The seawall may also potentially result in long-term impacts to sand exchange between the nourished beach and remaining southern foredune habitat present in the rear yards of the residences on Broad Beach. Hard stabilization structures tend to reduce sand exchange between these environments, consequently resulting in accelerated erosion of the beach described in Impact CP/GEO-8 (Pilkey and Wright 1988). Further, while additional sand being exposed seaward of the seawall may incrementally increase short-term benefits to sediment transport to down coast beaches, if and when the seawall becomes exposed, as a hard stabilization structure it may also have adverse down coast impacts, potentially resulting in accelerated erosion down coast in the direction of long-shore transport (Kelly 2000). Consequently, beneficial impacts associated with down-coast sediment transport identified in Impact CP/GEO-7 may be incrementally increased in the short- and medium-term but may be reduced in the long-term.

Construction of a properly engineered seawall would avoid potential adverse impacts associated with liquefaction and wave impacts and eventual damage to homes, ancillary structures, and OWTS with adverse indirect consequences for public trust resources. Relocation of up to 54 OWTS would be required in order to avoid the cast-in-place concrete seawall footprint, which may be infeasible due to space limitation and city code requirements, as discussed further for this alternative under *Utilities and Service Systems* below. This alternative would substantially reduce the long-term adverse effects associated with Impact CP/GEO-1; however, should effluent from OWTS and/or groundwater pooling behind the seawall, it may weaken the seawall and foundation, resulting in potential catastrophic structural failure of this hard stabilization structure and related additional adverse impacts.

Impacts related to sand compatibility (CP/GEO-4) and tides, currents, and wave height and direction (CP/GEO-5) would remain largely similar to those described for the Project. Short- and medium-term beneficial impacts to wave run-up (Impact CP/GEO-6) would remain similar, but may be extended due to the addition of more sand.

Marine Water Quality: Construction of a properly engineered seawall, installation of a wider dune field, and possible relocation of OWTS and other structures landward of the seawall would substantially reduce potential impacts to Marine Water Quality as long as the seawall remains intact. Protection for structures and OWTS would be increased and exceed the lifetime of the restored dunes as a last line of defense, as discussed by Impact MWQ-3. The seawall would provide long-term protection of existing development from coastal erosion.

Terrestrial Biological Resources: Removal of the existing revetment and construction of a seawall would require use of heavy cranes and bulldozers and major excavation and construction in backyards and degraded southern foredune areas, increasing the short-term construction effects on terrestrial biological resources described in Impact TBIO-2.

Although much of the habitat fronting the homes along Broad Beach has been subject to landscaping with non-native and invasive plant species associated with adjacent residential development, this area consists of degraded southern foredune habitat, a habitat type identified as rare by the CNNDB and CNPS. Moreover, due to the rarity and biological significance of dune habitat in southern California, southern foredunes are designated as ESHA under the Malibu City LCP. Construction activities including foundation excavation for the seawall in the southern foredunes would create potential temporary adverse impacts to native southern foredune vegetation and/or sensitive wildlife.[7] Adverse effects to ESHAs resulting from this alternative would be substantially more severe than those that occurred from previous installation of the existing revetments described in Impact TBIO-1. These activities would also increase the severity of Impact TBIO-2, as operation of heavy equipment could result in increased trampling of the degraded coastal dune ESHA. Impact TBIO-4 may also become more severe relative to the Project due to the operation of additional heavy equipment within ESHAs, resulting in a higher potential for hazardous spills. This risk would be compounded if a cast-in-place concrete seawall were selected, as removal of up to 54 OWTS would require additional construction activities and would contribute to the potential for accidents or spills.

However, restoration of a significantly larger dune field would substantially increase short- to mid-term benefits of dune restoration associated with Impact TBIO-6. This would potentially reduce the severity of the overall adverse impacts associated with the landward relocation of the revetment. Additionally, under this alternative the shared walkways would reduce habitat fragmentation and adverse effects of private access across the restored dune, increasing the beneficial effects identified in Impact TBIO-6 and slightly reducing the adverse effects described in Impact TBIO-7. However, long term erosion under this alternative would increase impacts to dune habitat described in Impact TBIO-8, as the dunes would be located almost entirely seaward of the seawall. The additional volume of sand would increase impacts related to longshore sand transport, identified in Impact TBIO-5. Impacts related to backpassing operations would be similar to those described for the Project in Impact TBIO-3.

Recreation and Public Access: Construction of a seawall landward of all public lands and all LAEs would incrementally increase adverse short-term construction impacts identified in Impact REC-1 due to the disruption of public use and enjoyment of public trust lands; however, due to constraints related to existing leach fields, not all portions of the seawall would be able to be located behind existing LAEs. Construction of a seawall as landward of the OHWM as possible would be substantially more consistent with shoreline protection and access policies. However, while this alternative would provide beneficial impacts associated with recreation and public access over the short- to mid-

[7] The highest quality remaining dune habitat suffered serious erosion damage during the winter of 2013-2014, with dunes eroding landward up to 100 feet at the east end of Broad Beach.

term as identified in Impact REC-3, this alternative may substantially increase long-term public access impacts identified in REC-4. Following the cessation of nourishment and erosion of the beach in 10 to 20 or more years, the beach is likely to vary in width seasonally and in relation to climate cycles and El Nino events; however, the beach could possibly erode as far back as the seawall, which would completely eliminate public access along Broad Beach during moderate and high tides. Backpassing operations and associated impacts to recreational users identified in Impact REC-2 would be similar to those described for the Project.

Utilities and Service Systems: Construction of a properly engineered seawall would substantially reduce potential damage to OWTS from coastal erosion, and associated indirect impacts to public trust resources identified in Impact UTL-2. Impacts to water quality and public use and enjoyment of the beach and ocean would be greatly reduced, as the engineered seawall would provide long-term protection of existing or relocated OWTS from coastal erosion.

While a steel sheet pile seawall could be installed fronting existing leach fields, a cast-in-place concrete seawall foundation would require relocation of up to 54 OWTS. However, it would not be feasible to relocate many of these OWTS due to space limitations and potentially city code requirements (see Table 4-5). According to a study prepared by the Applicant, (Moffatt & Nichol September 2012) and review of known OWTS locations, there is insufficient area for the landward relocation of a number of effected OWTS. Up to 26 residences would have insufficient area to accommodate landward relocation of their OWTS landward of Broad Beach. Further, some of these systems might feasibly be relocated between the home and seawall (refer to Table 4-5 and Figure 4-3), this option would require additional research regarding the feasibility for each OWTS and compatibility with the structural stability of the seawall (see discussion above regarding Coastal Processes, Sea Level Rise, and Geologic Hazards).

As no capacity exists in nearby public or private sewer systems, only one option exists to address potential impacts to the operation of existing OWTS if a cast-in-place concrete seawall is selected. The seawall would be sited 6 feet seaward of existing leach fields to reduce the potential for pooling of wastewater behind the structure. Adjusting seawall location would require siting the seawall towards the ocean where it would impact LAEs by overlying this land and restricting public access. This impact would be similar to existing impacts of the emergency rock and sand bag revetment, which overly and block access to these LAEs. While siting the seawall seaward to accommodate existing leach fields is feasible, it would be contrary to the intent of this alternative. Further, seawall design does not permit sharp breaks in direction, so any adjustment for one house would affect adjacent parcels and potentially additional LAEs.

Since the seawall would be relatively impermeable, and would extend far below grade (e.g., more than 30 feet for steel sheet pile wall) it could inhibit the lateral, shoreward

migration of effluent through the natural sand filtration. This may cause pooling of effluent below the remaining leach fields increasing hydrostatic pressure behind the wall, potentially contributing to wall failure of the wall and leach field malfunction (Moffatt & Nichol 2012).

Installation of the seawall under the alternative would likely result in substantially greater impacts to the storm drain system than the Project. As discussed in Section 3.7.6, *Utilities and Service Systems*, only six of the 11 buried storm drains are currently visible either under existing homes or through the existing revetment, and the specific size and detailed location of the remaining five storm drains are not fully known. However, although this alternative would likely require reconstruction of existing storm drains through private patios and other improvements and result in a commensurate increase in construction-related impacts, Impact UTL-3 would be a minor adverse effect with implementation of AMM UTL-3 (Master Drainage Plan), as described for the Project.

Other Resource Areas: This alternative would have similar impacts to the Project in terms of its effects on scenic resources, marine water quality, marine and biological resources, and environmental justice. Effects on transportation, traffic, parking, and noise would be somewhat more severe due to increase levels of vehicular activity and congestion related to construction phases. Effects on public health and safety hazards and historic resources may be incrementally increased due to increased construction activity associated with construction of the seawall (Table 4-6).

Table 4-5. Alternative 3 – Potential for Landward Relocation of OWTS

Address	Number of Affected OWTS	Potential for Landward Relocation Behind Seawall[1]	Potential for Relocation Landward of Home [2]
31336	1	Not Feasible	Insufficient Area
31324	1	Potentially Feasible	Insufficient Area
31316	1	Feasible	Feasible
31280	1	Potentially Feasible	Insufficient Area
31250	3	Feasible	Feasible
31240	1	Not Feasible	Insufficient Area
31228	1	Potentially Feasible	Insufficient Area
31220	1	Not Feasible	Insufficient Area
31122	2	Not Feasible	Insufficient Area
31100	2	Feasible	Feasible
31064	2	Not Feasible	Insufficient Area
31058	1	Feasible	Feasible
31054	1	Potentially Feasible	Insufficient Area
31052	2	Not Feasible	Insufficient Area
31038	1	Not Feasible	Insufficient Area
30134	2	Potentially Feasible for at Least One Component	Insufficient Area
31030	1	Feasible	Feasible
31020	2	Not Feasible	Insufficient Area
31012	1	Feasible	Feasible
31000	2	Feasible	Feasible
30970	2	Potentially Feasible for at Least One Component	Insufficient Area
30966	2	Potentially Feasible for at Least One Component	Insufficient Area
30956	1	Potentially Feasible	Insufficient Area
30952	2	Feasible	Feasible
30944	1	Not Feasible	Insufficient Area
30930	1	Not Feasible	Insufficient Area
30928	2	Not Feasible	Insufficient Area
30924	2	Potentially Feasible for at Least One Component	Insufficient Area
30918	1	Feasible	Feasible
30908	1	Not Feasible	Insufficient Area
30900	2	Potentially Feasible for at Least One Component	Insufficient Area
30866	1	Potentially Feasible	Insufficient Area
30860	2	Feasible	Feasible
30842	2	Potentially Feasible for at Least One Component	Insufficient Area
30830	2	Potentially Feasible for at Least One Component	Insufficient Area
30804	1	Not Feasible	Insufficient Area
Total Properties Affected	**Total System Components Affected**	**Number of OWTS Feasible to Relocate Landward of Seawall**	**Number of OWTS Feasible to Relocate Landward of Home**
36	54	10	10

Source: Topanga Underground 2012.

