Appendix A
Geomorphic Modeling

ESA

550 Kearny Street
Suite 900
San Francisco, CA 94108
415.262.2300 phone
415.262.2303 fax

www.pwa-ltd.com

memorandum

date July 24, 2013

to Doug George and Bob Battalio

from Elena Vandebroek

subject Technical Methods: A Quantified Conceptual Model of Coastal Evolution

project D211658.00 – San Francisco Littoral Cell Coastal Regional Sediment Management Plan (SF CRSMP)

A quantified conceptual model was developed for assessing the ability of management actions to address coastal erosion along the San Francisco Littoral Cell coastline. This memo summarizes the methods associated with this erosion model. The project study area includes 16 study reaches. Nine of these reaches were selected for in-depth analysis because of high erosion rates combined with heavy development along the coast. The results of this analysis will be provided to the economics team to compare the economic costs and opportunities associated with each management strategy.

Objectives

The purpose of this exercise was to develop an erosion projection model with the following attributes:

1. Simple, transparent methods.
2. Ability to differentiate between coastal management alternatives.
3. Automated process that can be efficiently applied to multiple reaches while still being flexible enough to address unique situations and exceptions.
4. Ability to incorporate impact of sea level rise.
5. Use historic erosion trends and shoreform characteristics specific to each study reach.
6. Output a set of useful, quantified results that can be input to an economic model.

Quantified Conceptual Model

This model tracks the shoreline location, backshore location, and beach width over time. For beaches backed by dunes or structures the backshore location represents the toe of the dune or structure. For reaches backed by bluffs the backshore location is the toe of the bluff. For each 1-year time step the shoreline movement and backshore erosion are calculated using relationships described in the following sections.

Beach Width

The beach width is the distance between the shoreline[1] and the backshore. A starting beach width was estimated for each reach by taking the average distance between the mean high water line[2] and the backshore location as

[1] Assumed to be located at Mean High Water.

observed in recent orthorectified aerial imagery. Subsequent beach widths are calculated based on the relative movement of the shoreline and backshore. If the shoreline erodes more quickly than the backshore then the beach narrows, and vice versa.

Shoreline Movement

Three components contribute to shoreline movement in this quantified conceptual model: landward movement due to sea level rise (SLR), shoreline erosion caused by other coastal processes (e.g. waves, wind, changes in sediment supply), and seaward movement of the shore due to sand placement activities:

$$Shoreline\ Movement = SLR\ transgression + Erosion_{shoreline} + Beach\ Nourishment$$

The impact of sea level rise on shoreline movement is incorporated by assuming that the shoreline will move inland based on the shape of the beach profile and the amount of sea level rise:

$$Sea\ Level\ Rise\ Transgression = \ shoreface\ slope * increase\ in\ sea\ level$$

The shoreface slope is the slope between the backshore toe location out to the estimated depth of closer. At least one representative profile was analyzed for each reach to calculate this value. The profile data came from a digital elevation model developed by USGS using recent high resolution bathymetric and topographic surveys. The sea level rise curve used in this analysis is based on the “High” sea level rise scenario described in recent U.S. Army Corps of Engineers guidance (USACE, 2011). This curve predicts 1.6 feet of sea level rise by 2050 and 5 feet by 2100 (relative to 2000). As the rate of sea level rise increases towards the end of the century, the contribution of sea level rise to shoreline movement will likely be greater than erosion.

Shoreline erosion is specified as a function of beach width. When the beach is nourished the beach widens and the shoreline moves seaward. In this unusually wide beach configuration the shoreline erosion rate is expected to increase (Dean 2002). If the shoreline moves inland (either due to sea level rise or erosion), the beach narrows and shoreline erosion decreases. When the beach width goes to zero, inland shoreline movement stops (but bluff erosion accelerates, as described in the next section) until the beach widens again. An exponential empirical relationship was established between shoreline erosion rate and beach width for each reach that reflects this conceptual model.

$$E_{shoreline}(t) = \min\left(E_{shoreline,historic} * e^{a\left(\frac{BW(t)}{BW_{stable}}-1\right)}, E_{shoreline,max}\right)$$

Where:

$E_{shoreline}$ (t)	= Shoreline erosion at time t
$E_{shoreline,\ historic}$	= Historic shoreline erosion rate
$E_{shoreline,max}$	= Maximum shoreline erosion rate
BW (t)	= Beach width at time t
$BW_{ambient}$	= “Ambient” beach width
a	= calibration parameter that determines how responsive the erosion rate is to beach width

[2] The mean high water line was extracted from a 2010 USGS LiDAR digital elevation model.

Similar exponential relationships have been proposed for existing sand placement projects (Dean, 2002). One assumption is that sand placements are self-similar. Existing studies have shown that an exponential relationship may overestimate the erosion rates (Dette et al 1994). Since very little data exists related to response of shoreline erosion to sand placement, we assume a decay parameter equal to 1. When a reef is implemented, this decay parameter is decreased to 0.5, to account for the reef wave sheltering effect.

An example of this relationship is plotted in **Figure 1**. When the beach width is equal to the ambient beach width then the erosion rate is equal to the long term historic erosion rate. The equation is capped with a maximum erosion rate to acknowledge that there is a limit to how quickly sand can be removed from the beach. A high value of the calibration parameter (a) leads to erosion rates being more responsive to beach width. A value of 0 would result in a constant erosion rate equal to the historic erosion rate, regardless of beach width.

Backshore Erosion

The backshore location is tracked using a similar empirical relationship as the shoreline (see below). However, bluff erosion is expected to have the opposite response to beach width: when the beach width is wide the backshore is expected to erode more slowly than if the beach is narrow, due to the additional protection from waves provided by the wide beach. When the beach becomes narrow, the backshore is expected to erode more quickly due to more frequent wave contact at the backshore toe. Once again, the erosion rate is capped by the maximum backshore erosion rate to acknowledge that the backshore (bluff/cliffs in particular) should have a maximum erosion rate which is a function of geology. Soft, weak bluffs would have a much higher maximum erosion rate than hard, impervious rock.

$$E_{backshore}(t) = \min\left(E_{backshore,historic} * e^{-b\left(\frac{BW(t)}{BW_{stable}}-1\right)}, E_{backshore,max}\right)$$

Where:

$E_{backshore}$ (t)	= Backshore erosion at time t
$E_{backshore, historic}$	= Historic backshore erosion rate
$E_{backshore,max}$	= Maximum backshore erosion rate
BW (t)	= Beach width at time t
$BW_{ambient}$	= “Ambient” beach width
b	= calibration parameter that determines how responsive the erosion rate is to beach width

Again, we assume a decay parameter (b) equal to 1. This value could be modified in more detailed studies with detailed information about how the backshore responds to narrower or wider beaches. Most reaches were relatively insensitive to this parameter.

It is important to note that this model does not address backshore erosion due to terrestrial processes. In particular, landslides in the Daly City bluffs are driven by numerous terrestrial factors (e.g. ground water levels, seismic forces, geology, land use, etc) that are independent of coastal processes and outside the scope of this study. This method was used to project average beach width for the Daly City bluffs, but was not used to develop complete hazard zones. The methods used to develop hazard zones for Daly City are described in the “Landslide Hazard Zones” section below.

Model Application

Management Actions

The quantified conceptual model described above was used to analyze five types of management actions. Up to four of these scenarios were assessed for each study area. For many of the reaches a scenario may combine multiple management actions for a “hybrid” approach. Each of the potential management actions and the associated model input parameters are described below. These descriptions focus on the physical implications of each management action rather than economic implications (which will be discussed in a later memo).

No Action, Hold the Line

This action maintains existing coastal protection infrastructure (seawalls, revetments) where it currently exists. With continued shoreline erosion and the additional impact of sea level rise, the beach will continue to narrow. This action is implemented by setting backshore erosion rate to zero. Some hazard still remains behind the structures due to high velocity flooding and potential for failure during a major (i.e. 100-year) erosion event. For the purposes of this model, presence of a structure is assumed to reduce the erosion of a 100-year erosion event by 50%.

No Action, Allow Erosion

The shoreline and backshore are allowed to erode at a natural rate. As sea level rises, the shoreline erosion is predicted to occur at a higher rate than backshore erosion, resulting in a beach that narrows over time, depending on the maximum permitted bluff erosion rate.

Managed Retreat

From a physical modeling perspective, this management action is very similar to *No Action, Allow Erosion*. One additional input parameter is the “permitted erosion distance,” which caps backshore movement to a set value in situations where the inland movement is limited.

Sand placement

Sand placement is implemented in the model by moving the shoreline seaward by the sand placement width (50 or 100 feet, depending on the reach/scenario). Sand placements are triggered at the beginning of the model and every subsequent time the beach reaches a “minimum beach width”. A “hold the line” option is still specified. If the intent of sand placement is to maintain a beach and slow backshore erosion, then the backshore is still allowed to erode (but erodes at a slower rate due to a wider beach width). If the intent of the sand placement is to maintain a wide beach in front of a seawall or development that cannot be moved, then backshore erosion is prevented (at an increased cost).

A minimum time between sand placements can be specified to address realistic limitations in sediment availability and construction feasibility. If the beach reaches the minimum beach width, but not enough time has elapsed since the last sand placement, then the beach becomes narrower than the minimum beach width until the required time has passed. If the backshore condition is to “hold-the-line” then this could potentially mean having no beach for some time. For many of the reaches, shoreline movement caused by accelerated sea level rise causes more rapid beach narrowing towards the end of the century, which triggers more frequent sand placements but still narrower beaches.

Sand placement with Offshore Reefs

The sand placement component of this management option is treated in the same manner as described in *Sand placement*, above. Offshore reefs are implemented in the model by adjusting the empirical relationship between erosion rate and beach width, historic erosion rate, and ambient beach width. Offshore reefs have successfully demonstrated the ability to widen the beach through formation of a salient (widening of the beach) along the beach behind the reef (Mead 2009, Black 2000). The beach reaches a new, wider equilibrium. This is implemented in the conceptual model by increasing the "ambient beach width" in the empirical relationships described previously. Another benefit of offshore reefs is the wave sheltering effect. Ignoring sea level rise, the future erosion rates are expected to decrease because of the added protection provided through wave dissipation at the reef. This is implemented in the model by decreasing the erosion rates in the empirical relationships described previously.

Limited data exist to quantify the extent to which offshore reefs would change shoreline movement rates, especially with the contribution of sea level rise. In general, a consistent approach was chosen for all reaches in the absence of robust data availability.

Example Application

The following figures show an example of how this conceptual model can be applied, as well as the types of outputs available for subsequent analyses. Please see the preceding sections for a description of how this conceptual model works and how various management actions are implemented.

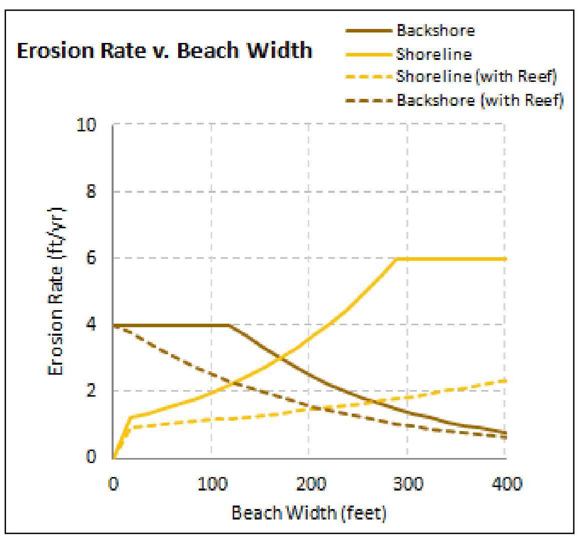


Figure 1: Example of Empirical Relationships between Erosion Rate and Beach Width. In this example the existing beach width is 170 feet. The historic shoreline and backshore erosion rates are both 3 ft/year (high erosion rate). When a reef is added, the ambient beach width is assumed to widen by 25% to 213 feet, and the shoreline and backshore erosion rates are decreased to 1.5 ft/year.

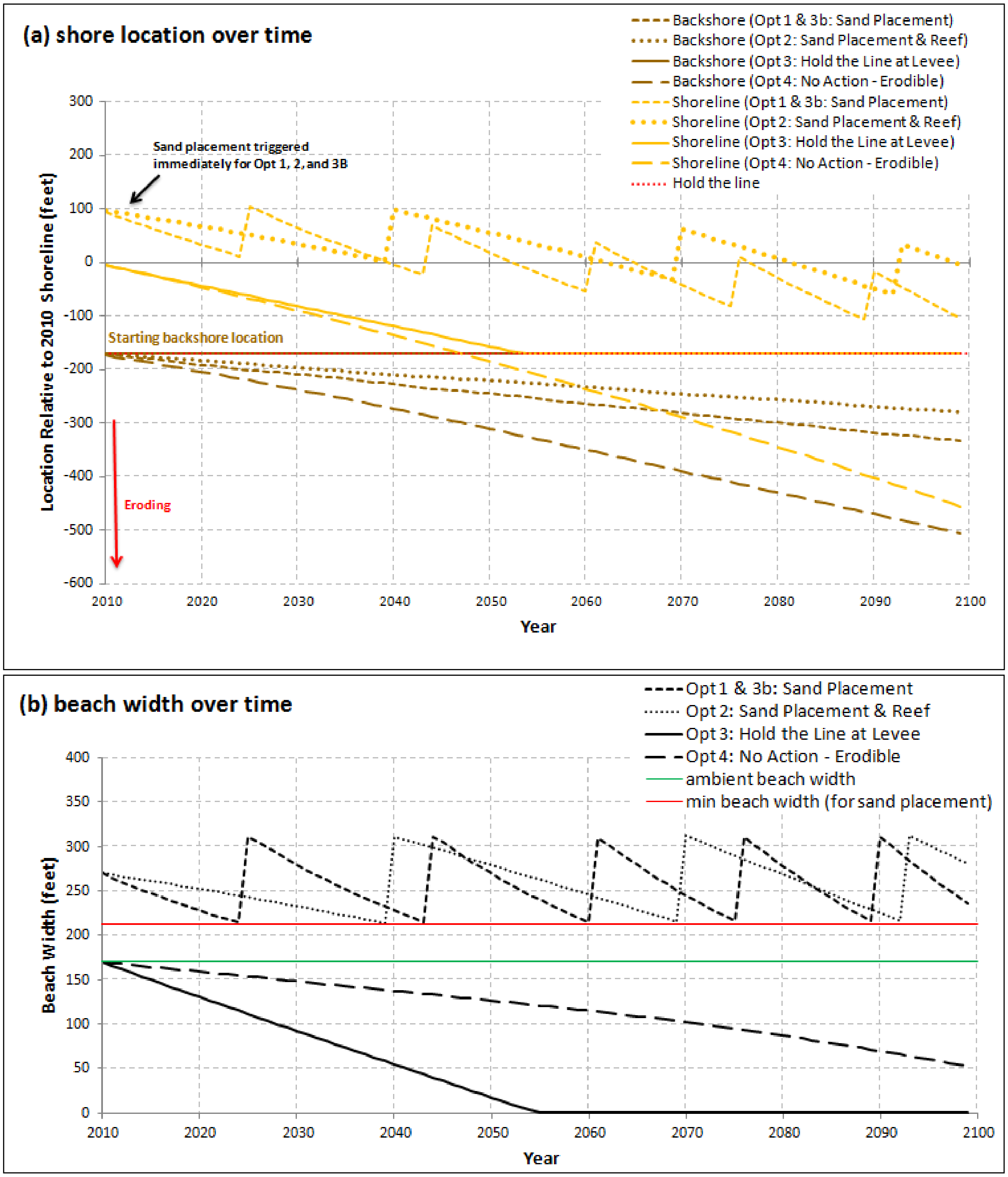


Figure 2: Example of shoreline, backshore, and beach width over time. (a) For the hold-the-line scenario, the shoreline erodes until the beach width reaches zero (see **b**). If sand placement is implemented at the start of the model, the shore erodes more rapidly at first due to the un-naturally wide beach. In this example, backshore erosion is allowed to occur for both sand placement scenarios. Sand placement in combination with an offshore reef results in less rapid erosion initially because the beach is more stable in its wider state. Sand placements are triggered when the minimum beach width is reached (see **b**). The sand placement is triggered later in time with an offshore reef. Additionally, backshore erosion occurs more slowly with a reef in place. **(b)** For the hold-the-line scenario, the beach narrows until there is no longer a beach. When sand placement is implemented, the beach narrows more quickly at first, due to the unnaturally wide beach. With a reef the beach narrows less quickly and reaches the trigger beach width later in time.

Limitations

1. Lack of site-specific data to use as inputs and to calibrate the conceptual model. In particular:
    - Impact of offshore reefs on erosion rates, especially in combination with sea level rise.
    - Relationship of beach width to shoreline erosion and backshore erosion has been qualitatively observed, but limited data exist to calibrate the empirical relationships.
    - Maximum erosion rates for shorelines, dunes, and bluffs. For bluffs this likely depends on geology while shorelines are far more dependent on sediment supply and wave processes (see limitation #2).
2. Not a hydrodynamic or sediment transport model.
3. Does not address erosion caused by terrestrial processes (i.e. landslides), which likely pose a greater threat than incremental annual shoreline erosion where they are prone to happen.
4. Hazard zone algorithm is fairly simple.

Outputs

The following outputs are extracted from the model for each reach and scenario. These outputs were chosen for their utility as inputs to the economic assessment.

- *Description*: Brief description of the model scenario.
- *Mechanism*: More detailed description of management scenario.
- *Sand Placement Frequency*: Number of sand placements triggered between 2010 and 2100, and the years that those placements are triggered.
- *Long Term Backshore Erosion*: Erosion that occurs at the back of the beach by 2050 and by 2100.
- *Average Beach Width*: The average annual beach width between 2010 and 2050, and the average annual beach width between 2050 and 2100. The beach widths are averaged over these time periods because nourishment activities lead to significant beach width variation from year to year, so taking the beach width at 2050 or 2100 might not be representative of the average conditions.
- *Storm-Induced Erosion*: Amount of erosion that could occur at the back of the beach during a large (i.e. 100-year) erosion event. This is adjusted if there is a shoreline protection structure or offshore reef for inclusion in the total hazard zone.
- *Reef or Structure*?: This field marks whether or not a reef or structure is present. This is used in determining the impact of a 100-year storm. If either are present, the 100-year storm impact is assumed to be 50% less.
- *Offset (toe to crest)*: This is the horizontal distance between the toe and crest of the backshore (dune, bluff, cliff, seawall, or revetment). This value is assumed to stay constant over time and is included in the total hazard zone.
- *Total Coastal Erosion Hazard Zone*: The distance from the reference toe line (backshore toe location in year 2010) to the inland extent of the erosion hazard. This value is calculated from the backshore erosion, storm-induced erosion, and offset using the method described below.
- Figure of shoreline and backshore locations over time (see example in **Figure 2a**).
- Figure of beach width over time (see example in **Figure 2b**).

Converting Projected Erosion into Hazard Zones

Erosion hazard zones will be used to analyze the economic impacts of various management scenarios. The final erosion hazard zones for each reach are shown in Figure 3. This section describes how the mapped hazard zone is derived from the shoreline modeling (described above).

A backshore toe line was identified using recent aerial imagery and digital elevation model in GIS. This line was offset by the hazard distance to generate a hazard zone.

