CHAPTER 2
PROPOSED PROJECT AND ALTERNATIVES

This chapter is a description of the development of alternatives and the proposed action, which is to protect 1,400 feet (427 meters) of East Cliff Drive from erosion and to implement parkway improvements along the bluff top. The chapter begins with an overview of the project and project alternatives. The No Action Alternative is then described, followed by a description of the alternatives considered and eliminated. The preferred alternative and the three considered alternatives are then described in detail. At the end of this chapter is a summary of potential agency permit and approval requirements.

2.1 PROPOSED PROJECT OVERVIEW

The project area is on East Cliff Drive between 33rd and 41st avenues. A 33-foot (10-meter) coastal bluff borders East Cliff Drive on the southeast for the length of the project area. The bluff consists of a lower layer of nearly vertical stone, known as the Purisima Formation, approximately 11.5 feet (3.5 meters) high, and an upper layer of terrace deposits extending to the top of the bluff at a 45- to 60-degree slope (SAGE [Sanders and Associates] 2005). The base of the Purisima Formation is undercut in some places up to 18 feet (6 meters) horizontally into the bluff (SAGE 2005), and the terrace deposits above are significantly more subject to erosion than the Purisima.

East Cliff Drive was a two-way road until 1995, when it was restricted to one-way traffic due to bluff erosion. Three soil nail walls were constructed as part of emergency repairs of three failing cribwalls in 2004. (A soil nail wall is a type of retaining wall.) These soil nail walls cover approximately 290 feet (88 meters) of the terrace deposits. The County of Santa Cruz has proposed a bluff protection project along 1,100 feet (334 meters) of East Cliff Drive to prevent further erosion (project 1). Because 290 feet (88 meters) of the terrace deposits were already protected in the County's 2004 emergency repairs, project 1 would involve protecting 1,100 feet (334 meters) of Purisima and 810 feet (247 meters) of terrace deposits. In addition, the County has proposed project 2, in which it would improve the road and adjacent pedestrian and bicycle lanes above the bluff, from Pleasure Point Park to 41st Avenue. Project 3 would involve a 300-foot (91-meter) bluff protection project at The Hook. Project 1 would be completed first, and project 2, which focuses on parkway improvements, would be constructed once project 1 is completed. Project 3 would be completed before the parkway improvements at The Hook are completed. The three projects are detailed below.

Project 1 (Main Bluff Protection Structure)

- Construct a bluff protection structure from 33rd Avenue to 36th Avenue; and
- Construct both new and replacement beach access stairways (one at Pleasure Point Park and one at 36th Avenue), demolish an abandoned restroom, and remove concrete rubble and rock riprap. A small portion of riprap may be used at the east end of the project as a transition to adjacent private parcels. (Riprap is a protective layer of rock placed to prevent erosion of a bluff.)

Project 2 (Parkway)

- Construct a new curb and drainages along the southern edge of the one-way travel lane, make pedestrian and multiuse path improvements from 32nd Avenue to Larch Lane, make landscape improvements, and install railings;
- Construct a retaining wall near 38th Avenue;
- Construct a new restroom and develop a park (referred to as Pleasure Point Park throughout this document), which will include landscaping, picnic tables, drainage improvements, and an interpretive area for the Monterey Bay National Marine Sanctuary; and
- Reconfigure parking spaces.

Project 3 (The Hook Bluff Protection Structure)

- Construct a second engineered bluff protection structure on a County-owned parcel, near the end of 41st Avenue at The Hook;
- Remove, repair, and replace the wooden stairway near 41st Avenue; and
- Make road and path improvements similar to those in project 2.

2.2 OVERVIEW OF ALTERNATIVES

The alternatives described below for the bluff and parkway project were developed by Santa Cruz County. The alternatives' respective environmental impacts are evaluated in this EIS/EIR.

2.2.1 Alternative 1: Full Bluff Armoring (Preferred Alternative)

Alternative 1 would consist of a bluff protection structure extending vertically from the bedrock on the beach to the top of the bluff, for approximately 1,100 linear feet (335 meters) from 33rd to 36th Avenue and then for 300 feet (91 meters) at The Hook. The bluff protection structure near Pleasure Point Park and associated stairways would be constructed first, followed by road and path improvements during project 2, and then the work at The Hook (project 3). The bluff protection structure would be a soil nail shotcrete concrete structure attached directly to the bluff face, and would be sculpted and painted to resemble the natural untouched surface.

2-1a Project Overview

2.2.2 Alternative 2: Partial Bluff Armoring with Full Parkway

With this alternative, the bluffs would be partially protected from erosion. The Purisima Formation would be completely protected, but only areas of the terrace deposits where there are washouts would be covered by the bluff protection structure. Retaining walls would be constructed and existing retaining walls would be repaired as needed. All other features of the project, such as parkway development and road improvements, are the same as those under Alternative 1.

2.2.3 Alternative 3: Partial Bluff Armoring with Limited Parkway Improvements

This alternative is similar to Alternative 2, except that no new retaining walls would be constructed to retain terrace deposits and no new armoring would be installed at the top of the bluffs. As a result, only limited parkway improvements would be possible, and only one multiuse path for both pedestrian and bicycle use would be constructed.

2.2.4 Alternative 4: Groins and Notch Infilling

This alternative would use means other than armoring to protect the bluffs, such as constructing groins on the beach to protect the bluff from waves and filling in the wave-cut notches at the base of the bluffs with concrete. As a result, only one multiuse path, with a minimum width of eight feet (2 meters), would be constructed. General parkway improvements under this alternative are similar to those under Alternative 3.

2.3 NO ACTION ALTERNATIVE

The other alternatives are compared against the No Action Alternative. Under this alternative, the project would not be built. Theoretically, this means that the current erosion and damage to the road section would continue, causing road closure and utility damage over time (Corps 2003). Historical rates of bluff erosion at the project site have been calculated up to eight to 12 inches (30 centimeters) per year. However, the bluff does not erode at a regular rate and can involve the loss of as much as six to nine feet (two to three meters) at one time. In order to identify the risk of this kind of episodic failure, the County commissioned SAGE to prepare a threat assessment report in 2005. SAGE evaluated the stability of the bluff at East Cliff Drive and found that roughly 65 percent of the roadway between 33rd and 36th avenues is failing or may be unsafe to use within the next few years (SAGE 2005a).

A recent episodic failure extended about six to nine feet (two to three meters) back into the face of the bluff. This bluff failure overlaps the motor vehicle lane on East Cliff Drive. Based on this pattern of failure, as described in the SAGE report, it is clear that under the No Action Alternative significant portions of the roadway could be lost within the next two or three storm cycles. Loss of as little as ten feet (three meters) of the bluff face could substantially disrupt motorized and pedestrian use of East Cliff Drive, even if the roadway were somehow to remain open. Additionally, utilities underneath East Cliff Drive could be affected soon by bluff collapse, particularly the waterline which is within three feet (one meter) of the bluff face between 35th and 36th avenues.

Emergency Repairs. The No Action Alternative would not necessarily lead to the immediate collapse of East Cliff Drive, unless the County is prevented from conducting repairs. Under this alternative, the County would continue to make emergency repairs, where feasible, in response to future bluff failures and to assure public safety. However the County's efforts are unlikely to prevent the erosion of the bluff, particularly where large volumes of the bluff face collapse unpredictably as a result of storms or seismic shaking. This would be particularly true if the emergency walls did not protect the Purisima layers from erosion; thus, the Purisima would still be subject to catastrophic collapses, which in turn could damage the upper sections of the bluff. Because emergency repairs would be conducted only where the bluff face had actually collapsed, or where there was an immediate threat to public safety, other portions of the bluff would continue to erode. Additionally, end effects would likely develop, which occur when the bluff erodes next to and behind the face of a wall or other bluff protection structure.

A series of emergency repairs would be less efficient and more disruptive to the community than a planned and scheduled project. While repairs would significantly slow erosion loss and risk to the roadway and utilities, they would not prevent bluff erosion entirely. Below is an overview of the physical influences to which the bluff is subject, the effects uncontrolled bluff erosion would have on the project area, and the need for emergency and long-term repairs. In order to describe to the public the forces at work on the bluff, much of the following discussion presumes a scenario where the County would not conduct emergency repairs. In reality, the County would likely repair the bluff in increments as the erosion continues, but not to the extent described in any of the four project alternatives. Additionally, the No Action Alternative includes no parkway improvements, because public investment in these improvements would require some assurance of their longer-term benefit.

Short-Term Bluff Erosion Projections. In its evaluation study, SAGE identified the causes of coastal bluff erosion as being wave induced or caused by strong ground shaking during large magnitude earthquakes. Short-term erosion is described by SAGE as occurring episodically as individual events rather than steadily over time.

SAGE suggested that the risk of bluff failure could be best estimated by evaluating the largest potential episodic bluff failure, the likelihood of such an event, and the proximity of improvements to areas likely to experience such an event. As previously noted, episodic bluff failures have occurred at the site or in the immediate vicinity and have extended from 6.5 to 10 feet (2 to 3 meters) inland into the face of the bluff. However, tree cover at the site concealed the bluff in the reviewed aerial photographs, so it was not clear from the aerial photographs if these failures represent the largest potential episodic bluff events.

Based on the information presented, SAGE evaluated the degree of threat to East Cliff Drive between 33rd and 36th avenues, and at 41st Avenue, and assigned specific sections to one of the three threat zones, as shown on Sheets 2 through 6 in the SAGE Report (Appendix G). The zones are as follows:

- *Zone 1. Active impact on improvements.* This includes sections of East Cliff Drive where the shoulder has been lost to erosion and where continued erosion will result in the further loss of road and other improvements. Between Pleasure Point and 36th avenues, Zone 1 covers 133 feet (40 meters), or 13 percent. None of the Hook is in Zone 1.

- *Zone 2. In Danger.* This pertains to existing structures may be unsafe to use within the next two or three storm season cycles (generally the next few years) if nothing is done. Between Pleasure Point and 36th avenues, Zone 2 covers 518 feet (158 meters), or 52 percent. Approximately 47 linear feet (14 linear meters), or 15 percent, of the Hook is in Zone 2.
- *Zone 3. Potentially In Danger.* This includes sections of East Cliff Drive not likely to be rendered unsafe within two to three storm season cycles but still subject to erosion. Between Pleasure Point and 36th avenues, Zone 3 covers 350 feet (106 meters), or 35 percent. The Hook has 253 linear feet (77 linear meters) or 85 percent of the bluff, in Zone 3.

The sections of East Cliff Drive assigned to Zone 1 generally correspond to where the road shoulder has been lost to erosion. Zone 1 also includes a ten-foot-long (three-meter-long) section of East Cliff Drive near one of the emergency repair structures (Wall 3), where a one-inch-wide (two-centimeter-wide) tension crack was observed in the asphalt shoulder (Sheet 4). An active landslide on the bluff appears to be undermining the road at this location, which has been fenced off for public safety.

Zone 2 generally includes sections of East Cliff Drive that are within ten feet (three meters) of the present bluff top and therefore within the assumed limits of potential episodic bluff failure. SAGE locally adjusted the limits of Zone 2 to reflect bluff configuration, retaining walls, undercuts, and landsliding. For example, the top of the bluff is within three feet (one meter) of East Cliff Drive at Wall 2, and there is evidence of sizable undercuts within the Purisima Formation. However, the terrace deposits are protected by a new soil nail wall, and the undercuts are generally concealed by riprap. Therefore, SAGE assigned this section of East Cliff Drive to Zone 3.

The remaining sections of East Cliff Drive are considered to be potentially in danger but at risk beyond the next two to three storm season cycles. These sections have been designated as Zone 3. Although the existing improvements in Zone 3 are greater than ten feet (three meters) from the present top of the bluff in these areas, SAGE believes there are several possible scenarios that could affect these areas, as detailed below.

Strong Ground Shaking. Santa Cruz is an area of historically high seismicity, characterized by strong ground shaking. As suggested by the slope stability analyses performed by HKA, the size of the potential bluff failure under seismic loading conditions may exceed ten feet (three meters), so larger areas of the site may be classified as being in danger than those currently shown using the ten-foot (three-meter) offset. Based on the SAGE stability analysis, the risk for a bluff failure during a seismic event on a nearby fault is relatively high. SAGE noted that steep slopes standing at angles of 30 degrees to near vertical are subject to topographic amplification of seismic waves and that the seismic-induced failure of these slopes tends to be brittle (Ashford and Sitar 2002, *in* SAGE 2005b). Recent research by the US Geological Survey (USGS) suggests the overall probability of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area between 2002 and 2031 is 62 percent (WGCEP 2003). Although the 1989 Loma Prieta Earthquake did not result in any failures of the bluff, this would not preclude the potential for future failures. In fact, SAGE estimates that the reason no failures were reported at the bluff in

1989 was probably due to the short duration of the earthquake (15 seconds), the earthquake's frequency of vibration, and a possible high soil strength (SAGE 2005b).

Undercuts in Purisima Formation. As noted previously, the Purisima Formation is locally undercut up to 18 feet (5.5 meters) horizontally from the face of the Purisima Formation bench. Although the Purisima Formation is relatively strong, field observations indicate that the bench will eventually collapse onto the beach after the underlying support has been removed. Where the Purisima Formation fails, the overlying terrace deposits could also be subject to substantial vertical movement.

As previously stated, based on SAGE's analysis, 651 feet (198 meters), or 65 percent, of the total shoreline between 33rd and 36th avenues, and 34 feet (10 meters), or 15 percent of the Hook area, will be affected in one of two ways. The shoreline will be *actively affected* where the road shoulder has already been lost to erosion or where it will continue to erode, resulting in further loss of the road and other improvements. Alternately, the shoreline will be *in danger* and existing structures may be unsafe to use within the next two or three storm season cycles if nothing is done. Of the remaining 350 feet (106 meters) in Zone 3 *(potentially in danger),* 290 feet (88 meters), or 83 percent, consists of three new sections of bluff stabilization.

Long-Term Bluff Erosion. An important element in calculating the impact of the No Action Alternative is that coastal bluff or cliff erosion is both *episodic* and *site-specific*. This complicates the County's ability to calculate the precise result of the No Action Alternative over the long term, although the short-term projections are discussed above.

