CHAPTER 8

Bluff and Adjacent Beach Erosion Adaptation

This chapter includes a range of adaptation measures to address vulnerabilities from erosion of bluffs and their adjacent beaches. This is relevant to the South Bluffs, bluffs along South Beach including low bluffs fronting Powerhouse Park, and the North Bluffs. Permitting for some adaptation measures may be processed through federal, state or City entities, as summarized in Section 8.3

Vulnerability assessment:

- With 1 foot of sea-level rise, the current localized vulnerability of the LOSSAN railroad to bluff erosion will increase and extend along almost the entire southern bluffs. The railroad would need to be moved inland or other adaptation measures, for example with underpinnings, cassons, or soldier piles, would be required to reduce the risk of the railroad collapsing.
- If a seawall is constructed to protect the railroad, it will accelerate beach erosion, and the beach will erode back to the seawall over time until little to no beach exists along the southern bluffs.
- If the railroad is moved inland and bluff erosion is allowed to continue, bluff-top property and sewer infrastructure in South Beach and along South Bluff would be vulnerable to erosion with 2 feet of sea-level rise.
- North Bluff properties and the low bluffs at Powerhouse Park would be similarly vulnerable to erosion.

Bluff adaptation options:

- Beach nourishment and retention
- Best management practices (BMPs)
- Railroad relocation
- Public infrastructure relocation

Bluff adaptation monitoring:

- Distance between coastal bluff edge and development
- Beach width adjacent to the bluffs

8.1 Bluff adaptation options

8.1.1. Adaptation option: beach nourishment and retention

Nourishing and retaining the sand on the beach below the southern bluffs could provide short-to-medium term benefits of maintaining a beach for ecology and recreational use and reducing wave run-up onto and erosion of the bluff toe. In the long term, beach nourishment and retention may become more expensive if sand sources become limited or if the amount of sand required increases with sea-level rise. Current studies indictate dune restoration may not be an effective solution for reducing erosion of the bluff toe, as the beach is already squeezed in front of the bluff toe and sand placed for dune creation may not last. Additionally, beach nourishment and retention would not affect the erosion processes at the bluff top. Given the proximity of the southern bluffs to the Los Peñasquitos Lagoon inlet, the effects of beach nourishment and retention on the Lagoon inlet would need to be fully considered.

Beach nourishment for the North Bluff is not likely to be effective if limited to the City limit given the relatively short length of bluff shoreline and proximity to the San Dieguito Lagoon mouth; however, beach nourishment could be pursued in coordination with the City of Solana Beach. Table 8.1.1 summarizes benefits and constraints of beach nourishment adjacent to bluffs.

Table 8.1.1
Bluff beach nourishment and retention benefits and constraints summary

Benefits	Constraints
• Preserves beach	• Limited sand resources
• Reduces bluff toe risk	• Less effective over time with increasing sea-level rise
	• Transportation of sediment to receiver sites
	• Short-term beach use and ecology impacts

8.1.2. Adaptation option: best management practices (BMPs)

Best management practices (BMPs) for reducing bluff erosion include management of surface drainage as well as shallow subsurface groundwater drainage to the bluff edge and face to control local erosion and slope failure due to drainage. The goal of these practices should be to control surface runoff and avoid concentrated flow down the bluffs, reducing shallow groundwater flow that saturates upper soils and facilitates erosion, and management of groundwater daylighting at geologic layers. NCTD and SANDAG are already employing surface and subsurface drainage control measures to reduce erosion.

In addition to these surface water and groundwater BMPs, the City could investigate whether over-watering of landscaping within the South Beach and bluffs along South Bluff could be contributing to elevated groundwater flows to the southern bluffs and whether reducing this irrigation could potentially reduce bluff erosion.

It is possible that public access down the bluffs could be contributing to increased bluff erosion, as people frequently walking down bluff foot paths may be de-stabilizing soil, both directly and by preventing vegetation from establishing on the paths given that vegetated bluff is more erosion-resistant than bare soil. Access down the southern bluffs by crossing the LOSSAN railroad track or walking along the tracks is unauthorized; however, multiple paths down the bluffs are currently used. Public access and associated bluff erosion (if any) could be controlled by installing authorized pedestrian crossings of the railroad, with pedestrian under-passes (or over-passes), and constructing stairways down the bluffs to the beach. The Adaptation Plan recommends exploring one or more authorized railroad crossings and vertical access paths down the southern bluffs to reduce erosion. For example, two crossings and pathways could be installed at 7th and 11th Streets, where there is more space between the railroad tracks and the top of the bluff. Railroad crossings and beach access stairways are difficult to implement and feasibility may be challenging. Even so, the City should investigate these and/or other options together with NCTD and SANDAG as part of the Adaptation Plan.