The hazard zone for reaches not prone to landslide failures was developed using the following relation:

$$HZ_{non-landslide} = E_{backshore} + \text{Offset}_{geometric} + E_{storm}$$

Where:

$HZ_{non-landslide}$	= Hazard zone width for non landslide areas, relative to existing backshore toe location
$E_{backshore}$	= Backshore erosion at time t
$\text{Offset}_{geometric}$	= Horizontal distance from backshore toe to crest (i.e. bluff crest relative to toe)
E_{storm}	= Erosion potentially caused by a large storm (for dunes, calculated for a 100-year event)

The following sections describe how the geometric offset and 100-year storm erosion were derived. There is also a section describing how erosion hazard zones were developed for landslide-prone areas.

Geometric Offset

For dune- and armor-backed areas the geometric offset was estimated by identifying the toe and crest location in one or more representative profiles and measuring the horizontal distance between them. For bluff-backed areas, the offset distance was estimated as the average bluff height (vertical distance between toe and crest, as identified in LiDAR) converted to a horizontal distance based on a stable slope of 2:1, which corresponds to a low to moderately stable coastal bluff (Griggs and Savoy, 1985).

Storm Impact Area

The100-year storm impact distances were developed starting with the erosion hazard zones developed in a previous study (PWA 2009, Revell et al 2011). Since the earlier study did not consider beach width or management actions, these storm hazard distances were adjusted based on beach widths, as follows:

1. An average storm hazard distance was calculated for each of the study reaches using storm set-back distances from PWA 2009 and Revell et al 2011. This set-back distance for dune-backed shorelines was calculated using the geometric model of foredune erosion proposed by Komar et al (1999). This model uses the foreshore slope to convert the 100-year total water level to a new toe location (further inland). The set-back distance for bluff-backed shorelines was calculated using two standard deviations of the historic erosion rates for each geologic unit multiplied by the time elapsed.

2. The mean beach width was calculated for each reach for the 2010 - 2050 and 2010 - 2100 time periods, based on the shoreline/backshore modeling described previously. The change between the starting and future beach width was used to adjust the storm hazard impact. For example, if the beach was an average of 30 feet wider in the future (because of sand placement, etc), then the 100-year impact zone was

decreased by 30 feet. If the beach was 30 feet narrower, the 100-year impact zone was increased by 30 feet.

3. The storm hazard distances were capped at 100-feet to account for the fact that storms have a finite duration and ability to transport sediment.

4. When a scenario calls for reef construction or maintenance of a seawall, the storm impact area is assumed to be 50% smaller (the storm hazard zone adjustment is equal to 0.5), to reflect the added protection. The economics analysis will compare the costs of constructing/maintaining these structures with the benefit reflected in the smaller 100 year hazard area.

Landslide Hazard Zones

The shoreline along Daly City is characterized by large, complex, and rotational landslides. Landslide failures in these areas are largely driven by terrestrial processes (groundwater levels, geology, landslides, land use, etc.) rather than coastal processes. Applying a simple erosion model driven by beach width (as described above) would not address the main factors causing erosion in this area. This section describes a different method which was applied to develop hazard zones for Daly City.

Ten representative transects were geomorphically interpreted to measure block failure widths. On more than half of the representative transects at least two block failures were identified. Based on these measurements block failure widths averaged 312 feet +/- 77 feet. One standard deviation was added to the average block failure width to represent the uncertainties in the method (total = 389 feet).

To delineate the hazard zones, the active bluff edge was determined using a break in slope derived from the 2009 - 2011 Statewide LiDAR digital elevation model. This bluff edge was buffered by 389 feet and 701 feet to produce hazard zones representing one and two landslide block failures. The first block failure width inland of the active bluff edge is the high hazard zone (used to represent the 2050 hazard zone) and the second block failure width represents the moderate hazard zone (used to represent the 2100 hazard zone).

This method was based on coastal hazard mapping experiences in Oregon for landslide backed shorelines (Marra, 1995). The formation of a headscarp was evident in many of the representative transects. This is an early indication of the next block failure. A second failure was included in the hazard zone delineation because a majority of interpreted profiles showed two to three historic failures. It is possible that a third block failure, outside of the mapped hazard zones, could be activated, especially along the highest bluffs or in the event of a large earthquake.

Although the landslide hazard zones will be the same for all scenarios, sand placement would provide for a wider beach, which will provide some economic benefit. Beach widths were tracked using similar methods applied at other reaches.

References

Black, K. (2000). Artificial Surfing Reefs for Erosion Control and Amenity: Theory and Application. Journal of Coastal Research: ICS 2000 Proceedings.

Dean, R. (2002). Beach Nourishment Theory and Practice. Advanced Series on Ocean Engineering – Volume 18. World Scientific.

Dette, H. H. A. Fuhrboter, and A. Raudkivi (1994). Interdependence of beach fill volumes and repetition intervals. Journal of Waterway, Port, Coastal, and Ocean Engineering, ASCE 120(6), pp. 580-593.

Griggs, G.B. and L.E. Savoy, (1985). Living With the California Coast: Durham, North Carolina, Duke University Press. 393 p.

Marra (1995). Littoral Cell Management Planning in Oregon. Technical Report to Department of Land Conservation and Development.

Mead, S.T. (2009). Multiple-Use Options for Coastal Structures: Unifying Amenity, Coastal Protection and Marine Ecology. Reef Journal 1:1:pg 291.

PWA (2009). "California Coastal Erosion Response to Sea Level Rise - Analysis and Mapping." Prepared for the Pacific Institute.

Revell, D.L., R.Battalio, B. Spear, P. Ruggiero, and J. Vandever, (2011). A Methodology for Predicting Future Coastal Hazards due to Sea-Level Rise on the California Coast. Climatic Change 109:S251-S276. DOI 10.1007/s10584-011-0315-2.

USACE, 2011. *Sea-Level Change Considerations for Civil Works Programs*. US Army Corps of Engineers, EC 1165-2-212.

Appendix B
Detailed Coastal Hazard Maps

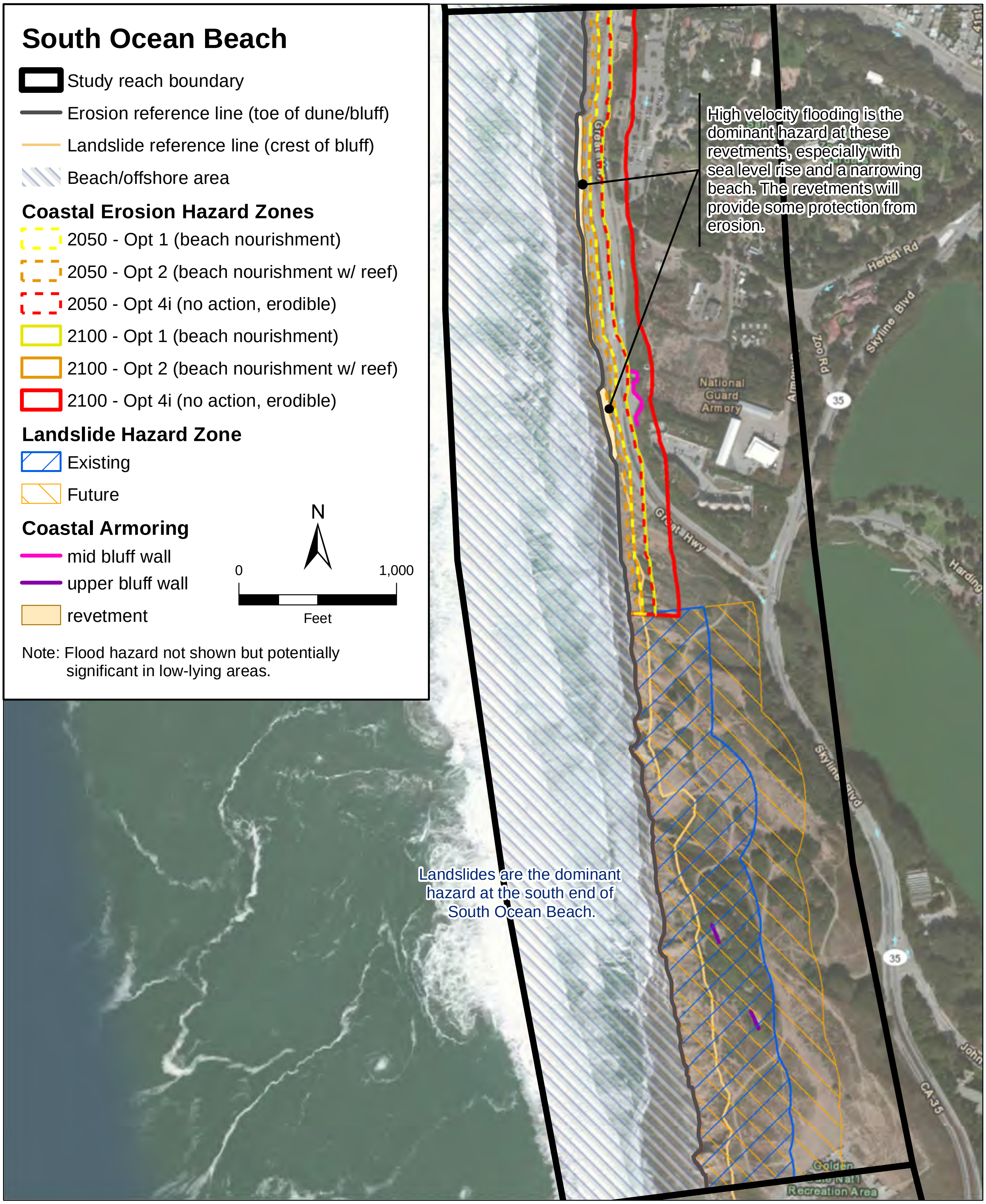
ESA

San Francisco Littoral Cell Coastal RSM Plan . 211658.00

Figure A-2.1

Coastal Erosion Hazard Zones: Middle Ocean Beach

G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_Sep2013\HZs_1_MOB.mxd
9/16/2013



San Francisco Littoral Cell Coastal RSM Plan . 211658.00

Figure A-2.2

Coastal Erosion Hazard Zones: South Ocean Beach

Service Layer Credits: Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_Sep2013\HZs_2_SOB.mxd
9/16/2013

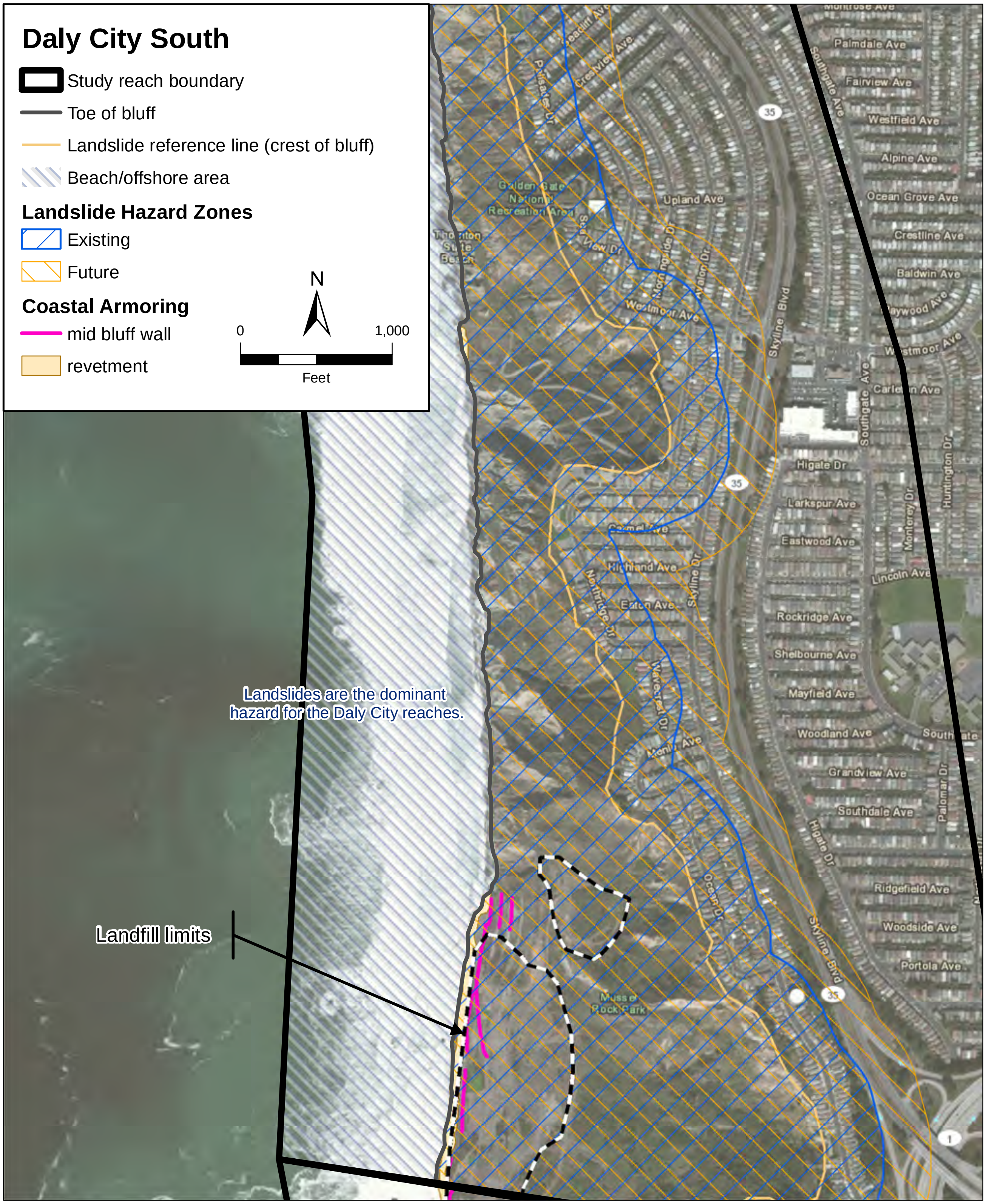
Service Layer Credits: Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

San Francisco Littoral Cell Coastal RSM Plan . 211658.00

Figure A-2.3

Landslide Hazard Zones: Daly City North

G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_May2013\HZs_3_DalyCityNorth_v2.mxd
9/16/2013



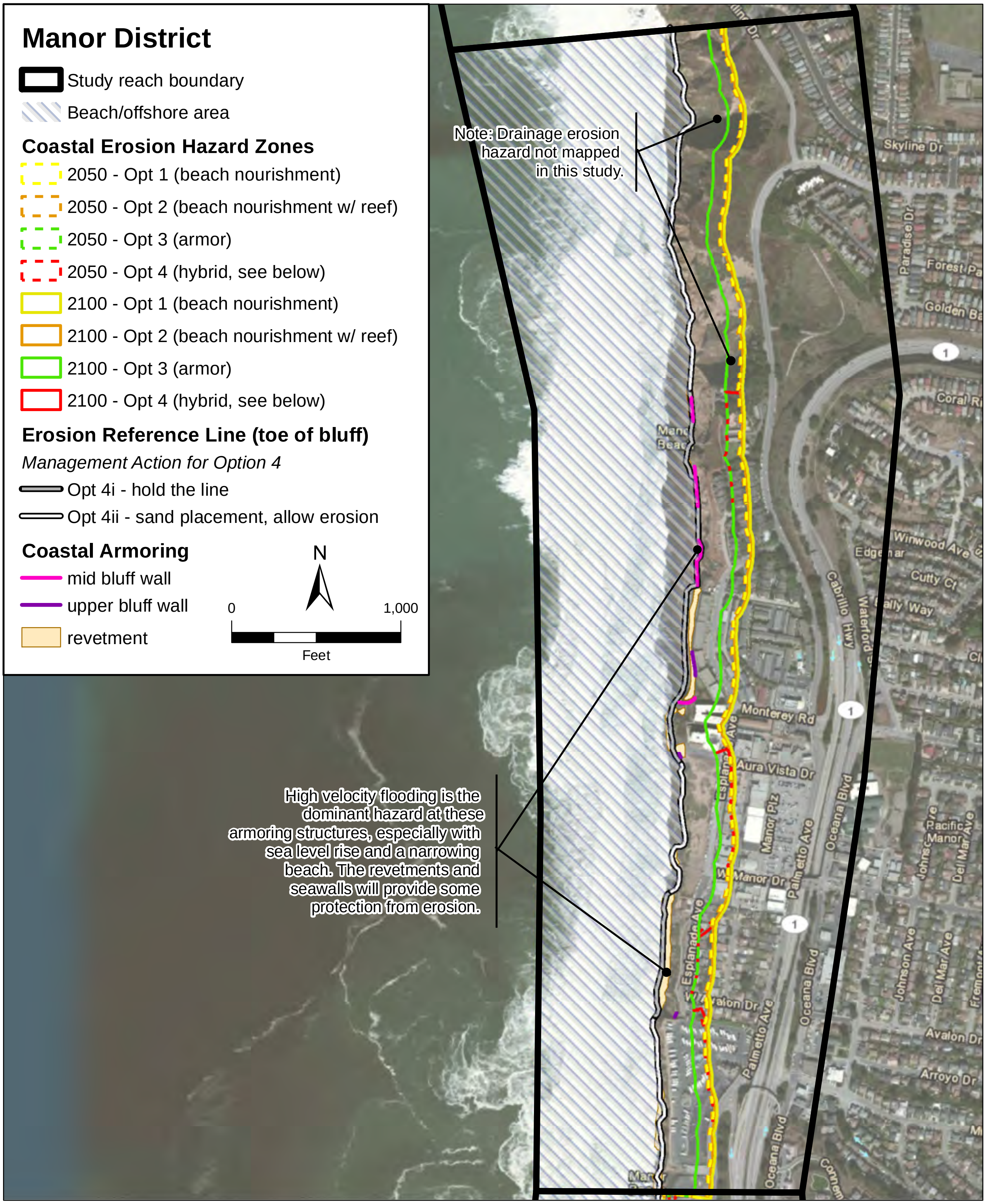
San Francisco Littoral Cell Coastal RSM Plan . 211658.00

Figure A-2.4

Landslide Hazard Zones: Daly City South

Service Layer Credits: Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_May2013\HZs_4_DalyCitySouth_v2.mxd
9/16/2013



