the existing profile of the bluff or make it steeper in portions where backfilling is required, the structure is not expected to increase wave runup elevation.

Water Quality

During construction, earthmoving activities and the use of heavy equipment within the project area could increase the potential for soil and sediment erosion and for spills that could affect water quality. Because the projects under this alternative would involve construction on more than five acres of land, a construction SWPPP would be required to be implemented, in accordance with the state general construction stormwater permit. Best management practices would be identified beforehand and would be implemented as part of the program to reduce or prevent pollutant and sediment discharges. Construction of the soil nail structure would be scheduled for the dry season, and construction activities would be timed to avoid high tides and wet weather. Spill cleanup procedures, prevention measures, and protocols for storing construction materials and wastes would be developed, in accordance with guidance for preparing SWPPPs.

Storm drainage from the project area comes primarily from streets and may contain a variety of urban pollutants. There are no industrial or commercial facilities within the storm drainage collection area of the project area; therefore, the principal contaminants in stormwater from the project area are expected to be trace levels of petroleum hydrocarbons from automobile traffic and household contaminants, such as fertilizers, household pesticides, and refuse and debris related to recreation in the area. Stormwater also may contain sediments from soil erosion in areas where soils are exposed. Concentrations of contaminants are likely to be highest during the first storm of the wet season and then would decline in subsequent storms. The improvements to the project area may lead to increased public use, which may increase the potential for waste to accumulate. However, most of the increased use would occur during the dry season. Routine street sweeping and park maintenance and continued public education (for example, nonpoint source reduction programs, hazardous waste collection programs, and storm drain stenciling) are expected to prevent any increase in pollutant discharge. Therefore, implementing this alternative is not expected to degrade water quality.

7.2.2 Partial Bluff Armoring with Full Improvements (Alternative 2)

Significant Impacts

Impact 7.1 Hazard of Flooding

Partial armoring of the Purisima Formation may lead to an increase in the 100-year wave runup elevation along portions of the project area because the slope of the terrace deposits would decrease as the bluff top continues to retreat, allowing waves to "ramp" up the slope, rather than being reflected by higher angle slopes. In the absence of modeling of wave runup for particular bluff profiles and wave conditions, the significance of the increase cannot be accurately evaluated. The Partial Bluff Armoring Alternative may still provide some protection of the bluff top from flooding and erosion by waves because wave energy would be dissipated as waves run up onto the slope and because the drainage system within the parkway on the bluff top would be improved to more efficiently drain the bluff top and street. An increase in wave runup elevation would be considered a significant impact of this alternative, although the magnitude of the increased hazard of flooding has not been quantified.

Mitigation 7.1

To minimize the impacts associated with flooding under this alternative, the County of Santa Cruz would evaluate existing flood warning plans and flood emergency response procedures and would implement those measures identified to reduce threats to life and property. It is not known whether this mitigation would reduce the impacts to a less than significant level.

Nonsignificant Impacts

Water Quality

The impacts on water quality during construction would be the same as those described for Alternative 1. Long-term impacts of Alternative 2 would be similar to those described for Alternative 1, except that the alternative would be less protective of the bluff. As a result, erosion and failure of the bluff could result in debris being generated or other impacts on water quality below the bluff. For example, although it is unlikely to occur so quickly that preventative action could not be taken, failure of the road during a large storm could result in failure of a sanitary sewer line. Since these impacts would be most likely to occur in conjunction with a major storm, many other water quality impacts on Monterey Bay would likely occur from other sources throughout the region, degrading background water quality conditions. In this context, the contribution to the overall impacts on water quality in Monterey Bay caused by this alternative may be less than significant.

7.2.3 Partial Bluff Armoring with Limited Improvements (Alternative 3)

Significant Impacts

Impact 7.2 Hazard of Flooding

The impacts associated with flooding under this alternative are similar to those described for Alternative 2. As with Alternative 2, some flood protection would be provided by improved drainage along the bluff top. Under Alternative 3, an increase in wave runup would be considered a significant impact, although the magnitude of the increased hazard of flooding has not been quantified.

Mitigation 7.2

Mitigation under this alternative would be the same as that proposed under Alternative 2. It is not known whether this mitigation would reduce the impacts to a less than significant level.

Nonsignificant Impacts

Water Quality

The impacts on water quality of the No Armoring Alternative would be similar to those of Alternative 2.

7.2.4 Groins and Notch Infilling (Alternative 4)

Significant Impacts

Impact 7.3 Hazard of Flooding

Although Alternative 4 would not involve armoring the Purisima Formation along the entire bluff face, it would include filling the existing undercuts at the foot of the bluff to prevent the bedrock foundation of the bluff from failing. The effect would be similar to bluff armoring, although the Purisima retreat would be slowed rather than prevented. The upper bluff would continue to retreat, and no additional retaining walls would be constructed on the upper bluff. Therefore, as described for the Alternative 2, the slope of the terrace deposits would be reduced, and wave runup might extend to a higher elevation on the bluff. The flooding hazard would be increased. Bluff top drainage systems would be improved, but the hazard of flooding due to wave runup would be the same or greater than that under alternatives 2 or 3, representing an increase in the hazard relative to the No Action Alternative. This would be considered a significant impact.

Mitigation 7.3

Mitigation is the same as for Alternative 2. It is not known whether this mitigation would reduce the impacts to a less than significant level.

Nonsignificant Impacts

Water Quality

The impacts on water quality of the No Armoring Alternative would be similar to those of Alternative 2.

7.2.5 No Action Alternative

Nonsignificant Impacts

Hazard of Flooding

The bluffs would continue to retreat, retaining its existing variable profile in the project area. The bluff top would remain in the 100-year wave run-up zone, and if the bluff top were to retreat, more structures would be endangered over time by the greater proximity to waves. The storm drain system would be repaired, as needed, but no substantial change in drainage design would occur. The hazard of flooding due to wave run-up would increase in the long- term as sea levels rise.

Water Quality

There would be no direct construction impacts to water quality from the No Action Alternative. However, this alternative does not preclude constructing emergency bluff protection measures in the future, in the same way that these measures have been performed in the past. The impacts on water quality from emergency construction, with less time available for planning, could result in a greater risk of spills, for example, than for a well-planned alternative. Although many of the same Best Management Practices may be adopted for any construction project in the coastal zone, a SWPPP would not be required for a project involving less than five acres.

The long-term impacts of the No Action Alternative on water quality would be similar to those of alternatives 2, 3, and 4. However, the rate of retreat of the bluff is likely to be faster, and the bluff is likely to be vulnerable to smaller and more frequent storms, accelerating the occurrence of impacts related to slope failure (for example broken utility lines and generation of debris).