

Excerpts re Half Moon Bay:
Coastal Regional Sediment Management Plan
Santa Cruz Littoral Cell - Pillar Point to Moss Landing
September 2015

2.3.2 Pillar Point East Breakwater to Miramontes Point

The reach extending from the East Breakwater of Pillar Point Harbor to Miramontes Point encompasses a moderately urbanized five mile long hook shaped bay (Figure 2-5). The north end of the reach has been most acutely affected by development, including the construction of two large breakwaters at Pillar Point Harbor. The impacts of these breakwaters on wave and sediment transport patterns has been the focus of discussion and study for several decades (Lajoie and Mathieson, 1985; Griggs et al., 2005), as increased beach and bluff erosion adjacent to the outside of the East Breakwater has threatened significant public infrastructure including Highway 1. Researchers have estimated that erosion rates may have ranged up to 6 to 7 feet per year in the section immediately adjacent to the East Breakwater, with the impacts of the breakwaters extending approximately one mile down coast (Lajoie and Mathieson, 1985; Hapke et al., 2006).

The response to this erosion problem began in 1959, with periodic placement of broken concrete and riprap to protect Highway 1 and other infrastructure. These placement efforts were unable to stem erosion from the 1960s to the early 1980s, and a county road and sewer lines were ultimately undermined and destroyed (Griggs et al., 2005). Following the major storms of 1983, more significant riprap was placed along Highway 1, and it currently protects an approximately 800-foot-long section of the highway from further erosion. Three-quarters of a mile south of the harbor, approximately 1600 feet of riprap was placed between 1978 and 1983, which currently provides some protection to the structures lining Mirada Road. However, erosion in this area remains a major concern, and USACE is currently studying erosion mitigation alternatives including beach nourishment and other engineering approaches (Section 2.5.2).

South of Pillar Point Harbor, beaches backed by eroding bluffs form a curved bay down to the headland at Miramontes Point. This curve gradually opens up to the south, which is typical of a crescent shaped bay formed by wave refraction around a headland (e.g., Pillar Point) or other feature resistant to erosion. The beaches fronting the bluffs are thought to be comprised of sand locally eroded from the bluffs, which generally consist of weak sediments (Lajoie and Mathieson, 1985). The beaches tend to increase in width from north to south, which suggests that the net quantity of available beach-building sand increases as one moves downcoast through the cell. However, the sand contribution from these bluffs is believed to be relatively minor, perhaps less than 10,000 cy of sand per year (Patsch and Griggs, 2007). These bluffs gradually increase in height to the south, culminating in the headland at Miramontes Point. These

bluffs are also fairly erosive, and some riprap has been placed to protect private development on this bluff.

2.5.2 North Half Moon Bay Continuing Authorities Program (CAP) 111 Study

At the northern end of the Santa Cruz Littoral Cell, USACE is currently involved in a study of potential solutions to beach and bluff erosion just south of Pillar Point Harbor (USACE, 2009). The study, which is currently in the feasibility phase, evaluates which (if any) erosion mitigation measures are economically justified investments. Several erosion mitigation measures have been modeled with the USACE Coastal Modeling System (CMS) software, including beach nourishment and modifications to the East Breakwater. Preliminary findings suggest that dredging 150,000 cy of sand from Pillar Point Harbor and placing it at El Granada County Beach (Surfer's Beach) could provide considerable erosion mitigation effects for a period of several years (USACE, 2014b). At this time, there has been no selection of a specific plan, and there is considerable uncertainty of which (if any) actions will be recommended by this study (J. Dingler, pers. comm., 2014).

2.5.3 Highway 1 Stabilization at El Granada County Beach

The beach and bluff erosion at El Granada County Beach (Surfers Beach) is also threatening to undermine Highway 1 and public access to the beach. As a result, Caltrans and the County of San Mateo have jointly developed several short-term approaches to protect the highway and improve the coastal access (Whitman, pers. comm., 2014). The primary approach will involve the construction of 175 linear feet of rock revetment with improvements to approximately 400 feet of the California Coastal Trail and stairway access (California Coastal Commission, 2015).