Revegetating/restoring bluff vegetation on existing pathways may be effective in reducing erosion. New vertical crossings and pathways (e.g., stairways) could be installed to replace beach access via bluff-side pathways. A program to restore/revegetate large sections of the bluffs with more erosion-resistant vegetation could potentially de-stabilize the bluffs during installation and/or the period over which plants are establishing.

8.1.3 Adaptation option: railroad relocation

The LOSSAN railroad track is currently at risk of bluff erosion, which is why NCTD and SANDAG have installed bluff stabilization projects. Removing the LOSSAN railroad track from the southern bluffs and relocating the track to an inland tunnel or other location would allow the natural processes of landward bluff erosion and beach migration to occur. While bluff erosion is not the only source of sand to the beach below, bluff erosion will continue to supply sand to the beach, in turn increasing the buffer the beach provides from wave action on the bluff toe.

The SANDAG 2050 Regional Transportation Plan (SANDAG, 2011) includes plans to remove and relocate the railroad; however, implementation of the planned project is not currently funded. The City supports railroad relocation as part of SANDAG plans and as a matter of City policy. The City Community General Plan (1976) includes zoning that designates the railroad property and right of way as a future open-space park area.

The City's current zoning and Local Coastal Program (LCP) includes a Railroad land use designation for the railroad property and right-of-way. The Railroad designation allows railroad facilities and related structures provided a Conditional Use Permit is obtained from the City and is in full force and effect; however, this process is not currently followed by NCTD, SANDAG, and the City. The railroad right-of-way is complex. Rail operations engaged in interstate commerce are considered not subject to state or local permit jurisdiction. Even so, the right-of-way is located within the current LCP's Shoreline Protection Area line and Beach Overlay Zone.

Railroad relocation would allow landward bluff erosion in order to maintain the beach below and the natural character of the Del Mar bluffs and beach. ~~Bluff stabilization structures installed by NCTD and/or SANDAG should be linked to a commitment to remove them as part of a plan to relocate the railroad and accommodate bluff erosion.~~ Currently, about 50 trains per day use the rail line, and SANDAG plans to increase this number to over 100 trains per day with double tracking of the corridor. On average, about 12 people per year are killed by trains in the San Diego corridor. Railroad relocation would further rail safety and operations, address an immediate safety problem, eliminate the need for reduced speeds due to bluff instability and service interruptions due to bluff inspections, and make increased traffic more feasible.

8.1.4 Adaptation option: relocate public infrastructure

After railroad relocation, the bluff will continue to erode landward through the current location of the railroad. With 1 ft of sea-level rise or more, the bluff is projected to erode and threaten buildings, roads, and the sewer line along the bluff landward of the railroad. The LCP as ammended by the BPI allows sea walls only as a last resort within the Shore Protection Area and Beach Overlay Zone. The City can consider relocation of public buildings, utilities and other infrastructure as the bluff erosion risk to public structures increases. Proactively, the City could consider options for facilitating public infrastructure removal where there is a public benefit, such as removing public structures to restore or preserve bluff trails or parks. As the low bluffs along Powerhouse Park erode due to sea level rise, they could be armored in the short run to preserve the park for public use, but the armoring will become expensive and less effective with extreme levels of SLR.

8.2 Bluff adaptation monitoring

The criteria to initiate consideration and planning for bluff adaptation is the distance between the the bluff top edge and the bluff top asset. A minimum buffer distance is based on an approximate structural buffer distance between the bluff top and a structure, which is required to provide enough bluff width to laterally support the structure. A structural buffer distance of approximately 10 ft is used based on a SANDAG study (Leighton & Associates 2010) of the distance within which bluff erosion presents a risk to railroad track stability (per the Coastal Hazards, Vulnerability, and Risk Assessment). The minimum buffer distance between the bluff top edge and a bluff top asset includes an additional safety buffer based on the approximate width of bluff that could collapse in a single erosion event. Adding this safety buffer to the structural buffer allows for the occurrence of an erosion event after monitoring criteria threshold has been reached and while the adaptation measure is being planned and implemented. A safety buffer of approximately 25 ft is used based roughly on the July 13, 2016, bluff collapse near 10th Street (Figure 8.1). Actual bluff top recession during this event is to be determined and may have been between 5 and 20 ft. To summarize, the minimum buffer distance is based on the following:

- Structural buffer distance = 10 ft
- Safety buffer distance = 25 ft

- Minimum buffer distance = structural buffer distance + safety buffer distance = 35 ft

These projected distances provide an indication of the amount of sea-level rise at which minimum buffer distances would be insufficient for some portion or all of the railroad, rows of buildings, and the sewer line. With 1 ft of sea-level rise, additional adaptation (e.g., beach nourishment and retention and/or BMPs) is expected to be required to reduce the risk of erosion to the railroad. If and when the railroad is relocated and the bluff is allowed to erode, adaptation would be required to reduce the risk to some public infrastructure including sections of the sewer line (e.g., south of Seagrove Park and near 10th Street) with 1ft of sea-level rise. With 3 ft of sea-level rise, the following assets are expected to be at risk: portions of the sewer line; and the entire railroad along the bluffs. This indicates that the railroad may need to be relocated by or before this point (depending on the effectiveness of beach nourishment and BMPs). Table 8.2.1 shows the approximate projected distance between the bluff top and the railroad, the first and fourth rows of buildings, and the sewer line along the bluffs with sea-level rise (distances below the minimum of 35 ft shown in red indicate potential need for bluff erosion adaptation for some or all of asset class). The sewer line changes locations along the Del Mar bluff. It is located between the railroad and the first row of buildings in some areas and between or under first to fourth row buildings in other areas. Table 8.2.1 shows distances for areas where the sewer is located east of the first row of buildings.