[1]Feasibility determined via aerial imagery provided by the city of Malibu.

[2]Feasibility determined via the recommendations of Topanga Underground (2012).

Table 4-6. Alternative 3 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
Scenic Resources	Incremental Increase in Adverse Impacts	Additional construction equipment associated with construction of a landward-located seawall would incrementally increase adverse impacts associated with temporary construction activities; this would slightly increase in the severity of adverse effects associated with Impact SR-2 and SR-4. Further, when exposed after erosion of the beach, the seawall would become more and more visible above beachgoers, incrementally increasing the severity of Impact SR-1 over the long term.
Marine Water Quality	No Major Change in Adverse Impacts	There would be a slight increase in the potential for hazardous spills, as additional heavy equipment would be used in seawall construction and additional sand would be added for beach nourishment. The beneficial impact to marine water quality due to protection of OWTSs would be increased under this alternative, due to the improved strength of the seawall.
Marine Biological Resources	No Major Change in Adverse Impacts	There would be no major changes in impacts to marine biological resources. The potential for fuel or oil release described in Impact MB-6 would be slightly increased due to increased construction activities.
Noise	Incremental Increase in Adverse Impacts	Revetment removal and seawall construction would result in major temporary increase in noise and adverse impacts to beach users associated with Impact N-1 and sensitive receptors associated with Impact N-2 and N-3.
Cultural and Paleontological Resources	Incremental Increase in Adverse Impacts	Additional disturbance of the nearshore environment associated with the removal of the emergency revetment and the construction of the seawall, in particular with foundation excavation, as well as the possible demolition and removal of OWTS would result in an increased potential to disturb cultural resources, potentially increasing the adverse effects associated with Impact CR-1.
Public Health and Safety Hazards	Incremental Increase in Adverse Impacts	Demolition and relocation of OWTS associated with selection of the cast-in-place concrete seawall would increase the potential for incidental leaks, increasing the potential for adverse effects associated with to Impact HAZ-2. Operation of additional heavy construction equipment would increase the potential for incidental spills, further increasing potential adverse effects associated with Impact HAZ-2. Increased heavy construction equipment operation would also increase potential adverse effects on safety associated with Impact HAZ-3.
Traffic and Parking	Incremental Increase in Adverse Impacts	Revetment removal would require additional heavy haul truck trips, which may also increase traffic on Pacific Coast Highway and in Zuma Beach Parking Lot 12. When combined with up to 3,920 cement truck trips, 1,750 revetment removal haul truck trips and 8,560 trucks for added sand, these activities would increase the severity of the adverse effects associated with Impact TR-1. However, these impacts would be reduced through implementation of AMM TR-1
Environmental Justice	No Major Change in Adverse Impacts	There would be no appreciable difference in impacts relative to the Project.

4.2.4 Alternative 4: Reduced Beach Nourishment Volume and Dune Restoration with Revetment in Current Location

Description

Under this alternative, less sand would be imported from inland sources for each beach nourishment event and the existing emergency revetment would be retained in place. During the initial nourishment event, this alternative would entail importing up to 400,000 cy of sand to Broad Beach, with 100,000 cy used to create the sand dunes and cover the revetment, and 300,000 cy used for beach nourishment.[8] Under this alternative, sand dune design would remain the same as described under the Project, with the dunes ranging between approximately 40 to 60 feet in width and dune hummocks varying in height from 17 to 22 feet above MMLW. However, post-construction beach berm width would be reduced to approximately 50 feet along the western 1,000 feet of Broad Beach and 100 feet along the eastern 5,000 feet of Broad Beach. Similarly, beach berm depth would be reduced from 17 to 12 feet in the western reaches and to 10 feet on the eastern reach (see Figure 4-4). Consequently, the total Broad Beach footprint would be reduced to approximately 30 acres from 46 acres.

This alternative would also include three smaller beach renourishment events of a shorter duration, rather than one larger renourishment event as described for the Project. The first event, which would occur after approximately 3 to 5 years, would include the deposition of up to 150,000 cy of sand. The second event, which would be approximately 8 to 10 years following the first nourishment event, would include up to 200,000 cy of sand. The third event would occur approximately 15 years after the first nourishment and include up to 300,000 cy of sand. The overall nourishment volume over the 20-year project duration would be equal to the Project, including the deposition of no more than 1,050,000 cy in total. As with the Project, sand would continue to be obtained from the three quarry sites located in the Moorpark/Simi area of Simi Valley, approximately 20 to 25 miles north of Broad Beach. More frequent nourishment events would likely require smaller annual or less frequent backpassing of sand using the Project objective triggers. The optimum size and timing of future renourishment would be determined based on monitoring data gathered during each phase of Project operation.

This alternative is intended to restore the beach and dunes while providing information on the beach's optimum equilibrium profile. This information would allow adaptive management to best implement long-term shoreline protection and beach restoration goals on Broad Beach and in the sub-littoral cell. By employing reduced nourishment events, this alternative may reduce the volume of sand lost offshore from post-

[8] This quantity is suggested as a potential value; a detailed study would be required to identify what the minimum sand volume would be to provide a viable beach and allow for assessment of sand transport.

construction beaches, as nourishment volumes can be best adapted to reflect the equilibrium beach.

As with alternatives described above, full public access would be permitted along the entire wide sandy beach, but it would be restricted at the toe of the dunes where a line of rope or cable as well as posted signs would prohibit access to this ESHA. This rope or cable system, combined with the approximately 40- to 80-foot-wide dune system would ensure resident privacy. This alternative would channel private access across the dunes into shared unpaved walkways spaced every 300 feet (each combining access for approximately six homes), which would be connected to a back dune walkway lined with low fencing inland of and parallel to the restored dunes.

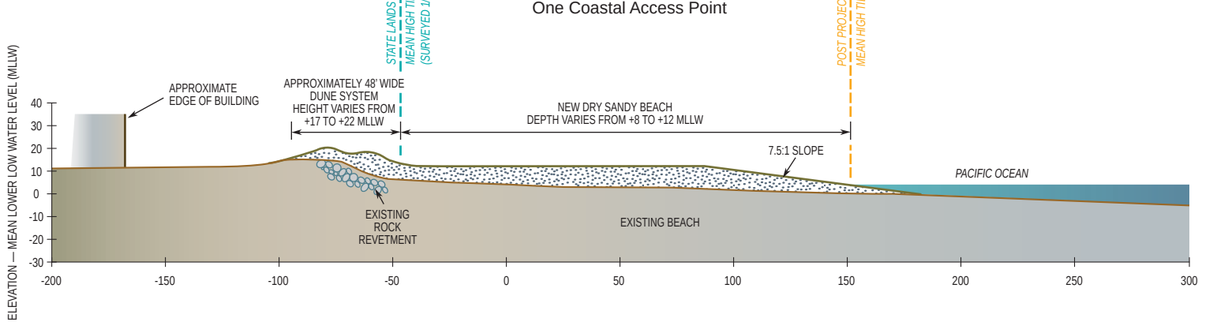
The existing two public vertical coastal access points along Broad Beach Road would remain open and the two public trails across the dunes would be roped off to limit access into the dunes. Additionally, this alternative would also recognize the public's rights to pass along public land below the January 2010 MHTL and across existing LAEs. This would ensure that over the long-term after nourishment ceases, the revetment is removed, and the beach and dunes erode, the public would continue to have access across the beach. Public access to and along these LAEs would be available when the sensitive dune habitats that overlie these LAEs eventually erode over the long-term and public access to these LAEs becomes necessary and available.

This alternative would require installation of many of the same improvements as the Project and associated construction activities. Major components would include:

- Transport of 400,000 cy sand from inland quarries to Broad Beach via 28,700 heavy haul truck trips;
- Transporting the sand from storage areas at Zuma Beach and hauling it up coast to Broad Beach with heavy trucks or scrapers;
- Redistributing sand on Broad Beach as needed with earthmoving equipment, such as bulldozers, and grading the beach fills to required dimensions;
- Creating a system of shared walkways to provide private lateral and vertical private coastal access for homeowners across the new dune system;
- Providing two vertical public access trails across the dunes to connect existing access points to the widened beach and ensuring public lateral access along the widened beach seaward of the OHWM;
- Backpassing of 25,000 to 35,000 cy of sand from the east to west end of the beach based using heavy equipment such as scrapers and bulldozers and employing nourishment triggers to account for beach width and profile; however, backpassing quantities are expected to be lower than the Project due to the increased frequency of nourishment activities under this alternative; and

Detail

REACH 3 – EAST CENTRAL
One Coastal Access Point



LEGEND

- Existing Public Access
- Approximate Limits of Beach Nourishment/ New Beach
- Existing Emergency Revetment to be Permanently Permitted
- Proposed New Dry Sandy Beach
- Proposed New Intertidal Beach Area
- Proposed Restored Dune
- Area of Dune or Beach Face (3:1 and 10:1 slopes)
- State Lands Commission Mean High Tide Line (surveyed 1/2010)
- Applicant Mean High Tide Line (surveyed 10/15/2009)
- Post Project Mean High Tide Line
- Ⓢ Existing Septic Tank
- Existing Leach Field/Drain Field
- Existing Lateral Access Easements (LAEs)
- * Easement on file, but no dry beach to dedicate
- Surf Grass
- ##### Property Address

Note: Beach dimensions and post project average high water line reflect beach status immediately after completion of beach nourishment and construction/shaping activities; the equilibrium beach that would result from dynamics such as waves, tidal and wind action would likely be of somewhat different dimensions.

amec

Reduced Beach Nourishment Volume and Dune Restoration with Revetment in Current Location

FIGURE 4-4

This page reserved for 11X17" figure.

- Initiating three future renourishment events, with the first (150,000 cy) in roughly 3 to 5 years, followed by a second, potentially larger renourishment event of up to 200,000 cy in 8 to 10 years, and a third renourishment event up to 300,000 cy in approximately 15 years.

Potential Impacts to Public Trust Resources

Similar to the Project, this alternative would result in the total deposition of 1,050,000 cy of sand over the course of four individual nourishment events throughout the Project life, though each deposition would be substantially smaller than the nourishment events proposed in the Project. This alternative would have similar impacts to the Project; however, the reduction in sand volume per deposition would potentially change effects on coastal processes, SLR, and geologic hazards, marine biological resources, terrestrial biological resources, recreation, and public access. Major changes to impacts to these resource areas relative to the Project are discussed in detail below, while the resource areas with negligible changes to impacts are summarized in Table 4-7 at the end of this subsection.

The emergency revetment would remain in its current location with dune restoration and beach nourishment burying the revetment as described for the Project. While other alternatives could be combined with this alternative (e.g., Alternative 1 or Alternative 2), no relocated or modified structures are proposed under this alternative. Under this alternative, the nourished beach would be as wide as 100 feet near the east end of Broad Beach and reduced to 50 feet on the west end. As a part of this alternative, backpassing frequency and potential volumes may be reduced, as backpassing would likely not occur the same year as a major renourishment event.[9] However, the timing and quantity of renourishment events would vary depending on results of the intensive monitoring plan and backpassing, with amounts adjusted to reflect beach width and profile.