The timeline for this project is rather short, with the relevant parties hoping to have construction completed before the onset of winter storms in December 2015 (Calderon, pers. comm., 2015). Design work is nearly complete, and a Coastal Development Permit (CDP) amendment was approved with a number of special conditions by the California Coastal Commission on 12 June 2015. Key special conditions include authorization of the revetment for only a ten-year period with the requirement that the applicant re-assess the project's impacts if an extension of the permit is sought, and the requirement that the applicant develop of a long-term plan to address erosion and protect Highway 1 and the public pathway (California Coastal Commission, 2015).

Given the need for a long-term solution, Caltrans is also considering several long-term approaches including relocation of the highway along with a component of managed retreat (Whitman, pers. comm., 2014). Several examples of these type of long-term approaches are outlined in a safety and mobility study that was released in 2010, and include plans to realign Highway 1 away from the

coastal erosion hazard zone (Local Government Commission et al., 2010).

7.3.1 Reach 1: Princeton to Pillar Point Harbor

This reach is entirely inside the outer breakwaters of Pillar Point Harbor, which were constructed by USACE in 1961. Along the approximately one mile of shoreline between the West Breakwater and the western arm of the inner breakwater are the West Shoreline Trail and a handful of commercial properties. The trail has been affected by erosion, and most of the properties have been fronted with riprap or debris to reduce the risk of future erosion. The erosion problem and potential measures to remedy it have been studied extensively (Moffatt & Nichol Engineers, 2001), but, according to conversations with local stakeholders, no erosion risk reduction project is currently being planned. This area is not included in the 2050 Coastal Erosion Hazard Zone dataset. No estimate of the use of the Shoreline Trail was available for this report.

7.3.2 Reach 2: Pillar Point Harbor to Miramontes Point

The recreational resources in this reach include several popular beaches, segments of the Coastside Trail, bluff-top park land, and a golf course. Although most are fronted by a rock revetment, there are numerous residential and commercial structures that are in the erosion hazard zone. Highway 1 and a segment of the Coastside Trail are only several feet away from the unprotected bluff in one location.

At the northern end of the reach, just outside of the Pillar Point Harbor East Breakwater, are El Granada or Surfer's Beach and an area that includes Vallejo Beach and Miramar Beach, which are adjacent, small beaches (Figure 7-1). This area has experienced significant erosion of the beach and bluff since the construction of the breakwater. In a 2009 report, the USACE stated that the construction of the breakwater accelerated the beach and bluff erosion in this area beyond what would have occurred without the breakwater (U.S. Army Corps of Engineers, San Francisco District, 2009).

The northern end of this reach is popular with local surfers (hence the name). From site visits and a discussion with a local surfer, it was estimated that the average use by surfers was as much as 40,000 per year. According to a representative of the Surfrider Foundation, changed conditions at Surfer's Beach over the last several years – including loss of the beach seafloor scour – have resulted in more dangerous surf conditions as it has become more challenging to exit the surf zone at medium to high tide. As the visible beach continues to disappear and the surf conditions become more dangerous, it is likely that the number of surfers will decrease as compared to the current estimate.

There are several small and large hotels in the area whose business is driven by the aesthetics and the recreation opportunities in the area. Besides surfers and

those walking on the beach, beach attendance is relatively sparse – presumably because of the narrow beach, limited parking, and lack of facilities such as restrooms. From site visits, most of the beachgoers appear to be patrons of the area’s various hotels and restaurants.

The Coastside Trail runs along the eastern boundary of the four beaches in this reach, providing close to a three-mile stretch to walk, jog or ride bikes. Erosion of the bluff along Surfer’s Beach has pushed the trail to the edge of the heavily-traveled Highway 1, which is a safety concern (Figure 7-2).