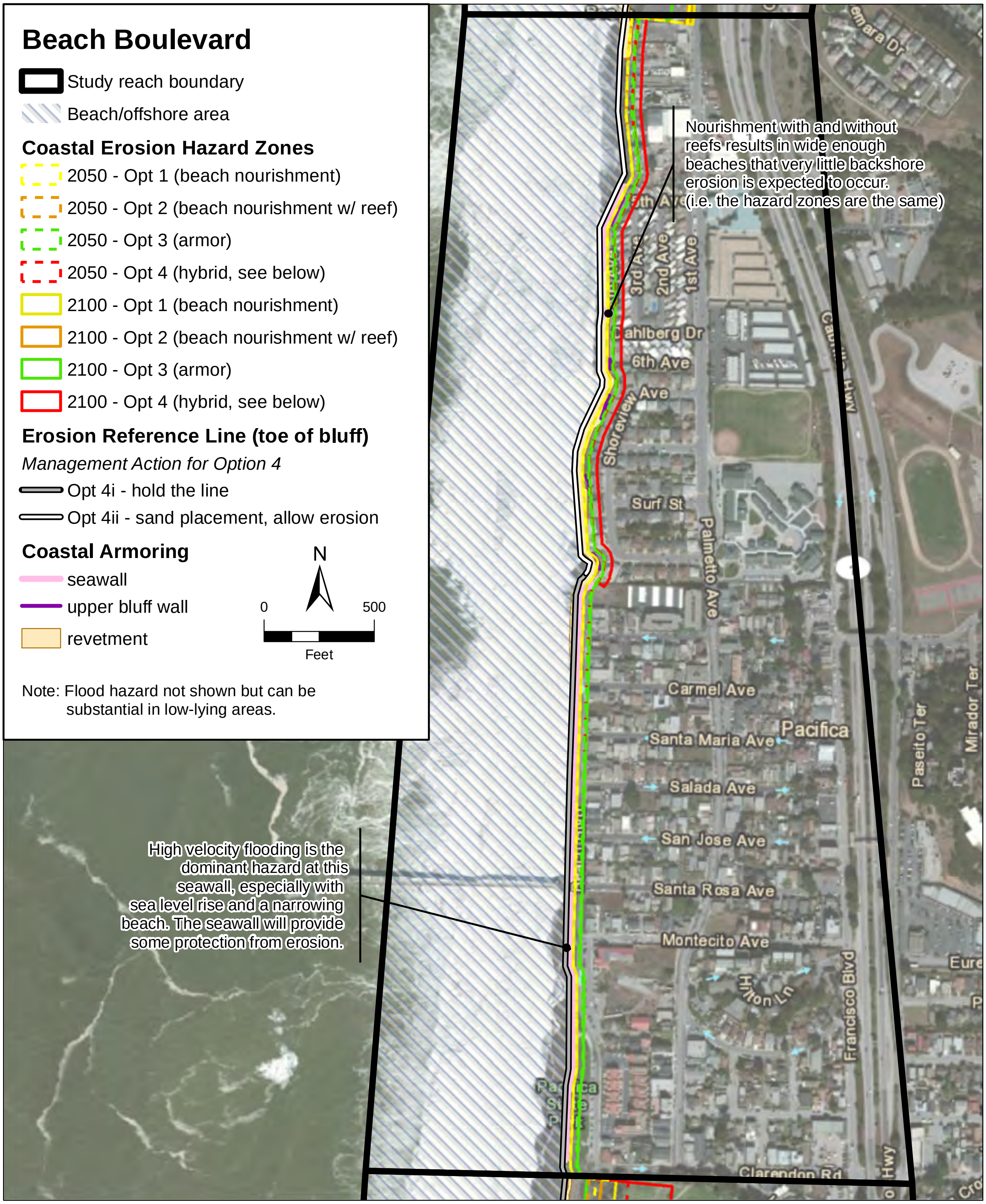
Service Layer Credits: Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

San Francisco Littoral Cell Coastal RSM Plan . 211658.00

Figure A-2.5

Coastal Erosion Hazard Zones: Manor District

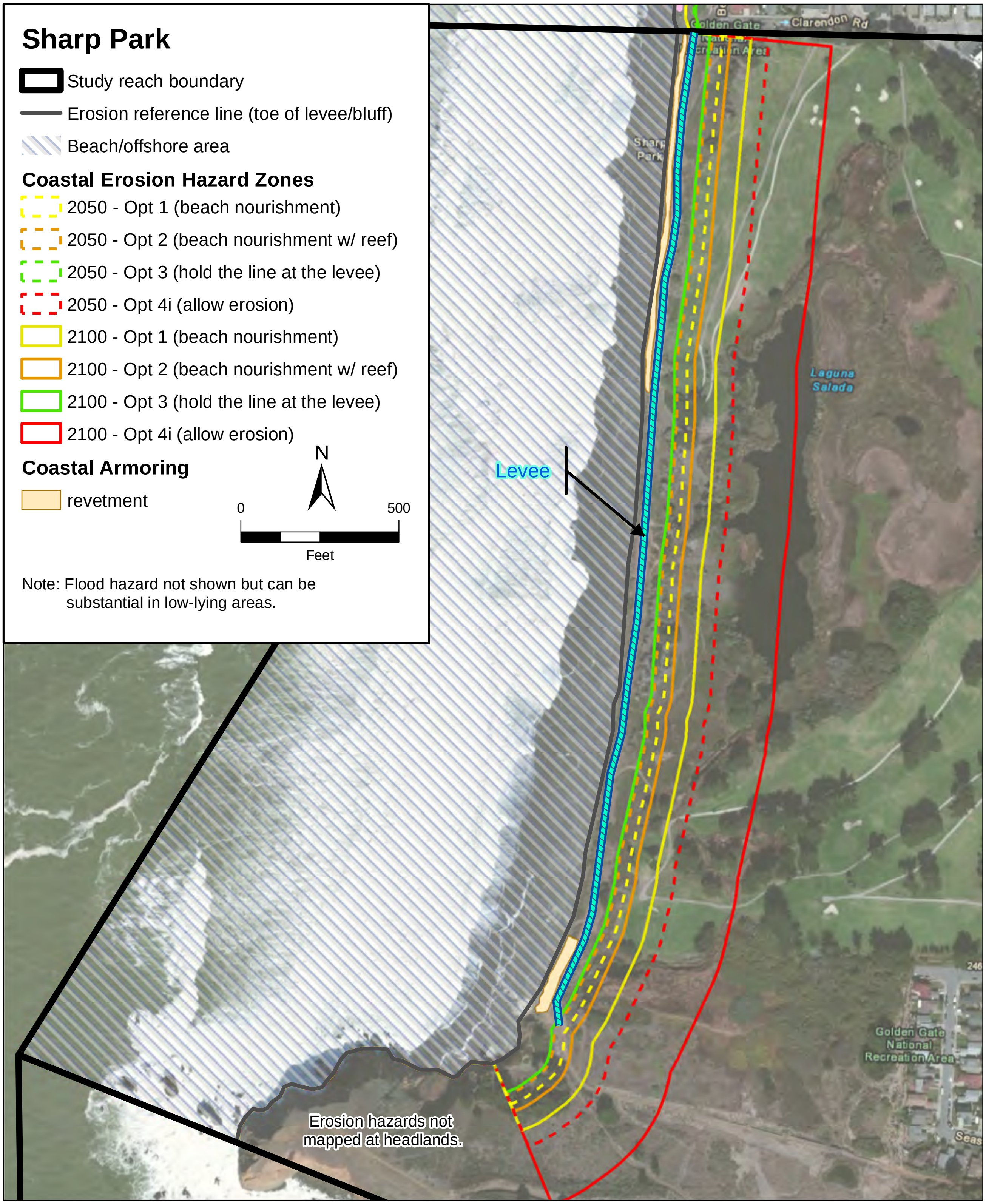
G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_Sep2013\HZs_5_Manor.mxd
9/16/2013



Service Layer Credits: Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure A-2.6
Coastal Erosion Hazard Zones: Beach Boulevard

G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_Sep2013\HZs_6_BeachBlvd.mxd
9/16/2013



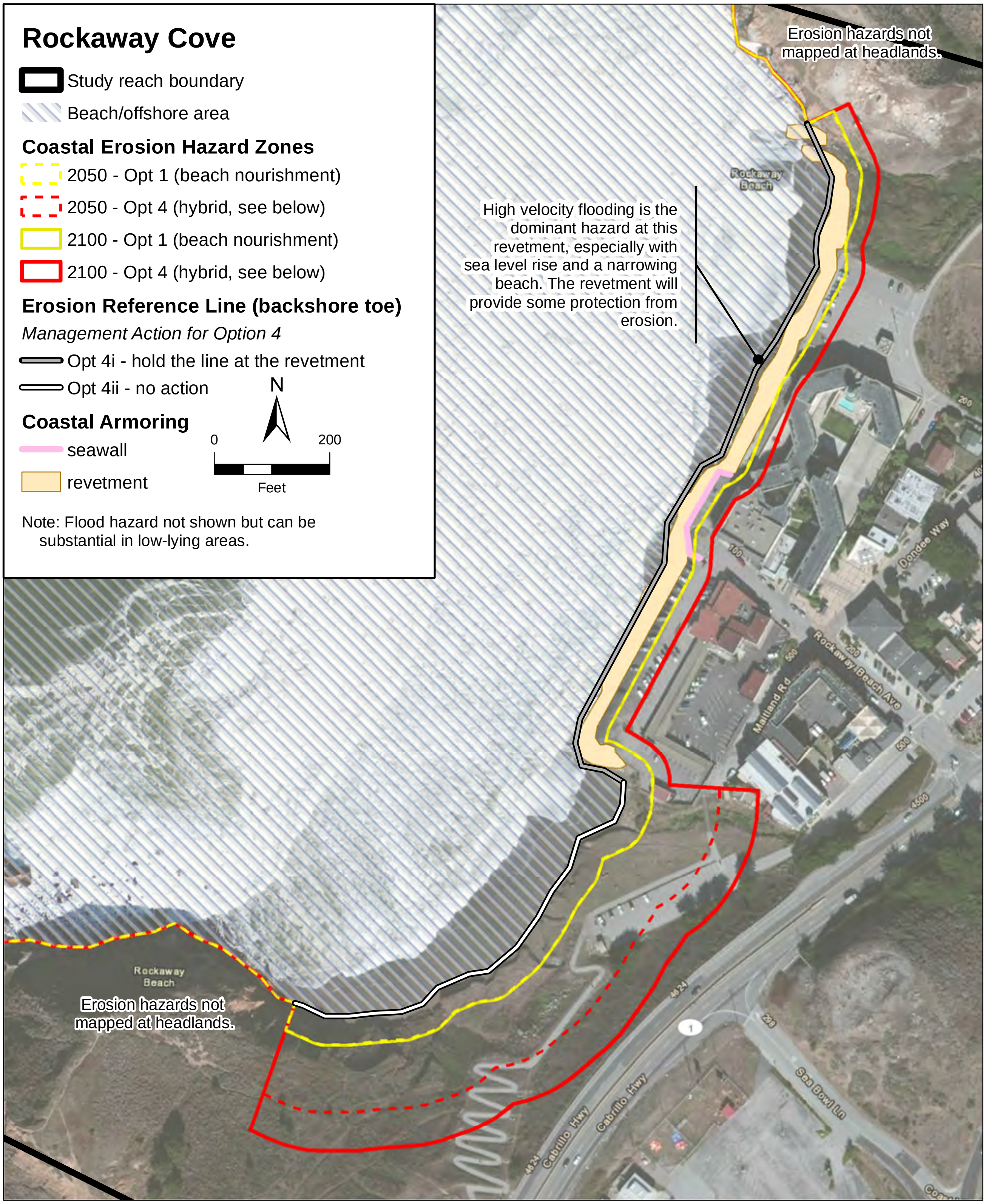
Service Layer Credits: Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

San Francisco Littoral Cell Coastal RSM Plan . 211658.00

Figure A-2.7

Coastal Erosion Hazard Zones: Sharp Park

G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_Sep2013\HZs_7_SharpPark.mxd
9/16/2013



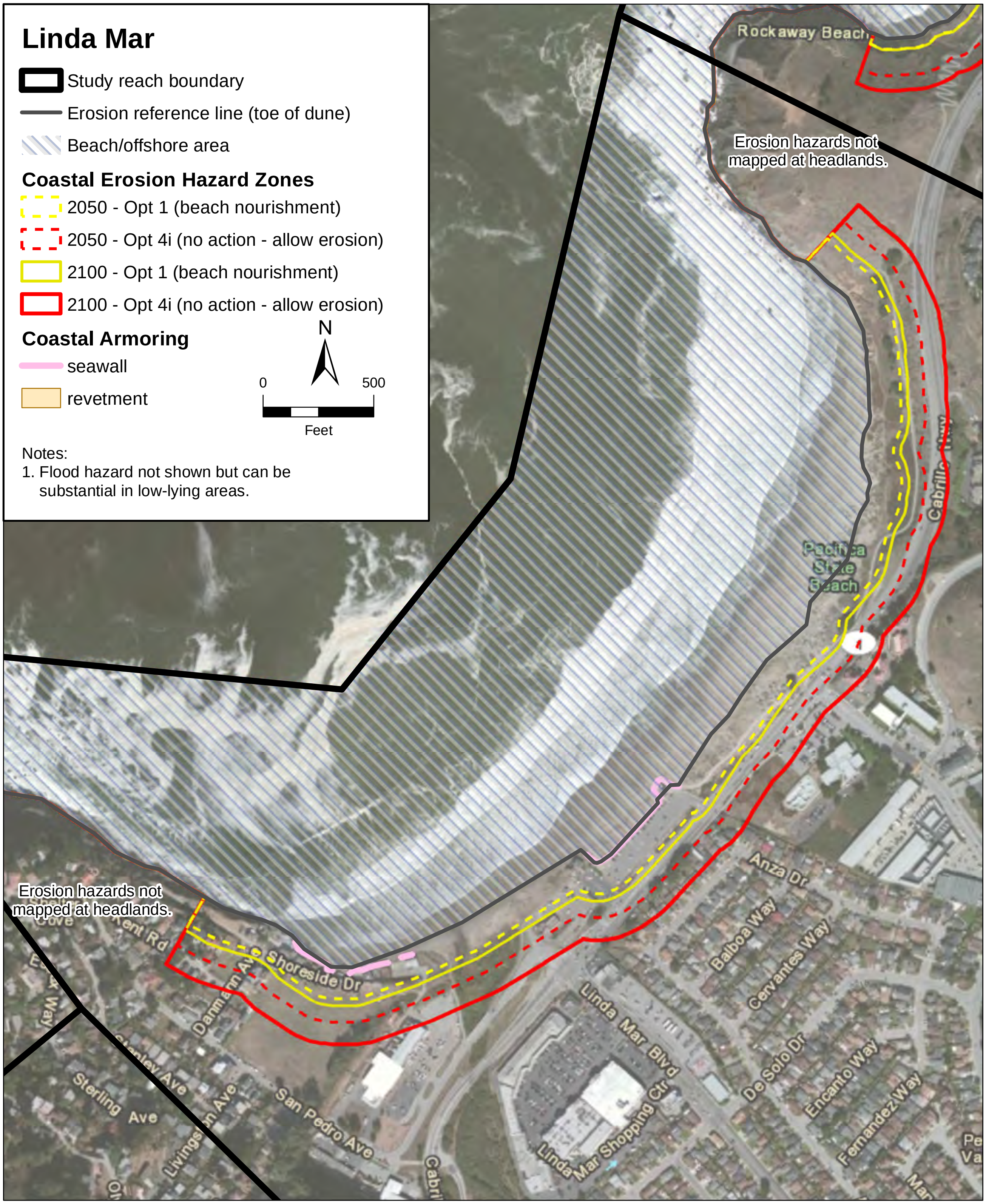
Service Layer Credits: Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

San Francisco Littoral Cell Coastal RSM Plan . 211658.00

Figure A-2.8

Coastal Erosion Hazard Zones: Rockaway Cove

G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_Sep2013\HZs_8_Rockaway.mxd
9/16/2013



San Francisco Littoral Cell Coastal RSM Plan . 211658.00

Figure A-2.9

Coastal Erosion Hazard Zones: Linda Mar

G:\211658.00_SFLitCellCRSMP\MXDs\Figuremaps\RevisedHZs_Sep2013\HZs_9_LindaMar.mxd
9/16/2013

Appendix C
Biological Assessment

ESA

SAN FRANCISCO PENINSULA COASTAL HABITAT SEGMENTS

Geographic scope: The scope of terrestrial coastal habitats considered for the study area is based on the potential significant biological effect zone of natural physical processes closely linked with shoreline retreat and related physical processes, as well as the backshore zone that would be affected by engineered shoreline structures or soft engineering adaptations. The ecologically significant natural physical processes affecting terrestrial coastal communities may include as slope processes (erosion, slope failure), sand transport, and wave overwash and seawater flooding of lowland, wetland or aquatic backshore habitats. The distance landward of the shoreline considered to be within the scope of background biology is therefore variable according to the distribution of existing habitats, and the physical reach of shoreline processes. The seaward extent of the study area (nearshore) is also based on an approximation of potential effects area of natural physical processes of shoreline retreat, or artificial structures or sediment management (e.g. turbidity plumes from bluff erosion or artificial sediment placement, vessel traffic). The study area can be objectively divided into natural, discrete coastal landscape units based on ecological and geomorphic settings, or ecogeomorphic units, modified by urban shoreline development. These are classified and described below as a framework for assessing potential impacts of sediment management strategies, based on a long-term, dynamic perspective on coastal habitat distributions and dynamics.

SEAL ROCKS HABITATS

Seal Rocks are steep, supratidal emergent islands of resistant Franciscan bedrock (San Bruno Mountain terrane, Franciscan graywacke; Schlocker et al. 1974, Sloan 2006). The local place-name Point Lobos refers to the Spanish name for sea-lion (sea-wolf), indicating early historic haul-out sites that have recently been re-occupied (Kay 2009). Historic records of surfgrass (*Phyllospadix torreyi*) are known from Point Lobos and Lands End from the late 19th and mid-20th century (Howell *et al*. 1958; Consortium of California Herbaria 2012) are known from Point Lobos, and surfgrass is presumed to be present in suitable rocky subtidal and low-intertidal habitat there.

Offshore islands, offshore rocks, and mainland cliffs on the San Francisco shoreline have provided historic nesting, roosting and foraging habitat for pelagic birds and shorebirds such as Brandt's cormorant (*Phalacrocorax penicillatus*), wandering tattler (*Tringa incana*), black oystercatcher (*Haematopus moquini*), and western gull (*Larus occidentalis*), among others. As their name suggests, Seal Rocks and Point Lobos are historically important haul-out sites for California sea lions (*Zalophus californianus*) and harbor seals (*Phoca vitulina*).

OCEAN BEACH HABITATS

Ocean Beach is the seaward remnant of the vast Holocene San Francisco dune sheet that mantled what is now the completely urbanized Sunset and Richmond districts (Cooper 1967). Most of Ocean Beach is backed by a constructed sand ridge planted with European beachgrass (*Ammophila arenaria*) in the mid-1980s, on which wind-blown sand has formed coastal dunes along its crest and seaward of wave-eroded dune scarps. Ocean Beach sand is well-sorted fine-medium sand that forms a wide, dissipative intertidal beach profile that is subject to strong wind deflation and onshore transport to form dunes. Two segments of Ocean Beach (Balboa to Lincoln Avenue, and Noriega to Santiago Avenue) are backed by seawalls.

The vegetation of Ocean Beach/Great Highway foredunes is a mostly unmanaged non-native dune vegetation (planted and invasive), with inclusions of unmanaged native dune vegetation. Spontaneous formation of foredunes has occurred along the Noriega-Santiago seawall-backed beach segments, in association with establishment of native (beach wildrye, *Elymus mollis*; beach-bur, *Ambrosia chamissonis*; yellow sand-verbena, *Abronia latifolia*; beach saltbush, Atriplex leucophylla) and non-native (European beachgrass; sea-rocket, *Cakile maritima*) beach and dune vegetation tolerant of rapid sand accretion and salt spray. Intensive trampling and beach grading appear to limit vegetation establishment in the broad sandy backshore of the Balboa-Lincoln seawall Ocean Beach segment. Beach grading has recently eliminated foredune vegetation and landforms of the Noriega-Santiago beach segment.