The rate at which any particular coastal bluff retreats depends on the interaction or combined effects of the properties of the cliff-forming materials, such as rock strength and its variation both alongshore and from beach level to the top of the bluff, on structural weaknesses, such as joints, fractures, and faults, and on the presence of groundwater, for example. The rate of bluff retreat also depends on the physical forces acting on the cliff or bluff and the magnitude, frequency, and timing of these processes. Of these processes, wave impact, tidal variations, sea level rise rate, rainfall and runoff, seismic shaking, and loading are the most important.

One element complicating the calculation of long-term bluff erosion rates is the difficulty in measuring bluff erosion. While aerial photography is frequently used, it is limited by problems of scale and clarity and of delineating the bluff top, by photographic distortion, and by the experience of the photographer and the analyst.

Another major complicating element is the variation over time in the processes that contribute to bluff erosion. It is now well known that the coast of California experiences different climatic conditions over cycles of 20 or 30 years (now known as the Pacific Decadal Oscillation) (Storlazzi and Griggs 2000; Storlazzi and Griggs 1998). The accuracy of any coastal bluff retreat rate is affected by the period investigated and the range of photograph dates used. Measurements made on aerial photographs taken primarily from a calmer or La Niña-dominated period (1945 to 1978, for example), would tend to underestimate a retreat rate and therefore the risk posed to oceanfront construction. Using only measurements from an El Niño-dominated period (1980 to

2000, for example) would tend to overestimate the long-term erosion rates. The shorter the period of record used, the more unreliable the extrapolated long-term rates will be (Lester 2005).

A third complicating factor in calculating bluff erosion rates is the unpredictability of some of these processes. For instance, much of the coastal erosion and storm damage along the California coast during the severe 1982-1983 winter was due to the simultaneous occurrence of very high tides with the arrival of the largest storm waves (Griggs, Patsch and Savoy 2005). This took place during seven different storms in the first three months of 1983. While the actual wave heights in 1997-1998 were greater, they did not coincide with the highest tides and therefore produced less storm damage and erosion. However, these conditions are impossible to predict in advance. Seismic shaking, for instance, which can produce significant coastal cliff failures (Griggs and Scholar 1997) cannot be predicted with any reliability.

A significant additional factor affecting future projections of bluff erosion is the future sea level rise rate. Sea level rise has been the primary factor driving shoreline retreat for the past 18,000 years. Sea level has constantly changed throughout the approximately four billion years of the ocean's history, in response to the cycles of global warming and cooling. While the global rate of sea level rise is now generally agreed to be a little less than a tenth of an inch (1.8 millimeters) per year, there is uncertainty in how continued burning of fossil fuels, tropical rain forest destruction, and the addition of other greenhouse gases will affect future climate and therefore the rate of sea level rise. While there is no agreed on projection, there is widespread scientific agreement that sea level rise will continue for at least the next 100 years, and at a rate at least as high as at present and probably higher.

The closest long-term tide gage records for Pleasure Point come from Monterey (1973 to present), where the gage has recorded an average sea level rise rate of 0.61 foot per century (1.86 millimeter per year). San Francisco from 1906 to the present has had a slightly higher rate of 0.7 foot per century (2.13 millimeters per year) (NOAA 2005). Assuming that the relative sea level rise rate along the coastline of northern Monterey Bay is similar to that of Monterey and San Francisco, this suggests that, based on available data, Pleasure Point is probably experiencing an overall sea level rise rate not too different from that of Earth as a whole. There is definitely some uplift going on, as witnessed by the elevated marine terraces that form the coast of the Pleasure Point area. This indicates that the relative sea level rise rate is somewhat lower here than the global average.

Rates of Long-Term Bluff Erosion. Based on the SAGE analysis, previously measured long-term bluff erosion rates in the immediate vicinity of the site average between 4 inches (9 centimeters) per year and 5.5 inches (14 centimeters) per year (Haro, Kasunich and Associates 1998, *in* SAGE 2006; Griggs 2005). Moore (1998), Moore, Benumof and Griggs (1999), and Moore and Griggs (2002) generated average long-term bluff erosion rates at the site using stereo aerial photographs from 1953 and 1994, softcopy photogrammetry, and a geographical information system (GIS). This period includes both a La Niña- and an El Niño-dominated periods, so it should be representative of longer-term conditions. Recent advances in shoreline mapping techniques described in Moore et al. (1999), Moore (2000), and Moore and Griggs (2002) allow for nearly complete removal of displacement and distortion errors common to

2-1b Shoreline Change Rates

traditional techniques using uncorrected aerial photographs. Bluff positions identified at a 16-foot (five-meter) spacing interval along the bluff using these new techniques indicate that average erosion rates along the bluff are generally less than 8 inches (0.2 meter) per year. In its report, SAGE describes discrepancies between new and previous rates as either a result of displacement or distortion errors or slower erosion rates due to placement of riprap along the base of the bluff. However, the report notes that long-term erosion rates are generally not well suited to estimate erosion over the short term due to the episodic nature of bluff erosion.

In addition to plotting average bluff retreat rates alongshore, as part of a Federal Emergency Management Agency- (FEMA)-funded study, Moore (1998) projected the 40-year erosion rates 60 years into the future along East Cliff Drive (Figure 1-2). This was to determine where the bluff edge would be in 2054 if the average erosion rate continues and no erosion control measures are constructed. While this projection is limited by all of the temporal variations in physical processes described above, it provides the most reasonable estimate of what might be expected over the next 60 years along the East Cliff Drive project area, assuming that the average annual erosion rate remains the same and that no armor or protection is added. It is clear that the bluff edge would extend well into the East Cliff Drive right-of-way and would render even the one-way street and the bicycle and pedestrian pathway impassable.

A FEMA map of the projected bluff edge between 33rd and 36th avenues (Figure 1-2) shows that about 625 feet (191 meters) of coastline would erode at least to the middle of East Cliff Drive by 2054. An approximately 75-foot (23-meter) portion of East Cliff Drive between 33rd and 34th avenues would be completely removed. Another section, about 475 feet (145 meters) long and extending from about midway between 34th and 35th avenues downcoast to 36th Avenue, would erode such that at least half of East Cliff Drive would be removed. At three locations, all of the roadway would be gone. We are already 11 years into that 60-year projection. It simply is not practical or economically feasible to completely relocate the roadway and utilities a few feet inland because this would not guarantee any substantial additional lifetime; a single large episodic event could remove the added buffer (see Section 2.4.1 for more detailed economic analysis).

There are slight variations over the longer term in the bluff erosion rates and projected shoreline. However, the shoreline will retreat in a more or less uniform manner alongshore over the longer term because of the relative uniformity of the bluff-forming materials, the physical processes that drive bluff retreat along this stretch of coastline, and the essentially linear trend of the coastline.

Infrastructure Loss. At some locations within the project area, the retreating bluff top has already caused segments of the road to fail, requiring road or lane closures and emergency repairs. The roadway has already been reconfigured from two lanes to one lane because of past bluff failures. As described above, the SAGE analysis indicates that over half of East Cliff Drive, between 33rd and 36th avenues, is subject to failure within the immediate future. The loss of East Cliff Drive would severely restrict access to the bluffs, thereby greatly reducing recreational access in the area. Such a loss would also disrupt major utilities and other public infrastructure in the area and would lead to the loss of the public right-of-way. The County's emergency repairs would protect these utilities as much as possible but could not prevent loss of the bluff altogether and, inevitably, damage to the utilities.

Improvements and Access. Under the No Action Alternative, Pleasure Point Park would remain in its current condition, with any improvements subject to funding. Parkway development, including landscaping and bicycle and pedestrian paths, would not be constructed. There would be no roadway improvements and the existing 27 parking spaces would remain, subject to continued bluff stability. Normal evaluation and maintenance or replacement of the existing drainage system would be conducted by Santa Cruz County Department of Public Works. The abandoned restrooms and access stairs near 35th Avenue would remain, protected as much as possible by the County's ongoing emergency repairs. However, the County's inability to prevent all bluff loss would result in long-term damage to the improvements in the project area. Portions of the bluff top pedestrian path would continue to deteriorate and would drop rubble and debris onto the beach below. Closing the stairways because of deteriorating conditions would limit access to the beach for surfers and other recreationists. Eventually loss of the roadway as the bluff erodes would lead to traffic issues and emergency response time delays for the surrounding neighborhood.

Conclusion. In conclusion, the long-term history of East Cliff Drive and recent studies all indicate that a significant portion of the roadway between 33rd and 36th avenues and at the Hook and its associated infrastructure are in imminent danger of collapse. While the County is committed to repairing any bluff failures so long as it is feasible to do so, such emergency repairs cannot prevent all erosion of the bluff, including catastrophic failures that could result in irreparable damage to the roadway and utilities. Therefore, the No Action Alternative in this particular situation would have serious consequences in terms of impacts on public infrastructure and public access to this stretch of the coastline. While the No Action Alternative in some CEQA situations may have the least environmental effect, that is not the case for this particular proposal.

2.4 ALTERNATIVES AND ALTERNATIVE COMPONENTS CONSIDERED BUT ELIMINATED

A variety of alternatives to control erosion of the bluff have been considered but deemed unsuitable. Nonstructural solutions, such as rerouting traffic and relocating utilities, maintain infrastructure over both the short term and long term but fail to preserve the public right-of-way from erosion. They would also disrupt the general traffic pattern in the area and would result in high projected costs with limited benefits. Planned retreat was found to be less effective than a structural solution because of anticipated long-term environmental impacts and project costs, resulting from the requirement to reroute traffic, relocate utilities, and purchase 12 to 14 private residences along East Cliff Drive to implement such a program. A rock revetment option (riprap) was considered but eliminated because of its high cost and large footprint, which would result in unacceptable environmental impacts. The following alternatives and alternative components were eliminated from further consideration because they failed to meet any or all of the following project objectives in a cost-effective way:

- Protect the coastal bluffs from erosion;
- Avoid loss of the public right-of-way; and
- Improve and enhance public access to the coast.

2.4.1 Bluff Protection Measures

Soft Solutions/Drainage Improvements

Alternative soft solutions, such as implementing erosion control measures and capturing additional surface drainage, have been suggested as methods to delay the time when coastal bluff protection measures would be needed. This includes new landscaping along the top of the bluff to capture more surface water runoff from the road and installing curbs along the top of the bluff to redirect water to a pipe or storm drain so that the water would not concentrate in one place and run down over the bluff face, contributing to erosion. While these options might be suitable for areas where the road structure is not currently threatened, the threat analysis by SAGE (discussed above under the No Action Alternative) demonstrates that there are five locations where the edge of the road has already been lost to erosion. There are 22 locations where the road is in danger of collapse within the next two or three storm cycles. In total, these areas constitute 651 feet (198 meters), or 65 percent, of the distance between 33rd and 36th avenues. Bluff collapse and loss of the road in even one of these areas would reduce public access and could require the road to be closed. Erosion control measures at the top of the bluff would not protect the Purisima from the effects of wave action and would not prevent larger bluff failures caused by storms, seismic events, or collapse of the Purisima. Nor would they prevent water from seeping through the face of the terrace deposits and causing erosion. Only an overall structural approach would protect the entire area. Landscaping and soft solutions are prevention measures that would not repair the damage that has already been done, nor would they effectively stop the ongoing erosion but would merely slow it to a minor degree. They slow down erosion in areas where there is space between the bluffs and the road, but soft techniques simply cannot withstand the erosive forces that occur during storms at high tide. The practical result of soft solutions would be very similar to that of the No Action Alternative: the County would continue to perform emergency repairs as necessary. The requirements of having to obtain emergency permits and mobilize construction crews to make repeated repairs make this approach difficult, costly, and ineffective.

Bluff Vegetation

Planting vegetation along the face and tops of the bluffs would increase visual quality of the area and could also provide limited protection to the bluff during minor storms. Because large storms are common in the area and the present level of erosion is so severe, plants alone would not provide adequate protection during major storms. Vegetation planted along the bluff would take a long time to become established—possibly a number of years—and thus would not serve the immediate need to protect the bluff face. Moreover, as previously noted, soft techniques like planting vegetation cannot withstand the erosive forces of wave run-up during storms at high tide. The Purisima Formation, underlying the terrace deposits, is subject to less frequent failures but larger and more catastrophic collapses. Even so, vegetation would not protect the Purisima from direct wave action in any measurable way, nor would it be possible to plant vegetation, given the nature of the Purisima.

Including planting pockets in the wall design to reduce visual impacts was considered and rejected because it would be very difficult for the County to access and maintain the vegetation. Small pockets would essentially function like containerized planters and, without regular care, would likely flood during the winter and dry out during the summer. Very few plants would be able to survive these conditions. In addition, the natural saline environment would limit plant selection. The few native plants that might be able to survive would probably not achieve the goal of softening the appearance of the wall. As stated above, regarding enhanced drainage solutions, the practical effect of this alternative would be continued erosion of the bluff face and the need for continued emergency repairs by the County. For these reasons, this alternative was eliminated from further consideration.

Move the Road and Utilities Inland ("Buying Time")

Another suggested option is to move the road and utilities to the existing inland right-of-way boundary between 33rd and 41st avenues. This would delay loss of the road to erosion and prolong public access along this stretch of East Cliff Drive, essentially "buying time" before bluff armoring is necessary. An analysis by Santa Cruz County Department of Public Works engineering staff indicates that there is sufficient area in some locations, primarily between 36th and 38th avenues, where public improvements could be moved inland as much as eight to ten feet (two to three meters). For East Cliff Drive, between 33rd and 36th avenues, where the ocean side of the road edge is threatened, there is only about five feet (a meter and a half) of inland shoulder available. Therefore, these locations constrain how far inland the road and utilities can be moved within the existing right-of-way.