From an economic perspective, Highway 1 – which is less than 20 feet from the top of the bluff in some locations – is the most important single piece of infrastructure at risk from potential future bluff erosion in this reach. Traffic counts from 2012 show that there are, on average, approximately 43,000 daily trips along this stretch of Highway 1 (Caltrans, 2012). Currently, approximately 800 feet of the bluff along the highway is armored with riprap to reduce erosion. Because some areas are unprotected, the threat of erosion to Highway 1 is imminent, and preventing or delaying adverse impacts to the highway will require measures such as beach nourishment, armoring of the bluff, or relocation of the road.

Along the coast just south of Surfer’s Beach is a small, two-lane coastal road (Mirada Road) with several residential and commercial properties, including a restaurant along its landward side. The road and these properties are fronted with a rock revetment.

8. Recommended Regional Sediment Management Strategies

8.1 PRINCETON SHORELINE IN PILLAR POINT HARBOR

The considerable erosion along the Princeton shoreline has been the subject of recent planning efforts (Dyett & Bhatia, 2014), and may be addressed by several RSM measures. The Princeton shoreline is unique from a regulatory standpoint, because it lies outside of the boundary of the MBNMS. As a result, this site could provide an ideal location to implement a RSM measure (e.g., beach nourishment) that is currently prohibited in the MBNMS. If implemented, the given measure could be closely monitored, with the results of the monitoring providing valuable information on project performance and potential environmental impacts.

8.1.1 No Action

This approach assumes that the existing practice of randomly armoring the eroding low bluff with riprap will continue over the next 50 years. This approach offers the advantage of serving to protect at least some of the vulnerable infrastructure and parcels in the short term. But, this approach does not provide a long-term solution to the erosion problem, and it is likely that continued

maintenance will incur additional costs. In addition, the continued haphazard placement of riprap could pose a safety hazard to visitors and prevent access to the beach area exposed at low tide.

8.1.2 Bluff Stabilization via Rock Revetment

This measure would involve the construction of an engineered rock revetment. Variations of this concept have been evaluated by previous shore-protection studies (Moffatt & Nichol, 2001; USACE, 2006). A rock revetment presents the advantages of offering protection to existing infrastructure with a fairly high certainty that the structure will perform this task. In addition, the revetment may be designed to enhance public access to the shoreline with stairways, ramps, or other access features. A rock revetment, however, may also indirectly contribute the narrowing of the sub-aerial beach through the process of passive erosion, and could present permitting issues with respect to the CCC. Additional concerns include a relatively high cost (up to \$9 million per USACE, 2006) and impacts to aesthetics and views.

8.1.3 Beach Nourishment

This measure would involve placement of sand directly on and below the toe of the eroding bluff to reduce the impacts of wave attack on the bluff toe. Beach nourishment offers the advantage of providing additional space for recreation, and the site is in an ideal location to receive suitable sediments dredged from the harbor. There is considerable uncertainty, however, as to whether beach nourishment can provide protection to existing infrastructure and commercial parcels, particularly when implemented as a stand-alone measure. In addition, the cost could be quite high, and a preliminary economic analysis suggests that public use of the beach is rather low when compared to other beaches in the Santa Cruz Littoral Cell (Bierman, pers. comm., 2014; Section 7.3.2).

8.1.4 Beach Nourishment with Retention Structures or a Perched Beach

The likelihood of success of the beach nourishment measure could be increased if the nourishment were to be combined with one or more structures designed to retain sand. These structures could be placed in either a shore perpendicular (groins) or parallel configuration (perched beach). They would comprise rock or other material such as geotextile tubes filled with sand. Advantages include longer retention time of placed sand and a higher degree of certainty that the backshore will be protected from wave attack. Disadvantages include high construction costs and potential permitting and regulatory issues (Section 6).

8.2 EL GRANADA COUNTY (SURFER'S) BEACH

The erosion of the beach and bluffs adjacent to Highway 1 at Surfer's Beach has been a significant source of concern for the local community for decades. This erosion issue has been the focus of a number of studies, with recent work by USACE strongly suggesting that construction of the Pillar Point Harbor outer breakwaters, particularly the East Breakwater, has exacerbated the erosion

problem. As a result, the community, private sector, and government agencies have proposed a number of erosion-mitigation measures: several of the most well documented ones are presented below.