An extensive foredune dominated by native beach wildrye established in the 1990s along the broad backshore beach profile seaward of the constructed foredune between Irving and Judah. An erosional remnant stand of beach wildrye also occurs south of the Noriega-Santiago seawall. South of Judah, persistent erosional trends have precluded persistence of native dune vegetation seaward of the constructed foredune ridge. A wave-cut scarp, and temporary wind-deposited sand ramps occur along the seaward margin of the constructed dune ridge from approximately Lawton south to Sloat Boulevard, where boulder armor protection has been placed areas of intensive shoreline retreat, extending to the northern end of the Fort Funston bluffs.

The crest of the constructed foredune has developed lobes and mounds peaks approximately 2-6 m thick composed of wind-blown dune sand, mostly trapped by European beachgrass. Funnel-shaped gaps in beachgrass cover, fanning towards the beach, occur opposite most pedestrian crossing stoplights, where trampling is intensive. Many of the pedestrian-influenced dune vegetation gaps are associated with local blowouts and unvegetated dune lobes formed by unimpeded wind-transport of sand through trampled vegetation gaps. Between zones of active blowouts, the stabilized vegetated surface of the constructed dune ridge bordering Great Highway is dominated by iceplant (*Carpobrotus edulis*, *C. edulis* x *chilensis*), and diffuse populations of native dune annuals (*Camissoniopsis cheiranthifolia*; including native subspecies *cheiranthifolia* and intermediates between native subspecies *cheiranthifolia* and introduced southern California subspecies *suffruticosa*). Many non-native weeds are established in small vegetation gaps among iceplant along the Great Highway. Non-native shrubs and trees (*Myoporum laetum*, *Acacia* sp.) and some native shrubs (coyote brush, *Baccharis pilularis*; Monterey cypress, *Hesperocyparis macrocarpa*) have also established infrequently in stable lee slopes of the constructed Great Highway foredune. The last known natural (not planted) population of the regionally uncommon silvery beach-pea, *Lathyrus littoralis*, was located near the historic mouth of Lake Merced's ocean outlet at the south end of Ocean Beach.

The backshore (supratidal) beach above daily high tide lines, seaward of perennial dune vegetation, supports limited cover by tidal litter (marine macroalgae, driftwood, plastic litter) and a European beach plant (annual to weakly perennial), sea-rocket (*Cakile maritima*). The width of the backshore beach zone varies along Ocean Beach, generally narrowing southward, often reduced to intertidal foreshore south of Sloat. The intertidal foreshore supports seasonally abundant populations of amphipods (invertebrates) on which shorebirds feed, including abundant beachoppers (*Traskorchestia traskiana*) and less abundant mole crabs (*Emerita analoga*) and annelids. Intertidal sand foreshores also support diatom biofilms on which shorebirds feed. Large concentrations of sand dollar (*Dendraster excentricus*) whole shell and fragment deposits are exposed episodically on Ocean Beach near Riviera-Santiago streets, suggesting the presence of persistent local populations in the nearshore zone.

Wildlife use of sandy beach habitat is predominantly by resident and migratory shorebirds that roost and forage between the water's edge and back beach areas. With the exception of western snowy plover, no shorebirds breed on sandy beaches in California and a few species such as killdeer (*Charadrius vociferus*) may breed locally to the coast, but not immediately on the beach. Common shorebirds that forage on clams, worms, and crustaceans on the beach include western sandpiper (*Calidris mauri*), sanderling (*C. alba*), willet (*Catoptrophus semipalmatus*), black-belied plover (*Pluvialis squatarola*), and western snowy plover (*Charadrius alexandrinus nivosus*), among many others. Located on the Pacific Flyway, Ocean Beach serves as an important stopover for the Pacific Flyway, the west coast bird migrations route, and supports seasonally diverse bird populations.

The developed neighborhood and recreational beach users inadvertently provide shelter and foraging opportunities for several native and introduced urban wildlife species. Such animals as raccoon (*Procyon lotor*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), and feral cats benefit from the widespread availability of food sources and cover.

FORT FUNSTON SANDY BLUFFS & CLIMBING DUNE HABITATS

Fort Funston support high wave-cut bluffs in weakly consolidated, uplifted, tilted beds of ancient yellow-brown (iron oxide-weathered) sandy beach, dune and shallow marine sediments (Colma and underlying Merced formation), contrasting with the bright gray-white marine beach sand of Ocean Beach. The bluffs increase in elevation southward to the Daly City border. Wind deflation of the wave-cut scarp in the high sandy bluffs of Fort Funston supplies the limited amount of dune sand that is transported to the active dunes landward of the bluff crest. The perched dunes on the uplifted marine terrace have long been effectively disconnected from modern beach sources of dune sand, and lack any beach-foredune interactions, in contrast with Ocean Beach. The local climbing dune sheet varies from a thin veneer over the marine terrace at the south end of Fort Funston, to thick, high relict dunes bordering at the north end, some of which remain active and semi-mobile blowouts and dune lobes. The topographic relief and thickness of the Fort Funston dunes diminishes southward. Most of the Fort Funston dunes have been stabilized by either native or non-native vegetation.

The coastal bluff (scarp) slopes expose Colma and Merced formation sediments subject to cyclic disturbance (slope failure and surface erosion from undercutting, slumps, gully and rill erosion, earthflow) and colonization, mostly by native and non-native vegetation derived from the blufftop edge, which rains down vegetative fragments and seeds on the slopes below. The extent and composition of bluff face vegetation is strongly influenced by the rate of shoreline retreat, which controls undercutting and slope failure. During periods of slow shoreline retreat between strong storm erosion events, iceplant spreads clonally and increases in relative abundance.

The mobile dunes at the north end of the Fort Funston support a mix of native dune vegetation that is adapted to the highly mobile sand transport regime there, which invades remnants of older stable dunes vegetated with a matrix of non-native trees and scrub (still prevalent along Skyline Boulevard). The mobile dunes support native dune vegetation tolerant of sand burial, many of which occur in the foredunes of Ocean beach (beach-bur, yellow sand-verbena, beach wildrye), as well as non-native plants tolerant of moderate accretion, such as iceplant.

The non-native stabilized dune vegetation matrix is composed of the typical historic San Francisco dune stabilization planting of blue gum (*Eucalyptus globulus*), acacia (*A. longifolia, A. melanoxylon, A. decurrens*), iceplant (*Carpobrotus edulis, C. edulis* x *chilensis*), Monterey cypress (*Hesperocyparis macrocarpa*), but even these contain variable assemblages of native dune plant species. Extensive areas dominated by mixed stands of iceplant and non-native annual grasses, or iceplant and common native shrubs (coyote-brush, *Baccharis pilularis,* bush lupine, *Lupinus arboreus*), associated with variable density of diverse native and non-native forbs and low-growing shrubs, are widespread in seaward and southern portions of the Fort Funston marine terrace, particularly where recreational impacts (trampling disturbances, nutrient deposition) are intensive.

Despite widespread occurrence of dominant non-native iceplant mats in Fort Funston dunes, significant populations of native dune scrub plant species have persisted or regenerated interspersed within the iceplant matrix. In addition, Fort Funston also supports important extensive and expanded (restored) stabilized old San Francisco old remnants of the largest remaining high-diversity native dune scrub vegetation stands on the San Francisco Peninsula.

These have been enhanced and expanded by GGNRA. The Fort Funston native dune scrub stands are related but distinct in composition compared with analogous examples in the Presidio (Baker Beach, Lobos Dunes) and interior San Francisco (Grandview Park, Hawk Hill, Sunset Heights).

Some of the characteristic plant species of relatively intact dune scrub vegetation of Fort Funston have very limited distribution on the San Francisco Peninsula and Central coast, (co-occurring in assemblages narrowly associated with older stable dunes). These old dune indicator species assemblages at Fort Funston include dune shrubs such as mock-heather (*Ericameria ericoides*; some of the largest remaining stands on the San Francisco Peninsula), and Chamisso lupine (*Lupinus chamissonis*); uncommon dune grassland elements including Pacific and creeping wildrye intermediates (*Elymus pacificus* and *E. triticoides*); perennial coastal dune forbs such as sand-mat (*Cardionema ramossisimum*), Indian-paintbrush (*Castilleja affinis* and intermediates with *C. wightii*), gumplant (*Grindelia stricta* var. *platyphylla*), cobweb thistle (*Cirsium occidentale* var. *occidentale*), Franciscan wallflower (*Erysimum franciscanum*) beach strawberry (*Fragaria chiloensis*), dune knotweed (*Polygonum paronychia*), dune tansy (*Tanacetum bipinnatum*); coast dudleya (*Dudleya farinosa*); and native annual forbs including ruby chalice clarkia (*Clarkia rubicunda*), San Francisco spineflower (*Chorizanthe cuspidata*), and woolly lotus (*Lotus heermanii* var. *orbicularis),* as well as most other elements of the native forb flora of historic San Francisco dune scrub vegetation*.* The old dune soils associated with locally high densities of co-occurring native dune scrub species contain buried dormant seed banks, soil microorganisms (fungi, bacteria, nematodes). These old successional dune scrub remnants represent some of the last opportunities for recovery of the federally endangered San Francisco lessingia (*Lessingia germanorum*) and its associated species in its southern recovery unit, where the last known population is currently threatened by development (USFWS 2003).

The Fort Funston climbing dune remnants are not static plant communities, and are subject to internal dynamics (blowouts, competitive interactions, disturbances from trampling, spontaneous vegetative stabilization and succession) over decades. Fort Funston dune vegetation is directly influenced by physical processes driven by shoreline retreat rates (bluff slope failure and erosional loss of dune habitat near the bluff edge). Indirect ecological influence of physical shoreline retreat may be even more significant and far-reaching in the long-term, particularly the physical process interactions between rate of bluff retreat, by exposure of unvegetated bluff sand subject to wind deflation, and onshore wind-transport rates of sand landward over the crest. Sand accretion rates and blowout activity strongly influence the species composition and diversity of native dune plant communities: relatively few dune scrub species are tolerant of even moderate rates of sand accretion.

The backshore (supratidal) fringing beach habitat along Fort Funston bluffs is generally very narrow, subject to wave runup during spring tides, with no emergent high tide beach during winter months in many headland areas.

The state-listed threatened bank swallow (*Riparia riparia*) nests in a single portion of the CRSMP study area, in the coastal bluffs at Fort Funston and Lake Merced. The sandy bluffs at Fort Funston are highly prone to shoreline erosion, which can cause substantial loss of active and inactive nesting areas. Since formal monitoring of the bank swallow colony began in 1993, population trends are near historic lows due to the rapid shoreline retreat and associated bluff slope failure.

MERCED BLUFF & LANDSLIDES HABITATS

At the south end of Fort Funston, where bluff elevations rise to nearly 180 ft, bluffs are increasingly dominated by large unstable landslides and slumps in cohesive, clayey sediments with relatively smaller amounts overlying sand; the bluff slope morphology and vegetation diminishes rapidly south of Fort Funston. The landslides, earthflows, and gullies north and south of Thornton State Beach, Daly City, expose frequent seeps, small spring, active earthflows, and gullies associated with local wetland and riparian vegetation and habitats, as well as a complex mosaic of native and non-native coastal scrub vegetation, distinct from dune habitat and vegetation of Fort Funston. Coastal scrub composition in the Daly City landslides is affected by high levels of natural soil disturbance and abundance of urban-edge non-native vegetation. Common to abundant plants include iceplant (*Carpobrotus* spp.), coyote brush (*Baccharis pilularis*), bush lupine (*Lupinus arboreus*), lizard-tail (*Eriophyllum staechedifolium*), *Acacia* spp., jubata grass (*Cortaderia jubata*) and cape ivy (*Delairea odorata*), manroot (*Marah fabaceus*), and poison-oak (*Toxicondendron diversilobum*). Non-native weeds comprise a significant, often dominant proportion of terrestrial vegetation in the disturbed bluffs. No relict stands of predominantly native, old coastal scrub are known to persist in the unstable landslide complex. Wetland and riparian patches with summer-mesic to saturated soils in seeps and drainages include stands of willow (*Salix lasiolepis*), seep monkeyflower (*Mimulus guttatus*), Himalayan blackberry (*Rubus armeniacus*), New Zealand spinach (*Tetragonia expansa*), radish (*Raphanus raphanistrum*), and rush species (J*uncus bufonius, J. phaeocephalus, J. lescurii*). The landslide-dominated coastal scrub and local wetland communities extend to the armored, stabilized slopes north of Mussel Rock.

MUSSEL ROCK CLIFF HABITATS

Mussel Rock cliffs near the Pacifica/Daly City border mark the transition to relatively more stable coastal bluff scrub habitat with higher native species diversity than the active landslides of Daly City slopes. The bluff toe is armored, and the bluff habitats above are relatively insensitive to shoreline retreat processes compared with the unarmored soft sediment bluffs to the north and south of Mussel Rock.

NORTH PACIFICA SAND BLUFF & CLIMBING DUNE HABITATS

South of Mussel Rock in Pacifica, the coastal bluff top near the north end of Palmetto Avenue supports one of the two largest remaining old climbing dune scrub habitats stands in Pacifica, including the only one with both persistent active blowouts and coastal scrub vegetation. The bluffs here also support landslide scarps with active groundwater seeps and slope wetlands. The wetlands include a hanging scarp wall with a seasonal to perennial groundwater-fed surface flows (waterfall to seep face), and consolidated willow-dominated riparian thickets (Arroyo willow, *Salix lasiolepis;* California waxmyrtle*, Myrica californica;* twinberry*, Ledebouria involucrata;* bee-plant*, Scrophularia californica*) and peripheral slope marsh patches (slough sedge, *Carex obnupta*; rushes, *Juncus lescurii, J. effusus*; Indian thistle, *Cirsium brevistylum*; stinging nettle, *Urtica dioica*). The dune scrub stands include blowouts bordered by early-succession dune forbs and grassland including Pacific wildrye and creeping wildrye populations (*Elymus pacificus, E. triticoides*), maritime brome (*Bromus carinatus*), beach evening-primrose (*Camisoniopsis cheiranthifolia*), beach strawberry (*Fragaria chiloensis*), dune bluegrass (*Poa douglasii*), varied lupine (*Lupinus variicolor*), as well as stable dune scrub elements (coyote-brush, *Baccharis pilularis*, dune knotweed, *Polygonum paronychia*), and deerweed (*Lotus scoparius*).

A separate, smaller climbing dune remnant occurs on the undeveloped blufftop parcel along Esplanade Avenue near Manor. This remnant has a distinct early succession coastal bluff scrub phase, including the only remaining natural population of silvery beach pea (*Lathyrus littoralis*) on the San Francisco peninsula, and one of the largest natural (not planted) populations of beach wildrye (*Elymus mollis*). These occur mixed with a population of Chamisso lupine (*Lupinus chamissonis*), yellow sand-verbena (*Abronia latifolia*), beach strawberry (*Fragaria chiloensis*), beach-bur (*Ambrosia chamissonis*) and iceplant (*Carpobrotus edulis* x *chilensis*).

SALADA BEACH /LAGUNA SALADA WETLAND AND BARRIER BEACH HABITATS

At Laguna Salada (Sharp Park), the marine terrace slopes below sea level, creating a broad coastal lowland and valley gradient associated with Sanchez Creek. This is the location of a historic barrier beach and backbarrier lagoon wetland complex (Laguna Salada), formed by impoundment of freshwater runoff from the local watershed, and intermittent marine overwash, establishing a fresh-brackish nontidal wetland gradient (ESA- PWA 2010). Laguna Salada is the only one of the three historic lagoon ecosystems of the San Francisco Peninsula (Lake Merced, Laguna Salada, and the former San Pedro Valley lagoon) that retains both extensive native wetland plant communities and hydrologic connections to the Pacific Ocean through its barrier beach.

Salada Beach is a currently steep, coarse-grained, reflective beach that lacks the wide, dissipative medium-fine grained low tide terrace characteristic of Ocean Beach. The relative lack of intertidal space and foraging time restricts its habitat value for migratory shorebirds. The prevalence of coarse sand at the beach surface strongly restricts onshore wind-transport of sand today, and there is no significant foredune or sand shadow deposition along the beach crest or berm. A narrow fringe of mixed native foredune vegetation (mostly beach-bur) and non-native beach and upland weeds (sea-rocket, iceplant) occupies the toe of the erosional earthen berm in remaining exposed segments where rock armor has not been placed. Gulls and ravens are the most frequent birds on the beach, but Caspian terns that forage on fish in the lagoon also occasionally roost on Salada Beach. Marbled godwits, willets are also present on Salada Beach, but in relatively small numbers compared with flatter, wider finer-grained Linda Mar and Ocean Beach-Daly City sandy foreshores.

The modern Laguna Salada is an artificially drained managed pond (water surface elevations normally drawn down to near or below +7.0 ft NAVD due to pump discharge of beach-impounded freshwater inflows), with nearly most storm overwash excluded by an earthen berm constructed along the barrier beach crest. The lagoon wetlands are oligohaline (fresh-brackish, 2-4 parts per thousand salinity) despite flushing of freshwater inflows, due to residual sediment salinity, beach groundwater salt seepage, and evaporation. Most of the remaining unfilled portions of Laguna Salada's historic open water bed is managed (drained) to relatively stable, shallow water depth range that have allowed extensive encroachment of tule and cattail vegetation up to the depth of their flooding tolerance (approximately between 3-4 ft mean water depth).

Fresh-brackish emergent nontidal fringing marsh of the lagoon is mostly dominated by native tules (*Schoenoplectus californicus*, with local stands of *S. acutus*) and cattails (native *Typha latifolia*, European *T. angustifolia*), bordered by bulrush and rush (*Schoenoplectus pungens, Juncus lescurii*) and marsh silverweed (*Potentilla anserina*). The same dominant emergent marsh species that fringe the lagoon today were present during the agricultural phase of the lagoon's development, prior to golf course construction (ESA-PWA 2010). The seaward marsh edge grades into coastal scrub and iceplant-dominated vegetation; the landward marsh vegetation edge is routinely mown to the height of turgrass, with which it intergrades. No submerged aquatic vegetation has recently been detected at Laguna Salada, but it formerly supported submersed beds of wigeongrass (*Ruppia maritima*) and sago pondweed (*Stuckenia pectinata*) as recently as mid-20th century.

The mouth of Sanchez Creek discharges to Laguna Salada at the south end (Horse Stable Pond), through a dense willow riparian thicket (*Salix lasiolepis*). Local brackish marsh (pickleweed, *Sarcocornia pacifica*; saltgrass, *Distichlis spicata*; and fleshy jaumea , *Jaumea carnosa*) occurs along the seaward edge of an old sandy washover fan a the central western shore of the lagoon, apparently influenced by seasonal beach groundwater seepage that also causes intermittent salt efflorescence and turfgrass dieback behind the berm (ESA-PWA 2010).

The eastern fringing marsh, Horse Stable Pond, and lower Sanchez Creek and riparian wetlands of Laguna Salada support a substantial breeding population of federally listed threatened California red-legged frog (*Rana draytonii*), as well as Sierra chorus/Pacific tree frog (*Pseudacris sierra*). The federally listed endangered San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) inhabits the fringing marsh and adjacent upland and riparian habitats of Laguna Salada. The California red-legged frog and San Francisco Garter snake populations extend to a series of artificially constructed freshwater ponds (fringing freshwater marsh and submerged aquatic vegetation) bordering Laguna Salada at the toe of Mori Point slopes, on GGNRA lands. In addition to the California red-legged frog and San Francisco Garter Snake, Laguna Salada wetland complex supports other special-status species and species of conservation concern, including the northwestern pond turtle *(Clemmys marmorata)*, San Francisco forktail damselfly *(Ischnura gemina)*, salt marsh common yellowthroat *(Geothlypus trichas)* and the dusky-footed woodrat *(Neotoma fuscipes)*.