Moving the road inland five feet (a meter and a half) between 33rd and 36th avenues alone would provide limited benefit while costing perhaps up to $500,000. Considering the average bluff erosion rate of 8 to 12 inches (20 to 30 centimeters) per year, this would preserve the road for perhaps five to ten years. However, it would likely take several years to obtain the required permits and approvals and to relocate the road. Thus, the amount of time that would actually be gained would be only five or six years, at best. In the meantime, pedestrian and bicycle access along the bluff top would continue to diminish as erosion proceeds. In a relatively short time, erosion would again threaten the road, necessitating bluff armoring in order to protect East Cliff Drive and the public's investment in the new roadway improvements. Under this scenario, road access would be maintained for several years but public access for pedestrians and bicycles along this stretch of the coastline would be lost.

With respect to utilities, the County Sanitation District evaluated the feasibility of moving the two sewer lines beneath East Cliff Drive. These lines could be replaced by a new sewer main one block north beneath Hawes Drive, but all of the lateral sewer service connections and lines beneath 34th, 35th, and 36th avenues would also have to be replaced to flow in a northerly direction to connect to this new main. While this is possible from an engineering standpoint, it would cost up to 1.7 million dollars (Bolich 2004). It is unlikely that this much funding would be available if public access were lost along the road. Additional costs would be associated with moving other utilities, but no estimates have been developed for rerouting the water mains, gas line, and other utilities. Responsibility for these would fall under the jurisdiction of the various utility companies. As with moving the road inland, rerouting utilities would not stop bluff erosion and the eventual loss of public access to this stretch of coastline. Consequently, aside from the limited benefits this approach would realize for considerable public expense, it would not achieve one of the main project objectives, which is maintenance and enhancement of public access.

Beach Nourishment

Beach nourishment would consist of a formal program of replacing sand that is lost by the force of the waves along the bluff face. Under normal conditions, beaches in the project area are very narrow and sometimes nonexistent. Waves reach near the base of the cliff at virtually every high tide and the cliffs are either actively eroding or armored. Beach nourishment would be an attempt to establish a larger beach profile that would serve to force the shoreline seaward, thus reducing impacts on the base of the bluffs. The reach of the coastline in the project area faces east or southeast, in contrast to the beach areas farther west, which all face southwest. As a result, due to the predominant angle of wave approach from the northwest and wave refraction patterns, littoral (shore) transport is at a maximum along this stretch of coastline, and little sand accumulates.

There are natural variations in beach width along the shoreline from year to year as a function of sediment discharge from source rivers, wave energy and direction of approach, storm severity and frequency. However, in the absence of human activity, beaches tend to vary in width. The Main Beach in Santa Cruz (farther west), while fluctuating in width from winter to summer, returns to about the same width each summer, as do the other beaches in the area. Even after the severe beach erosion of El Niño winter of 1998-1999, all of the beaches monitored between Scott Creek and Capitola had essentially returned to their pre-El Niño width by the next fall (Brown 1998).

In an area with a high littoral drift rate (the Santa Cruz County coast, for example, where the annual average rate is about 300,000 cubic yards [229,000 cubic meters]), nourishing or adding sand to a beach, in and of itself, will not widen the beach if there is no natural beach there to begin with. This is due to the shoreline orientation and lack of a littoral drift barrier or obstruction. Regardless of where the sand comes from, a sand nourishment program is not going to significantly change the condition of the shoreline and create a beach for any significant period where one did not exist naturally.

The construction of the west jetty of the Santa Cruz Small Craft Harbor in 1963 did lead to the trapping of a large volume of littoral sand in the first 15 years or so following construction, significantly widening Seabright Beach. Downcoast beaches narrowed immediately following construction, and the beach at Capitola disappeared altogether a few years later (Griggs and Johnson 1976). However, dredging began in the harbor entrance in 1965 and has continued annually ever since. Sand dredged from the harbor entrance in the winter and spring is discharged onto Twin Lakes Beach and continues on downcoast. By the early 1980s Seabright Beach was essentially fully charged, such that all of the littoral drift now is either transported by waves across the entrance channel or is trapped in the channel, where it is dredged out and pumped onto Twin Lakes Beach. There is no evidence in the bathymetry that any significant volume of sand is diverted offshore so that downcoast beaches now receive the sand that they did prior to harbor construction.

Annual harbor dredging rates vary somewhat based on varying winter wave conditions and, therefore, littoral drift rates, but these rates average about 200,000 cubic yards (153,000 cubic meters). This sand volume is put back into the littoral system after having been moved around the harbor entrance and continues alongshore. It is carried along the Pleasure Point shoreline and eventually moves into the head of Monterey Submarine Canyon at Moss Landing. Thus the system today has essentially been in equilibrium for about 25 years. Modifications to the jetties, as suggested by some, would have no permanent impact on the shoreline in the Pleasure Point area as the amount of littoral sand moving along the shoreline annually (about 300,000 cubic yards [229,000 cubic meters]) is the same as it was prior to harbor construction. This would not change. There is no permanent beach at Pleasure Point shown in the aerial photos taken prior to jetty construction (1928, 1943, 1956, or 1963, for example), except in the area immediately upcoast of the O'Neill house, where a short natural rock groin exists and impounds a narrow beach at the bottom of the stairway across from 36th Avenue. Thus, there is no reason for a beach to accumulate now.

Nourishing beaches with imported sand is a process that to date has been little used in California. Most of California's beach nourishment is a by-product of harbor dredging and, therefore, just moves sand from one side of a harbor to the other (the Santa Cruz, Santa Barbara, Ventura, and Channel Islands harbors, for example). A number of southern California beaches, particularly in the Santa Monica cell, were artificially nourished for years with sand derived from several very large coastal construction or dredging projects, but this activity ceased some years ago.

The only significant nourishment project carried out with imported sand for the sole purpose of widening beaches was completed by San Diego Association of Governments in 2002. In this project 2,000,000 cubic yards (1,529,000 cubic meters) of sand was dredged from six offshore sites and placed on 12 northern San Diego County beaches at a cost of $17.5 million ($8.75 per cubic yard [cubic meter]). However, as there were no sand retention devices, and this is an area of high littoral drift rates (about the same as Santa Cruz, approximately 300,000 yards [229,000 cubic meters] per year), most of this sand was carried alongshore or offshore by winter waves and little remained on the beaches within a year. Because of the orientation of the shoreline at Pleasure Point and the lack of any barriers to trap littoral sand, adding sand to this beach or to upcoast beaches would not provide permanent or significant additional protection from wave erosion of the bluffs.

Close East Cliff Drive to Through Traffic

One option considered early in the planning process was to close East Cliff Drive entirely to vehicular traffic, while retaining some pedestrian and bicycle access to East Cliff Drive and thereby the bluff. Through traffic would likely be redirected north to Portola Drive, with traffic-control devices, such as bollards, placed at the intersection with 32nd Avenue. However, this option was not pursued for a number of reasons. It would not prevent the imminent collapse of significant portions of the bluff face, as described in the SAGE report, as the rate of erosion and stability of the bluff face appears unrelated to the load on the roadway. If implemented as the sole County response to the erosion of the bluff, closing East Cliff Drive would not result in any protection of the bluff face from erosion, and would lead inevitably to the results discussed under the No Action Alternative above. The failure of substantial sections of the bluff face in the near future would likely interrupt pedestrians' and cyclists' use of East Cliff Drive. Closing East Cliff Drive to through traffic would not satisfy the project purpose and need, which includes maintaining public access to the shoreline for motorists, cyclists, and pedestrians, increasing the longevity of the public right-of-way, and protecting the right-of-way, including utilities, from bluff face erosion.

Additionally, implementing this proposed alternative would force traffic into adjacent neighborhoods, likely creating traffic congestion problems. Individuals seeking to access the coastline between 32nd and 41st avenues would be forced to the north and onto the primarily residential streets. These streets are relatively narrow (approximately 15 to 20 feet wide) and are not designed as major thoroughfares. Off-street parking is limited. Blocks in neighborhoods closest to the bluff would functionally be turned into dead-ends, further complicating the local traffic pattern. Detouring traffic would restrict public access to the coast and would have negative effects on the businesses along 41st Avenue, south of Portola Drive. It would also increase emergency response times to residences along East Cliff Drive between 32nd and 41st avenues. Closing East Cliff Drive to vehicular traffic would eventually lead to the need to relocate utilities and for private property owners to install bluff protection. Such bluff protection efforts would be privately funded and would first have to be approved by regulatory agencies. Only limited benefit would be realized from implementing this proposal, and bluff erosion would not be reduced in any fashion. For these reasons, this alternative component was eliminated from further consideration.

Acquisition of Private Property (Planned or Managed Retreat)

Planned retreat, sometimes referred to as managed retreat, is an approach to dealing with coastal beach and bluff erosion, whereby the natural erosional processes are allowed to occur, and structures and other improvements are moved, torn down, or otherwise modified as they become threatened. Sometimes this approach uses soft interventions, such as drainage improvements, revegetation, and beach sand nourishment programs to slow the impacts of natural processes. In this context, planned retreat would eventually involve the purchase of private parcels and moving East Cliff Drive inland to allow for continued public access between 32nd and 41st avenues.

To undertake such an alternative requires a comprehensive approach tailored to the context of the local community and environment for which it is proposed. Local geology and shoreline dynamics determine the rates and impacts of erosion. Economics and legal and property rights issues determine what is feasible and what may meet the needs of the community. Public policy and social issues also determine how such a concept would be implemented. Additionally, there is a significant difference between using planned retreat in undeveloped or rural areas and using it in developed or urban settings.

Based on the SAGE threat analysis, with continued erosion, the existing pedestrian, bicycle, and vehicle facilities along East Cliff Drive will soon be lost, and eventually the homes that line the roadway will be threatened. However, implementing planned retreat in the Pleasure Point area raises a number of issues and questions regarding private property rights, loss of development potential, project goals and objectives, cost effectiveness, and the sustainability of such a program. Historically, planned retreat has been most successful as a planning tool in rural or undeveloped areas, where it takes less money for public agencies to purchase and relocate buildings and public infrastructure; East Cliff Drive's very importance to the community as a thoroughfare in a residential neighborhood and means of access to the coastline works against the feasibility of planned retreat as a viable option.

Property Rights. Implementing planned retreat assumes that private property would be acquired through voluntary sale to the County or through the process of eminent domain. In this scenario, if most property owners resist selling their property, the Board of Supervisors would have to use eminent domain to implement this alternative. Historically in Santa Cruz County, eminent domain has not been used to take private residences. It has been used when there are no other viable options available to obtain additional rights-of-way for public improvement roads, side walks, etc. Where programs of planned retreat have been established, for example, along the southeast coast of the United States for preserving dune beaches with very different geologic conditions than found here, the programs have been voluntary and have not had much success. The City of Solana Beach, California, examined the possibility of planned retreat in its master EIR in 2003 and concluded that fully implementing such a program might require a change in state law. When the County of Santa Cruz uses eminent domain, the Board of Supervisors must make a finding of the greatest public benefit for the least private impact. In this case there are other options and the board may not be able to make the findings to meet this test. As the City of Solana Beach found, language within the Coastal Act requires the California Coastal Commission to continue to approve shoreline and coastal bluff protection structures under certain circumstances. Thus, even if a planned retreat policy were adopted, the Coastal Commission's current mandate would conflict with such an approach by allowing the continued approval of seawalls and other coastal armoring in order to protect bluff top structures on private properties. Furthermore, even if state law were changed so that planned retreat could be implemented, the County and Coastal Commission would likely face privately initiated litigation from bluff top property owners alleging the taking of their private property without just compensation (AMEC Earth & Environmental, Inc. 2003).

Project Goals and Objectives. The goals set forth in the initial formulation of the project alternatives for East Cliff Drive included increasing the longevity of the public right-of-way, reducing bluff erosion, and improving and enhancing public access to the area. Planned retreat would fail to meet these goals because the bluffs would continue to erode, requiring road and public pathway improvements to continue to be moved and reconstructed over time. Depending on how planned retreat would be implemented, loss of the public right-of-way along the bluff could reduce public access to the coast and continued erosion could damage other amenities in the area, such as Pleasure Point Park. Therefore, in order to select planned retreat as a viable alternative, the project goals and objectives would need to be modified or abandoned.

Cost Effectiveness. It is not financially feasible to purchase private property, relocate underground utilities, rebuild pedestrian, bicycle, and vehicle access farther back from the bluff top, obtain permits, and prepare additional design plans and environmental documentation.

A rough estimate of the current costs for a planned retreat alternative is as follows, according to County estimates:

- Purchase and demolish 12 to 14 residences along East Cliff Drive at an estimated cost of $2 million to $3 million each; total: $24 to $42 million;
- Relocate utilities. Sanitary sewers lines: $1.7 million (Santa Cruz County Sanitation District 2004), water mains and connections: $250,000; gas lines: $100,000; total: $2,050,000;
- Rebuild pedestrian, bicycle, and vehicle facilities: $2 million; and

- Design plans and produce environmental documentation: $750,000.

The estimated first time total cost for planned retreat is $28 to $46 million.

Because erosion is expected to continue and to threaten improvements and private property, the costs outlined above are considered first time costs only. It is likely that in about 75 years erosion would advance to a point where relocating facilities and purchasing additional private property would be necessary, at a cost of an additional $20 million. This would result in a total estimated cost of $58 to $66 million for the first 100 years of planned retreat.

Sustainability. For all of these reasons, planned retreat is not practical in an urban developed area. Implementing planned retreat would create a continuing burden on the County and would likely lose community support due to its financial and social costs.

Conclusions. Planned retreat was considered during the early planning process but was removed from further consideration. While planned retreat might have few short-term environmental effects, it would have significant adverse environmental effects related to relocating utilities and providing emergency services, traffic circulation, and public access to coastal resources. Additionally, as discussed above, planned retreat would not be cost effective.

Finally, a planned retreat alternative could not reasonably be devised for the project area alone but would need to be pursued at a policy level and on a regional basis, in concert with other land management agencies. While the County of Santa Cruz does not have a planned retreat policy per se, it requires all new development to be set back at least 25 feet from the top edge of a bluff, and a setback of more than 25 feet may be required based on site-specific conditions (Policy 6.2.12). County Ordinance 16.10.070(h)3 further regulates construction of new coastal structures. Because a planned retreat program would require an extensive public review and political process, the near-term result would be the same as the No Action Alternative, that is, deteriorating conditions and loss of public access.