Coastal Processes, Sea Level Rise and Geologic Hazards: Implementation of the reduced Project alternative would substantially reduce the amount of initial sand lost offshore and down coast of Broad Beach during the establishment of sand equilibrium on the beach. Further, depending upon the rate at which beach erosion proceeds, damage to the dune system and exposure of the revetment could occur as early as the second year at the west end of the beach, although this may be delayed by backpassing activities. Adding sand in smaller, more frequent increments would alter the benefits identified in Impact CP/GEO-3 by potentially exposing the beach to more rapid erosion earlier than described for the Project, but this would be offset with three additional nourishment events. The overall longevity of this effort is difficult to estimate,

[9] Precise renourishment volumes are difficult to forecast for a variety of reasons. A much smaller beach footprint would need to be recharged with sand, but backpassing may provide less effective at extending beach life due to the more limited Project area and lower sand volumes available to backpassing.

but smaller more frequent renourishment events may allow for adaptive management, potentially resulting in a wider beach profile over the long term and reduced loss of sand to longshore transport. This could prolong Project life under this alternative beyond the 10 to 20 or more years forecast for the Project. Anticipated SLR of approximately 8.5 inches by 2030 would further exacerbate erosion effects stated in Impact CP/GEO-8, including increased frequency and intensity of storm surges and wave attack.

This alternative may also result in reduced indirect closure of the Trancas Creek Lagoon mouth and reduced nourishment of Zuma Beach. However, long-term impacts would remain similar to those identified in Impact CP/GEO-2, as the beach erodes and the inadequately engineered revetment becomes exposed to damaging coastal process and wave action over the long term, leading to indirect impacts to public trust resources. Impacts CP/GEO-1, CP/GEO-4, CP/GEO-5, CP/GEO-6, and CP/GEO-7 would remain similar to the Project.

Marine Biological Resources: The reduced size and more frequent nourishment events would -incrementally increase adverse effects identified in Impacts MB-2 and MB-3 due to repeated burial of rocky intertidal and sandy intertidal habitats. Impacts to near shore subtidal marine habitats, including surfgrass, kelp, and other sensitive marine organisms as stated in MB-4 would be slightly less adverse due to decreased indirect burial. By reducing the beach width in the 1,000 feet of Reach 6 on the west end of the beach to 90 feet from more than 160 feet under the Project, this alternative would substantially reduce both direct and indirect burial of rocky habitats. In particular, by pulling back the toe of beach fill by 70 feet, this alternative would substantially reduce direct and indirect burial of surfgrass, which is concentrated within Lechuza Cove at the west end of Broad Beach. Both the depth and duration of such surfgrass burial would be reduced. Additionally, this alternative would substantially reduce indirect turbidity impacts and impacts to offshore and down coast marine resources as stated in Impact MB-7, including subtidal reefs, as less sand would be lost offshore during each nourishment event. Further, although nourishment events would occur more frequently under this alternative than described for the Project, if Alternative 4 would reduce the need for backpassing, it may incrementally reduce impacts to Impact MB-5, on sandy intertidal organisms between nourishment events. However, mortality of marcoinvertebrates and loss of beach wrack as stated in Impact MB-3 would increase under this alternative as the entire beach would be disturbed more frequently by renourishment, four times under this alternative compared to twice under the Project. Under this alternative, the duration of the nourished beach may be extended, delaying exposure of the revetment. Additionally, more renourishment events would increase the potential for accidents or spills as identified in Impact MB-6. Impacts MB-1 and MB-8 would be similar to the Project.

Terrestrial Biological Resources: Impacts TBIO-1, TBIO-6, and TBIO-8 would be similar to the Project; however, if adaptive management for this alternative is successful and the life of the nourished beach is extended, impacts to coastal dune ESHA would be

delayed. Additionally, as described above for marine biological resources, as less backpassing is anticipated under this alternative, impacts to terrestrial biological resources from backpassing identified in Impact TBIO-3 would also be reduced but similar to the Project. Further, smaller more frequent nourishment events may reduce adverse effects on the hydrology of the Trancas Creek Lagoon identified in Impact TBIO-5. Additionally, creation of shared walkways would reduce habitat fragmentation impacts identified in TBIO-7, and increase the beneficial effects associated with Impact TBIO-6. However, three major renourishment events would increase the frequency of disturbance of the entire beach, with associated mortality of marine marcoinvertebrates and diminishment of value of Broad Beach for foraging shorebirds as described in TBIO-2. Additional nourishment events would also incrementally increase adverse effects of construction activities identified in Impact TBIO-4, due to increased risk of accidental hazardous spills and resulting degradation of habitat resources.

Recreation and Public Access: Implementation of the reduced Project alternative would result in more frequent major short-term disturbance impacts to public access during construction activities identified in REC-1 with all or most of Broad Beach likely being closed to public access for several months during nourishment and renourishment events. Additionally, the east end of Zuma Beach would be disturbed during these activities, as Zuma Beach Parking Lot 12 is proposed for use for equipment staging and the beach for sand storage. Under this alternative, three renourishment events would occur after the initial nourishment, two more than included in Project; however, each of these renourishment events would be smaller, requiring a shorter duration of construction. As fewer backpassing events are anticipated, impacts identified in REC-2 would be less adverse. This alternative may also increase the beneficial recreational effects identified in Impact REC-3 by potentially incrementally extending the life of the beach through adaptive management. Long-term effects to recreation identified in Impact REC-4 would remain similar to the Project.

Other Resource Areas: This alternative would have similar or slightly incremental impacts to the Project in terms of its effects on scenic resources, air quality and GHGs, marine water quality, cultural and paleontological resources, noise, public health and safety hazards, utilities and service systems, traffic and parking, and environmental justice.

Table 4-7. Alternative 4 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
Scenic Resources	No Major Change in Adverse Impacts	There would be negligible changes in short-term visual and aesthetic impacts relative to the Project. While the adverse impacts associated with beach nourishment in SR-2 would occur for a shorter duration under this alternative, they would also occur at a greater frequency.
Air Quality and Greenhouse Gases	No Major Change in Adverse Impacts	There would be negligible changes in air emissions under this alternative. While there would be two additional renourishment events under this alternative relative to the Project, total sand

Table 4-7. Alternative 4 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
		deposition under Alternative 4 would be identical to the Project. Consequently, this alternative would have similar total emissions from trucking over the long-term, although these emissions would be spread out over a longer period.
Marine Water Quality	Incremental Increase in Adverse Impacts	There would be an incremental increase in the potential for accidents or spills relative to the Project as there would be three renourishment events under Alternative 4. In decreasing sand lost from the post construction beach, this alternative may incrementally reduce the severity of turbidity and tidal exchange impacts in MWQ-1 and MWQ-2, but increase their frequency. However, other marine water quality impacts would generally be similar to those described for the Project.
Cultural and Paleontological Resources	No Major Change in Adverse Impacts	Cultural and paleontological resource impacts would be similar to those described in the Project. This alternative would increase the number of renourishment events on Broad Beach. However, each of the renourishment events associated with this alternative would be shorter in duration relative to those described for the Project. Over the Project life, this alternative may slightly increase the amount of time heavy equipment is mobilized on Broad Beach, which could negligibly increase the adverse impacts associated with Impact CR-2. However, these impacts would be similar to those described for the Project.
Noise	Incremental Increase in Adverse Impacts	This alternative would result in two additional smaller renourishment events of shorter duration when compared to the Project. These additional renourishment events would create two additional periods of construction noise, the shorter duration of the events would result in slightly more adverse overall noise impacts on recreational users and sensitive receptors identified in Impacts N-1,N-2, and N-3 to those described for the Project.
Public Health and Safety Hazards	No Major Change in Adverse Impacts	Increased nourishment event frequency may slightly increase the potential for hazardous spills to occur, which could incrementally increase adverse effects identified in Impact HAZ-2. The increased frequency of construction under this alternative would result in negligible or similar changes to Impacts HAZ-1, HAZ-3, HAZ-4, and HAZ-5.
Utilities and Service Systems	No Major Change in Beneficial Impacts	Impacts would remain similar to the Project, as the emergency revetment would become exposed after the cessation of nourishment, resulting in the potential for damage to OWTS and other improvements. Damage to these features may also result in indirect effects to public trust resources.
Traffic and Parking	No Major Change in Adverse Impacts	Traffic impacts from construction would be similar to but reduced from the Project; less sand would be hauled during each nourishment event and there would be less severe transportation impacts for each nourishment event relative to the Project. However, two additional renourishment events would increase the frequency of traffic disruptions.
Environmental Justice	No Major Change in Adverse Impacts	There would be no appreciable difference in impacts relative to the Project.

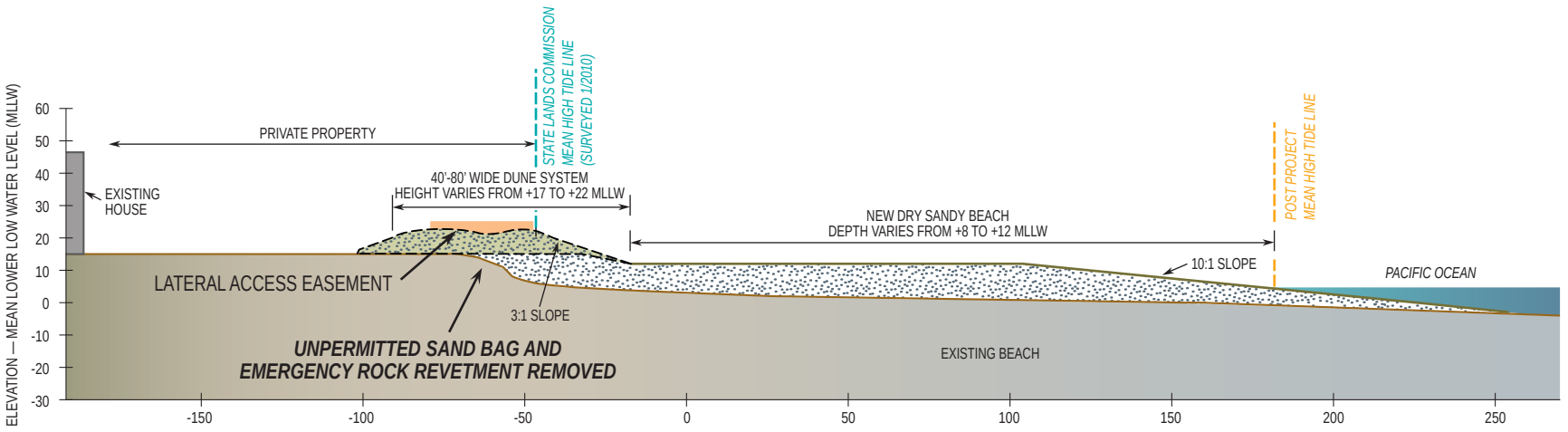
4.2.5 Alternative 5: Beach Nourishment and Dune Restoration with No Shore Protection Structure

Description

Under this alternative, Broad Beach would undergo beach nourishment, dune restoration with 600,000 cy of sand, and habitat restoration as described for the Project (see Figure 4-5.). Similar to the Project, post-construction beach width would range from 85 feet on the west end of Broad Beach (i.e., Lechuza Cove) to as wide as 230 feet near the east end of Broad Beach. Dune design would remain the same as described under the Project with dunes of approximately 40 to 60 feet wide and 17 to 22 feet above MLLW. The new post-construction dry sand beach berm and dune system would extend approximately 30 to 50 feet inland and 0 to 10 feet seaward of the OHWM. This alternative would also involve annual backpassing activities and a renourishment event following 10 years after initial beach nourishment, similar to the Project.