The landward end of the Laguna Salada wetland gradient (the freshwater end of the fresh-brackish lagoon wetland gradient) is occupied by an earthen fill of golf course originally constructed in the drained lagoon margins in the 1930s, and still in use. The western end of the lagoon and barrier beach has reverted to wetland and sandy beach-dune habitats formed on washover fans that buried former sections of turfgrass. The remnants of the Salada Beach barrier beach (relict washover terrace and low dune mounds) occur behind the earthen berm with patchy boulder armor that serves as a public trail along the beach crest. The washover terrace supports a skeletal “forest” of mostly dead Monterey cypress (*Hesperocyparis macrocarpa*), extensive, dominant iceplant (*Carpobrotus*) mats, and patches of dune grassland (*Elymus mollis*), saltgrass (*Distichlis spicata*), and small amounts of native coastal scrub.

There are currently no data on fish assemblages in Laguna Salada, but threespine stickleback have been observed stranded in the pump outfall pool on the beach. Caspian tern foraging over the remaining open water areas of the lagoon in summer indicates the presence of substantial small forage fish populations. Great egrets, snowy egrets, and great blue herons also forage along marsh edges of the lagoon.

Laguna Salada wetland complex supports the highest concentration of special-status wetland wildlife species on the San Francisco Peninsula coast. The barrier beach and lagoon ecosystem that supports them is inherently subject to coastal geomorphic and fluvial processes (overwash, barrier narrowing and landward transgression/rollover, lagoon fluvial flooding and breaching) associated with shoreline retreat.

MORI POINT HABITATS

Mori Point (GGNRA) is a relatively resistant high rocky headland south of Laguna Salada, capped with non-resistant sediments and weak sandstones. Mori Point coastal habitats include nearshore emergent rocks, rocky intertidal habitats, coastal bluff scrub, and coastal grassland habitats. Seasonal freshwater wetland ponds have been constructed on and eastern plateau to support local foraging habitat for endangered San Francisco Garter Snakes. The coastal bluff grassland at Mori Point supports the largest populations of Nuttall’s milkvetch (*Astragalus nuttallii*) and California saltbush (*Atriplex californica*) on the San Francisco Peninsula. The dynamics of coastal bluff habitats of Mori Point are relatively less sensitive to shoreline retreat processes (compared with Fort Funston and North Pacifica bluffs) because of the relatively resistant bedrock geology at the toe of the bluffs. Localized erosion and slope failure at the north end of Mori Point's unconsolidated sandy headland, however, appears to be related to the recurrent winter saturation and streamflow of the Laguna Salada pump outfall, which forms a backbeach channel that often deflects south against the bluff toe.

At the south end of Mori Point, Calera Creek forms a local freshwater marsh behind its narrow boulder-choked outlet to Rockaway Beach. The marsh is supplied with perennial freshwater discharges of treated wastewater. Red-sided garter snakes and San Francisco Garter snakes both occur along the marsh edge and adjacent uplands. The freshwater marsh is dominated by California tule (*Schoenoplectus californicus*), with chairmaker bulrush (*S. americanus*) and small-fruited bulrush (*Scirpus microcarpus*) and broadleaf cattail (*Typha latifolia*) abundant along the shallower edges. Horned pondweed (*Zannichellia palustris*) occurs locally in the bed of the creek. Mallard ducks frequently forage in the marsh, and the presence of ducklings some years suggests that breeding habitat is likely to recur.

ROCKAWAY BEACH AND HEAD HABITATS

Rockaway Beach is a steep, reflective, coarse-grained pocket beach between Mori Point and Rockaway Head. Like Salada Beach, it lacks a broad low tide terrace, but shorebird foraging habitat does occur, particularly in association with headland wave-sheltered extreme ends of the beach.

Rockaway Head is another relatively erosion-resistant headland like Mori Point, but its north-facing slope supports a well-preserved local ancient dune deposit with dune scrub remnants similar to those of Fort Funston and North Pacifica blufftop dunes. The mesa-like top of Rockaway Head also supports native species-rich coastal grassland remnants on sandstone, including an atypical and uncommon coastal bluff population of an annual paintbrush (*Castilleja densiflora*), and extensive Wight's paintbrush (*C. wightii*). Rockaway Head, like Mori Point, is similarly relatively resistant to erosional shoreline retreat compared with the soft sandy sediments of North Pacifica bluffs. The rocky intertidal zone of Rockaway Head supports intertidal and shallow subtidal surfgrass meadows (*Phyllospadix* sp.) at the extreme north end of Linda Mar Beach, similar to the meadows at the south end of the beach.

LINDA MAR BEACH HABITATS

Linda Mar Beach (Pacifica State Beach) is a fringing pocket beach in the head of a shallow embayment formed between two headlands, Pedro Point and Rockaway Head. It was formerly a barrier beach enclosing a lagoon wetland complex and floodplain of San Pedro Valley, now filled and urbanized except along the channelized creek. Linda Mar Beach varies from medium-fine to coarse grained sand, forming a distinct berm profile with a relatively steep beachface. A cobble-boulder storm berm underlies the south end of the beach, exposed as a lag surface following storms, and locally in the intertidal erosional "delta" of the San Pedro Creek mouth. Natural boulder lag armor occupies the lower foreshore of the beach at the extreme south end, bordering the headland bluffs and rocky shore. An intertidal and shallow subtidal surfgrass meadow (*Phyllospadix* sp.) occupies the boulder lag foreshore, which is occasionally subject to partial burial by beach sand.

Linda Mar Beach is backed by a low foredune ridge extending between the broad berm and Highway 1. The foredune has recently established a planted beach wildrye (*Elymus mollis*) stand that has spread and dominated much of the central foredune zone, with active sand accretion along its foreslope and crest approximately 2 to 3 m in height above the berm top. A natural stand of prostrate beach morning-glory (*Calystegia soldanella*) occurs on the beach and low foredune terrace north of Crespi Avenue, south of a zone of the beach where seasonal stream drainage forms a meandering backbeach delta channel. Numerous other San Francisco coastal dune species have been introduced from Fort Funston, including a southern range extension of dune tansy (*Tanacetum bipinnatum*), adding to the local native foredune assemblage. Beach sandwort (*Atriplex leucophylla*), a relatively uncommon beach forb otherwise scarce on the San Francisco Peninsula today, has established a persistent population at Linda Mar beach.

As noted for other sandy shoreline habitat in the CRSMP, Linda Mar Beach supports shorebird foraging and resting habitat. Western snowy plovers winter in the flat, back beach areas that experience low pedestrian use.

SAN PEDRO CREEK LAGOON

The mouth of San Pedro Creek Lagoon forms a small freshwater lagoon and marsh where artificial beach fill has been removed as part of a floodplain and creek restoration project (USACE – *need ref*). The lagoon wetland complex is dominated by California tule (Schoenoplectus californicus) and broadleaf cattail (*Typha latifolia*), with shallower edges bordering the creek channel dominated by salt-intolerant species such as small-fruited sedge (*Scirpus microcarpus*) and water-parsley (*Oenanthe sarmentosa*). Fresh-brackish tolerant emergent marsh vegetation occupies the storm overwash zone on cobble and sand substrates, including salt rush (*Juncus lescurii*), bentgrass (*Agrostis stolonifera*) and wildryes (*Elymus triticoides, E. x vancouveriensis, E. mollis*). Salt spray-flagged willow (*Salix lasiolepis*) borders landward portions of the marsh.

No data on California red-legged frogs populations are currently available for the local lagoon, but they are present in a tributary drainage along San Pedro Road, and in the San Pedro Creek watershed upstream; they are presumed to be present in suitable habitats within the lagoon wetland complex. Tree frogs occupy the lagoon wetlands. Juvenile and adult red-sided garter snakes are present in at least upland habitats (gopher burrows) around the creek mouth and lagoon wetlands. Steelhead (federally listed threatened) are present in the stream channel mouth at least seasonally as migrants and kelts. Mallards and coots are frequently present in the shallow backbeach lagoon channel. Great egrets, snowy egrets, and great blue herons also forage along marsh edges of the lagoon and stream channel.

INDICATOR SPECIES FOR SENSITIVE HABITATS

The availability of contemporary, reliable data on the distribution of sensitive species and habitats in coastal habitats (terrestrial and wetland backshore, shoreline, intertidal, and nearshore) within the San Francisco Peninsula coast study area is uneven. Some areas of important habitats and sensitive species populations are relatively well-studied and inventoried, such as within GGNRA boundaries or special management areas like Sharp Park. This may result in sampling bias about important coastal resources because of uneven data availability on sensitive habitat distribution: some of the same species and communities occur in other reaches of the study area, but with less contemporary or rigorous survey data available. Furthermore, because many of the coastal habitats are highly dynamic (subject to transformative coastal processes including dune migration, blowouts, stabilization, slumping, slope failures, overwash, shoreline retreat, severe storm erosion, extreme drought; events occurring over years or decades), exclusive reliance on short-term, high resolution spatial data on coastal habitat distributions from relatively well-studied areas may be less relevant to long-term coastal sediment management planning than the identification of indicator species that correspond with sensitive habitat complexes within dynamic landscape settings. A set of indicator species, based on high ecological fidelity for specific high-value coastal ecosystem conditions or "hot spots" of biological diversity, have been selected to identify likely coastal settings for sensitive biological resources. Review of indicator species (including special-status species) supplements the general approach of describing discrete ecogeomorphic coastal zones (coastal habitat segments; Section --) for early identification of important biological resources.

STEELHEAD

Adult steelhead (*Oncorhynchus mykiss*) throughout the North Pacific Ocean, with instream spawning in the CRSMP study area available in San Pedro Creek in the Linda Mar study reach. San Pedro Creek flows northwesterly and enters the Pacific Ocean at Linda Mar Beach, draining a watershed comprising about eight square miles. Spring-fed flows in the upper portions of the drainage (south and middle forks) produce perennial flows that support steelhead reproduction (Becker and Reining, 2008). This highly urbanized stream continues to support steelhead runs despite current and historic passage impediments, elevated turbidity levels due to bank erosion, and canopy gaps. A broad study of the San Pedro Creek watershed completed in 2002 characterized habitat conditions for steelhead and framed the strategy for subsequent creek enhancement efforts. In describing conditions for steelhead in San Pedro Creek, the Steelhead Habitat Assessment for the San Pedro Creek Watershed (HES, 2002) report inventoried the size and location of pool habitat, substrate size classes and embeddedness, condition of the riparian canopy, temperature, and obstacles to fish movement.

Suitable spawning and rearing habitat occur throughout the mainstem and middle fork of San Pedro Creek, with the high quality spawning grounds located in the later region (HES, 2002;

Becker and Reining, 2008). A description by Sullivan (1990) characterized riparian habitat between the stream mouth and the Highway 1 bridge as “very degraded;” however, the 2002 HES study focused on populations and habitat conditions upstream from Highway 1 and did not identify shoreline barriers to steelhead movement at Linda Mar Beach. The 2005 beach habitat restoration program created a small estuarine lagoon at the mouth of San Pedro Creek has improved downstream habitat conditions somewhat for steelhead.

The importance of lagoons to steelhead development is well documented, though the specific fish benefits vary depending upon such contributing factors as lagoon size (area and depth), presence and timing of shoreline sandbar development, and the volume and quality of water flows following sandbar formation (Smith, undated). Lagoon ecology also differs between years based on the timing of sandbar formation and the quantity and timing of summer inflows. Due to the relatively small size of the San Pedro Creek lagoon and lack of riparian cover, steelhead use is likely on transitory during migration of

adult fish from the ocean and downstream migration of juveniles to oceanic rearing areas. The lagoon may be too small and distant from spawning areas to provide significant spring feeding or summer rearing habitat for juveniles; however, it may provide limited brackish transition habitat for outmigrating smolts.

In summary, benefits provided by the nearshore lagoon primarily include providing a brackish water transition environment that allows outmigrating smolts to gradually acclimate to higher oceanic salinity levels. In the absence of such transition habitat, the movement from freshwater to ocean conditions can exacerbate stress and activate bacterial kidney disease. As a result, juveniles may survive movement to the stream mouth; however, are unable to make the appropriate changes in kidney function to successfully transition to seawater (Foott, 1992).

CALIFORNIA RED-LEGGED FROG

The federally listed threatened California red-legged (CRLF) (*Rana draytonii*) occurs in two portions of the CRSMP study area: in the Laguna Salada/Mori Point area and the middle and upper reaches of San Pedro Creek and its tributaries. The Sharp Park population resides on lands that are owned and managed by the City of San Francisco (Sharp Park) and the National Park Service (Mori Point). San Pedro Creek and the coastal lagoon are owned and managed by the City of Pacifica in cooperation with the California Department of Transportation (CalTrans) near Highway 1.

The Laguna Salada freshwater marsh complex lies at the terminus of the 844-acre Sanchez Creek watershed. Historically a small channel connected the brackish lagoon with the ocean; however, this connection was eliminated with the construction of the golf course and seawall. Runoff from the watershed has been pumped from the lagoon to the ocean since 1941. The complex includes the 27-acre open water Laguna Salada lagoon, neighboring vegetated wetlands, a 1,000 foot connecting canal, a small inland pond (Horse Stable Pond).

Sharp Park supports a robust CRLF population that includes several notable breeding sites and non-breeding foraging and basking habitat. Focused CRLF surveys by K. Swaim in 2008 documented 85 egg masses at Sharp Park, with 57 egg masses in Horse Stable Pond, 20 in Laguna Salada, and 4 in the canal (Tetra Tech Inc., et al., 2009). Areas that provide CRLF foraging and basking habitat, but offer relatively limited breeding opportunities included Sanchez Creek and the northern portion of Laguna Salada. In 2007, the Golden Gate National Recreation Area (GGNRA) constructed two ponds at Mori Point to expand local CRLF breeding opportunities and enhance local conditions and forage availability for the San Francisco garter snake (Thamnophis sirtalis tetrataenia) (SFGS).

Embryonic stages of CRLF have a low salinity tolerance, with significant (>40 percent) developmental abnormalities or mortality observed from salinities between 5 and 6.5 parts per thousand (ppt) (Jennings and Hayes, 1990). The presence of viable CRLF breeding populations at Laguna Salada and Horse Stable Pond indicates normal salinity levels that are generally below 5 ppt. Jennings and Hayes (1990) noted that adult CRLF at Pescadero Marsh vacated areas where salinities increased above 6.5 ppt.

To the west of Laguna Salada, a sparsely vegetated 25-foot tall seawall and levee protect the marsh complex from tidal inundation. High storm surges such as those in 1956 and 1983 caused levee overtopping and temporarily introduced seawater into the complex; however, levee reinforcement in 1989 has prevented additional occurrences. The USFWS perceives that snake populations at Laguna Salada decreased following the two salt water inundation events in the 1980s, which reduced amphibian breeding capacity and reduced prey availability for garter snakes. Salinity levels in the lagoon are normally somewhat elevated, though are generally below the threshold at which they would harm amphibians or other wildlife (Tetra Tech Inc., et al., 2009). Minimizing saltwater intrusion is key to maintaining freshwater habitat for continued CRLF breeding at the Laguna Salada wetland complex. The City of San Francisco is presently exploring management options to restore aquatic and upland habitat within the wetland complex.

The small CRLF population reported in San Pedro Creek occurs upstream from Highway 1; however, portions of the recently restored coastal lagoon at the mouth of San Pedro Creek may eventually support CRLF as the restoration project matures and estuarine functioning returns. If present, CRLF would use freshwater or mildly brackish areas for foraging and basking, or potentially as breeding sites is salinity levels are muted. CRLF have not been identified to date downstream from Highway 1.

SAN FRANCISCO GARTER SNAKE

A single population of the federal and state-listed endangered San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) occurs in the CRSMP study area in the Laguna Salada/Mori Point area. Habitat for this species is also present in upper San Pedro Creek, though SFGS are absent from the recently restored lagoon mouth. The U.S. Fish and Wildlife Service (USFWS) considers the Laguna Salada/Mori Point SFGS population as one of six that is significant to species recovery (USFWS, 2006). This population resides on lands that are owned and managed by the City of San Francisco (Sharp Park Golf Course) and the National Park Service (Mori Point).

SFGS habitat needs vary during the year, and include aquatic foraging habitat and nearby upland retreats located in underground burrows and soil crevices, typically located in grassland or shrub habitats (Tetra Tech E.C., et al., 2009). Adult SFGS feed primarily on CRLF. A deficiency in suitable upland habitat next to Laguna Salada is limiting factor for this species at Sharp Park. SFGS presumably use the entire 27-acre Laguna Salada freshwater marsh complex and are documented from the lagoon, Horse Stable Pond, and in the canal that connects the two water bodies. To the south of Mori Point, the Calera Creek watershed also supports CRLF and provides potential habitat for SFGS. Both species may move between some or all of these sites.

LEATHERBACK SEA TURTLE

The National Marine Fisheries Service (NMFS) listed the leatherback sea turtle (*Dermochelys coriacea*) as federally endangered throughout its range in 1970. In January 2012, NMFS additionally announced the designation of marine habitat off the coast of California as critical habitat for leatherback sea turtles. The California designation covers coastal areas from Point Arena to Point Arguello east of the 3,000-meter depth contour. The ruling targets activities that could alter the distribution, diversity, abundance or density of turtle prey species, and particularly the brown sea nettle (Chrysaora fuscescens) and moon jelly (Aurelia aurita). The seven identified activity types that could affect prey populations are: pollution from point sources (e.g., National Pollution Discharge Elimination System (NPDES)); runoff from agricultural pesticide use; oil spill response; power plant operations; desalination plant operations; tidal, wave, and wind energy projects; and liquefied natural gas (LNG) projects. Protections for turtle migration corridors were not addressed by the ruling. The ruling also does not require special provisions for shoreline beach management. Leatherback sea turtles lay their eggs on tropical and subtropical beaches and do not use shoreline habitat in the CRSMP study area.

BANK SWALLOW

The state-listed threatened bank swallow (*Riparia riparia*) nests in a single portion of the CRSMP study area, in the coastal bluffs at Fort Funston and Lake Merced. In 2010, the colony was divided among three principal nesting areas (north, middle, and south) that were located on the bluffs immediately above the beach (Etchell, 2010). These lands are located within the GGNRA managed by NPS; however, the San Francisco Department of Public Works (SFDPW) also maintains areas near The Great Highway.

This neotropical migrant arrives in the Lake Merced area in early April. The period from early May through mid-June comprises the peak of breeding activities by the Fort Funston colony, with active nest excavation, egg laying and incubation, and fledging of young (Etchell, 2010). This is also the period when populations are especially prone to nest loss by burrow collapse and predation. Young birds fledge between early July and August and roost communally in the local area before migrating south.

In 1993, GGNRA established a formal program to monitor the condition and location of the Fort Funston bank swallow colony. Monitoring trends indicate that nest burrow density has steadily declined since 1993, with a peak of 924 burrows detected in 1994 and just 148 burrows in 2009 (Etchell, 2010). GGNRA estimates that about 40 to 60 percent of burrows are actively used for nesting in a given year (GGNRA, 2007). To safeguard remaining nesting areas from human disturbance, graffiti, and erosion, GGNRA maintains a 12-acre permanent bank swallow closure area and a minimum 50 foot buffer distance for human activities.