Riprap (Revetment)

Riprap consists of a layer of large angular stone designed to protect and stabilize areas subject to erosion, such as the East Cliff Drive bluff area. Riprap has been used for many residential protection projects along the Santa Cruz coast and was considered for the proposed project area. In order for riprap to be effective against further bluff erosion in the project area, it would require a base wide enough to support the height needed to protect the Purisima. To achieve this, large amounts of riprap would be placed on the beach, consuming much of the beach area at the project site and eliminating public access. Riprap would be an impediment to surfers exiting the surf. Additionally, as noted in Coastal Protection Structures and Their Effectiveness (Fulton-Bennett and Griggs 1986), "the success rate of riprap walls is marred by relatively high repair and maintenance requirements, and by the fact that significant property damage often occurs when these walls suffer even partial failure." These structures often fail due to loss of material under the foundations or in front of them. Riprap placed on sand would significantly modify the visual character of a beach. The large rocks, crevasses, and gaps between the rocks change the sand habitat to a new rocky habitat, which often supports rats, squirrels, and other burrowing rodents that would not normally find habitat on a sandy beach (California Coastal Commission 1999). For these reasons, this alternative was eliminated from further consideration.

Corps of Engineer Wall Plans

When the East Cliff Drive Bluff Protection Project was originally proposed as a County/Corps project, the Corps identified several possible wall plans, as described below.

Shotcrete/Cribwall Plan

This option would use a combination of a "shotcrete" base and a cribwall extension to protect the bluff. Shotcrete is the process of forcing concrete through a hose onto a surface at a high velocity using compressed air. A two-foot-thick (.6-meter-) shotcrete (gunnite) wall would be constructed from the toe to 16 feet (5 meters) National Geodetic Vertical Datum (NGVD) to provide necessary protection from incident waves. The formed concrete toe would consist of a three-foot-deep (one-meter-deep) footing into the Purisima sandstone and a four-foot-wide (1.5-meter-wide) toe apron. Typically, erosion directly in front of seawalls is exacerbated due to the increased turbulence caused by the wall. Sandstone still would erode in front of the apron but at a rate more typical of the beach slope erosion.

From 16 feet NGVD to the top of the bluff, a cribwall would be constructed to protect the bluffs above the shotcrete wall from wave run-up and spray. The cribwall (built to California Department of Transportation [Caltrans] specifications) would be closed faced from 16 feet NGVD to 24 feet (7 meters) NGVD to protect against the heaviest portion of the run-up. From 24 feet NGVD to the top of the bluff, the crib wall would be open faced with stone fill to protect against the remaining run-up (Corps 2003).

To secure the wall to the bluff face, tiebacks would be used. One row of tiebacks would be required with horizontal spacing of eight feet (2.4 meters). The tiebacks would be installed 18 feet (5.5 meters) into the Purisima to provide the necessary horizontal support for the shotcrete wall.

The soil behind the wall would be drained by installing a porous plastic mat and a PVC pipe network between the shotcrete and Purisima. Without proper drainage a potentially damaging hydrostatic head could build up behind the wall. Drainage of the soil behind the cribwall is not an issue since the cribwall would not block the bluff.

This plan met erosion prevention objectives but was not found to be economically justified based on the Corps' benefit-to-cost analysis model. It would also result in greater construction impacts and would have poor visual aesthetics. For these reasons, it was not recommended for implementation.

Concrete/Shotcrete Plan

Under this option, the same wall as in the Shotcrete Plan would be installed, but the shotcrete base wall portion would be replaced by a two-foot (four-meter) thick, formed concrete wall covered with six inches (15 centimeters) of shotcrete, resulting in a final wall thickness of two and one-half feet (.8 meter). The soil behind the concrete portion of the wall would be drained by using stone fill between the wall and the Purisima and PVC pipes through the concrete wall.

Above the concrete/shotcrete base wall, the same cribwall described under the shotcrete plan would be constructed (Corps 2003).

This plan met erosion prevention objectives but was also found to be uneconomical based on the Corps' model. Similar to the shotcrete/cribwall plan, it would also result in greater construction impacts and would have poor visual aesthetics. For these reasons, this plan was not recommended for implementation.

Gravity Wall Plan

This option is similar to the Shotcrete and the Concrete/Shotcrete Plans but would use a gravity based, formed concrete seawall. The wall would have had a base thickness of five and one-half feet (1.7 meters) and then would taper to a minimum thickness of two and one-half feet (.8 meter) at the top. The toe would be built to accommodate these dimensions. The wall would not need to be tied back into the bluff face due to the shear weight of the wall. The soil behind the concrete portion of the wall would be drained by using stone fill between the wall and the Purisima and PVC pipes through the concrete wall (Corps 2003).

This plan met the erosion prevention objectives of the project and provided benefits of the project (such as protecting infrastructure, roadway, and utilities). However, it was not recommended for implementation because the Shotcrete Wall Plan included in Alternative 1, Full Bluff Armoring, provided similar benefits and was strongly preferred by the community and the County of Santa Cruz over the Gravity Wall Plan, based on aesthetic appearance and constructability.

2.4.2 Road and Parkway Improvements

The options below for road and parkway improvements were considered and eliminated from further consideration.

Two-Level Pedestrian/Multiuse Path

It has been suggested that a grade separation between pedestrian and vehicles or bicycles would benefit the quality of experience for visitors to the area. This approach might be successful if more space were available between the bluff top and the road.

Installing a two-level pedestrian and bicycle path would create severe complications along the path. A two-level design would require extensive ramps and walls to comply with the Americans with Disabilities Act. In most locations, secondary railings would also be needed, adding to visual clutter with limited benefits. This alternative component was eliminated from further consideration for these reasons, as well as drainage complications associated with two levels.

One-Way Traffic on East Cliff Drive

In response to the failure of the cliff and road in the vicinity of Larch Lane during heavy storms in January 1994, East Cliff Drive was converted to one-way operation in the westbound direction between 38th and 41st avenues. The purpose of the one-way conversion was to respond to the narrowed road width in that area following cliff repairs, and to reduce future vehicular loading on the cliff edge. As a result of the westbound one-way conversion, East Cliff Drive saw a reduction of approximately 2,000 to 3,000 vehicles per day, while 38th Avenue experienced a traffic increase of approximately 1,000 vehicles per day from rerouted eastbound traffic (Santa Cruz County 1996).

The County of Santa Cruz conducted a community meeting in February 1994 to gather public comments on the westbound one-way conversion. According to a County memorandum, there was strong community consensus at the meeting that the one-way westbound traffic pattern should be reversed to reduce the traffic volume on 38^{th} Avenue. Following the meeting, on the recommendation of the County Planning and Public Works Departments, traffic flow between 38^{th} and 41^{st} avenues was reversed to an eastbound one-way direction. Subsequently, East Cliff Drive between 32^{nd} and 38^{th} avenues was converted to an eastbound one-way direction to reduce vehicular loading along the entire road. As a result of these decisions, by early 1995 East Cliff Drive was an eastbound one-way road for the entire segment between 32^{nd} and 41^{st} avenues.

Following the conversions, the County Public Works Department extensively studied the effects of eastbound one-way traffic on neighborhood traffic volumes. Traffic counts, conducted in the summer to obtain a worst-case scenario, showed that traffic decreased for most roads in the study area with the exceptions of 30^{th} Avenue and Hawes Drive. Following conversion, 30^{th} Avenue carried approximately 500 to 800 more vehicles per day and Hawes Drive carried approximately 400 more vehicles per day.

A community meeting was conducted in October 1995 to gather public comments on the eastbound one-way conversion. According to a County memorandum dated October 26, 1995, the community strongly supported maintaining the eastbound one-way conversion of East Cliff Drive between 32^{nd} and 41^{st} avenues. However, residents of 30^{th} Avenue were concerned about increased traffic volumes. To respond to these concerns, the County installed road bumps on 30^{th} Avenue to reduce traffic and speeding.

Still, some community members have suggested that the segment of East Cliff Drive between 32^{nd} and 41^{st} avenues be reversed to the westbound one-way direction as part of the proposed parkway improvements, a primary reason for which being safer viewing of the ocean for motorists. While such a reversal would allow easier ocean viewing, it would also alter traffic patterns within the area. Using turning movement counts conducted in July 2001 at the intersections of 32^{nd} Avenue/East Cliff Drive and 41^{st} Avenue/East Cliff Drive and average daily traffic volume counts conducted in 1995 by the County Public Works Department (increased by a factor of 13 percent to correlate to the July 2001 counts), the circulation effects of reversing the one-way direction on East Cliff Drive were evaluated as part of this EIS/EIR. The July 2001 traffic counts and the January 1996 East Cliff Drive Traffic Study (which contains the 1995 Public Works counts) are both included in Appendix D.

Currently, there is an overall west-to-east movement of vehicles along the Santa Cruz coastline, and within the traffic corridor that includes the arterial roads of Portola Drive and East Cliff Drive (approximately 12,500 vehicles per day move in the eastbound direction, and 9,500 vehicles per day move in the westbound direction; see Figure 2-2). The reasons for this east-west traffic imbalance may vary, but they likely include a pattern of motorists traveling progressively

2-2 Existing Traffic Volumes in Vicinity of East Cliff Drive east from Santa Cruz for coastal viewing or surfing, then looping back to Santa Cruz via 41st Avenue and Highway 1. For this traffic analysis, it was assumed that this overall regional circulation pattern would not be affected by a localized reversal of traffic on East Cliff Drive.

The preparers of this analysis also assumed that existing overall traffic volumes along the study segment of East Cliff Drive would not be affected by a reversal in the one-way direction. Thus, a one-way reversal would not make it more or less attractive for motorists to drive on the study segment of East Cliff Drive but would simply alter the way in which they accessed the road. However, note that the one-way reversal would be expected to decrease traffic along the segments of East Cliff Drive west of 30th Avenue, as motorists traveling to the study area would use the more direct Portola Drive from points west.

Reverse Traffic Circulation

Under the reverse (westbound) one-way scenario, eastbound motorists on East Cliff Drive would be required to detour to Portola Drive via 30th Avenue. Those motorists wanting to view the coastline, but still wishing to continue eastbound to 41st Avenue or other areas of Capitola, would be required to drive a loop: north on 30th Avenue, east on Portola Drive, south on 36th, 37th, 38th, or 41st Avenue, and west on East Cliff Drive back to 30th Avenue, thus increasing overall vehicle miles traveled in the area (Figure 2-3).

On 30th Avenue, an increase of up to 1,500 additional vehicles per day would be expected, consisting of eastbound traffic detouring up 30th Avenue to Portola Drive and looping traffic turning right from the westbound one-way portion of East Cliff Drive.

On Portola Drive, overall traffic volumes would increase slightly, and a wider imbalance between eastbound and westbound traffic would occur. Specifically, the number of westbound motorists would decrease by approximately 3,700 vehicles per day as these motorists use westbound East Cliff Drive, and the number of eastbound motorists would increase by approximately 4,000 vehicles per day. The eastbound increase would include motorists detouring up 30th Avenue from East Cliff Drive and motorists traveling to the study area on Portola Drive.

As noted above, traffic on the residential avenues providing direct access between Portola Drive and East Cliff Drive would also increase as motorists drive in the looping pattern. Most of the traffic increase would occur on 36th, 37th, and 38th avenues, which would provide the earliest opportunities to directly cut between Portola Drive and East Cliff Drive. Traffic on these three roads would increase by up to 1,000 vehicles per day. Compared with existing volumes, traffic on 41st Avenue would decrease from approximately 4,500 vehicles per day to approximately 3,800 vehicles per day.

On Hawes Drive, traffic levels would decrease as there would be fewer motorists cutting through to East Cliff from 30th Avenue via 32nd, 33rd, 34th, and 35th avenues. Under the reverse one-way scenario, this pattern would be less prevalent because most westbound motorists on East Cliff would continue on to 30th Avenue, where there is a direct connection to Portola Drive. Along with Hawes Drive, traffic on the avenues that do not provide direct connections between East Cliff Drive and Portola Drive would decrease. Table 2-1 summarizes both the existing traffic flow and the projected traffic flow for the reversed one-way option.

2-3 Expected Traffic Volumes Following Reversal of One-way Traffic

Table 2-1
Projected Increases in Residential Traffic
Under One-Way Reversal

Road Segment	Existing ADTs[1,2]	Reverse Flow ADTs[3]	Percent Change
30th Avenue (near Scriver Street)	3,790	5,290	+40%
36th Avenue (near East Cliff Drive)	580	920	+60%
38th Avenue (near Floral Drive)	1,450	1,800	+24%
41st Avenue (near East Cliff Drive)	4,530	3,800	-16%
Hawes Drive (near 32nd Avenue)	960	470	-50%

Source: Alta Transportation 2001

Notes:

1. ADT (Average Daily Traffic) =. Historic traffic volumes adjusted to July 2001 levels. Actual July 2001 counts and historic traffic counts are contained in Appendix D.
2. Adjusted or actual traffic volumes with current East Cliff Drive configuration.
3. Adjusted traffic volumes with projected changes from reverse in East Cliff Drive one-way flow.

In summary, a reversal of the one-way traffic direction on East Cliff Drive from eastbound to westbound would be counter to the prevailing west-to-east traffic pattern in the area, would result in a looping driving pattern in the study area, causing an increase in vehicle miles traveled, and would increase neighborhood intrusion and "cut through" by motorists. Most motorists would continue to travel through the area from west to east and would be required to use Portola Drive as a detour then loop around through the residential neighborhood to East Cliff Drive. Traffic levels would increase on 30th Avenue as motorists detoured to Portola Avenue, and would increase on 36th, 37th, and 38th avenues as motorists cut through to access East Cliff Drive. Traffic levels would decrease on 41st Avenue, on Hawes Drive, and on the adjacent avenues that do not provide a direct connection to Portola Drive.