This alternative would involve removal of the existing shoreline stabilization structures on Broad Beach, including the existing 4,100 foot-long rock revetment and underlying sand bag revetments that were approved under emergency permits (the sand bag revetments are presumed to be intact, at least in some locations, beneath the existing visible rock revetment). Erosion of the nourished beach and dune system would occur over time similar to the Project, but under this alternative, the existing revetment would not re-emerge and provide shoreline protection in the absence of beach nourishment and backpassing activities. While removal of the emergency revetment would reduce impacts associated with recreation and public access policy inconsistencies, it would also result in major future long-term impacts associated with coastal processes and potential damage to private improvements, including private OWTS, such as septic systems and leach fields, and resultant indirect impacts to public resources.

Similar to the Project, under this alternative, public use of and access along the beach berm would be permitted to the toe of the restored dune system where a line of rope or cable and signs would prohibit access to the dune habitats. This rope or cable system, combined with the approximately 50-foot-wide dune system, would also ensure resident privacy. In addition, rather than provide for 112 coastal access walkways across the restored dunes, as proposed by the Project, this alternative would include installation of shared private coastal access walkways, with one unpaved and demarcated walkway approximately every 300 feet to be shared between six homes. The approximate 300-foot distance between walkways was selected as an intermediate value that would improve dune habitat quality while minimizing disruption to private homeowner beach access. These walkways would be connected by a shared path along the back dune, lined with a sand fence along the seaward side to minimize sand migration into private yards and minimize resident and pet access into the dune ESHA, and be roped off to minimize private access into the dune ESHA.



amec

Beach Nourishment and Dune Restoration with No Shore Protection Structure

FIGURE 4-5

The existing two public vertical coastal access points along Broad Beach Road would remain open and the two public trails across the dunes would be roped off to limit access into the dunes. Additionally, this alternative would also recognize the public's rights to pass along public land below the January 2010 MHTL and across existing LAEs. This would ensure that over the long-term after nourishment ceases, the revetment is removed, and the beach and dunes erode, the public would continue to have access across the beach. Public access to and along these LAEs would be available when the sensitive dune habitats that overlie these LAEs eventually erode over the long-term and public access to these LAEs becomes necessary and available.

Construction under this alternative would be similar to the Project; however, under this alternative, additional heavy construction equipment and approximately 3,600 new heavy haul truck trips would be required to remove the entire existing emergency revetment prior to initial beach nourishment activities. The removed materials would be transported to an approved location or facility (e.g., a rock quarry). Major components of this alternative would include:

- Removing the 4,100-foot long existing revetment using heavy cranes, backhoes, bulldozers and an estimated 3,600 heavy haul truck trips to transport boulders, sand bags, and other materials composing the existing revetment off of the beach;
- Redistribution of beach sand within the sand bags and removal of sand bag liners and other remaining debris;
- Transport of 600,000 cy of sand from inland quarries to Broad Beach via 43,000 heavy haul truck trips;
- Transporting the sand from storage areas at Zuma Beach and hauling it up coast to Broad Beach with heavy trucks or scrapers;
- Distributing the nourishment sand on Broad Beach with earthmoving equipment, such as bulldozers, and grading the nourished beach to dimensions similar to the Project;
- Delineating a distributed system of shared walkways (one walkway per six homes) to provide private lateral and vertical coastal access across the new dune system;
- Provide two vertical public access trails across the dunes to connect existing access points to the widened beach and ensuring public lateral access along the widened beach seaward of the OHWM;
- Backpassing of 25,000 to 35,000 cy of sand from the east to west end of the beach using heavy equipment, such as scrapers and bull dozers, with a generally annual frequency based on beach width and profile measurement triggers; and
- Initiating one future major renourishment event of approximately 450,000 cy in roughly 10 years following initial nourishment activities.

Potential Impacts to Public Trust Resources

This alternative would remove the existing emergency rock and sand bag revetment with accompanying proposed beach nourishment and dune restoration, returning Broad Beach to a wide sandy beach backed by coastal dunes. Removal of the revetment would substantially affect a number of resource areas, including coastal processes, SLR, and geological hazards, air quality, GHGs, terrestrial biological resources, utilities and service systems, recreation, and public access. Major changes to impacts of these resource areas are discussed in detail below, while the resource areas with negligible changes to impacts are summarized in Table 4-8 at the end of this subsection.

Air Quality and Greenhouse Gases: Under this alternative, criteria pollutant emissions would incrementally increase relative to the Project associated with the 3,600 additional heavy haul truck trips used to transport armor boulders offsite, as well as the operation of additional heavy equipment, necessary to remove the revetment. These emissions would increase the severity of Impact AQ-1, particularly for emissions of VOCs, which would exceed SCAQMD and VCAPCD thresholds for project-level significance under the Project, and NO_x, which would exceed SCAQMD and VCAPCD thresholds for onsite and project-level significance under the Project, including SCAQMD LSTs for construction activities. Relative to the Project, emissions of both of these criteria pollutants would incrementally increase under this alternative, as there would be additional construction activities and an increase in heavy haul truck trips associated with the removal of the revetment (Appendix G). Additionally, there would be an incremental increase in other criteria pollutants. GHG emissions described in Impact AQ-2 would remain below SCAQMD and VCAPCD thresholds. TAC emissions related to diesel engines and construction activities would also increase, with Impact AQ-3 becoming incrementally more severe.

Coastal Processes, Sea Level Rise and Geologic Hazards: Removal of the revetment would substantially increase the potential impacts of coastal processes on existing private improvements, including OWTS across the length of the 4,100-foot revetment. Erosion of beach and dunes after cessation of nourishment would continue as described under the Project, with the benefits of nourishment enduring for an estimated 10 to 20 or more years as described in Impact CP/GEO-3. Following the effective life of the beach nourishments and backpassing activities, existing homes, OWTS, and other improvements would once again become exposed to coastal processes as a result of persistent erosion associated with wave action. Under this alternative, after the revetment is removed potential impacts of coastal processes on the revetment identified in Impact CP/GEO-2 would no longer apply, as the revetment would be removed. However, as a consequence of removing the revetment, it would no longer act as a last line of defense to coastal processes, and damage to homes, OWTS, and accessory structures would be increased from coastal erosion, as well as associated indirect

impacts to public trust resources identified in Impact CP/GEO-2, such as impacts to water quality.

Removal of the existing rock and sand bag revetments would also affect coastal processes by initially decreasing wave refraction and allowing the created dune system to erode, thereby increasing nourishment of down coast beaches (e.g., Zuma Beach). Impact CP/GEO-7 would remain beneficial, as effects of the longshore currents on nourishment and renourishment of sand in the short- to mid-term include both erosion of sand from Broad Beach and accretion of sand at down coast beaches. This beneficial impact would be incrementally increased under this Alternative as additional dune sand would be exposed seaward of the homes. However, over the long-term, longshore currents would transport this sand farther down coast and possibly offshore. Further, when erosion reaches homes and OWTS, adverse impacts would occur as debris, pollutants, and other materials are washed into the surf zone following damage from wave action.

With cessation of beach nourishment, impacts to homes, OWTS, and accessory structures from coastal erosion described in Impact CP/GEO-2 would become substantially more severe. The dune system would erode and homes would be exposed to damage and destruction as the dune field alone does not appear to constitute adequate protection from wave attack during major storm events. As demonstrated by dune erosion occurring during the winter of 2013-2014, where sand erosion of up to 100 feet was observed at the beaches' west end, the dune system may slow, but not halt, coastal erosion absent major changes in climatic cycles and the sediment budget of this littoral cell or continuing renourishment beyond the life of the Project or this alternative. Sea level rise, anticipated to be approximately 8.5 inches by 2030 would further exacerbate erosion effects stated in Impact CP/GEO-8.

Removal of the revetment would substantially increase direct impacts to revetment stability identified in Impact CP/GEO-1, while exposing homes, OWTS and other improvements to impacts from wave action. The removal of the revetment and eventual erosion of the dunes would lead to more damage to homes, private improvements, and/or OWTS, resulting in adverse indirect consequences for public trust resources. These effects would be experienced over the long-term and would be temporarily reduced by backpassing activities and the follow-up renourishment event. Following the cessation of nourishment, homeowners may again request or install emergency coastal protection structures to prevent the impacts resulting from long-term erosion, which may result in major geological impacts related to the public trust resources. Impacts CP/GEO-4, CP/GEO-5, and CP/GEO-6 would remain similar to the Project.

Terrestrial Biological Resources: The removal of the revetment under this alternative would directly impact the existing degraded dune habitats, as heavy equipment would operate on and near these degraded dunes to remove the existing rock and sand bag

revetments. This would potentially increase the adverse effects of short-term construction associated with Impact TBIO-2. Although this equipment would be operated from the seaward side of the revetment, impacts to ESHA would still be likely to occur. These impacts would be largely offset by successful implementation of dune restoration. Hazardous spill impacts due to the removal of the revetment may also increase impacts described in TBIO-4.

However, removal of the existing rock and sand bag revetment would allow for the more natural movement of windblown sand within the restored active coastal dunes relative to the Project, resulting in less beneficial impacts to dune habitat functions under this alternative, at least over the next 10 to 20 years. Additionally, the construction of shared walkways at 300-foot intervals would reduce dune habitat fragmentation, ultimately reducing the adverse effects of private access across the restored dune system as stated in TBIO-7. However, over the long term, cessation of nourishment and elimination of the revetment would eventually lead to the erosion of the restored southern foredune habitat in the rear yards of private residences over the long-term, as no hard stabilization structure would be in place as a last line of defense to protect this area. This would represent an additional long-term adverse impact to terrestrial biological resources at Broad Beach as stated in Impact TBIO-8. Implementation of the long-term monitoring and maintenance activities and adaptive management strategies described in AMM TBIO-1a, would reduce, but not eliminate this impact. Impacts TBIO-1, TBIO-3 and TBIO-5 would remain similar to the Project.