The sandy bluffs at Fort Funston are highly prone to shoreline erosion, which can cause substantial loss of active and inactive nesting areas. Wholesale erosion of nesting areas on a large scale has the potential to destroy entire nesting colonies. Such was the case with the south colony on May 19, 2010, when the bluff above the 102-burrow colony collapsed and destroyed most nests (Etchell, 2010). Shoreline erosion from winter storms in 2009 and 2010 also undermined some swallow nesting areas and a portion of the southbound lane of The Great Highway between Sloat Blvd. and Skyline Blvd. In response, SFDPW initiated a shoreline stabilization project and installed a 425 foot rock revetment beneath the north colony prior to the swallow nesting season. Subsequent biological surveys found that the armoring did not reduce nesting site availability nor site utilization by nesting birds (Etchell, 2010).

WESTERN SNOWY PLOVER

The Pacific coast population of the western snowy plover (WSP) (*Charadrius alexandrinus nivosus*) breeds primarily on coastal beaches from southern Washington to southern Baja California, Mexico (USFWS, 2007). Their main coastal habitats for nesting include sand spits, dune-backed beaches, beaches at creek and river mouths, and salt pans at lagoons and estuaries, and less commonly, bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and river bars (Stenzel et al. 1981; USFWS, 2007). Along the west coast of the United States, the WSP nesting season extends from early March through late September (USFWS, 2007).

WSP breeding sites in the regional vicinity occur coastally in Monterey County and the beaches of northern Santa Cruz County (PRBO, 2010; CDFG, 2012). Current nesting areas in San Francisco Bay occur at the Napa-Sonoma Marshes Wildlife Area, Hayward Shoreline, and salt ponds the South Bay.

Non-breeding “wintering” populations of WSP are seasonally present in two portions of the CRSMP study area: Middle Ocean Beach (Stairwell #21 to Sloat Blvd) and Linda Mar Beach, though their distribution is somewhat more widespread. WSP may spend up to 10 months of the year, from July to May, foraging and resting at these coastal sites while building their fat reserves. WSP at Ocean Beach commonly use the wide profile segments of backshore between the edge of perennial vegetation (European beachgrass, beach wildrye, sand-verbena, and beach-bur) and the high tide line. Resting areas include small depressions such footprints. WSP forage among tidal litter & around flowering sea-rocket. Forage may include flies, beetles, sand hoppers, clams, crabs, and amphipods that occur in debris near the high tide line. WSP foraging in the upper intertidal beach is opportunistically done during low human foot-traffic periods; typically at dusk and dawn. On windy days WSP may shelter in the lee of sea rocket. In spring WSP move up and down the coast and to inland sites to nest.

GGNRA manages the Ocean Beach Snowy Plover Protection Area (SPPA) and prohibits incompatible activities such as off-leash dogs, and disturbance to wildlife and WSP. WSP activity at the Linda Mar Beach wintering site is monitored by the Pacifica Shorebird Alliance, Point Reyes Bird Observatory (PRBO) and citizen monitors. A formal protection area has not been established at Linda Mar Beach at California State Parks.

MARINE MAMMALS

The U.S. Fish and Wildlife Service is responsible for managing stocks of California sea otters (*Enhydra lutris nereis*) in central California, while the National Marine Fisheries Service (NMFS) has management authority for cetacean and pinniped stocks. Of the 64 marine mammal stocks found in the Pacific region, 13 stocks are listed under the ESA (2 threatened, 11 endangered), and 16 stocks are strategic under the MMPA (NMFS, 2009). Within the CRSMP study area, strategic stocks include the endangered sperm whale (*Balaenoptera acutorostrata*), blue whale (*B. musculus*), fin whale (*B. physalu*), humpback whale (*Megaptera novaeanglia*), short-finned pilot whale (*Globicephala macrorhynchus*), long-beaked common dolphin (*Delphinus capensis*), and threatened Guadalupe fur seal (*Arctocephalus townsendi*) and California sea otters (NMFS, 2009). Marine mammals within the CRSMP study area include the ubiquitous California sea lion and harbor seal, northern fur seal (*Callorhinus ursinus*), Steller sea lion (*Eumetopias jubatus*), humpback whale, harbor porpoise (*Phocoena phocoena*), Risso's dolphin (*Grampus griseus*), blue whale, northern elephant seal (*Mirounga angustirostris*), and the occasionally minke whale (*Physeter macrocephalus*), sperm whale, and striped dolphin (*Pseudorca crassidens*), among others (GFNMS, 2012). In all, NMFS identifies at least 39 species of marine mammals in coastal California, all of which are protected under the Marine Mammal Protection Act (MMPA) and 13 under the federal Endangered Species Act (NMFS, 2009).

Open water in the CRSMP provides a key movement and migration corridor for cetaceans, as well as a seasonally important foraging area for many species. The seasonal upwelling of cold, nutrient-rich waters from the ocean depths occurs at the edge of the continental shelf near the Farallon Islands. The resulting explosive growth of phytoplankton and krill during the summer and early fall attract foraging baleen whales and in particular blue whales and humpback whales in the years when upwelling occurs. Nearshore observations of whales diving, feeding and rubbing against hard surfaces such as rocks are not uncommon in the CRSMP study area.

Sea lions and harbor seals haul-out (exit the water) on a daily basis to rest and regulate their body temperature; whereas the larger and better insulated northern elephant seals can remain in ocean waters for months at a time. Haul outs and rookeries for marine mammals usually consist of beaches (gravel, rocky or sand), ledges, or rocky reefs. On the Pacific coast such areas support major concentrations of California sea lions, harbor seals, and Steller sea lions.

Pinnipeds give birth on land, typically at established haul-out or rookery sites. The Marine Cadastre dataset identifies several current and historic haul-out sites and rookeries within the CRSMP. Traditional California sea lion and harbor seal haul-out sites include Pt. Lobos and Seal Rocks in the Pt. Lobos CRSMP reach and Shelter Cove and Pt. Pedro in the Shelter Cove CRSMP study reach. The later area is an important harbor seal rookery. Harbor seals may also briefly haul-out individually or in small groups on beaches throughout the CRSMP study area. Such activities have been noted at China Beach, Baker Beach, Sharp Park, Rockaway Cove, and Linda Mar Beach. Major haul-out and rookery areas for the endangered Stellar sea lion occur at Southeast Farallon Island and Año Nuevo Island, outside of the CRSMP. Designated critical habitat for this species includes a 20 nautical mile buffer around these islands, and is not within the study area.

PLANTS

Beach saltbush, *Atriplex leucophylla*. Beach saltbush is the only native beach-colonizing plant with tolerance of salinity and sand burial comparable with the naturalized European sea rocket, *Cakile maritima*. It has been reduced to very infrequent and unstable populations along Central Coast dunes dominated by European beachgrass, and is prone to local extirpation following storms, since seed source populations are usually excluded from beachgrass-dominated foredunes beyond the reach of storm erosion. It is often associated with relatively stable or wide backshores lacking beachgrass. Populations have established and persisted at Linda Mar Beach and middle Ocean Beach, where it is threatened with local extirpation by routine beach grading.

Beach wildrye, *Elymus mollis* (syn. *Leymus mollis*). Prior to the introduction and invasive spread of European beachgrass (*Ammophila arenaria*), two prostrate perennial coastal dune forbs (beach-bur, *Ambronia chamissonis*; yellow sand-verbena, *Abronia latifolia*) and one coarse creeping grass, beach wildrye (*Elymus mollis*) were the principal foredune mound-building and beach-colonizing species of the San Francisco Peninsula, in association with other spreading, low-growing forbs with limited ability to trap and stabilize blowing sand. Beach-bur and yellow sand-verbena remain relatively common colonizers of beaches, but beach wildrye has declined from a formerly abundant and widespread native foredune plant to a local, uncommon fugitive from European beachgrass dominance throughout the Central Coast. Large stands of beach wildrye in foredunes or mobile dunes are significant coastal dune biological resources in themselves, and they are associated with relatively high native plant and insect diversity. The size and distribution of beach wildrye stands can change rapidly, but they tend to recur in suitable settings. Stands of beach wildrye are identified in multiple reaches of the study area including two segments of Ocean Beach, North Pacifica bluff-top climbing dunes, Salada Beach, and Linda Mar Beach.

Pacific wildrye, *Elymus pacificus* (syn. *Leymus pacificus*). Pacific wildrye is an uncommon and under-identified component of stabilized interior dune grassland and openings in coastal dune scrub. On the San Francisco Peninsula dunes, it usually occurs with morphological traits intermediate with creeping wildrye, a species typical of clayey alluvial soils. Pacific wildrye seldom flowers except near margins of blowouts or mobile dunes with very low rates of sand accretion. It is usually associated with other native remnant forb and grass species of old stabilized dunes that have escaped competitive displacement by iceplant, bush lupine or European beachgrass.

Mock-heather, dune golden heather, *Ericameria ericoides*. Mock-heather is a characteristic shrub species of Central Coast dune scrub, and San Francisco is the near the northern limit of its distribution. In contrast with associated dune scrub species with strong colonizing ability, like coyote-brush, it is relatively slow to spread in stabilized dunes, and is an indicator of long-stabilized, relatively intact and mature remnant dune scrub communities.

Silvery beach-pea, *Lathyrus littoralis*. Silvery beach pea was formerly reported from the entire length of Ocean Beach and landward dunes, and was a significant component of Central Coast dune vegetation. Urban development and exotic dune stabilization plantings reduced it to one natural remnant occurrence near the historic outlet location of Lake Merced, near the north end of Fort Funston, where its current status is doubtful. This species has been reintroduced to Crissy Field, but there are no other natural occurrences on the San Francisco peninsula other than one tenuous locality on bluff-top Esplanade dunes near Manor Drive in Pacifica, where it has escaped displacement by European beachgrass, but is threatened by development, shoreline retreat, and slope failure.

Native coastal dune annual forbs (multiple species). Gaps in coastal dune scrub, and stabilized or semi—stabilized backdune grassland and forbland historically supported extensive meadows with abundant or dominant annual forbs. Non-native annual grasses, iceplant, bush lupine, and European beachgrass have reduced native annuals to very limited distribution and abundance, usually in association with local remnants of relatively intact dune soil profiles that have escaped both blowouts and non-native plant invasions. The persistence of native dune annuals is a relatively reliable indicator of significant relict native plant community diversity in coastal dunes. Some dune annuals in particular have relatively weak or slow dispersal and colonizing ability, and their co-occurrence usually represents important refuges for biological diversity conservation. Indicator species include *Castilleja exserta, Chorizanthe cuspidata, Cryptantha leiocarpa, Gilia capitata* subsp. *chamissonis, Phacelia distans, and Lupinus nanus*.

Dune tansy, ***Tanacetum bipinnatum*** (syn. *T. camphoratum*). Dune tansy occurs at the southern limit of its natural range in San Francisco, and it occurs in widely disjunct populations along the coast northward in morphologically distinct and isolated populations. It was associated with dune slacks edges and mobile dunes bordering them. The species *T. camphoratum* (now placed in synonymy with *T. bipinnatum*) was formerly treated taxonomically as a rare, geographically narrow taxon. Natural populations are limited to San Francisco, and only Fort Funston within the study area. An artificially transplanted (range extension) population occurs at Linda Mar Beach.

Perennial coastal wetland plants species (multiple species). Coastal wetlands occur with very limited distribution along the San Francisco Peninsula because most low-lying areas have been filled, channelized, drained, or developed. Lake Merced was formerly a coastal lagoon with an intermittent Ocean Beach outlet; it is now a disconnected inland lake. The remaining locations of coastal wetlands on bluff slopes and backshore depressions or stream mouths are generally important refuges for coastal wetland species, including special-status species, and represent limited, structurally embedded opportunities for wetland conservation. Strong coastal wetland plant indicators in the study area include tules and bulrushes (*Schoenoplectus acutus, S. californicus, S. pungens, S. americanus, Scirpus microcarpus*), brown-head rush (*Juncus phaeocephalus*), salt rush (*Juncus lescurii*), saltgrass (*Distichlis spicata*), jaumea (*Jaumea carnosa*), monkeyflower (*Mimulus guttatus*), willows (*Salix* spp.), California waxmyrtle (*Myrica californica*), and stinging nettle (*Urtica dioica* subsp. *holosericea*).

Hemiparasitic and holoparasitic perennial coastal scrub forbs (*Castilleja affinis, C. wightii, C. densiflora, C. exserta*, and *Orobanche* spp.; broomrape family, Orobanchaceae). Hemiparasitic forbs (green, photosynthetic plants with specialized root connections primarily for obtaining water from hosts) and holoparasites (non-green plants that parasitize hosts for both water, nutrients, and organic carbon sources) are dependent on establishing host connections to maintain viable populations, and they are relatively slow to establish new populations. Most occurrences are associated with mature, old coastal scrub, grassland or coastal dune scrub with high native species diversity. Holoparasites and hemiparasites are prone to local extirpation following disturbance or non—native plant invasions that reduce host populations. They are therefore sensitive indicator species of mature and fragile coastal plant ecological relationships, and are important biological conservation resources.

IMPACT DISCUSSION BY REACH

OCEAN BEACH

Short-term impacts:

WSP roosting areas are seasonally active at Middle Ocean Beach from approximately July to May and are susceptible to physical disturbances during the period. It is well documented that WSP avoid areas with dog use or human activity, such as near trailheads (Lafferty, 2001). While susceptible to short-term disturbance, the long-term WSP use of the CRSMP study area depends upon the ability to maintain high quality habitat and support ongoing recreational uses under retreating beach conditions. The beach nourishment options under consideration would use dredging and pumping to supply sediment and land-based equipment to distribute materials. These activities would enlarge the beaches by approximately 50 feet perhaps once every 20 to 30 years. During active beach nourishment activities, short-term disturbances within WSP protection areas would presumably occur outside the sensitive roosting period for this species. Because sediment additions would be gradual, the availability of shoreline WSP forage species is expected to diminish somewhat, though expected to change to the extent during the augmentation period that shoreline forage quality would be substantially diminished for WSP.

Little information is available on the reaction of shorebirds to vehicles and other equipment in general or to beach nourishment activities in particular, but based on their vulnerability to human disturbance, shorebirds including WSP would be expected to avoid areas of high activity (SAIC, 2007). The Chambers Group (2005) monitored dredging of a sand bar in the Talbert Channel in Huntington Beach and placement of the dredged sand in the upper intertidal zone of the adjacent beach. Western snowy plovers avoided the immediate areas where the dredging and disposal activities were occurring but foraged undisturbed in the neighboring intertidal beaches (SAIC, 2007). Placement of new sand on a beach that impacts the intertidal invertebrate community can result in forage reduction for shorebirds for the period associated with benthic invertebrate recovery (SAIC, 2007). Potential impacts would be expected to relate to size of affected area, invertebrate recovery rates, and proximity to alternate forage locations (SAIC, 2007).

Substrate characteristics of placed sands may impact shorebird foraging. Sediment too coarse or high in shell content can inhibit a bird's ability to extract food from the substrate (Greene, 2002). Coarse sediment that is similar in size to target prey may interfere with prey detection and capture (Baird, 1993).

Long-term ecological consequences:

Western snowy plover. Long-term shoreline retreat at Ocean Beach is likely to result in a narrow backshore below either wave-cut foredune scarps or seawalls along Great Highway, and concomitant reduction of emergent high tide beach area available for roosting during high tides and winter storms. Alternative high tide roost and foraging areas for WSP would not likely be available at Ocean Beach or southward, where backshore areas are already very narrow or absent at high tide. This would result in significant contraction of potentially suitable winter foraging and roosting areas for WSP at Ocean Beach, increased concentration of pedestrian beach use at high tide in potentially suitable WSP habitat. This compression and reduction of beach habitats may cause or contribute to significant increases in risk of abandonment or marginal habitat use of Ocean Beach by WSP. Alternatives that result in maintenance of at least minimal shoreline segments of wide backshore beach areas outside primary zones of intensive recreational use may increase potential for continued habitat functions of Ocean Beach for WSP.

Native dune vegetation. Beach nourishment may enable Ocean Beach management to eliminate reliance on an artificially steep, high, narrow backshore dune profile dependent on European beachgrass or seawalls, and accommodate compatible sand transport patterns associated with managed diverse native vegetation and low-angle foredune ridges, similar to that of Linda Mar Beach's successful beach wildrye-dominated foredune ridge, with a broad foreslope to trap beach sand and release it back to the beach during storm erosion events. In contrast, the steep, high European beachgrass dune ridge traps sand behind a high backshore dune crest, effectively exporting it from the littoral cell, beyond reach of storm waves. Steep footpath gaps through high European beachgrass also facilitates funneling and blowouts that remove sand from the beach and increase nuisance blowsand, and create high chutes (wind ramps) on accreting bare sand dune crests that increase suspended load during extreme high winds. Integration of beach nourishment with a managed low-angle native foredune vegetation system may benefit biological resources of the National Park in a manner consistent with recreational uses, and less intensive sand active sand management (reduced reliance on routine beach grading). This modified system may also benefit diversity of beach invertebrates, including special-status tiger beetle species that are no longer known to occur in San Francisco.

FORT FUNSTON

Bank swallow populations can be affected by flooding and erosion disturbances, which have both positive and negative effects on nesting sites (Garrison, 1998). Other natural disturbances such as fire, windthrow, and landslides have little direct effect on bank swallows due to the natural protections afforded by excavated nesting sites. Erosion can improve the conditions of exposed vertical banks as nesting habitat, provided that exposed soils are friable enough to allow burrowing by these small birds. However, erosion and landslides that occur during the swallow nesting season, as seen in 2010, can have catastrophic effects on colony viability.

The lack of erosion can also result in banks that are too gently sloped and thereby unsuitable as nesting sites. Bank protection measures such as armoring that are used to protect streambanks and bluffs from erosion have the potential to reduce or eliminate nesting habitat. The CRSMP implementation options at Fort Funston recommend “no action”. It is believe that swallow nests are sufficiently elevated in the Fort Funston bluffs that nesting sites are somewhat shielded from the direct impacts from unplanned shoreline armoring, as seen during the 2010 SFDPW shoreline stabilization project.

Long-term conservation of Fort Funston dune habitats may be potentially be managed indirectly by modifying rates of bluff retreat. Where bluff retreat maintains favorably high rates of wind deflation supplying sand transport to climbing blufftop dunes, bluff retreat at natural (accelerated) rates may be compatible with dune processes and habitat conservation. In contrast, where bluff crest retreat encroaches or threatens irreplaceable mature dune scrub vegetation and soils, or where dune migration threatens to bury stable old species-rich dune habitats and replace them with early-succession dune communities, reduction of bluff retreat rates may be beneficial for biological resource conservation. Alternatives that may be compatible with conservation of both natural beach profiles and bluff processes may include beach nourishment or multipurpose reefs; armored shorelines would be incompatible with conservation of natural coastal processes in National Parks, and protection of Merced Formation outcrops and exposures for scientific, and educational, and esthetic values.