The neighborhood traffic effects of reversing the one-way flow on East Cliff Drive are not desirable for three reasons:

- It would be counter to the overall eastbound traffic pattern within the study area;
- Previous neighborhood concerns with high traffic volumes on 30th, 37th, and 38th avenues; and
- Overall community support of the eastbound one-way traffic during the 1995 studies.

The expected traffic volumes on 38th Avenue following the one-way reversal would be approximately 1,800 vehicles per day, which is normally considered the maximum desirable traffic volume for a residential street. Expected traffic volumes on 30th Avenue would be approximately 3,000 vehicles per day. Therefore, this alternative component was considered unreasonable and was eliminated from further consideration.

Counterflow Bike Lane

A Class II counterflow bike lane, adjacent to the car lane, would address the needs of high-speed cyclists wishing to travel westbound on East Cliff Drive. However, due to safety concerns at the numerous avenue intersections and residential driveways with East Cliff Drive, the existing back out and diagonal parking along the road and the overall lack of space for such a lane, a counterflow Class II bike lane is not recommended. The number of conflicts the additional space would require make this alternative difficult to implement. Also, immediately to the north, the Portola Drive arterial provides a functional bike lane for bicyclists wishing to pass through the area in the westbound direction. For these reasons, this alternative component was eliminated from further consideration.

Note that slow counterflow traffic would be permitted on the proposed curb-separated bicycle path on the ocean side of the road. High-speed westbound cyclists would use Portola Drive or other two-way neighborhood streets as a detour to East Cliff Drive.

2.5 ALTERNATIVES DEVELOPMENT

Various construction methods and designs were considered for the different alternatives selected to be evaluated in this EIS/EIR. The following criteria were used in determining the most appropriate design for the project area:

- The design has to be able to protect the bluff from toe scour (where the base or foundation is undermined);
- The design needs to be tied into the existing protective structures installed as emergency repairs in 2004 and at both ends of the project site;
- The design has to be compatible with recreational uses of the area so as to preserve as much of the beach as possible; and
- The design has to ensure adequate protection against most wave effects.

The County determined that the soil nail type of construction (see Figure 2-4) would be the most effective in protecting the bluffs in the project area and meeting the requirements of a scenic area. The following criteria were used to determine the most appropriate construction method:

- The bluff protection has to be technically feasible;
- The protection has to minimize construction-related impacts on the natural environment; and
- The finished construction has to look natural.

Soil nail construction, along with the natural looking concrete face (colored, stained, and sculpted to match the natural cliff face), were determined by the County to be the best technical and visual solutions to the problem of ongoing coastal bluff erosion in the project area. The proposed structures would offer coastal bluff protection while maintaining sensitivity to the valuable scenic coastal resources and the recreational uses of the area (including use of the surf and access for motorists, bicycles, and pedestrians).

Below is a brief description of each of the construction methods that make up the different alternatives. To recapture recently lost bluff top areas, mechanically stabilized earth (MSE) construction would be used only in a few select locations where small build outs are planned.

2-4 Soil Nail Wall Construction

Mechanically Stabilized Earth (Alternatives 1 and 2)

MSE walls, such as those that would be used on the bluffs along East Cliff Drive, are constructed with reinforced soil. Reinforcing elements, such as steel strips, steel, or polymeric grids, or geotextile sheets are placed in the soil to improve resistance. Improved resistance reinforces and strengthens the soil significantly and allows very steep slopes or even vertical walls to be constructed without support from a massive structural system at the face of the slope.

The principal purpose for using MSE is to construct an embankment or wall at an angle steeper than could otherwise be safely constructed with plain soil (Figure 2-5). The increase in stability allows for construction of steeper slopes on firm foundations for such features as new highways and as replacements for flatter unreinforced slopes and retaining walls.

Additionally, using MSE at the edges of a compacted fill slope provides lateral resistance during compaction. The increased resistance increases soil density and provides increased confinement for the soil at the face. Even modest amounts of reinforcement in compacted slopes have been found to prevent sloughing and reduce slope erosion.

Soil Nail Construction (Alternatives 1, 2, and 3)

Soil nail construction has been successfully used as a means of stabilizing embankments and constructing retaining walls throughout the United States and Europe since the early 1970s. (Emergency repair of three failing cribwalls at the project site was performed in 2004 to provide immediate local cribwall stability and flank protection, using soil nail construction.) Soil nails (Figure 2-6) are structural, high-strength rebars, grouted into drilled holes and inclined slightly downward into the soil. The soil nails stabilize a potentially unstable or active soil mass by improving the continuity of the overall mass and providing anchorage into the more stable soil zone behind the active mass. Soil nails typically are spaced four to six feet (1.2 to 2 meters) horizontally and vertically along the face of the structure and generally extend behind the structure face to a distance of 0.8 to 1.2 times the height of the structure. This spacing depends on the soil strength, backslope geometry, and surcharge loading conditions. Following the installation of the soil nails, a reinforced shotcrete facing is constructed to cover the exposed slope. Permanent soil nail structures generally have 6- to 12-inch (15- to 30-centimeter) thick reinforced shotcrete facings, which can be textured and stained to blend with the surrounding rock and soil (Sanders and Associates 2000). Shotcrete is a process where concrete is projected or shot under pressure using a feeder or gun onto a surface to form structural shapes. Shotcrete has a high strength and durability and low permeability. Figure 2-7 illustrates the over the bluff, soil-nail construction method that would be used for the proposed project.

Riprap (Revetment) (Alternatives 1, 2, 3, and 4 and the No Action Alternative)

Riprap revetments (commonly referred to as riprap) are the most common form of shoreline protective device along the California coast. These are rock structures built to protect a bluff, dune, or some coastal structure against erosion by wave action (Appendix A, Photo 33). An engineered revetment typically has an outer layer of heavy cap rock or stone. The outer layer must be large enough to withstand anticipated wave forces. Underneath this layer is a support layer of smaller material (core stone) and then geotextile fabric or filter cloth that keeps sand and soil in the supporting embankment or beach from being removed by waves or water flows.

2-5 MSE Reinforcement

2-6 Soil Nail Assembly

2-7 Soil Nail Construction Method

Riprap consists of whatever large material may be available and often is just dumped on a beach or bluff edge. While riprap is considerably less expensive, it rarely offers adequate protection for an area and usually requires constant maintenance and resupply of rock or other material to perform its function (California Coastal Commission 1999). Riprap would be required to protect freestanding stairways in alternatives with less than full bluff armoring and to protect existing stairs at the Hook. Existing riprap at the east end of the wall near 36th Avenue was installed under permit to protect an adjacent private parcel.

Groins (Alternative 4)

Groins are relatively short, shore-perpendicular structures that can be constructed of rock, concrete, or other materials (Appendix A, Photo 34). Groins are used to stabilize a beach or trap sand to form a larger protective beach. Groins have been successfully used in California to create, widen, or stabilize beaches. Many of California's beaches exist because of downcoast sand barriers, such as natural groins that act to catch sand, such as headlands. A number of beaches owe their existence to artificial barriers, such as groins, jetties, and breakwaters. The size and spacing of groins is partially a design issue, dependent on the dominant direction of approaching waves but also depends on the extent of an existing beach and how much additional beach width is desired. Once a groin has been constructed, it is filled with sand, which prevents the area's naturally occurring downcoast sand supply from being depleted during the natural process of sand accumulating on the newly expanded beach (Griggs 2003c).

2.6 COMPARISON OF ALTERNATIVES

Table 2-2 is a summary of the different project features for Alternatives 1, 2, 3, and 4 and the No Action Alternative.

2.6.1 Alternative 1: Full Bluff Armoring (Preferred Alternative)

The various project components of Alternative 1 are detailed below. The bluff protection structure near Pleasure Point Park and associated stairways would be constructed first (Figure 2-1a, 2-8) followed by road and path improvements during project 2 (Figures 2-9a through 2-9c). Figure 2-10 is a representative cross-section of the bluff protection structure, together with the parkway improvements.

Table 2-2
Summary of Project Alternatives

Project Feature	Alternative 1—Full Bluff Armoring	Alternative 2—Partial Bluff Armoring with Full Parkway Improvements	Alternative 3—Partial Bluff Armoring with Limited Parkway Improvements	Alternative 4—Groins and Notch Infilling	No Action Alternative
Bluff Protection (in addition to emergency cribwall repairs conducted in 2004)	Install two bluff protection structures: 1,100-foot (335-m) segment covering Purisima and 810-foot segment covering terrace between 33rd and 36th Avenues, and	Two bluff protection structures, same location and length as Alternative 1. Armor Purisima bedrock along entire area and armor the terrace deposits at the bluff top and	Two bluff protection structures, same location and length as Alternative 1. Armoring Purisima bedrock only. No MSE reinforcement. Fill existing	No protection structures constructed on the bluff. Three subtidal groins (between 33rd and 36th Avenues) approximately 100 feet (30 meters)	No additional planned bluff protection. (Note: emergency repairs would be constructed in future, where feasible, in response to bluff failures and to assure public

Table 2-2
Summary of Project Alternatives

Project Feature	Alternative 1—Full Bluff Armoring	Alternative 2—Partial Bluff Armoring with Full Parkway Improvements	Alternative 3—Partial Bluff Armoring with Limited Parkway Improvements	Alternative 4—Groins and Notch Infilling	No Action Alternative
	300-foot (91-meter) segment near the end of41st Avenue. Armor the entire bluff face, including both the Purisima and terrace deposits. Install MSE reinforcement where needed to retain terrace deposits and support buildouts for parkway development. Fill existing undercut notches in Purisima with shotcrete.	over failing cribwalls in two washout areas. Install MSE reinforcement, same as Alternative 1. Fill existing undercut notches in Purisima with shotcrete.	undercut notches in Purisima with shotcrete.	long and perpendicular to shore to trap sand and form protective beaches. No groins would be constructed at The Hook. Fill existing undercut notches in Purisima with shotcrete.	safety.
Cribwalls	Cover one cribwall with new bluff protection structure. New retaining wall near Manzanita and 38th Avenues would not be covered by proposed bluff protection structure.	Same as Alternative 1. New retaining wall near Manzanita and 38th Avenues would not be covered by proposed bluff protection structure. No new retaining walls are planned. New walls may have to be built on an emergency basis in response to future bluff failures.	One cribwall would be covered by the bluff protection structure. New retaining wall near Manzanita and 38th Avenues would not be covered by proposed bluff protection structure. No new retaining walls planned. New walls may have to be built on an emergency basis in response to future bluff failures.	One cribwall and soil nail walls would remain in place. New retaining wall near Manzanita and 38th Avenues would not be covered by proposed bluff protection structure. Same as Alternative 3. No new retaining walls planned. New walls may have to be built on an emergency basis in response to future bluff failures. Same as Alternative 3.	One cribwall and soil nail walls would remain in place. New retaining wall near Manzanita and 38th Avenues would not be covered by proposed bluff protection structure. Same as Alternative 3.
Beach access	Construct one stairway, retain one stairway, and replace two stairways.	Same as Alternative 1, but with concrete piers or caissons as support.	Same as Alternative 1, but with concrete piers or caissons as support.	Construct one stairway and retain three stairways, with concrete piers or caissons as support.	Retain and maintain three existing stairways.
Abandoned restrooms	Demolish abandoned restrooms. Construct a replacement restroom and outdoor shower at	Demolish abandoned restrooms. Construct a replacement restroom and outdoor shower at	Demolish abandoned restrooms. Upon demolition, affected bluff may require stabilization or rebuilding,	Retain restroom structure as is (closed). Construct a replacement restroom and outdoor shower at	Retain restroom structure as is (closed).

Table 2-2
Summary of Project Alternatives

Project Feature	Alternative 1—Full Bluff Armoring	Alternative 2—Partial Bluff Armoring with Full Parkway Improvements	Alternative 3—Partial Bluff Armoring with Limited Parkway Improvements	Alternative 4—Groins and Notch Infilling	No Action Alternative
	Pleasure Point Park. Remove and dispose of all concrete rubble from project area.	Pleasure Point Park. Remove and dispose of all concrete rubble from project area.	depending on condition. Construct a replacement restroom and outdoor shower at Pleasure Point Park. Remove and dispose of all concrete rubble from project area.	Pleasure Point Park. Remove and dispose of all concrete rubble from project area.	
Riprap/ concrete rubble on beach	Remove all concrete rubble and most riprap. Relocate some riprap to where the structure terminates, near the O'Neill property; use some riprap to protect the stairway at The Hook.	Riprap used to protect stairways and endwalls.	Use riprap to protect stairways and endwalls.	Use riprap to protect stairways. Some of the existing rock riprap could also be used in the construction of the groins.	Riprap and concrete rubble to remain on the beach.
Road improvements	Road to remain single-lane, one-way (eastbound). Narrow and improve road with a curb and gutter.	Road to remain single-lane, one-way (eastbound) , subject to competence of terrace deposits. Road expected to narrow over time as bluff fails. Bluff failures would be repaired based on feasibility evaluation.	Road improvements similar to Alternative 1, except where existing right of way width is insufficient. Bluff expected to continue to fail, eventually requiring road closure.	Road improvements similar to Alternative 1, except where existing right-of-way width is insufficient. Bluff expected to continue to fail, eventually requiring road closure.	No road improvements. Bluff expected to continue to fail, eventually requiring road closure.
Utilities (lines to be upgraded as necessary prior to construction)	Cap potable and sanitary sewer lines at abandoned restroom at mains along East Cliff Drive. No changes to electrical, gas, sanitary sewer, or water lines under and along East Cliff Drive.	Cap potable and sanitary sewer lines at abandoned restroom at mains along East Cliff Drive. Bluff expected to continue to fail, eventually requiring relocation of utilities.	Cap potable and sanitary sewer lines at abandoned restroom at mains along East Cliff Drive. Bluff expected to continue to fail, eventually requiring relocation of utilities.	Cap potable and sanitary sewer lines at abandoned restroom at mains along East Cliff Drive. Bluff expected to continue to fail, eventually requiring relocation of utilities.	No changes or improvements to existing utilities. Bluff expected to continue to fail, eventually requiring relocation or projection of utilities.