Utilities and Service Systems: The removal of the existing emergency rock and sand bag revetments would eliminate the beneficial impacts identified in UTL-1 associated with these shoreline stabilization structures with regards to protection of OWTS from coastal erosion. Following long-term erosion of beach and dunes, approximately 60 OWTS in the rear yards of private residences would become exposed to the effects of coastal erosion, substantially increasing impacts to public trust resources associated with release of sewage effluent identified in Impact UTL-2. However, revetment removal will reduce impacts to drainage systems described in UTL-3. The analysis of impacts to OWTS in the Broad Beach Coastal Engineering Report, completed by Moffatt & Nichol in 2013, projects that coastal erosion could reach and destroy exposed OWTS for many homes that lack sufficient area for landward relocation (Appendix B).

Potential for such dune erosion was recently exemplified in the winter of 2013-2014 when wave action largely destroyed existing sand bag and Sakrete revetments protecting homes and dunes at the east end of Broad Beach. As a result of this wave attack and destruction of sand bar and Sakrete revetments, the wide dune system at the east end of Broad Beach was eroded landward by 80 to 100 feet to within 30 to 50 feet of existing homes. Following cessation of nourishment and erosion of the beach and dune system in 10 to 20 or more years, another emergency revetment would likely be

requested by homeowners to prevent destruction of homes and OWTS by wave attack and the associated indirect impacts to public trust resources.

Recreation and Public Access: This alternative would result in increased adverse effects associated with Impact REC-1, as heavy equipment utilized for revetment removal would reduce public access during construction activities. However, by removing the sand bag and rock revetments, this alternative would be the most consistent with coastal policies concerning public access and minimizing use of hard coastal protection structures. Short to medium-term beneficial impacts in REC-3 would also increase due to the removal of the revetment. Impact REC-2 would remain similar to the Project.

As identified in Impact CP/GEO-2, after cessation of nourishment and eventual erosion of the wide sandy beach and dune system, impacts described in Impact REC-4 would be less adverse as the revetment would no longer be in place after long-term cessation of beach nourishment. However, the public access benefits of the wide sandy beach of this alternative would be eliminated. Lateral access would again be restricted to low and medium tides. Further, as the beach erodes back to the dunes, public access would be dependent upon a patchwork of LAEs, the locations of which are often uncertain to beachgoers. This could again bring homeowners and beachgoers into conflict over private versus public property. Eventually, as erosion reaches homes, OWTS, and other improvements, beachgoers would encounter obstacles to lateral access, including debris, OWTS, effluent, or other barrier to use and enjoyment of public trust resources; owners may also request or install emergency coastal protection structures, further limiting public access.[10]

Marine Water Quality: Removal of the emergency rock and sand bag revetment would result in the potential for impacts to marine water quality to occur resulting from long-term erosion and potential damage to existing OWTS occurring behind existing revetments. Construction related to revetment removal would have more adverse impacts to water turbidity as described in Impact MWQ-1. Under this alternative, the beneficial impacts described under Impact MWQ-3 would not occur as the existing revetment would be removed and would no longer serve as the last line of defense for existing development along Broad Beach. This would constitute a major adverse impact and would likely cause homeowners to install or request installation of additional emergency revetments in response to the long-term erosion of Broad Beach after the cessation of proposed nourishment activities. Impacts MWQ-2 and MWQ-4 would remain similar to the Project.

[10] Although permits are required prior to installing emergency coastal protection structures, in some emergency situations homeowners have installed structures in order to protect their homes without first obtaining authorization. This would likely occur again in future emergencies.

Other Resource Areas: This alternative would have similar impacts to the Project for scenic resources, marine biological resources, cultural and paleontological resources, noise, public health and safety hazards, traffic and parking, and environmental justice.

Table 4-8. Alternative 5 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
Scenic Resources	Incremental Short-term Increase and Long-term Decrease in Adverse Impacts	There would be a slight increase in adverse effects associated with Impact SR-2, as this alternative would result in additional construction equipment relative to the Project. However, removal of the revetment would eliminate the potential for long-term exposure eliminating the adverse effects associated with Impact SR-1. Eventual destruction of homes, patios and OWTS by coastal erosion would create additional aesthetic impacts. All other impacts to scenic resources would be either negligible or similar to the Project.
Marine Biological Resources	No Major Change in Adverse Impacts	There would be no appreciable difference in direct effects relative to the Project. Under this alternative, impacts to marine biological resources would remain similar or slightly increased relative to the Project. However, over the long-term, exposure of OWTS to wave attack could create indirect impacts to such marine biological resources due to release of septic effluent into the surf zone.
Cultural and Paleontological Resources	No Major Change in Adverse Impacts	Additional disturbance of the near shore environment associated with removal of the emergency revetment would result in an increased potential to disturb cultural resources, slightly increasing the severity of the adverse effects associated with Impact CR-1. However, as heavy equipment would only be operated on the seaward side of the revetment, the probability of uncovering cultural resources would be minimal. All other cultural and paleontological impacts would be similar to the Project.
Noise	Incremental Increase in Adverse Impacts	Operation of additional heavy haul trucks, cranes, and bulldozers used during revetment removal would incrementally increase the severity of the adverse effects associated with Impact N-1. All other noise impacts would be either similar or slightly increased in relation to the Project.
Public Safety and Health Hazards	Incremental Increase in Adverse Impacts	Additional heavy equipment used during revetment removal would increase the potential for incidental release of hazardous materials, resulting in an incremental increase in the severity of Impact HAZ-2. Further, operation of additional heavy equipment on the beach would increase the short-term hazardous conditions during construction, incrementally increasing the severity of Impact HAZ-3. Impact HAZ-5 would also become a long-term or permanent beneficial impact instead of having a short- to mid-term duration. Impact HAZ-1 would also no longer be relevant, as the revetment would no longer be present to create potential hazards.
Traffic and Parking	Incremental Increase in Adverse Impacts	Revetment removal would require an additional 3,600 truck trips and additional heavy equipment over that required for the Project. This would incrementally increase severity of the adverse effects associated with Impact TR-1 and potentially TR-2, depending on the disposal location of the removed

Table 4-8. Alternative 5 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
		boulders (i.e., rock quarry). Other traffic impacts would be similar to the Project.
Environmental Justice	No Change	There would be no appreciable difference in impacts relative to the Project.

4.2.6 Alternative 6: Relocation of Improved Revetment along Upgraded Leach Fields with Beach Nourishment and Dune Restoration

Description

A key goal of this alternative would be to ensure improved disposal of wastewater at Broad Beach, consistent with existing codes. This alternative would include beach and dune restoration identical to the Project, as well as strengthening of the existing revetment and relocation of segments of this revetment. However, this alternative would differ from the Project and the other alternatives in that the existing OWTS located seaward of the residences at Broad Beach would be upgraded to meet current code. Because leach fields for such upgraded OWTS are space-intensive, parcels with limited room for such upgrades near the west end of the existing revetment would require seaward relocation of the revetment. Under this alternative, the majority of the revetment would remain in place, with eastern segments relocated substantially landward and areas to the west relocated seaward onto public trust lands.

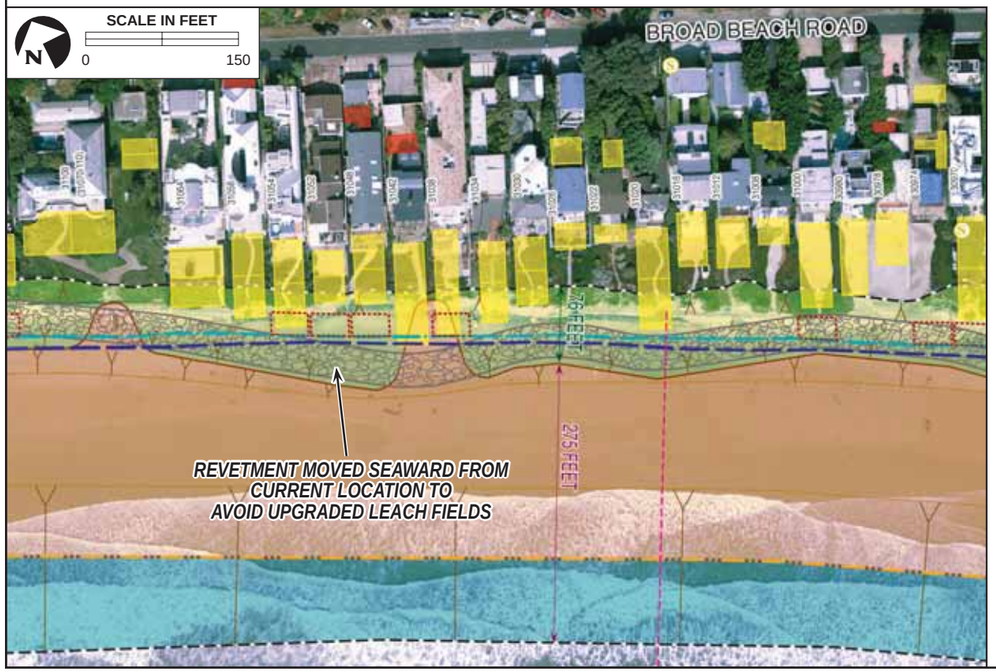
Beach nourishment, dune creation, and habitat restoration components under this alternative would remain similar to those described for the Project, with approximately 43,000 haul heavy trips being required to haul 600,000 cy of sand from inland quarry sources. Similar to the Project, post-construction beach width would range from 85 feet on the west end of the Project area (i.e., Lechuza Cove) to as wide as 230 feet near the east end of Broad Beach. Dune habitats would be established and restored by creating a sand berm that would run along the length of the beach, with a minimum of 2 feet of sand over the existing rock and sand bag revetment. The beach berm would extend approximately 30 to 50 feet inland and 0 to 10 feet seaward of the revetment, depending on location. The restored dune system, consisting of hummocks varying in height from 17 to 22 feet above MLLW would be constructed on top of this berm. The width of the dune system would vary from 50 to 60 feet wide. In places, these dunes would overlie expanded leach fields of OWTS and in places would extend further seaward below OHWM than under the Project.

This alternative would include upgrades to and relocation of OWTS and/or leach fields as far landward as feasible, consistent with the location of existing primary residences, but regardless of existing auxiliary buildings, landscape, and hardscape (Moffatt & Nichol 2013). Most properties at Broad Beach would require significantly larger leach fields to meet current code, in most cases this would include doubling of the size of the leach field. Homes along the eastern reaches of the beach often have setbacks of 75 to 100 feet or more from the revetment, providing space for leach field expansion. In contrast, homes in the central and western reaches of the beach have smaller setbacks from the existing revetment, which limits space necessary for expansion of existing leach fields.