Figure 8.1
Bluff Collapse near 10th St. in Del Mar on July 13, 2016

Projections in Table 8.2.1 are approximate and could be greater or less due to uncertainties. Actual distances will be monitored over time as part of the adaptation plan process. Table 8.2.2 presents monitoring criteria and adaptation measures with anticipated erosion ranges over

which measures will be effective. Table 8.2.3 provides lead times to begin advance planning before adaptation measures could be in place to limit risk.

Table 8.2.1
Projected distances from bluff top to railroad, sewer line, 1st and 4th rows of buildings with sea-level rise (for areas with sewer between buildings)

Sea-level rise:	0 ft	1 ft	2 ft	3 ft	5.5 ft
RR	15 - 110 ft	0 - 70 ft	0 - 40 ft	0 - 10 ft	0 - 0 ft
1st row	40 - 170 ft	0 - 140 ft	0 - 120 ft	0 - 80 ft	0 - 0 ft
Sewer	65 - 175 ft	10 - 190 ft	0 - 150 ft	0 - 100 ft	0 - 50 ft
4th row	270 - 450 ft	170 - 340 ft	140 - 300 ft	100 - 280 ft	10 - 210 ft

Table 8.2.2
Bluff erosion monitoring criteria to consider adaptation options

Criteria & Thresholds	**Railroad setback from bluff edge**	**15 - 110 ft**	**0 - 60 ft**	**0 - 35 ft**	**0 - 5 ft**	**0 ft**
	Sewer setback from bluff edge	**40 - 170 ft**	**0 - 130 ft**	**0 - 110 ft**	**0 - 65 ft**	**0 ft**
	1st row setback from bluff edge	**65 - 175 ft**	**10 - 190 ft**	**0 - 150 ft**	**0 - 100 ft**	**0 - 50 ft**
Adaptation Options	**Protect (soft measures)**	Beach and dune nourishment and retention				
			Best management practices			
	Retreat (Phase 1)		Relocate Railroad			
	Retreat (Phase 2)			Remove sewer, storm drains, fiber optic cables		

Table 8.2.3
Lead times for planning bluff erosion adaptation options

Risk	Actions	Lead Times	Adaptation Options
Bluff	**Protect**	**5-10 years**	Beach and dune nourishment
erosion	**Retreat**	**5-10 years**	Relocate sewer, storm drains, fiber optic cables
	Retreat		Relocate railroad

As bluff erosion continues with sea-level rise, the beach below the bluffs could be nourished to reduce erosion at the bluff toe and improve beach access, aesthetics and habitat function. BMPs could also be implemented to reduce bluff erosion, such as installing vertical access

paths (e.g., stairs) down the bluffs with authorized railroad under-pass (or over-pass) crossings and pursuing studies and measures to potentially reduce irrigation and groundwater flow-related erosion effects. With enough sea-level rise (e.g., 2 ft of sea-level rise), these adaptation strategies are not expected to be effective and the railroad would need to be relocated. Relocating the railroad would provide some buffer within which bluff erosion could occur without posing a risk to landward assets; however public infrastructure such as portions of the sewer line would also likely need to be relocated.

8.3 Bluff adaptation coastal permitting

Coastal Development Permit review and approval for bluff adaptation measures may fall within the California Coastal Commission and/or the City's coastal permitting jurisdiction as well as the US or California Fish and Wildlife Service, the US Army Corps of Engineers, and California Regional Water Quality Control Boards. Depending on the jurisdiction, permits may be processed through the City of Del Mar's LCP and/or pursuant to the California Coastal Act. Table 8.3 summarizes the likely coastal permitting mechanisms relevant to developing the LCP amendment for bluff adaptation measures. Other approvals and permits would also be required and would need to be addressed separately.

Table 8.3
Summary of likely California Coastal Act approval and permitting process for bluff erosion adaptation measures

Adaptation Measure	LCP Jurisdiction	CCC Jurisdiction	Note
Beach and dune nourishment and retention	✔	✔	• LCP review for above water portion • CCC Coastal Development Permit required for below water portion
Relocate railroad	✔	✔	• Implemented by NCTD/SANDAG
Relocate infrastructure	✔		• LCP redevelopment policies and regulations