Table 2-2
Summary of Project Alternatives

Project Feature	Alternative 1—Full Bluff Armoring	Alternative 2—Partial Bluff Armoring with Full Parkway Improvements	Alternative 3—Partial Bluff Armoring with Limited Parkway Improvements	Alternative 4—Groins and Notch Infilling	No Action Alternative
Bicycle and pedestrian paths	Create separate pedestrian and bicycle paths (each eight feet [2.4 meters] wide, where feasible), one of asphalt and one of crushed granite.	Same as Alternative 1.	One multiuse path (minimum eight-foot [2.4-meter] width) would be constructed, its width depending on the amount of setback available.	Same as Alternative 3.	Existing asphalt multiuse path to be maintained, pending irreparable bluff failure.
Park development	Develop Pleasure Point Park. Construct small restroom, install landscaping, picnic areas, and Monterey Bay Marine Sanctuary Trail interpretive exhibit.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Park to be retained in present condition, with future park development subject to funding.
Landscape improvements	Landscape shrubs and trees along path, with benches for viewing.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	No new landscaping.
Railings	Fencing with wooden posts and metal railings measuring 42 inches (107 centimeters) high to be installed along a portion of the ocean side of the parkway where needed for pedestrian safety. Where sufficient setback is available, use wooden split-rail fence instead of railing.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	No new railings except as needed in the future for public safety. Existing fences and guardrails retained.
Parking	Create 8 new parking spaces, in addition to the existing spaces, for a total of 35 spaces.	Same as Alternative 1, subject to continued bluff stability.	Same as Alternative 1, subject to continued bluff stability.	Same as Alternative 1, subject to continued bluff stability.	Existing 27 parking spaces to remain, subject to continued bluff stability.
Crosswalks	Install new crosswalks at six locations.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	No new crosswalks installed.
Drainage improvements	Design street drainage system to minimize drainage over bluff face.	Same as Alternative 1, except groundwater drainage system	Same as Alternative 1, except no groundwater	Same as Alternative 1, except no groundwater	Normal evaluation and maintenance or replacement of drainage system.

Table 2-2
Summary of Project Alternatives

Project Feature	Alternative 1—Full Bluff Armoring	Alternative 2—Partial Bluff Armoring with Full Parkway Improvements	Alternative 3—Partial Bluff Armoring with Limited Parkway Improvements	Alternative 4—Groins and Notch Infilling	No Action Alternative
	Combine and connect new catch basins to upgraded filtering mechanism. Provide additional drainage to prevent groundwater retention behind soil nail structure. Replace storm drain lines that now protrude from the bluff face; stormwater would discharge through the face of the new structure.	limited to drainage of retaining walls.	drainage system.	drainage system. Repair or consolidate storm drain lines protruding from bluff face, as needed.	Same as Alternative 3.

2-8 Map Legend for Figures 2-9a-c

2-9a Project Site Map-Sheet 1

2-9b Project Site Map-Sheet 2

2-9c Project Site Map-Sheet 3

2-10 Representative Cross Section of Bluff Protection Structure and Parkway Improvements

The proposed action includes the construction of two bluff protection structures, approximately 30 to 32 feet (9 to 10 meters) high (from 33rd to 36th avenues, constructed in project 1) and 35 to 40 feet (11 to 12 meters) high (at 41st Avenue, constructed in project 3), over a total distance of about 1,400 feet (427 meters), to protect the coastal bluffs seaward of East Cliff Drive. The longer bluff structure would be built between 33rd and 36th avenues. This would cover about 1,100 linear feet (335 meters) of Purisima Formation, but only about 810 feet (247 meters) of terrace deposits because of emergency repairs constructed in 2004. The second structure, about 300 feet long (92 meters), would be built at The Hook overlook, at the end of 41st Avenue. The bluff protection structures proposed are referred to as soil nail walls. These would be supplemented as needed with MSE retaining walls in areas where the terrace deposits have failed. These walls would support buildout areas needed for the parkway development under project 2. The buildout areas are needed in order to support the roadway and parkway improvements in sections lost to erosion. Any MSE walls used in this alternative later would be covered by the soil nail wall.

Approximately 31 percent of the project segment from 33rd to 36th avenues presently contains soil nail walls (which were part of the emergency cribwall repairs of 2004), concrete cribwalls, or similar structures. Some of these structures are in poor condition because they were not constructed to withstand the harsh marine environment of the area. The proposed soil nail wall would be constructed over the remaining cribwalls by drilling through them to install the soil nails, thereby eliminating the need to remove the walls. The emergency soil nail wall repair work would be left in place and integrated into the full bluff protection structure. As mentioned above, MSE walls would be used where needed to support buildout areas.

The two proposed bluff protection structures would be designed to protect the slope and to look natural. The proposed structures would be sculpted and stained to match the existing soils and rock layers and would follow closely or hug the natural cliff face. The soil nail walls, constructed as part of the emergency repairs, demonstrate that they can match the natural color and texture of the bluffs.

Soil Nail Construction

The construction design includes a series of horizontal metal tieback rods inserted into the bluff face. The base of the soil nail structures would be founded in a shotcrete footing set three feet (one meter) into the bedrock, with a scour apron extending four feet (1.2 meters) in front of the base of the wall (Figure 2-10). Excavation into the bedrock would be required to properly prepare for the footing and apron. The apron would protect the structures from wave action and erosion, and its upper surface would be flush with the surrounding bedrock. The steel rods (grouted steel rebars) would be fastened at the bluff face to a wire mesh grid or other reinforcing material and covered with two layers of sprayed-on concrete (Figure 2-4). The first layer (10 to 12 inches [25 to 30 centimeters]) would be the structural component covering all the steel rods and reinforcing the second layer. This second layer (6 to 12 inches [15 to 30 centimeters]) would be the sculptural element and would be shaped and colored to replicate the natural appearance of the bluffs.

Drainage devices (also known as weep holes) would be staggered in the bluff protection structures to drain groundwater. Storm drain lines that now protrude from the bluff face would be consolidated as feasible and would discharge stormwater through the face of the new structure in shielded openings.

Stairs and Abandoned Restroom (Projects 1 and 3)

Access to the beach and surf area is a major concern, as expressed through public comments. Currently, there are three stairways in the project area. Of the two that would be replaced, their construction would be coordinated with the construction phases in order to maintain continuous public access to project area beaches (Figures 2-11 and 2-1a). One new stairway is proposed (Table 2-3). All stairways would be constructed of either wood or concrete, with wood and metal railings.

Table 2-3
Stairway Locations

Stairway Reference Number	Location	Stairway Condition	Stairway Material
Stairway #1	33rd Avenue (Pleasure Point Park)	New stairway to be constructed.	Concrete (for Alternative 1); wood (for Alternatives 2, 3 and 4)
Stairway #2	35th Avenue, near the abandoned restroom	Stairway to be demolished and rebuilt a block from current location, near 36th Avenue.	Concrete (for Alternative 1); wood (for Alternatives 2, 3, and 4)
Stairway #3	38th Avenue	Stairway to remain in place, unaffected by project.	Wood
Stairway #4	41st Avenue (The Hook)	Stairway to be temporarily removed, repaired, and reinstalled.	Wood

33rd Avenue Stairway (Project 1). A new stairway for beach access would be added near 33rd Avenue, at Pleasure Point Park. This site was chosen because of the natural entry and exit point to the water and because of its proximity to Pleasure Point Park. If feasible, in order to maintain access to the beach at the west end of the project, a new stairway at 33rd Avenue would be constructed before the stairway near 35th Avenue is removed.

35th Avenue Stairway (Project 1). The abandoned restroom and its stairway, between 35th and 36th avenues, would be demolished. The potable water and sanitary sewer lines for the restroom would be capped at the mains under East Cliff Drive. The stairway would be redesigned and relocated eastward, closer to the intersection of 36th Avenue and East Cliff Drive, in response to public concerns about access and surfer safety. The final design would include all reasonable safety features and would comply with all regulatory safety requirements. Because the stairway is to be connected to the protective structure, there must be sufficient bedrock to support the anchoring process. There was not enough bedrock under the previous stairway location (the old restroom site) to support the anchoring process without additional structural elements.

2-11 Stairway Beach Access

38th Avenue Stairway (Project 1). The stairway at the end of 38th Avenue would remain in place and would be unaffected by the project, as there are no structures proposed at this location.

41st Avenue Stairway (Project 3). The Hook stairway would be temporarily removed to facilitate construction of bluff protection and would be repaired and reconstructed to make entry and exit safer during high surf and tides. This stairway would be reassembled in the existing location and would retain its general appearance. Because of the height of the bluffs above the beach (35 to 40 feet [11 to 12 meters]), the number of stairs needed require a run of up to 100 feet (30 meters). The bluff in this location is very irregular, and a straight stairway run would not be possible without severely altering the bluff top area and perhaps jeopardizing the existing trees and bluff top viewing area. Therefore, one continuous run of stairs against the face of the new structure would be impractical. Such stairway construction would also place the entry and landing points in unsuitable locations. Constructing one or more switchbacks pushes the stairs out far from the face of the bluff, which does not allow for integration with the wall structure. Thus, the entire stairway cannot be sculpted into the protection structure but would need to be an independent structure. Rebuilding it in the existing location is the best option, even though some riprap may need to be retained to protect the base of the stairs.

Removal of Concrete Rubble and Riprap (Project 1 and 2) and Excavation

Constructing the bluff protection structure in the vicinity of 33rd to 36th avenues would allow, and in some instances require, the removal of concrete rubble from the beach area. In addition, the rock riprap would be removed or relocated. The broken concrete rubble (2,800 to 4,800 cubic yards [2,140 to 3,670 cubic meters]) and riprap (1,200 cubic yards [917 cubic meters]) at the project site occupy a large portion of the beach and reduce the beach sand area that might otherwise be available for recreation. The County has proposed removing all of the concrete rubble for disposal at the County landfill. If possible, the rubble would be ground down at another off-site location into smaller sizes and reused for other construction road projects. The rock riprap in areas where the proposed protection structures would be erected would be removed. A small portion at the east end of the larger bluff protection structure was placed under a separate permit for the adjacent private parcel. County records indicate that permits were issued for this riprap in 1978 and 1981. A riprap portion in the vicinity of the stairs at The Hook would remain as a protective armoring to the stair supports. Other riprap along the project area, on private parcels, where no protection structure is proposed, would remain. Additionally, approximately 560 cubic yards (428 cubic meters) of excavated material in the project area would be displaced by the foundation excavations for the protection structures. Excavated material would be disposed of off-site.

Road Improvements (Projects 2 and 3)

East Cliff Drive would be configured as a single, 16-foot-wide (5-meter-wide) lane, with one-way travel in the eastbound direction from 32nd Avenue to 41st Avenue, similar to the existing alignment. Pedestrian and bicycle paths would be constructed and additional public parking would be added (Figures 2-9a through 2-9c). A rolled curb (a curb with a curved top that can be driven over by vehicles) between the roadway and the paved path would allow emergency use and would meet state standards for fire access. It would also control surface drainage (see below). Traffic guardrails would be removed and a new pedestrian guardrail would be installed in some locations. Some roadside signs would be required, but there would be no overall increase in signage along the proposed project site. At each of the intersections, cross walks and access ramps through the rolled curb would be installed. The width of the road in these areas would be widened to accommodate left turn requirements onto East Cliff Drive.

Pedestrian and Bicycle Improvements (Projects 2 and 3)

Separate pedestrian and bicycle paths would be constructed on the ocean side of East Cliff Drive. The first phase of pedestrian and bicycle path improvements would occur during project 2. These improvements would begin near Pleasure Point Park and would terminate just south of Larch Lane. The remaining construction would be completed under project 3 and would continue the pedestrian and bicycle path improvements to The Hook.

The pedestrian path would be eight feet (2.4 meters) wide, constructed of crushed granite (approximately two to three inches [five to eight centimeters] deep), and would generally follow the cliff edge. The pedestrian path would meander among pockets of landscaped shrubs and trees, and viewing areas with benches would be provided at various points. The pedestrian path is expected to be used primarily by walkers and joggers, who generally prefer a softer trail surface. In some locations where the bluff face has eroded significantly, the pedestrian path may narrow, to less than eight feet (2.4 meters). This path has been identified as a portion of scenic trail for Monterey Bay National Marine Sanctuary, and appropriate trail markers and signage would be included along the path.

The paved bicycle path would be eight feet (2.4 meters) wide, would be constructed of asphalt, and would be between the pedestrian path and the car lane. The bicycle path would be separated from the car lane by a rolled curb. Where sufficient width is available, a landscaped buffer, composed of low coastal vegetation, would be installed along the pedestrian and bicycle paths. This vegetation would be irrigated until the plantings become established, at which time the County Parks Department would assume management of the landscaping. Both the mountable curb and the bicycle path itself would be designed to accommodate emergency vehicles using the road and path along East Cliff Drive. Due to its slow-speed nature, the bicycle path generally is not expected to be used by bicycle commuters or sport cyclists, who prefer to travel at higher speeds. Eastbound high-speed cyclists would need to use the East Cliff Drive car lane; westbound high-speed cyclists would use the bike lanes on Portola Drive, the nearest arterial just north of East Cliff Drive. Westbound cyclists wishing to stay near the ocean or to reconnect to East Cliff Drive upcoast of 32nd Avenue would be required to traverse the neighborhood, using a combination of streets, such as Floral, Hawes, and Calla, to connect to 32nd Avenue.

Painted crosswalks would be installed on East Cliff Drive at 34th, 35th, 36th, 37th, and 38th avenues and at the parking lot at 41st Avenue. For safety, railings approximately 42 inches (107 centimeters) high would be installed along the ocean side of the parkway, similar to those on West Cliff Drive in Santa Cruz. These railings would be wooden posts with metal railings where the walkway is adjacent to the bluff top and would be all wood split rails where landscaping separates the path from the bluff top. Where there are sufficient setbacks, sections of the railings would be replaced with landscaping to help minimize their visual impacts.