SCALE IN FEET
0 370

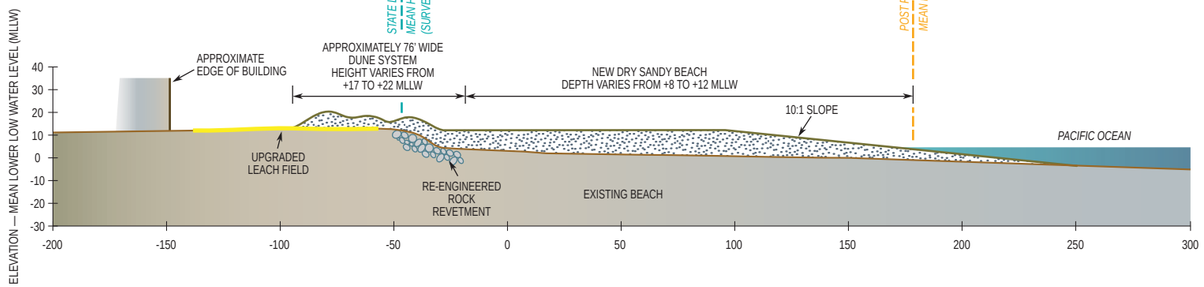
Detail

SCALE IN FEET
0 150



REACH 3 – EAST CENTRAL

One Coastal Access Point



LEGEND

- Existing Public Access
- Approximate Limits of Beach Nourishment/ New Beach
- Existing Emergency Revetment to be Permanently Permitted
- Proposed New Dry Sandy Beach
- Proposed New Intertidal Beach Area
- Proposed Restored Dune
- Area of Dune or Beach Face (3:1 and 10:1 slopes)
- State Lands Commission Mean High Tide Line (surveyed 1/2010)
- Applicant Mean High Tide Line (surveyed 10/15/2009)
- Post Project Mean High Tide Line
- Existing Septic Tank
- Existing Leach Field/Drain Field Not Requiring Upgrade
- Upgraded Leach Field
- Existing Lateral Access Easements (LAEs)
- * Easement on file, but no dry beach to dedicate
- Surf Grass
- ##### Property Address

Note: Beach dimensions and post project average high water line reflect beach status immediately after completion of beach nourishment and construction/shaping activities; the equilibrium beach that would result from dynamics such as waves, tidal and wind action would likely be of somewhat different dimensions.

amec

Relocation of Improved Revetment along Upgraded Leach Fields with Beach Nourishment and Dune Restoration

FIGURE 4-6

This page reserved for 11X17" figure.

Under this alternative, the emergency revetment would be relocated landward where feasible along the upgraded leach fields. Ensitu (2013) estimated that landward relocation of the revetment would be infeasible for all properties west of 30918 Broad Beach Road due to leach field encroachment within the wave run-up zone. However, research into required setbacks for OWTS did not uncover a documented requirement between an OWTS and Wave-Uprush Line. In addition, the OWTS would be protected by both the revetment and overlying sand dunes, which are projected to endure for 10 to 20 or more years. The revetment and sand dunes would minimize potential for wave uprush to affect the OWTS. Therefore, wave run-up was not used to guide design of this alternative, but is assessed as a potential impact.

Consequently, this alternative includes landward relocation to the maximum extent feasible consistent with expanded leach fields, but acknowledges that after the cessation of nourishment and erosion of the beach and overlying dunes in 10 to 20 or more years there may be OWTS impacts due to splashing or overtopping of the exposed revetment during large storms (see *Utilities and Service Systems* discussion below). Regardless, as a result of increasing the leach field size for each property, it is likely that segments of the revetment would be relocated *further* seaward onto public land in some locations west of 30918 Broad Beach Road. This would result in major trade-offs between potential impacts to water quality and recreation, and public access. The reinforced revetment would be no wider than the existing 38-foot width at its base with a crest elevation of approximately 15 feet above Mean Low Low Water (MLLW). This design would be required to demonstrate that the armoring of the existing revetment would not increase the width of the revetment to minimize beach coverage, which may require removal of existing smaller stones, or incorporation of these smaller stones into a steeper reinforced revetment.

Similar to the Project, public use of and access along the beach berm under this alternative would be permitted to the toe of the restored dunes where a line of rope or cable and signs would prohibit access to potential ESHA within the dunes. This rope or cable system, combined with the approximately 50-foot-wide dune system, would also ensure resident privacy. In addition, rather than provide for 112 unpaved coastal access walkways across the restored dunes, as included in the Project, this alternative would include installation of shared private coastal access walkways, with one walkway approximately every 300 feet to be shared between six homes. These walkways would be connected by a shared path along the back dune, lined with a sand fence along the seaward side to minimize sand migration into private yards and minimize resident and pet access into the dune habitat. Each of these walkways would be roped off to minimize private access into the dune habitats. This distance was selected as an intermediate value that would retain dune habitat continuity and quality while minimizing disruption to private homeowner beach access.

The existing two public vertical coastal access points along Broad Beach Road would remain open and the two public trails across the dunes would be roped off to limit access into the dunes. Additionally, this alternative would also recognize the public's rights to pass along public land below the January 2010 MHTL and across existing LAEs. This would ensure that over the long-term after nourishment ceases, the revetment is removed, and the beach and dunes erode, the public would continue to have access across the beach. Public access to and along these LAEs would be available when the sensitive dune habitats that overlie these LAEs eventually erode over the long-term and public access to these LAEs becomes necessary and available.

This alternative would involve additional new major construction activities compared to the Project. Installing a properly engineered revetment would require use of heavy equipment to remove some of the boulders, move some of the existing boulders inland, and install larger boulders to enhance revetment stability. Revetment reconfiguration would require an estimated 4,500 new haul truck trips to deliver additional boulders (approximately two or three boulders per truck) to the beach in order to armor approximately 3,650 feet of the revetment, as well as for potential export of smaller stones as needed.[11] Armoring would consist of placing a layer of boulders (one or two boulders deep) from below the revetment toe to its crest. A somewhat larger staging area within the Zuma Beach Parking Lot 12 may also be required to accommodate additional equipment and material storage. Additional construction equipment would also be required to relocate the existing rock revetment and move and position new rock, such as one or two heavy cranes and bulldozers along with additional associated construction personnel,. This would result in increased fueling activity and additional traffic along the beach. This additional truck traffic would increase congestion associated with sand importation by approximately 10 percent. Traffic control measures for sand haul trucks entering and leaving the parking lot, as well as transiting along the beach would be implemented.

In addition, because the revetment would be located further landward, additional excavation and construction would be requires for patio and landscape removal, as well as upgrade and relocation of existing OWTS. These activities may be scheduled concurrently or preceding beach nourishment and thus would extend the projected construction horizon beyond the proposed 8 months by at least 1 to 2 months.

- Upgrade and expansion of all OWTS that are located seaward of primary structures to roughly double the size of leach fields, thereby meeting existing code requirements and improving wastewater disposal;
- Relocation of the existing rock and sand bag revetment using heavy cranes and bulldozers to an inland configuration, where feasible, along the seaward edge of

[11] The westernmost 470 feet of the emergency revetment was built to a different standard and incorporated larger boulders; thus it would not receive further armoring.

the upgraded OWTS locations (in some locations, the revetment may have to be relocated seaward to accommodate the upgraded leach fields);

- Importing large 3- to 5-ton boulders via an estimated 4,500 heavy haul truck trips and potentially exporting a portion of the smaller existing rock revetment;
- Placing new larger boulders over and at the toe of the existing revetment using heavy cranes and bulldozers;
- Transporting 600,000 cy of sand from inland quarries to Zuma Beach via 43,000 heavy haul truck trips;
- Transporting the sand from storage areas at Zuma Beach and hauling it up coast to Broad Beach with heavy trucks or scrapers
- Redistributing sand on Broad Beach as needed with earthmoving equipment, such as bulldozers, and grading the beach fills to required dimensions;
- Creating a system of shared unpaved walkways to provide private lateral and vertical private coastal access for homeowners across the new dune system;
- Provide two vertical public access trails across the dunes to connect existing access points to the widened beach and ensuring public lateral access along the widened beach seaward of the OHWM;
- Performing backpassing of the sand, ranging from 25,000 to 35,000 cy, from the east to west end of the beach based on triggers and using heavy equipment, such as scrapers and bull dozers; and
- Initiating one future major sand supply renourishment event of approximately 450,000 cy in roughly 10 years.

Potential Impacts to Public Trust Resources

This alternative to the Project would result in additional construction activities associated with upgrade of the existing OWTS, demolition of improvements to provide space for such upgrades, and landward relocation of the revetment where feasible or required to accommodate OWTS upgrades. This alternative would result in major trade-offs concerning potential water quality impacts and impacts to recreation and public access (see Illustration 4-4). This alternative would also result in major changes to impacts associated with terrestrial biological resources. Adverse impacts resulting from this alternative may include effects on coastal dune ESHAs on the eastern end of Broad Beach identified in the Malibu LCP, as well as an incremental increase in potential for hazardous spills in the terrestrial environment. Further, public access during construction activities would be incrementally reduced relative to the Project due to increased heavy equipment use. Beneficial impacts associated with this alternative would include reduced long-term potential impacts to marine water quality protection. However, this alternative may be less consistent with coastal public access and recreation policies, as the revetment would remain in its current location partially overlying public lands for more than 50 percent of its reach. Further, seaward relocation

of the existing revetment may even be required in front of up to 20 homes in order to permit OWTS expansion. Resource areas with major changes to impacts relative to the Project are discussed in detail below, while the resource areas with negligible changes to impacts are summarized in Table 4-9 at the end of this subsection.

Air Quality and Greenhouse Gases: Criteria pollutant emissions would increase by more than 10 percent relative to the Project associated with the 4,500 additional heavy haul truck trips used to transport armor stone and the operation of additional heavy equipment necessary to upgrade and relocate the OWTS. Further, operation of additional heavy equipment would be necessary to relocate and improve the revetment. These emissions would increase the severity of Impact AQ-1, particularly for emissions of VOCs, which would exceed SCAQMD and VCAPCD thresholds for project-level significance, and for $NO_{X,}$ which would exceed SCAQMD and VCAPCD thresholds for both onsite and project-level significance similar to the Project, including SCAQMD LSTs for construction activities. Emissions of these criteria pollutants would substantially increase under this alternative when compared to the Project due to additional construction activities and a 10 percent increase in heavy haul truck trips (Appendix G). Additionally, this alternative would incrementally increase other criteria pollutants including CO, SO_x, and PM. This increase in emissions relative to the Project, particularly the increase in VOC and NO_x emissions, would require implementation of AMMs, such as use of newer haul trucks with clean-burning diesel engines, but would still have a major adverse effect. GHG emissions described in Impact AQ-2 would remain below SCAQMD and VCAPCD thresholds. TAC emissions related to diesel engines and construction activities as stated in Impact AQ-3 would also incrementally increase, but would remain below thresholds.