8.2.1 No Action

This approach assumes that Caltrans and San Mateo County will continue to take the necessary actions to maintain Highway 1. In the past, this action has included the construction of a rock revetment just downcoast of the root of the East Breakwater. As of this writing, Caltrans and San Mateo County are actively designing an approximately 150- foot-long extension to the revetment (Section 2.5.3). Thus, it can be assumed that this Highway 1 will continue to be protected at least over the next several years. The current “status quo” presents the disadvantages of only offering a temporary fix to a persistent erosion problem and of continuing the impacts of armoring on public access and surf conditions at this popular surf break.

8.2.2 Beach Nourishment

Beach nourishment at Surfer’s Beach would likely involve the direct placement of 150,000 to 200,000 cy of sand on the beach (USACE, 2014b). This option presents several advantages, including a wider beach for recreation and access and potentially reducing wave attack on the toe of the eroding bluff. In addition, Surfer’s Beach presents a logical placement site for sand dredged from the harbor side of the East Breakwater with minimal transportation costs because of the proximity of this beach to the potential sand source. Preliminary cost estimates suggest that placement of 150,000 cy of sand would cost approximately \$5 million including a 20 percent contingency (USACE, 2014b). But, there is considerable uncertainty whether the sand placed on the beach will persist beyond several years, particularly if a large storm were to occur shortly after placement. There are also potential impacts to sandy habitats during beach placement (Section 5) along with permitting challenges involving the MBNMS (Section 6).

Beach nourishment could also be difficult to justify from an economic perspective in terms of preventing damage to infrastructure, particularly if it assumed that actions will be taken to protect Highway 1 independent of any beach nourishment project. However, stakeholders could engage Caltrans and San Mateo County in a discussion regarding potential financial support for a future beach nourishment project in conjunction with the currently planned Highway 1 stabilization project (Section 2.5.3).

8.2.3 Offshore Artificial Reef

This measure would involve the construction of one or more offshore artificial reefs designed to dissipate wave energy and facilitate the formation of one or more salient beach features. These reefs offer the advantage of increasing beach width and enhancement to recreational opportunities such as surfing. There are also several disadvantages, including uncertainty of performance –

these features are rare on the US West Coast – and significant alteration of seafloor habitats. The design process could also be relatively costly as complex hydrodynamic modeling of the wave reflection from the East Breakwater and the nearby revetment would be necessary. In addition, there are also likely to be significant permitting challenges under current MBNMS regulations (Section 6).

8.2.4 Managed Retreat

Highway 1 will continue to be threatened by erosion, which will likely result in the need for a considerable maintenance effort including extension of the existing revetment south along the unprotected bluff. There may be a point at which maintenance of Highway 1 in its current alignment becomes prohibitively costly. With that in mind, the community and Caltrans have already started to discuss potential realignment options (Local Government Commission et al., 2010; Whitman, pers. comm., 2014). The primary advantage of this approach is that it represents a long-term systematic approach to managing infrastructure in the face of continuing erosion. Other advantages include significantly reduced infrastructure maintenance costs, removal of armoring, and the potential for improved public access.

The primary disadvantage involves the high cost of highway realignment, which could be in the range of \$4,000 per linear foot of highway (Moffatt & Nichol, 2007; USACE, 2014b). This would translate into approximately \$18 million if 4,400 feet of Highway 1 is realigned as proposed by some of the conceptual plans (Government Commission et al., 2010). While the initial cost of highway realignment is significantly greater than a one-time beach nourishment of 150,000 cy, it is likely that several beach nourishment episodes will be necessary over the next 50 years to generate comparable benefits. Thus, a careful long-term analysis of costs associated the different measures should be undertaken as part of the long-term planning process.