Parking Improvements (Project 2)

There are approximately six formal public parking spaces on the ocean side of East Cliff Drive (adjacent to the O'Neill property), and approximately 21 on the inland side, within the right-of-way (adjacent to residential buildings). A free off-street public parking lot constructed by the County in 1999 across from The Hook provides 64 parking spaces. Project 2 would result in reconfiguration of the road lanes and parking spaces and a net gain of 8 new parking spaces, for a total of 35 on-street public parking spaces following project implementation, as follows:

- Five diagonal spaces on the ocean side of the road, between Pleasure Point Drive and 33rd Avenue;
- Two parallel spaces at 36th Avenue;
- Between 36th Avenue and 37th, 11 diagonal spaces on the ocean side, and six diagonal spaces on the inland side;
- Fifteen spaces between 36th Avenue and Manzanita Avenue on the inland side; and
- Two parallel spaces on the ocean side of the road, between 38th Avenue and Larch Lane.

Park Development (Project 2)

Pleasure Point Park is approximately 7,635 square feet (709 square meters) in area and is at the westernmost end (upcoast) of the proposed project site (southeast corner of the intersection of 32nd Avenue/Pleasure Point Drive and East Cliff Drive). This small park is a viewing area for the beach and surf and is heavily used by surfers as an access point to the beach below. Proposed improvements to the park include construction of a small restroom with an outdoor shower, similar to the restrooms at The Hook. New landscaping, outdoor seating, and picnic tables would be developed. Also, this park has been identified as the location for a major interpretive exhibit as part of the scenic trail for the Monterey Bay National Marine Sanctuary. The park would additionally serve as an access point for new stairs (designated as Stairway #1 in this report).

Storm Drainage (Projects 2 and 3)

The park site and the road and roadside sections would be designed to drain away from the top of the bluff into new catch basins. New catch basins would be used that comply with best management practices for improved infiltration and water quality assurances. The current drainage structures at 33rd Avenue (CDS units) were installed during a previous project and would tie into the new proposed drainage system, which would combine some existing drain lines and new drain lines, reducing the number of outfalls. The project would require capping and replacing several old storm drain outfalls, whose pipes protrude near the top of the bluff. All the new storm drain lines are designed to be embedded in the bluff and would release water at the base of the cliff through the bluff protection structures. These drains would discharge water over an energy dissipater in the base of the bluff structure to prevent erosion and to minimize turbidity. The outfall pipes would also be partially covered by the bluff and would be designed to blend with the surrounding bluff structure. Table 2-4 summarizes the proposed drainage improvements in the project area.

Table 2-4
Proposed Drainage Improvements

	Location	Actions Proposed
#1	30th, 32nd, and 33rd avenues	Existing storm drain and outfall to remain (CDS units installed in 2001, per coastal permit A-3-SCO-00-076). New drain from Pleasure Point Park with CDS unit to connect to existing outfall.
#2	34th Avenue	Old silt/grease trap device monitored as part of coastal zone permit conditions and requirements for drainage monitoring program; to be replaced with new filtration unit. Remove two catch basins and outfall pipe and replace them with CDS units and one new outfall.
#3	35th Avenue	One new outfall to replace two existing outfalls and drain inlet downcoast of 35th Avenue. New filtration units would be installed.
#4	36th Avenue	A new filtration unit would be installed at the existing outfall, and, if possible, combined with the 35th Avenue outfall. New drains from the parking lot would be connected to CDS units.
#5	Manzanita Avenue	One new outfall to replace three existing pipe outfalls, in conjunction with a new retaining wall. New filtration unit would be installed.
#6	Larch Lane	One drain to remain upcoast of the intersection installed as part of cliff and road improvements in 1995.
#7	The Hook (41st Avenue)	Outfall, installed as part of the parking lot improvements in 1998, to remain.

Some of the above-listed outfalls may be combined or abandoned where feasible, in association with parkway improvements.

Construction Actions for Proposed Project

Anticipated Construction Sequence

The main bluff protection structure between 33rd and 36th avenues would be constructed first, followed by many of the road and path improvements. The bluff protection structure at The Hook and any remaining road and path improvements would be constructed last as part of project 3. The proposed construction sequence would begin with the removal of debris, rubble, and riprap and the installation of the keyway (footing and apron), beginning near the west end of the project, near 33rd Avenue, and proceeding downcoast to avoid any potential scouring of the wall from westerly approaching waves. The keyway would protect against scour at the toe of the wall. Rubble and riprap would be removed only during low tide, when the construction area is above the water line, or using equipment suspended from the top for access to the bluff face. The final project design would include a construction plan to prevent work on the bluff from depositing debris in the water. This plan could include requirements for a silt fence and temporary construction berms and the use of impermeable sheeting to protect the beach and water from debris, as needed for the various portions of the work.

Once a section of the keyway is completed, the soil nails and primary layer of shotcrete would be installed. This work would be conducted from the top of the bluff, thereby minimizing equipment and machinery on the beach. The rate at which the shotcrete layers are applied would be at least twice as fast as the soil nail installation, causing a reoccurring time lag between these two phases of work. The secondary shotcrete layer and sculpturing also would be done from the top of the cliff. As noted above, work would be conducted only when the construction area is above the water line, and careful coordination of the work with the tides would be required to prevent project debris and silt from washing into the intertidal area.

Construction Schedule

Construction is planned to begin in 2007 or as soon as funding and permit processing will allow. Project 1 (main bluff protection structure) would begin in the spring and would end in the fall, to take advantage of lower tides. These low tides create a larger beach area necessary for rubble removal, resulting in greater beach access, lessening the potential impacts of construction on biota in the intertidal zone. Project 2 construction (parkway and road improvements) would begin in 2008, once the project 1 construction is completed. Project 3 would likely follow completion of project 2 but, as previously noted, might be done in conjunction with project 1 if it is more cost effective or less disruptive to the community.

Construction activities would be consistent with standard County work hours, which are 7:30 AM to 4:30 PM, Monday through Friday. Due to the noise generated by heavy equipment and machinery during operations and the proximity of the project site to residential areas, these standard work hours are not expected to vary. However, tidal variations may require some adjustments to the regular work hours and schedule as long as noise and other construction-related impacts can be mitigated.

Construction of Bluff Protection Structures

According to analysis and feasibility studies (Sanders and Associates 2000) and work completed as part of emergency repairs in 2004, the soil nail wall concept is viewed as the most effective method for halting erosion and stabilizing the bluffs in the project area. SAGE (SAGE 2000) made several basic assumptions about timing while developing the construction scenario and sequence discussed below. However, various other factors can affect these assumptions and extend the construction period of the soil nail wall. These factors are accessibility to the bottom of the cliff, tidal constraints and wave action, environmentally sensitive areas, and unknown field conditions (e.g., extent of concrete debris). Construction of a bluff protection structure would require excavating Purisima Formations or the bases of the cliffs to provide sufficient space for the footing. At some excavation of the cliff faces, it would be necessary to remove vegetation and debris in order to provide the proper surface for construction.

Construction Access

Based on physical constraints and related impacts, it is not feasible to construct an access ramp to the bottom of the cliff for construction equipment. During previous cliff improvements, any equipment was lifted by crane onto the beach. This technique would be used for the proposed project and would result in the least disturbance to the cliff face.

Rubble and Riprap

An estimated 2,800 to 4,800 cubic yards (2,140 to 3,670 cubic meters) of concrete rubble and 1,200 cubic yards (917 cubic meters) of riprap are on the beach. This estimate is based on the assumption that it would cover an area 30 feet (9 meters) wide and five feet (1.5 meters) deep, along 1,400 feet (427 meters) of cliff. However, the exact depth of the concrete debris and riprap would be determined once excavation of the existing concrete debris and riprap begins for the preparation of the keyway.

Heavy Equipment and Machinery

In order to minimize the impacts of heavy equipment operating on the beach, much of the work would be conducted from the top of the cliff with the use of cranes and worker lifts; this includes preparing the surface, installing the drainage layer and welded wire mesh, and applying shotcrete. However, an excavator or large backhoe inevitably would be used at the toe of the cliff to install the keyway and at the lower portion of the wall to receive soil nails.

Diesel fuel is required for machinery and heavy equipment; refueling such equipment would be limited to designated areas (such as one of the staging areas) so as not to expose sensitive habitats to the possibility of a fuel spill. Additionally, best management practices, such as a spill contingency plan, would be in place during the construction period. Other best management practices, such as vegetable oil-based hydraulic fluids, which are standard for operating construction equipment near environmentally sensitive areas, would be used for this phase of the project.

Vehicular and pedestrian traffic would be disrupted whenever wide equipment, such as cranes, excavators, and trucks, are operating on the cliff. These disruptions would be as short as possible and would occur between 9 AM and 3 PM so as not to interfere with commute hours.

Segments of East Cliff Drive would be closed and detour routes would be established throughout project 2 and for periods during projects 1 and 3. The County would ensure adequate emergency access during these phases by limiting the closed segments of the road. In addition, the County would notify local emergency service providers of these closures at least 48 hours in advance.

Following is a list of the equipment to be used in one or all three of the projects:

- Track-mounted drill rig (similar to excavator);
- Excavator or large backhoe;
- Crane with dragline or bucket;
- Forklifts;
- Man lifts and lift baskets;
- Concrete pumps; and
- Trucks of various sizes.

Workforce

Due to the magnitude of the proposed project and seasonal and tidal time constraints, the workforce is expected to vary, depending on the phase of the work. The workforce for a typical soil nail installation project is generally one drill rig operator and two or three laborers. During the shotcrete application, two workers would be in the lift basket and one at the pump. In the case of this project, additional personnel, such as a crane operator, forklift operator, and traffic control and public safety workers (i.e., flag people), are anticipated.

Construction Staging Areas

Due to the nature of the site and its physical constraints, the contractor would have to store and service some equipment away from the project site. No equipment would remain on the beach unless it is sufficiently above maximum water levels (including wave run-up). A staging area in the project vicinity would be necessary, including portions of the bluff top road area adjacent to Pleasure Point Park.

Proposed Monitoring and Maintenance Activities

Monitoring and maintenance constitute two essential elements in ensuring the successful performance of the proposed protection structures. While there might be a few specific maintenance items to address periodically, the type of maintenance necessary is going to depend primarily on the results of the monitoring efforts.

The main objective of the monitoring program is to help detect potential problems before they occur and to prevent minor problems from turning into major ones. The following post construction items would be checked periodically and immediately after a major storm or earthquake:

- Scour (erosion) at the toe of the wall;
- Evidence of outflanking (process where material to either side of a seawall or protection structure erodes to a point where it threatens or damages the wall itself or the property behind it at the ends of the wall);
- Rise in groundwater levels in the terrace sediments behind the structure (based on instrument data);
- Weep hole drainage (which would be open and free flowing);
- Wall tilting; and
- Evidence of cracking in the wall and in the ground behind the wall.

The following conditions would be checked periodically:

- Early signs of water damage, such as small gullies at the ends of the wall;
- Spalling (deterioration of the surface of the protection structure) or cracking of the wall;
- Rust stains in the wall or exposed steel reinforcement;
- Deterioration of drain lines;
- Changes in the original condition of the wall; and
- Evidence of channeling in the shotcrete.

Periodic and occasional maintenance items aimed at protecting the integrity of the bluff protection structures include the following:

- Clearing all site drainage, including drainage at the top of the wall;
- Repairing leaking water lines and storm or sanitary sewer lines within the parkway;
- Repairing or patching shotcrete;
- Grouting cracks in the wall;
- Filling small gullies;
- Redirecting drainage away from the wall; and
- Redirecting groundwater or allowing it to flow through the wall.

2.6.2 Alternative 2: Partial Bluff Armoring with Full Parkway Improvements

This alternative includes measures to partially armor the bluff to protect it from erosion. A soil nail structure would be constructed primarily at the bottom portion of the bluff face to protect the Purisima Formation. This alternative also would incorporate new MSE walls with shotcrete and would be constructed as needed to retain terrace deposits and support buildout areas for parkway development (Figure 2-5). As a result of these buildout areas, the bluff armoring may extend to the top of the bluffs in the existing washout areas. Repairs to the remaining walls would be made as needed. All other features of the project, such as parkway development and road improvements, would be the same as those described for Alternative 1 (Section 2.6).

Scouring of the Purisima Formation bedrock at the base of the cliff has been identified as a principal cause of bluff retreat. Partially armoring the bluff would include armoring the Purisima Formation bedrock layer (lower half of the bluffs) with a soil nail structure, as described for the full bluff armoring alternative. The top of the bluff protection structure would vary in height depending on where the Purisima Formation meets the terrace deposits. In many locations, the height would be approximately 15 feet (4.5 meters), although the elevation varies along the project area, and in some locations the protection structure may reach the top of the bluffs. The top of the soil nail structure would conform to this variation in height along the project area as needed to stabilize the bluffs. The length of bluff face to be armored would be the same as for the full bluff armoring alternative (approximately 1,400 feet [427 meters] total).

The terrace deposits above the Purisima Formation would receive little or no protection from either rain and runoff or wave erosion, except in buildout areas where the structure would extend to the top of the bluff and where existing walls have been repaired. In these areas prone to failure, soil nail walls would be constructed as needed to help stabilize terrace deposits and to prevent washouts, thereby protecting the integrity of the proposed parkway. Additionally, the slope and top of the bluffs would be planted with vegetation designed to afford some protection from erosion. The remaining terrace deposits would be vulnerable to direct impacts from large waves, storm runoff, weathering, and seismic shaking.

After demolition of the abandoned restrooms, the upper bluff behind the structure may require stabilization or rebuilding, depending on its condition. As mentioned in Alternative 1, the stairway associated with the abandoned restrooms would be relocated one block east of the present location and would be supported by concrete piers or caissons. The stairways and endwalls would need to be buffered by riprap to protect them from storm surges. While the soil nail structure itself under this alternative is expected to last approximately as long as the soil nail structure in the full bluff armoring alternative, overtopping and erosion of the terrace deposits could undermine the integrity of the structure, resulting in failure of the structure sometime after the first 25 years. Additionally under this alternative, the terrace deposits are likely to continue to recede and over time may endanger improvements made to the bluff tops, including the pedestrian and bicycle paths, the road and underground utilities, parking, and other features. However, the extent of reduction in the life of the parkway improvements cannot be accurately predicted because the rate of erosion of the terrace deposits would be mainly a function of the size and duration of waves and storms, as well as the condition and number of retaining walls designed and constructed to prevent failure of the terrace deposits.