Coastal Processes, Sea Level Rise, and Geologic Hazards: Similar to Alternatives 1 and 2, reinforcement of the revetment with 3- to 5-ton armor stone would reduce the potential impacts of coastal processes on existing private improvements, including upgraded OWTS across the majority of the length of the existing 4,100-foot revetment. Erosion of the beach and dunes after cessation of nourishment would continue as described under the Project, with the benefits of nourishment enduring for an estimated 10 to 20 or more years, followed by a reemerging revetment as a result of persistent wave action. Anticipated SLR of approximately 8.5 inches by 2030 would have the same erosion effects described in Impact CP/GEO-8 as the Project, including increased frequency and intensity of storm surges and wave attack. However, after the revetment is exposed, potential impacts of coastal processes on the revetment identified in Impact CP/GEO-2 would be reduced as the revetment would be substantially strengthened by addition of heavier armor stones. Consequently, beneficial impacts to public trust resources identified in Impact CP/GEO-3 (e.g., water quality) due to protection to homes, OWTS, and accessory structures from coastal erosion would be increased. Although, the reengineered revetment would provide long-term protection for existing

development from coastal erosion, its potential relocation further below the OHWM might incrementally alter coastal processes and impact public trust lands.

Similar to the impact of the existing revetment, the reengineered revetment would also impact coastal processes by incrementally increasing wave refraction when exposed and negligibly depriving down coast beaches (e.g., Zuma Beach) of a minor source of sand from dune erosion. However, Impact CP/GEO-7 would remain beneficial as effects of the longshore currents on nourishment and renourishment of sand in the short- to mid-term include both erosion of sand from Broad Beach and accretion of sand at down coast beaches.

The reinforced revetment with larger boulders as coastal armoring would increase the structural stability of the revetment, reducing potential adverse impacts under the Project associated with persistent wave attack. This alternative would substantially reduce the adverse effects associated with Impact CP/GEO-1. However, if the revetment could not be keyed into the bedrock located at 16 feet below ground level, the risk of liquefaction, seismic settlement, and lateral spreading in the event of an earthquake would still exist as described for the Project (SubSurface Designs, Inc. 2006). Impacts CP/GEO-4, CP/GEO-5 and CP/GEO-6 would remain similar to the Project.

Terrestrial Biological Resources: The upgrade and relocation of existing OWTS and the relocation of approximately 1,000 feet of the eastern segment of the existing revetment would require use of heavy cranes and bulldozers that would have major adverse effects on the existing, but often degraded southern foredune habitat fronting the homes along Broad Beach. Although much of the habitat in these areas has been subject to landscaping with non-native and invasive plant species associated with adjacent residential development, this area consists of southern foredunes, a habitat type identified as rare by the CNNDB and the CNPS. Moreover, due to the rarity and biological significance of dune habitat in Southern California, southern foredunes are designated as ESHA under the Malibu City LCP. Upgrade and relocation of the existing OWTS and installation of large boulders in these existing degraded dunes would create major adverse impacts to native southern foredune vegetation and/or sensitive wildlife as stated in Impact TBIO-2. As the revetment would be relocated up to approximately 20 feet further landward in places under this alternative relative to the Project, the relocation and reinforcement of the revetment would substantially increase the impacts to existing degraded southern foredune habitat; however, much of the highest quality remaining dune habitat at the east end of Broad Beach was eroded and destroyed by wave action in the winter of 2013-2014, particular during the storm of March 2, 2014.

Adverse effects to ESHAs resulting from this alternative would be similar to those described in Impact TBIO-1 for the Project. Additionally, due to the upgrade and relocation of OWTS, this alternative would result in even more severe impacts than

Alternative 1 and 2 to remnant dune habitats although this impact would be largely offset by successful dune creation. Impact TBIO-4 may also become more severe due to operation of additional heavy equipment within ESHAs necessary to upgrade and relocate the existing OWTS as well as the revetment. However, the potential beneficial effects of dune restoration associated with Impact TBIO-6 would be less beneficial this alternative, offsetting adverse impacts to existing degraded ESHA. Additionally, requiring shared private coastal access walkways would also substantially reduce disturbance of the proposed dune system as described in TBIO-7, protecting this newly established and restored dune habitats. Impacts TBIO-3 and TBIO-5 would remain similar to the Project.

Recreation and Public Access: This alternative would result in the operation of substantial additional heavy equipment on Broad Beach which would increase short-term adverse effects to public access associated with Impact REC-1. However, while landward relocation of the revetment along the upgraded and relocated leach fields would increase consistency with coastal public use and recreation policies in some locations, particularly east of 30918 Broad Beach Road, in other locations leach field expansion would result in relocation of the revetment seaward, *further* onto public lands. Consequently, under this alternative, the revetment could cover larger areas of public trust land or LAEs than described for the Project. This would result in a major increase in the severity of Impact REC-4. This alternative would be substantially less consistent with coastal polices for recreation and public access.

After the 10- to 20- or more year Project life, nourishment sand would be washed away through erosion and the beach would recede back to the new revetment, leaving little to no dry-sand beach area for recreation without continued renourishment. However, a maximum landward-relocated revetment combined with increased dune width at the east end of Broad Beach would provide limited additional room for public beach use at the east end of Broad Beach, particularly at low and moderate tides. This would decrease the beneficial effects of Impact REC-3. However, this benefit may be offset by less accessible beach on the west end of Broad Beach and by rising sea levels after 2050. In addition, impacts related to backpassing as stated in Impact REC-2 would be similar to the Project.

Marine Water Quality: Unlike the Project or any of the other alternatives, this alternative would see the upgrade of each of the OWTS for many of the residences along Broad Beach Road. This alternative would bring each of the existing systems up to city code and move each of the systems as far landward as practicable. Further, this alternative would include the installation of a properly engineered revetment that would substantially reduce potential impacts to marine water quality. Potential damage to homes, OWTS, and accessory structures from coastal erosion would be reduced and beneficial impacts to public trust resources identified in Impact MWQ-3 would be increased, as the reengineered revetment would provide long-term protection of existing development from coastal erosion. However, leach fields west of 30918 Broad Beach

Road would be located within 15 feet of the wave uprush limit calculated by Moffatt & Nichol (2013). Consequently, after cessation of beach nourishment and erosion of the newly widened beach in 10 to 20 or more years these leach fields may experience splashing or minor seawater intrusion from waves overtopping the improved revetment during large 100-year storm events, which may incrementally impact near shore water quality. However, this would also require waves to erode the overlying seaward end of the dune system.

Further, after cessation of nourishment and erosion of the beach in 10 to 20 or more years, the CSLC would consider disposition of all improvements overlying state sovereign lands and LAEs and would address these issues as part of lease extension or termination. However, while impacts to marine water quality would be substantially reduced under this alternative, Alternative 6 would involve major trade-offs which recreation and public access, as discussed above. All other impacts identified in Section 3.5, *Marine Water Quality* would be similar to the Project.

Utilities and Service Systems: As previously described, this alternative differs from the Project and each of the alternatives in that it includes upgrades and relocation of the OWTS many of the residences along Broad Beach Road. Additionally, similar to Alternative 1 and 2, the alternative would relocate the revetment inland where feasible, though, due to the increase in the size of the upgraded leach fields, the revetment would be extended *further* seaward onto public land in some locations. West of 30918 Broad Beach Road, where landward movement is not possible in front up to 20 residences, the revetment would be redesigned and narrowed, but would still lie partially on or in front of the public lands in these areas, resulting in a major adverse effect to recreation and public access.

This alternative would resolve future potential permitting issues with the city of Malibu and potentially other agencies as properties are reviewed for compliance with city code if repairs or upgrades are made to an existing OWTS. Such repairs are required for major remodels or home expansion and for resale (Ensitu 2013) (see Illustration 4-4).

Illustration 4-4: *This alternative would include the upgrade and landward relocation of OWTS for all residences fronting the Project area (pictured). This would reduce potential adverse impacts associated with water quality and utilities, but would result in major trade-offs with regard to recreation and public access as the revetment would have to be located seaward of the existing location in many areas in order to accommodate additional leach field space.*

Under this alternative, beach nourishment, OWTS upgrades, and, to a greater degree, reinforcement of the existing revetment would reduce potential impacts to Utilities and

Service Systems. This alternative would substantially increase the beneficial impacts associated with UTL-1. Potential damage to OWTS from coastal erosion, and associated indirect impacts to public trust resources identified in Impact UTL-2, including adverse effects to water quality and public use and enjoyment of the beach and ocean would be substantially reduced, as the reinforced revetment would provide long-term protection of OWTS from coastal erosion. However, leach fields west of 30918 Broad Beach Road would be located within 15 feet of the wave uprush limit calculated by Moffatt & Nichol (2013) after cessation of nourishment activities and erosion of the newly widened beach and dune system in 10 to 20 or more years. Consequently, these leach fields may experience splashing or minor seawater intrusion from waves overtopping the improved revetment during large 100-year storm events.

Relocation of the revetment inland would also result in similar public drainage-related impacts of the Project as discussed in Impact UTL-3, as construction of the restored dunes and beach nourishment would bury or obstruct public drainages. Similar to the Project, Impact UTL-3, such impacts would be a minor adverse effect with implementation of AMM UTL-3 (Master Drainage Plan).

Other Resource Areas: This alternative would have similar or incremental changes to impacts in comparison to the Project for scenic resources, marine biological resources, cultural and paleontological resources, noise, public health and safety hazards, traffic and parking, and environmental justice.

Table 4-9. Alternative 6 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
Scenic Resources	No Major Change in Adverse Impacts	Additional construction equipment associated with OWTS upgrade and landward relocation of the revetment may intensify the adverse impacts associated with temporary construction activities, with a slight increase in the severity of adverse effects associated with Impact SR-2. Similar to the Project, permanent authorization of the revetment through a long-term lease and approval of CDPs would create the potential for long-term degradation of the visual environment of Broad Beach after nourishment activities end and natural coastal erosion causes the revetment to become exposed as described in Impact SR-1. All other scenic resource impacts would be similar or slightly increased in comparison to the Project.
Marine Biological Resources	Incremental Decrease in Indirect Adverse Impacts	Placement of sand and potential burial of rocky intertidal and subtidal marine biological resources would have a major adverse effect to intertidal habitats and offshore habitats of Broad Beach similar to the Project as described in Impacts MB-2, MB-3, and MB-4. Additionally, similar to the Project, impacts to down coast habitats would be negligible as discussed in Impact MB-7. However, potential indirect impacts associated with water pollution from damage to OWTS from coastal erosion would be reduced along the length of the

Table 4-9. Alternative 6 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
		existing revetment with improved coastal armoring. Further, this alternative would potentially conflict with the city of Malibu LCP and California Coastal Act policies resulting in increased impacts as stated in MB-8.
Cultural and Paleontological Resources	No Major Change in Adverse Impacts	Disturbance of the near shore environment associated with the OWTS upgrades and landward relocation of the revetment would result in a slightly increased potential to disturb cultural resources, resulting in an additional adverse impact similar in type to Impact CR-1. However, implementation of standard BMPs would reduce this impact. All other cultural and paleontological impacts would be similar to the Project.
Noise	Incremental Increase in Adverse Impacts	A temporary increase in noise due to additional construction activities associated with the landward relocation of the revetment would result in adverse impacts to beach users. Consequently, this alternative would result in slight increases in adverse effects associated with Impact N-1. However, these impacts would be reduced through implementation of AMM N-1a, similar to the Project. All other noise impacts would be similar to the Project.
Public Health and Safety Hazards	No Major Change in Adverse or Beneficial Impacts	This alternative would result in a slight increase in the adverse effects associated with Impact HAZ-2, as the presence of additional heavy construction equipment (i.e., bulldozers, cranes, and haul trucks) would increase the potential for an incidental release of hazardous material on Broad Beach. The increase in construction equipment and construction personnel would also result in increased inaccessibility and hazardous conditions during construction, slightly increasing the severity of adverse effects associated with Impact HAZ-3. These impacts would be reduced through implementation of AMMs HAZ-2, HAZ-3a, and HAZ-3b. All other public health and safety hazard impacts would be similar to the Project.
Traffic and Parking	Incremental Increase in Adverse Impacts	Landward relocation of the revetment would require an estimated 4,500 additional heavy haul truck trips and additional heavy construction equipment and construction personnel, which would likely increase traffic and congestion on PCH and in the Zuma Beach Parking Lot 12, incrementally increasing the severity of the adverse effects associated with Impact TR-1. These impacts would be reduced through implementation of AMM TR-1. All other traffic and parking impacts would be similar or slightly increased in comparison to the Project.
Environmental Justice	No Major Change in Adverse Impacts	There would be no appreciable difference in impacts relative to the Project.