SHARP PARK

The Conceptual Ecosystem Restoration Plan and Feasibility Assessment for Laguna Salada (ESA-PWA, 2010) observed that the existing land uses compress fresh-brackish wetlands of Laguna Salada to the seaward end of the lagoon, in conflict with sea level rise and barrier beach transgression. It also observed that the artificial drainage of the lagoon to average operating water surface elevations of +7 ft NAVD forces fresh-brackish marsh to occupy precariously low elevation ranges relative to extreme high tides and storm surges, placing all wetlands at artificially high risk of complete submergence by seawater following extreme storm overwash events. ESA-PWA (2010) concluded that the long-term sustainability of Laguna Salada habitats for CRLF and SFGS is also threatened by gradual salinization of the lagoon by chronic beach groundwater inflows to the artificially low lagoon. Raising operating freshwater levels of the lagoon to natural, supratidal elevation ranges by reducing artificial drainage (pumping) would increase the resilience of the wetland ecosystem to challenges of accelerated sea level rise and extreme coastal storms, and increase its capacity to maintain viable populations of sensitive amphibians and reptiles (California red-legged frog, San Francisco Garter Snake, western pond turtle). These long-term coastal adaptations would require shoreline modifications of the Salada Beach (partially armored barrier beach and its artificial earthen berm), so that overwash and natural breach outlet processes may result in constructive barrier rollover (gradual landward shoreline retreat and transgression of the barrier profile, cyclic lagoon outlet breaching and closure) rather than catastrophic hydrological and geomorphic responses to sea level rise and storms. Maintenance of the existing artificial berm prevents barrier retreat, and is likely to result in net barrier profile narrowing and instability of backbarrier wetland habitats

The three shoreline management options considered by the CRSMP at Sharp Park are beach nourishment, the use of multi-purpose reefs, and allowed erosion of the existing artificial berm (levee). Criteria for comparing benefits and risks of alternatives are related to long-term barrier beach integrity in response to rollover (profile maintenance by washover, landward transgression), barrier crest elevations, and capacity for rapid breach and closure cycles. The artificial levee is presently armored against shoreline erosion in the north and south portions of the park, though the central portion consists of earthen fill without armoring. Beach nourishment with sufficiently coarse sand compatible with the existing beach slopes would support constructive barrier beach profile responses to storm overwash, and would potentially facilitate maintenance of barrier integrity (increase in barrier crest elevations) during overwash and landward transgression. Multi-purpose reefs, in contrast, may reduce beach wave runup during periods of constructive swell and result in lower barrier crest elevations and integrity in response to extreme storm events. This may increase the risk of catastrophic barrier failure during extreme storm events, and would likely increase threats to sensitive species and wetland habitats. Passive retreat of the existing levee-capped beach would likely result in scarp formation and net narrowing of the barrier profile, due to an elevated elevation threshold for washover deposition on the landward side of the barrier. Combining a lower barrier crest elevation (replacement of the artificial berm with a modular ground-level or low-elevation boardwalk behind the barrier crest) and beach nourishment would promote constructive profile responses to extreme storm overwash events. This would support continued barrier maintenance of the backbarrier lagoon wetland complex. A continuous, unarmored sand barrier profile at the south end of the beach would be compatible with natural lagoon outlet breaching and closure for rapid discharge of impounded high lagoon waters. It would also be compatible with increased retention of freshwater inflows, allowing lagoon levels to rise to natural supratidal elevation range before overtopping and either low-energy or high-energy breaches.

LINDA MAR

Management options under consideration in the Linda Mar CRSMP Reach, which includes the restored coastal lagoon at the mouth of San Pedro Creek, include no action, beach nourishment, and managed retreat. Downstream portions of San Pedro Creek that were restored in 2005 support aquatic habitat and riparian vegetation that provide movement and aquatic transition habitat for steelhead, and potential non-breeding foraging and basking habitat for CRLF. The strong freshwater gradient of San Pedro Creek mouth, perched above tidal elevation range as it is today, is likely to maintain a freshwater or fresh-brackish lagoon suitable for CRLF if sufficient beach sediment is available to form a full berm profile impounding freshwater outflows. This is generally the case at most other San Mateo Coast stream mouths that support CRLF populations in backbarrier wetland complexes. The degree of low flow (dry season) lagoon impoundment (depth, area, and stratification of the stream mouth lagoon suitable as steelhead foraging and smolting habitat) may potentially be increased by nourishment of coarser sediment size range (coarse sand, gravel, cobble) available for berm construction by high swell. As a result, all of the options would have negligible short- or long-term effects on habitat quality or availability for steelhead and CRLF.

Similar impacts to WSP are anticipated at Pacifica State Beach to those discussed for Middle Ocean Beach. Shoreline retreat may narrow suitable backshore beach areas of suitable WSP habitat. Beach nourishment may compensate for beach narrowing due to shoreline retreat, or even increase the extent of suitable WSP habitat in segments of the beach with relatively lower pedestrian density and recreational use. This may reduce future competition for beach space between recreational and wildlife uses. Beach nourishment may increase the frequency and thickness of sand burial episodes on the low tide terrace at the extreme south end of the beach, where surfgrass beds occur. This risk may be greatest for finer sand in the grain size distribution matching the existing low tide terrace, and least for coarser grain sizes that are associated with the steeper berm profile.

PACIFIC OCEAN

Alternatives that will locally increase turbidity during implementation, if only temporarily, could have localized short-term (< 1 year) effects on bottom-dwelling invertebrate populations; however, these would not affect jellyfish populations. Beach nourishment, would locally smother inbenthic (living within bottom sediments) invertebrates and epibenthic (surface-living) invertebrates during sand placement and subsequent stabilization. Affected marine organisms may include immobile and slow-moving bottom-dwellers such as amphipods, polychaetes, and tanaid crustaceans, as well as sea stars, crabs, sea urchins, sand dollars, and similar marine fauna. Deposit feeding polychaetes and mollusks can be expected to colonize disturbed areas within a matter of months; however, suspended sediment may temporarily inhibit some higher order invertebrate successional assemblages. This occurs because unstable substrate tends to impede water filtration structures, bury larvae, disturb larval settlement, and prevent many filter feeders from attaching to the substratum (Rhoads and Young, 1970). Two alternatives, allowed erosion and managed retreat, could contribute moderate amounts of suspended sediment to the marine environment. Under these scenarios we anticipate that some erosion-prone coastal bluffs will periodically erode into the marine environment, thereby disturbing bottom habitat and releasing sediment. The impact of sediment plumes on swimming invertebrates, marine fish would be short-lived with few residual effects following bottom stabilization. None of the implementation options under consideration would affect the distribution, diversity, abundance or density of loggerhead sea turtle prey populations, thus, effects to this species would likely be nominal under any management scenario.

REFERENCES

Becker, G.S. and I.J. Reining. 2008. Steelhead/rainbow trout (*Oncorhynchus mykiss*) resources south of the Golden Gate, California. Cartography by D.A. Asbury. Center for Ecosystem Management and Restoration. Oakland, CA.

Baird, P. H., 1993. Birds, Pages 541-603 In: Ecology of the Southern California Bight: A Synthesis and Interpretation. M.D. Dailey, D.J. Reish, and J.W. Anderson (eds.). University of California Press, Berkeley, California.

California Department of Fish and Game (CDFG). 2012. California Natural Diversity Database (CNDDB). GIS Data for the Plan Area. Sacramento, California: CDFG. May 14, 2012.

Chambers Group, Inc., 2005. Monitoring Report for Western Snowy Plover at the Talbert Channel. Prepared for County of Orange.

Etchell, S., 2010. Fort Funston Bank Swallow Colony Analysis for Incidental Take Permit Great Highway at Ocean Beach Repair Project, San Francisco, San Francisco County, California. Prepared for Robert Chew Geotechnical, Inc. and the City and County of San Francisco Department of Public Works, September 2010.

Foott, J.S. 1992. Disease survey of Trinity River salmonid smolt populations, 1991 report. U.S. Fish and Wildlife Service, California-Nevada Fish Health Center, Anderson, CA, 31 pages.

Garrison, B. A. 1998. Bank Swallow (*Riparia riparia*). In The Riparian Bird Conservation Plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/htmldocs/riparian_v-2.html

Golden Gate National Recreation Area (GGNRA). 2007. Bank Swallow Monitoring at Fort Funston, 1993-2006. National Park Service, March 23, 2007.

Greene, K. 2002. Beach Nourishment: A Review of the Biological and Physical Impacts. ASMFC Habitat Management Series #7. Atlantic States Marine Fisheries Commission.

Gulf of the Farallones National Marine Sanctuary (GFNMS). 2012. Farallones Marine Sanctuary Association, Beach Watch Online, 2012. Online bird and mammal data database . http://www.farallones.org/BeachData/BeachWatchData.php

Hagar Environmental Science (HES). 2002. Steelhead Habitat Assessment for the San Pedro Creek Watershed. Prepared for the San Pedro Creek Watershed Coalition, February 15, 2002.

Jennings, M. R., and M. P. Hayes. 1990. Final report on the status of the California red-legged frog (*Rana aurora draytonii*) in the Pescadero Marsh Natural Preserve. Prepared for the California Department of Parks and Recreation under contract No. 4-823- 9018 with the California Academy of Sciences.

Lafferty, K.D. 2001. Disturbance to wintering western snowy plovers. Biological Conservation 101 (2001) 315–325.

National Marine Fisheries Service (NMFS). 2009. Our living oceans. Report on the status of U.S. living marine resources, 6th edition. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-80, 369 p.

Moyle. P.B., J.A. Israel, and S.E. Purdy. 2008. Salmon, Steelhead, and Trout in California, Status of an Emblematic Fauna. Prepared by the U.C. Davis Center for Watershed Sciences for California Trout, 2008.

Point Reyes Bird Observatory (PRBO). 2010. Nesting of the Snowy Plover at Monterey Bay and on Beaches of Northern Santa Cruz County, California, in 2010. PRBO Publication #1776, December 2010.

Rhoads, D.C. and D.K. Young. 1970. The influence of deposit-feeding organisms on sediment stability and community trophic structure. Journal of Marine Research, 28:150-178.

Science Applications International Corporation 2007. Draft Review of Biological Impacts Associated with Sediment Management and Protection of California Coastal Biota. Prepared for the California Coastal Sediment Management Workgroup, under contract with the Beacon Erosion Authority for Clean Oceans and Nourishment (BEACON).

Stenzel, L.E., S.C. Peaslee, and G.W. Page. 1981. II. Mainland Coast. Pages 6-16 in Page, G.W. and L.E. Stenzel, (eds.). The breeding status of the snowy plover in California. Western Birds 12(1):1-40.

Sullivan, M., United States Fish and Wildlife Service. 1990. Steelhead Trout Juvenile Study.

Tetra Tech, Inc., Swaim Biological, and Nickels Golf Group. 2009. Sharp Park Conceptual Restoration Alternatives Report. Prepared for the San Francisco Recreation and Parks Department, November 2009.

U.S. Fish and Wildlife Service (USFWS). 2006. San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*)*:* 5-Year Review: Summary and Evaluation, U.S. Fish and Wildlife Service, Sacramento Field Office, Sacramento, California, September 2006.

U.S. Fish and Wildlife Service. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). In 2 volumes. Sacramento, California. xiv + 751 pages.

Zeiner, D.C., W.F. Laudenslayer, K.E. Mayer, and M. White. 1990. California's wildlife. Volume II: birds. California statewide wildlife habitat relationships system. California Department of Fish and Game, Sacramento, CA.

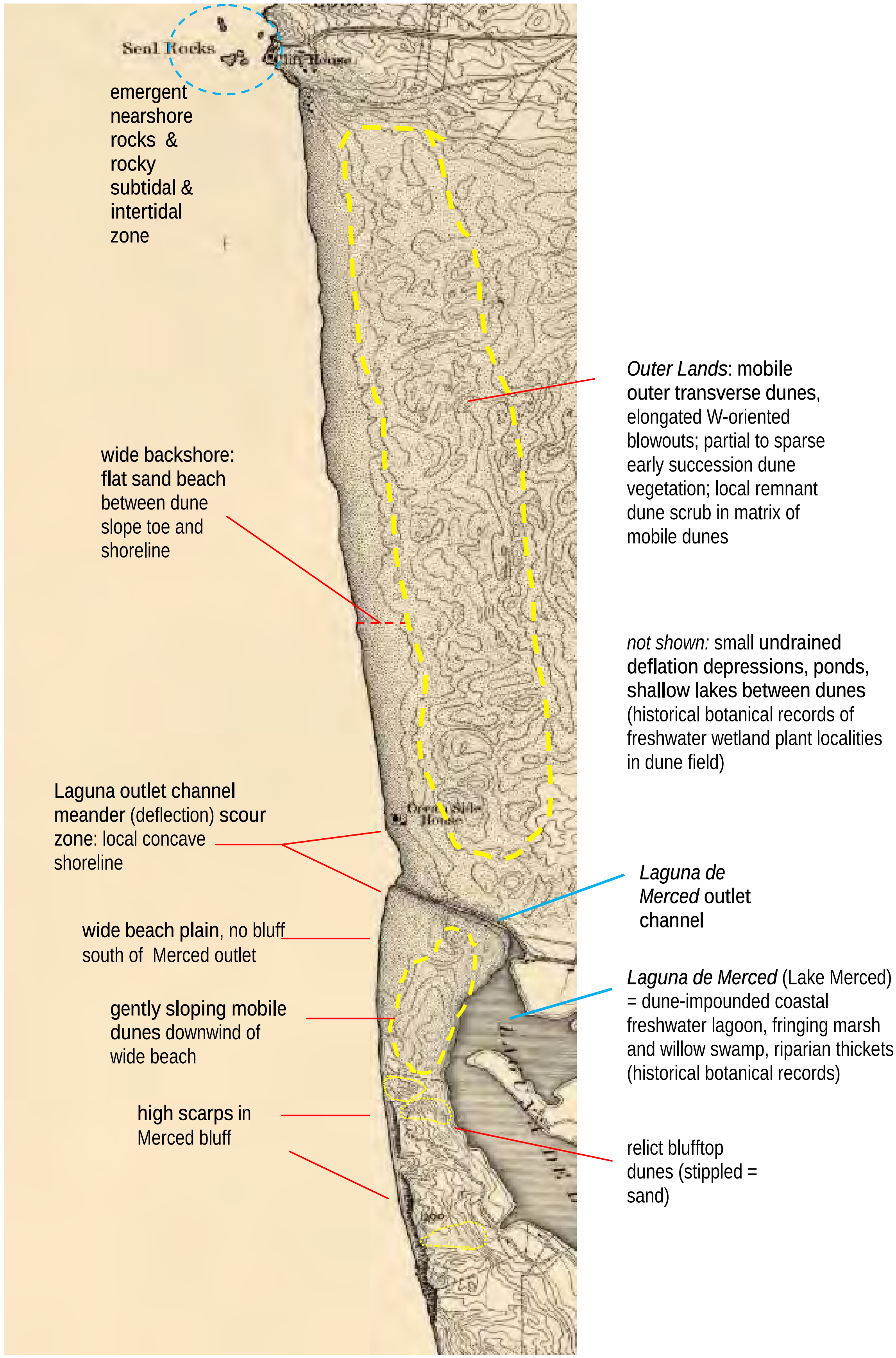


Figure 1. San Francisco coastline 1869 (composite U.S. Coast Survey T sheets 1850s topography): Seal Rocks, Ocean Beach, Outer Lands (western dunes: Sunset, Richmond), Lake Merced outlet, Merced bluffs and bluff-top dunes.

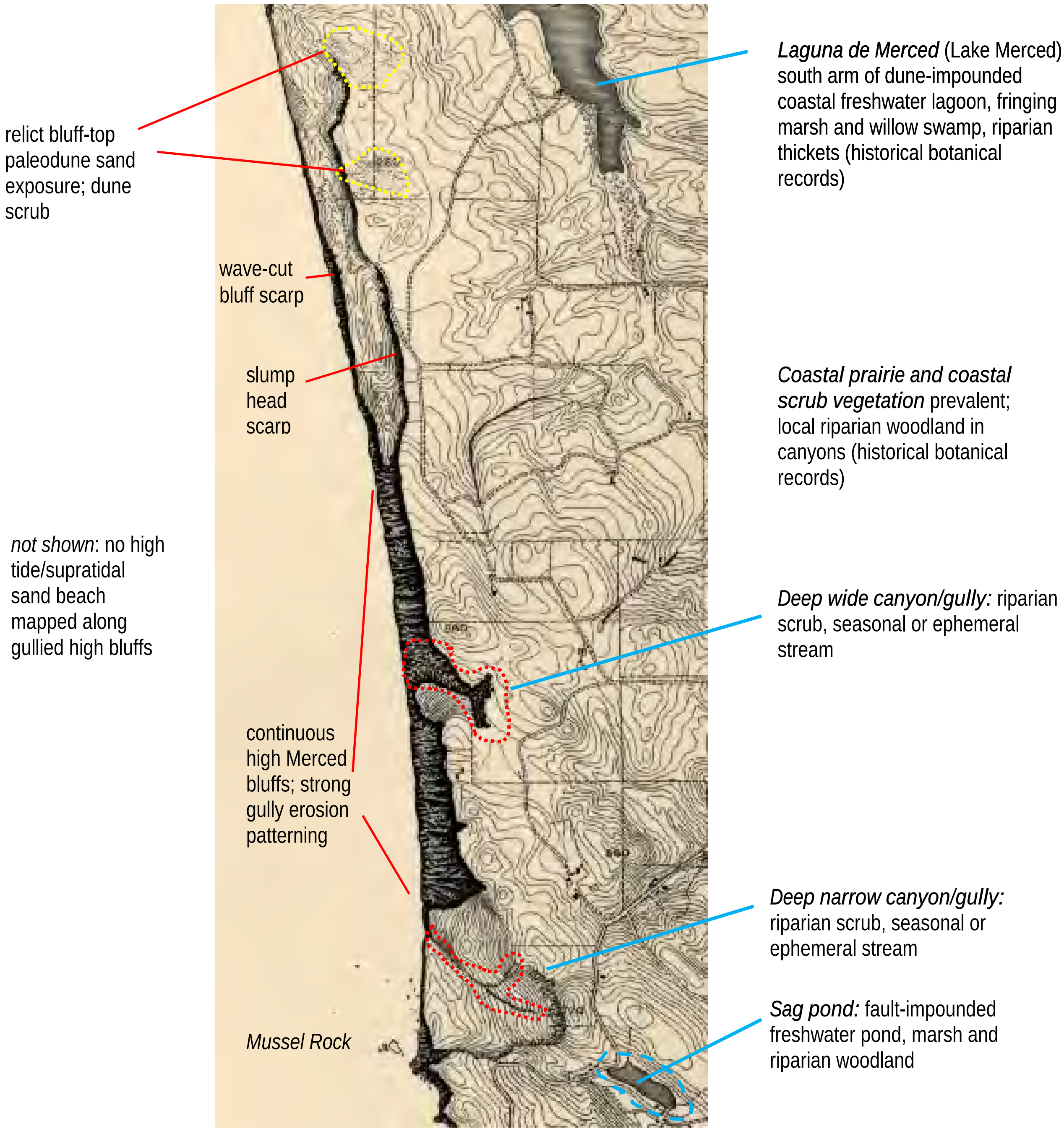


Figure 2. Daly City coastline 1869 (composite U.S. Coast Survey T sheets 1850s topography): landslide scarps, gullied bluffs, sag pond, coastal scrub, paleodune remnants