Under the partial bluff armoring alternative, the pedestrian and bicycle paths, or even portions of the road, might have to be closed or rerouted in response to future continued bluff top erosion. In fact, SAGE identified a one-foot (three-meter) section of East Cliff Drive near 35th Avenue with a one-inch-wide (two-centimeter-wide) tension crack. SAGE recommended that this section be fenced off for public safety. SAGE identified other sections of East Cliff Drive as being "in danger" or "potentially in danger." The in danger sections may be unsafe within the next two or three storm seasons, if no protection measures are taken. The potentially in danger sections are considered to be beyond this two to three storm season criteria. However, SAGE identified several scenarios that would result in the potential for these areas to be affected. Two of these scenarios include strong ground shaking and undercuts in the Purisima Formation. Based on the SAGE analysis, the size of the potential bluff failure under seismic loading conditions may exceed ten feet (three meters), so larger areas of the site may be classified as in danger than are currently shown using the ten-foot (three-meter) offset. Additionally, although the Purisima Formation is relatively strong, field observations indicate that the bench will eventually collapse onto the beach after the underlying support has been removed.

2.6.3 Alternative 3: Partial Bluff Armoring with Limited Parkway Improvements

As with Alternative 2, this alternative would partially armor the bluffs to protect them from erosion. Alternative 3 differs from Alternative 2 in that no new soil nail walls would be constructed to retain terrace deposits, and no new armoring of the top of the bluff would occur. As a result, only limited parkway improvements would be possible. Because there would be limited measures taken, such as installing landscaping, to protect the terrace deposits from further erosion, only one multiuse path (a minimum of eight feet [2.4 meters] in width), for both pedestrian and bicycle use would be constructed. As described for Alternative 2, after the abandoned restrooms are demolished, the affected upper bluff may require stabilization or rebuilding, depending on its condition after demolition. Most other features of the project, such as the stairway replacement, the parkway development, and road improvements (parking, crosswalks, and drainage), would be the same as those described for Alternative 2. As under Alternative 2, the stairways and endwalls would need to be buffered by riprap to protect them from storm surges.

As with Alternatives 1 and 2, scouring of the Purisima Formation bedrock at the base of the cliff has been identified as a principal cause of bluff retreat. Partially armoring the bluff would include armoring the Purisima Formation bedrock layer only (lower half of the bluffs) with a soil nail structure, using the same construction methods as described for Alternative 1. The top of the bluff protection structure would be only to the top of the Purisima Formation. The length of bluff face to be armored would be the same as for Alternatives 1 and 2 (approximately 1,400 feet [427 meters] total).

The terrace deposits that overlie the Purisima Formation would receive no protection from either rain and runoff or wave erosion. No vegetation would be planted along the terrace deposits. As with Alternative 2, the terrace deposits would be vulnerable to such processes as direct impact from large waves, stormwater runoff, weathering, and earthquake-induced slides. As mentioned above, no new soil nail walls would be constructed, thereby providing no stabilization for the terrace deposits or preventing washouts. The soil nail structure under this alternative is expected to last approximately as long as the soil nail structures in Alternatives 1 and 2. However, under this alternative as with Alternative 2, the terrace deposits are likely to continue to recede, eventually endangering improvements made to the bluff top, including the multiuse path, the road and underground utilities, parking, and other features. The extent of reduction in the life of the parkway improvements cannot be specifically predicted but according to the recent SAGE threat analysis, portions of East Cliff Drive and underlying utilities could be lost within a few years. As a result, the multiuse path and possibly the road may have to be closed or rerouted in response to continued bluff top erosion. The rate of erosion of the terrace deposits would be mainly a function of the size and duration of waves and storms.

2.6.4 Alternative 4: Groins and Notch Infilling

This alternative would not armor the bluff but instead would use other means to protect the bluff from erosion. Under this alternative, no new retaining walls would be constructed, therefore no buildout would occur near the terrace deposits. As a result, only one multiuse path, with a minimum width of eight feet (2.4 meters), depending on the amount of setback available, would be constructed. General parkway improvements would be made under this alternative, such as installing landscaping along East Cliff Drive and developing Pleasure Point Park, similar to Alternative 3.

Implementing this alternative would involve filling in the wave-cut notches at the base of the bluffs between 33rd and 36th avenues with concrete. This infilling would reduce further undercutting and bluff failure. Also included under this alternative is the construction of several groins at strategic locations perpendicular to the shore. Groins are relatively short, shore-perpendicular structures that can be constructed of rock, concrete, or other materials and that stabilize a beach or that trap sand to form a protective beach. The groins would be designed to trap sand carried downcoast by the long shore current and to create beaches along the 33rd to 36th Avenue area. Initially, sand fill would be placed on the upcoast side of the groins to ensure that the down-current flow of sand to existing beaches is not interrupted or reduced, thereby eliminating any impact on the downcoast sand supply.

The proposed configuration would include three groins, and the construction details would include the following:

- Patching and extending a naturally occurring groin-like Purisima Formation (also known as a finger) in front of the O'Neill house;
- Extending a second naturally occurring finger just down the coast from the end of 35th Avenue; and
- Extending a third naturally occurring finger in the Purisima Formation that extends a short distance seaward, immediately down the coast from the end of 34th Avenue.

Rock would be used to construct the groins. In order to match the bluffs, these rock groins then would be covered with shotcrete to match the existing fingers of Purisima. They would be tied to the Purisima bedrock platform and would extend seaward from the base of the bluffs for approximately 75 to 100 feet (23 to 30 meters). The groins would be attached by drilling and placing engineered tiebacks into the Purisima. The groins would be low in relief and would slope gradually seaward with the same slope and elevation as the existing Purisima bedrock to mimic the natural bedrock as closely as possible.

The beaches would initially be charged with nourished or delivered sand, and, as this nourished sand is moved downcoast by littoral drift, the groins would trap some of the approximately 300,000 cubic yards (229,367 cubic meters) of sand that moves downshore in this area each year. This 50- to 75-foot-wide (15- to 23-meter-wide) beach would buffer the bluffs from wave attack during most of the year, thereby reducing the rate of erosion. The width of the beaches, and therefore the degree of protection of the bluffs, would be related to the length of the groins, with longer groins expected to create wider and more protective beaches. Groins extending approximately 100 feet (30 meters) from the shore would create wide enough beaches to protect the bluffs under most conditions. The three groins would trap or hold approximately 15,000 cubic yards (11,468 cubic meters) of sand. This amount of sand would extend the beach out to a maximum of approximately 75 feet (15 meters) in the summer immediately upcoast of each groin. During the winter, the beach is expected to narrow under average conditions, although the beach is still expected to be wider than at present and to provide additional bluff protection. During severe El Niño events, with elevated sea level and large waves from the west or southwest, the beach may be eroded down to bedrock, although this may happen only every five years or so. Nonetheless, under the most severe conditions for bluff erosion (major El Niño events), it is very unlikely that a wide beach would remain at the site despite the existence of the groins.

In order to compensate for the sand that would be trapped by the groins, it would be important to initially charge or fill the area with sand upcoast from each groin once construction was complete. Based on the construction of three groins measuring 100 feet (30 meters) in length, and 1,000 feet (305 meters) of total beach, about 15,000 cubic yards (11,468 cubic meters) of sand would be required. This figure represents about 500 to 1,000 dump truck loads of material. Costs would be in the $350,000 to $400,000 range.

Sand used to charge the groins would come from the sand quarries in Scotts Valley because of its proximity to the proposed project site and its quality of sand.

As in Alternative 1, all rubble would be removed to the County landfill, and the riprap in the construction areas would be relocated to the base of the stairways in order to help protect them from heavy storms, or it might be used to construct the groins. Most other features of the project, such as the stairway replacement, the parkway development, and road improvements (parking, crosswalks, and drainage), would be the same as those described for Alternative 1.

Under Alternative 4, there would be no groins constructed at The Hook. Due to the geological characteristics of this area and the lack of any natural finger formations or any significant sandy beaches, construction of a groin would increase erosion and scour immediately downcoast of the groin (Griggs 2003c).

Implementing Alternative 4 would not prevent waves originating from large winter storms from reaching the bluff face. To reduce erosion and mitigate against further collapse of the Purisima Formation, the existing scour notches at the base of the bluffs would be filled with concrete. Because collapse of these scour notches has been identified as a principal cause of bluff recession, this infilling would help to reduce the rate of bluff recession. By slowing or halting the Purisima erosion, the failure of the terrace deposits would be reduced as well, even though such processes as weathering, runoff, and wave overtopping would still erode the terrace deposits. As previously mentioned, the extent of reduction in the life of East Cliff Drive cannot be specifically predicted, but according to the recent SAGE threat analysis, portions of the road between 33rd and 36th avenues and the underlying utilities could be lost within a few years.

2.7 ENVIRONMENTALLY PREFERABLE /ENVIRONMENTALLY SUPERIOR ALTERNATIVE

Because the Army Corps was originally a project cosponsor, the 2003 EIS/EIR was required to identify an environmentally preferable alternative under NEPA and an environmentally superior alternative under CEQA. While NEPA and CEQA are quite similar, they are not identical and some differences exist. Consequently, the environmentally preferable/environmentally superior alternative identified in 2003 was primarily based on the Corps' procedures for implementing NEPA.

The Corps' criteria for selecting the environmentally preferable alternative for this project was based solely on the following criteria:

- It would result in the least physical disturbance to the project area and if
- It would result in the smallest physical footprint (the least amount of physical construction) in the project area.

Based on these criteria, the 2003 EIS/EIR identified Alternative 3 (Partial Bluff Armoring with Limited Parkway Improvements) as the environmentally preferable/environmentally superior alternative. While Alternative 3 best meets the Corps' criteria for implementing NEPA, this alternative would not fully achieve the project objectives. Under Alternative 3, only the Purisima Formation would be armored. This would reduce the project footprint but would provide less protection to the public right-of-way and infrastructure because the upper bluff terrace deposits would still be subject to erosion. The parkway footprint would also be reduced, but this would be accomplished by eliminating some of the improvements to public access.

Under CEQA, project objectives can be considered in identifying the environmentally superior alternative. In fact, only alternatives that "could feasibly attain most of the basic objectives of the project" need be examined in detail in an EIR (CEQA Guidelines Section 15126.6[f]). Because the Corps is no longer a project cosponsor and NEPA requirements would be satisfied through conformance with Nationwide Permit #13, CEQA requirements prevail in preparing the Revised EIS/EIR.

When taking the project objectives into consideration, a mitigated Alternative 1 (Full Bluff Armoring), as described in this Revised Final EIS/EIR, is the environmentally superior alternative. This alternative would protect the public right-of-way and infrastructure from coastal bluff erosion and would improve public access to the coast, while minimizing the associated environmental impacts. The specific mitigation measures that would be implemented with project approval are identified in subsequent chapters of this document.

2.8 PERMIT AND REVIEW REQUIREMENTS

The proposed projects would require numerous permits and review requirements from various agencies, such as those listed below in Table 2-5.

Table 2-5
East Cliff Drive Bluff Protection and Parkway Project
Permit and Approval Requirements

Agency	Permit/Approval	Authority
Local Government		
County of Santa Cruz	EIR certification (the County will certify that the EIR is adequate). Adopt mitigation monitoring and reporting program.	CEQA, Cal. Pub. Res. Code § 21115; CEQA Guidelines § 15090.
County of Santa Cruz	County must determine if projects are consistent with its local coastal program. Construction in coastal zone requires County to issue coastal zone permit.	California Coastal Act of 1976, Cal. Pub. Res. Code § 30000 *et seq.*
County of Santa Cruz	Grading approval, variance permit, master site plan, park master plan.	County of Santa Cruz Code of Regulations.
State Agencies		
California Coastal Commission	Coastal Zone Development Permit.	California Coastal Act of 1976, Cal. Pub. Res. Code §§ 30000 et seq.; Coastal Zone Management Act, 16 USCA §§1451-1465.
California State Lands Commission	A permit would be required for construction within tidelands trust property (land below mean high tide line).	California Public Resources Code § 6301; California Code Regulations, Title 2 §§2800-2803.
Central Coast Regional Water Quality Control Board	Construction of the proposed projects requires a general construction activity stormwater permit. A stormwater pollution prevention plan must be developed and implemented.	State Porter-Cologne Water Quality Control Act, Cal. Water Code §§ 13000-14958, Federal Clean Water Act, 33 USCA §1341.
State Historic Preservation Office	No historic properties identified within the area of potential effect; SHPO concurred.	National Historic Preservation Act of 1966, as amended, 16 U.S.C. §§470-470x-6
California Department of Fish and Game	Interagency consultation not required because no listed species in project area.	California Endangered Species Act, Cal. Fish & Game Code § 2090 et seq.
Monterey Bay Unified Air Pollution Control District	Coordination with district for use of any portable engines (used in construction) that are not exempted from district regulations.	Cal. Health & Safety Code §§ 41750-41755 et seq.
Federal Agencies		
USACE	Nationwide Permit #13 under Clean Water Act Section 404 applies to construction.	33 USC §401, Section 10: 1413, Section 404; 42 USC §§4321-4347
US Fish and Wildlife Service	Interagency consultation, pursuant to Section 7 of the Endangered Species Act. No effects determination made so no formal consultation required.	Endangered Species Act. 16 USC. §1636; 50 CFR Part 402.
US National Marine Fisheries Service	Interagency consultation, pursuant to Section 7 of the Endangered Species Act. No effects determination made, so no formal consultation required.	Endangered Species Act. 16 USC. §1636; 50 CFR Part 402.
National Oceanic and Atmospheric Administration, Monterey Bay National Marine Sanctuary	Special use permits required for construction below the mean high water mark within the National Marine Sanctuary.	National Marine Sanctuaries Act, 16 USCA §1441; 15 CFR Part 922.