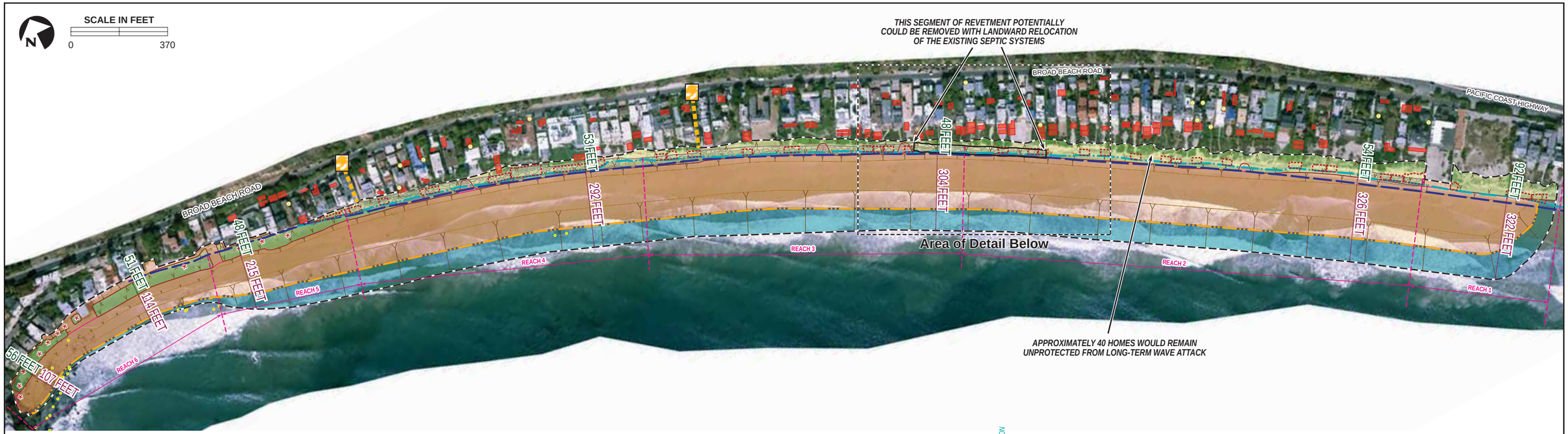
4.2.7 Alternative 7: Removal of Existing Emergency Revetment on the Eastern End of Broad Beach with Beach Nourishment and Restoration

Description

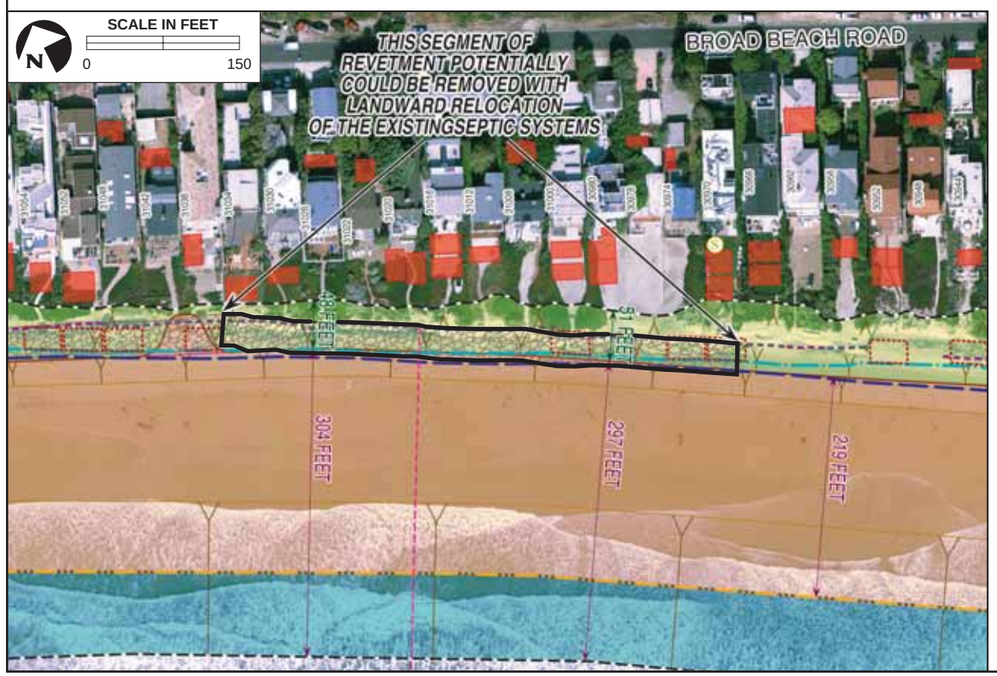
Similar to the Project, this alternative would include beach nourishment, dune creation and restoration across the length of Broad Beach. However, this alternative would include removal of the revetment on the eastern end of Broad Beach. Two different options were considered for Alternative 7. One of which would involve removal of approximately 1,617 feet of revetment on the eastern end with onsite wastewater treatment system (OWTS) upgrades, including septic tanks, leach fields, and/or other treatment infrastructure. The other would involve removal of 1,136 feet, a slightly shorter section of the revetment, without any upgrades to the existing systems. In addition, this alternative would also involve receiving permits for installation of up to 1,617 feet of sand bag revetment at the east end of Broad Beach, if necessitated by severe erosion conditions. The goal of this alternative would be to improve consistency with coastal public access and recreation.

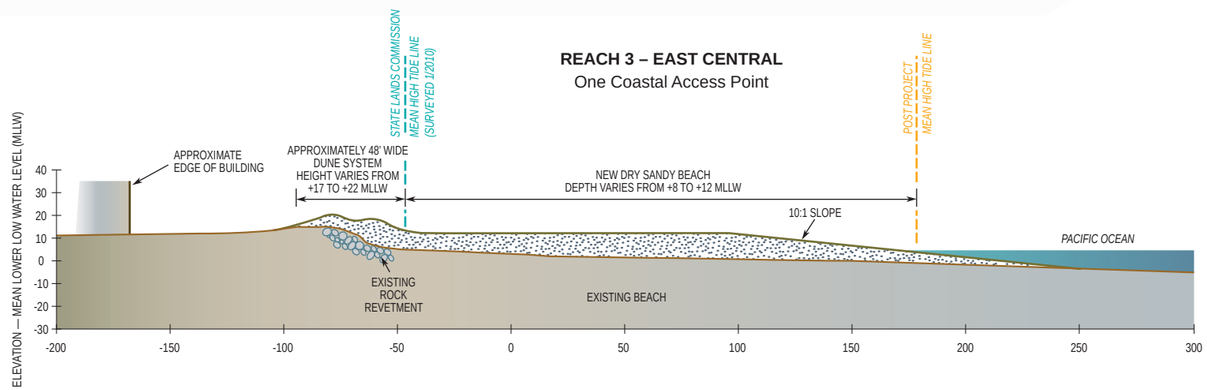
Implementation of this alternative with upgrades to the OWTS on the eastern end of Broad Beach would allow for the removal of approximately 1,617 feet of the revetment, with the remaining 2,483 feet (i.e., 61 percent) being retained in place. Under this option, septic systems and leach fields that could be moved landward would be moved. For added safety, these systems would be located outside of the 15-foot wave uprush line on the eastern end of Broad Beach, as calculated by Moffatt & Nichol (2013). While this alternative is analyzed separately from Alternative 1 and 2, it is possible that Alternative 7 could be combined with one of these alternatives to further remove the retained revetment off public lands. However, as noted in Alternative 2, potential for maximum landward revetment relocation the revetment landward of all LAEs may be limited due to lack of space to accommodate landward OWTS relocation and city code issues.

The second option under Alternative 7 would include removal of the approximately 25 percent of the existing emergency rock and sand bag revetments at the east end of Broad Beach without any upgrades to the existing OWTS. Under this alternative, approximately 1,136 feet of revetment would be removed on the eastern end of Broad beach with the remaining 2,964 feet (i.e., 72 percent) of the existing revetment being retained in place. Moffatt & Nichol (2013) determined that without landward relocation, existing leach fields behind the eastern segment of the revetment would have adequate setbacks to withstand potential short- to mid-term erosion following removal of the revetment in this location.



Detail





LEGEND

- Existing Public Access
- Approximate Limits of Beach Nourishment/ New Beach
- Existing Emergency Revetment to be Permanently Permitted
- Proposed New Dry Sandy Beach
- Proposed New Intertidal Beach Area
- Proposed Restored Dune
- Area of Dune or Beach Face (3:1 and 10:1 slopes)
- State Lands Commission Mean High Tide Line (surveyed 1/2010)
- Applicant Mean High Tide Line (surveyed 10/15/2009)
- Post Project Mean High Tide Line
- Existing Septic Tank
- Existing Leach Field/Drain Field
- Existing Lateral Access Easements (LAEs)
- * Easement on file, but no dry beach to dedicate
- Surf Grass
- ##### Property Address

Note: Beach dimensions and post project average high water line reflect beach status immediately after completion of beach nourishment and construction/shaping activities; the equilibrium beach that would result from dynamics such as waves, tidal and wind action would likely be of somewhat different dimensions.

amec

Removal of the 2012 Emergency Revetment on the Eastern End of Broad Beach with Beach Nourishment and Dune Restoration

FIGURE 4-7

This page reserved for 11X17" figure.