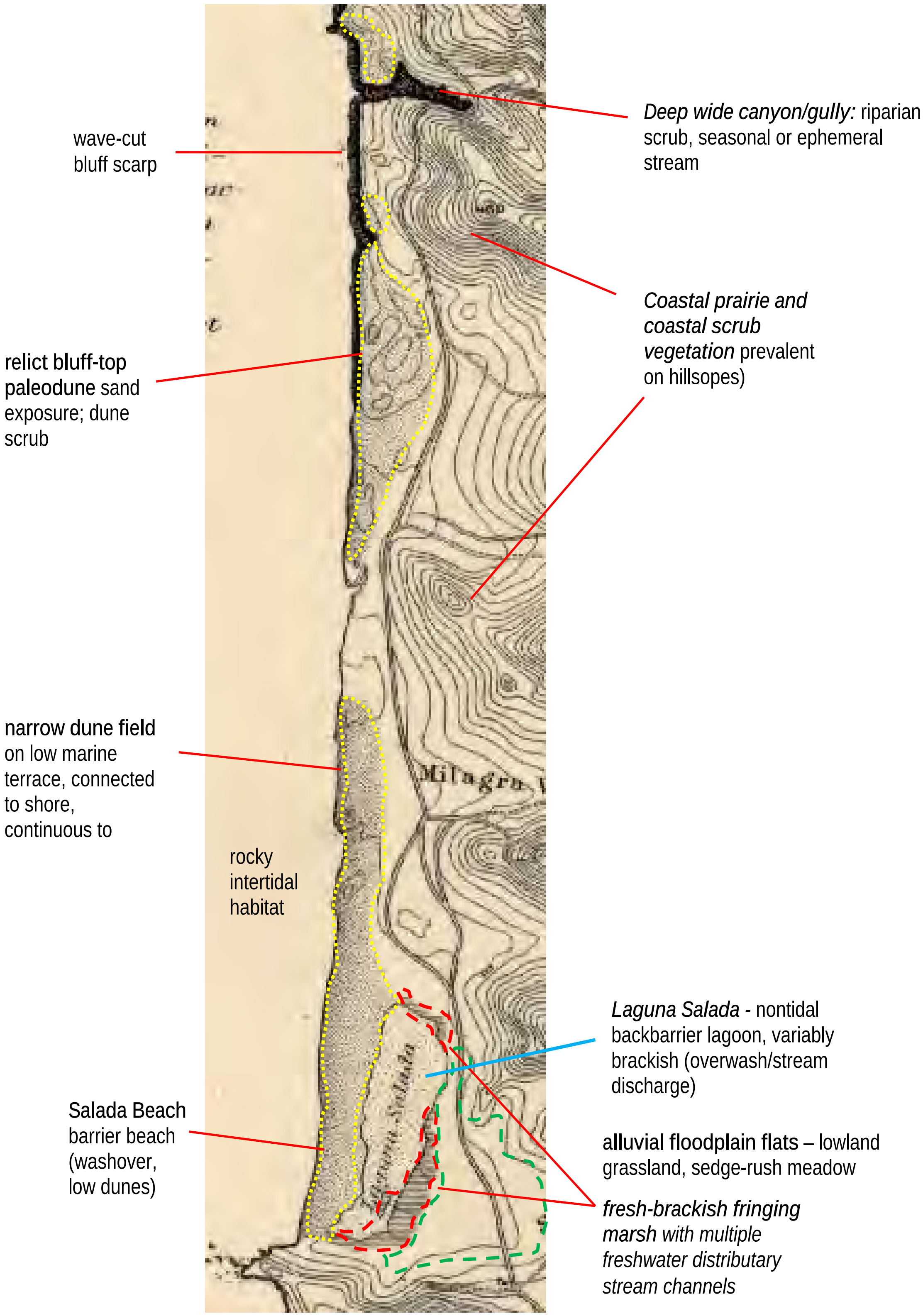


Figure 3. Pacifica coastline south of Mussel Rock to Mori Point, 1869 (composite U.S. Coast Survey T sheets 1850s topography): high coastal bluff scarp (coastal bluff scrub), marine terrace (coastal scrub) perched bluff-top dunes, coastal scrub, coastal canyon, barrier beach and non-tidal brackish lagoon and fringing fresh-brackish marsh (Laguna Salada)

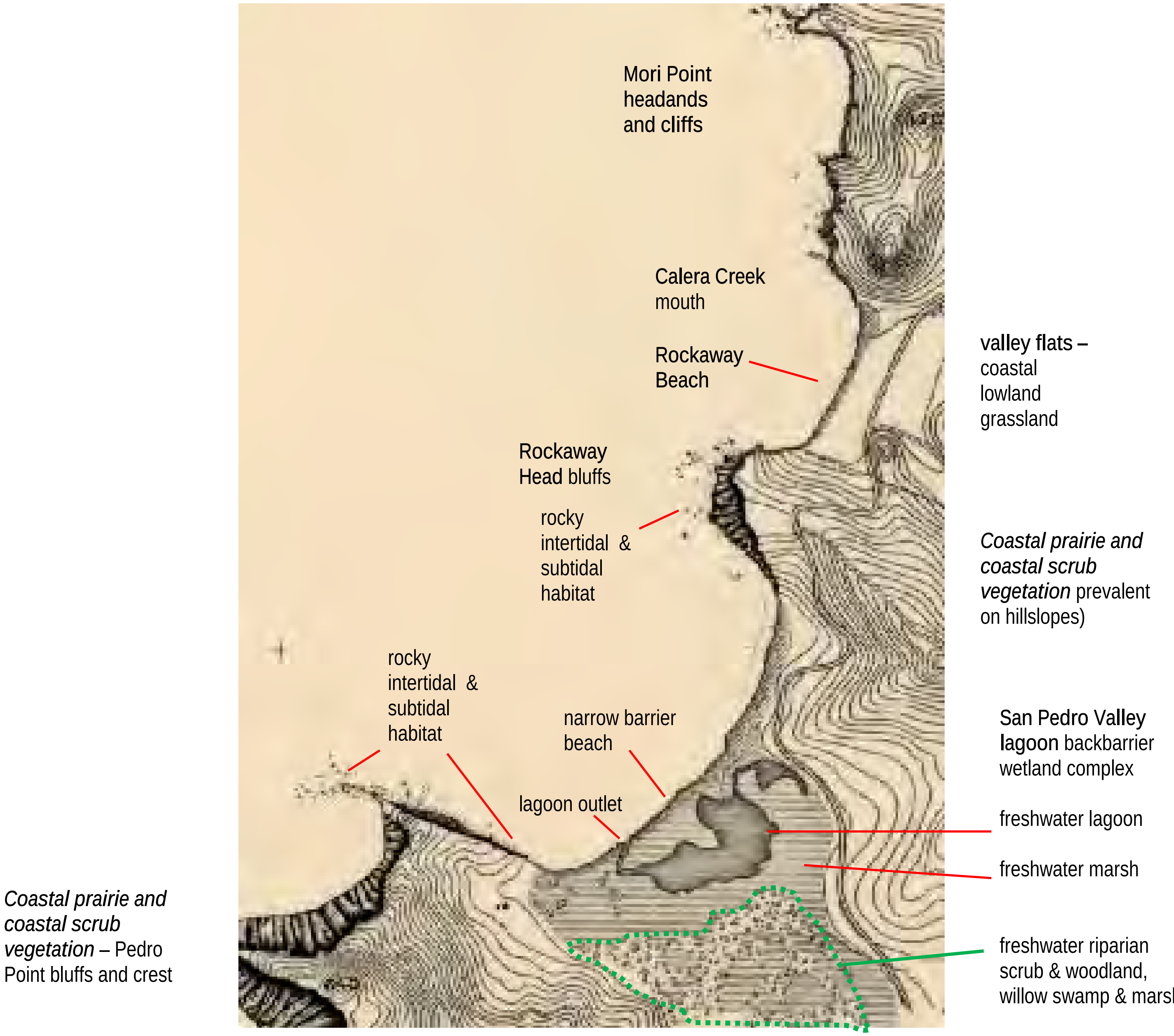


Figure 4. Pacifica coastline, Mori Point to San Pedro Valley (Linda Mar) 1869 (composite U.S. Coast Survey T sheets 1850s topography): high coastal bluff scarp (coastal bluff scrub), coastal scrub, barrier beach and non-tidal freshwater lagoon, marsh, and swamp

Appendix D
Coastal Policy Analysis

ESA

Coastal Management Plans, Policies, and Regulations

Coastal management policies and regulations that would influence the implementation of a regional sediment management plan stem from local, state and federal jurisdictions along the shoreline that intersect with the study region, including:

- **Golden Gate National Recreation Area**
- **City of San Francisco**
- **City of Daly City**
- **County of San Mateo**
- **Thornton State Beach**
- **City of Pacifica**
- **Pacifica State Beach**

The following plans and policies within the above geographical jurisdictions have been examined for pertinent measures that could influence sediment management efforts within the project area are listed below. Applicable provisions of these documents are described in the sections that follow.

- *GGNRA Draft General Management Plan Update 2012*
- *Ocean Beach Master Plan*
- *California Coastal Act*
- *Coastal Zone Management Act*
- *City and County of San Francisco Local Coastal Program*
- *County of San Mateo Local Coastal Program*
- *City of Daly City Local Coastal Program*
- *City of Daly City Draft Local Coastal Program Policies*
- *City of Pacifica Local Coastal Program*
- *City of Pacifica Draft Local Coastal Program Update*
- *Pacifica State Beach General Plan*

GGNRA Draft General Management Plan Update 2012

The *Draft General Management Plan and Environmental Impact Statement for the Golden Gate National Recreation Area and Muir Woods Monument* (“*Draft GMP*”) is applicable to study region segments that contain GGNRA lands. The Plan is currently undergoing revisions with a final Plan is expected to be published in the winter of 2012. The *Draft GMP* plan employs a zone-based approach to management of parklands. Each management zone concerns a general priority use for the area of designation. More specific management policies are indentified within each zone category. Each zone within the study region includes specific management policies concerning: (1) geologic resources; (2) water resources; (3) marine environment; and (4) coastal ecosystems. Other pertinent *Draft GMP* management policies concern climate change and ocean stewardship. A more detailed summary of these policies is provided in Appendix XX.

The following policies are applicable to the study region.

1. <u>Management Measures Common to all GGNRA Lands/Waters within the Study Area</u>

Climate Change (Vol. 1, p. 117)

The National Park Service has developed goals to guide the way climate change will be addressed. Sustaining and restoring park resources in the face of climate change will require the National Park Service to address many challenges to the integrity of cultural and natural resources. The general management plan describes the approach that the park would take to reduce emissions, educate visitors on the topic, and adapt to the effects of climate change during the next 20 years. In addition, the park maintains a "Climate Change Action Plan" that outlines the actions that would be taken to accomplish these broad goals…

- *Assess Impacts and Respond to Changing Conditions*…The park staff would coordinate with neighboring communities while implementing adaptation strategies that support the protection, preservation, and restoration of coastal wetlands and coastal processes, and can serve as vital tools in buffering coastal communities from the effects of climate change and sea level rise.

Climate Change Management Strategies (Vol. 1, p.118)
To meet the above goals, a more detailed management approach would be developed. The management approach would be an evolving process. The park staff would utilize local, regional, and larger scale monitoring, modeling and mapping evaluations. Through this data gathering, the park staff would identify and refine the assessment of park lands and resources that are vulnerable to sea level rise, extreme storms, and associated coastal erosion. Predictions and observations of other climate change effects, including weather, local climatic conditions, and phenology, would be gathered. Based on this information combined with the results of targeted monitoring, park managers could position themselves to respond and adapt according to changing conditions—a sort of early detection system. The following approaches and management actions could be implemented to respond to the effects of climate change on park resources.

Natural Resources
- Reduce current and future stressors to the resource and the environment; this would improve the condition of the resource and build resiliency in the ecosystem that would help to minimize future adverse effects of climate change.
- Collect and/or document resources that would be otherwise lost to the effects of the climate change (e.g., fossils, unique geologic resources, and unique biological resources).
- Sustain native biodiversity.
- Reduce habitat fragmentation and increase habitat connectivity and movement corridors.
- Restore and enhance habitats.
- Focus on ecosystem management and natural processes.
- Restore naturally functioning ecosystems.
- Manage for biological diversity.
- Minimize impact of invasive species.
- Plan for post-disturbance management.
- Employ adaptive management.
- Manage for realistic outcomes (triage).

Cultural Resources

- Pursue managed retreat when the results of the triage process indicate that preservation treatment or relocation is not practical.
- Pursue recordation and relocation of the resources with high significance and technically and economically feasible treatment and relocation options, and where there is high confidence in the predicted effects of sea level rise or other climate change impacts…

Visitor Experience

- Continue to provide a range of experiences by transitioning recreational use away from locations where changes in resource conditions no longer support such uses.
- Remove existing visitor facilities and discontinue recreational uses where continued use is unsafe, infeasible, or undesirable due to changing environmental conditions.
- Evaluate and support changing visitor use patterns as appropriate.

Ocean Stewardship (Vol. 1, p. 129)

This section of the general management plan articulates an ocean stewardship policy that is based on and intended to support the Pacific West Region's strategic plan. The strategies and objectives included therein are targeted at addressing the unique needs of Golden Gate National Recreation Area's ocean resources. The park would develop an implementation plan that would contain specific actions intended to achieve the goals and strategies identified below. The document notes that climate change will cause sea level rise, changing storm patterns, and ocean acidification. It states further that natural sediment transport, which affects shoreline and beach dynamics, is affected by sand mining, dredging, dredge disposal, shoreline stabilization structures, and altered flow regimes such as dams.

Ocean Stewardship Goals and Management Strategies (Vol. 1, p. 129)

In order to be an effective steward of the park's natural and cultural ocean resources, park staff must research, monitor, and protect these resources, expand current and explore new partnerships with other agencies and organizations, and communicate an ocean stewardship message to visitors, park managers, and the public. To accomplish this, park staff must develop a plan and then pursue funding and leverage partnerships.

Goal 2. Inventory, Map, and Protect Ocean Parks

- Strategy 2.2. Park staff will identify and quantify threats to marine resources, including those associated with climate change and land- and water-based activities.
- Strategy 2.3. Through the establishment of sensitive resource zones and special closure areas, the park will protect the most sensitive biological resources from disturbance.
- Strategy 2.4. Park staff will engage in restoration of estuarine and coastal wetland habitats and will assess new restoration opportunities in response to changes from climate change.
- Strategy 2.5. Park staff will continue to work with the State Lands Commission to obtain additional state lease of all tidelands and submerged lands within the park's legislated boundary.

Goal 4. Increase Technical Capacity for Ocean Exploration and Stewardship

- Strategy 4.2. Park staff will partner with regional agencies on research and modeling of, and management response to, sediment dynamics and other coastal and ocean processes within the San Francisco littoral cell.
- Strategy 4.4. Park staff will continue to partner with regional, state, and federal agencies to monitor and model sea level rise and other local effects of climate change and assess affects on ocean and coastal resources.

- Strategy 4.5. Park staff will partner with local and regional scientific and political entities to develop protection, mitigation, adaptation and restoration strategies and provide guidance on management of park resources that may be affected by climate change, including inundation and accelerated coastal erosion associated with sea level rise, increased storm wave energy and altered flow regimes.

2. Management Measures ('Zones') Specific to Certain Geographic Locations within the Study Area

Under the General Management Plan Update, GGNRA would adopt a zone-based approach to management of parklands. Each management zone concerns a general priority use for the area of designation. More specific management policies are indentified within each zone category. Those management zones, and associated policies, proposed for lands within the project area are summarized below.

Description of "Diverse Opportunities Zone" (Vol 1, p. 57)
This management zone provides a range of natural and historic settings and facilities to welcome and support a wide variety of visitor opportunities appropriate in the park. Significant fundamental park resources would be preserved while different levels of visitor use would be accommodated. People would have a wide range of educational, interpretive, and recreational opportunities to enjoy and appreciate the park's resources.

- *Geologic Resources.* Natural geologic processes, including natural physical shoreline processes, would be left unimpeded except when required for safety and to protect human health. To the greatest extent possible, infrastructure would be designed or relocated to avoid paleontological resources and geologic resources and hazards. Impacted areas would be restored to the greatest extent possible. Geologic and paleontological features and resources would be protected from visitor use impacts.
- *Water Resources.* Natural hydrologic systems and processes would be left unimpeded to the greatest extent possible. Impacted areas would be restored to the greatest extent possible. Hydrologic systems and processes would be reestablished while incorporating visitor use objectives. Potential impacts from visitor use, including erosion, surface and groundwater contamination, and alteration of natural processes, would be avoided or minimized.
- *Marine Environment.* The natural physical processes of marine and coastal areas would be left unimpeded to the extent possible. Impacted areas would be restored to the greatest extent possible. Marine resources would be protected from visitor use impacts.
- *Coastal Ecosystems: Vegetation.* Native vegetation and vegetation communities (including aquatic vegetation) would be preserved to the greatest extent possible.
- Species that can withstand and support intense visitor use may be desired in developed areas or areas that receive high levels of trampling. Exotic invasive plants could be present, but would be suppressed and actively managed.
- *Coastal Ecosystems: Aquatic and Terrestrial Wildlife.* Native wildlife and wildlife habitat would be protected from visitor use impacts to the greatest extent possible and wildlife watching opportunities would be available. Exotic invasive animals would be managed to the extent feasible, with emphasis on species that have inordinate impacts on native communities or are associated with human health risks.

Description of "Scenic Corridor Zone" (Vol 1, p. 63)
This management zone includes scenic trails, roads, and coastlines that provide for sightseeing and related recreational opportunities. Resources could be modified in this zone, and facilities

would highlight and enhance the natural, cultural, and scenic values, as well as provide for a safe tour route.

- *Geologic Resources.* Natural geologic processes, including natural shoreline processes, would be left unimpeded except when human health and safety are threatened. To the greatest extent possible, infrastructure would be designed or relocated to avoid paleontological resources and geologic resources and hazards. Impacted areas would be restored to the greatest extent possible. Geologic and paleontological features and resources would be protected from visitor use impacts.

- *Water Resources.* Natural hydrologic systems and processes would be left unimpeded to the greatest extent possible. Impacted areas would be restored to the greatest extent possible. Hydrologic systems and processes would be reestablished while incorporating visitor use objectives. Potential impacts from visitor use, including erosion, surface and groundwater contamination, and alteration of natural processes, would be avoided or minimized.

- *Marine Environment.* The natural physical processes of marine and coastal areas would be left unimpeded to the extent possible. Impacted areas would be restored to the greatest extent possible. Marine resources would be protected from visitor use impacts.

- *Coastal Ecosystems: Vegetation.* Native vegetation and vegetation communities (including aquatic vegetation) would be preserved to the greatest extent possible. Vegetation—focused on sites lacking native habitat value—could be modified in this zone to accommodate and enhance scenic views. Intact native habitat loss would be mitigated through restoration actions and result in no net loss. Species that can withstand and support high levels of visitor use and trampling may be desired. Exotic invasive plants could be present, but would be suppressed and actively managed in the park.

- *Coastal Ecosystems: Aquatic and Terrestrial Wildlife.* Native wildlife and wildlife habitat would be protected from visitor use impacts to the greatest extent possible. Exotic invasive animals would be managed to the extent feasible, with emphasis on species that have inordinate impacts on native communities or are associated with human health risks in high use areas.

Description of "Natural Zone" (Vol 1, p. 83)
This management zone would retain the natural, wild, and dynamic characteristics and ecological functions. The natural resources would be managed to preserve and restore resource integrity while providing for backcountry types of visitor experiences. Visitors would have opportunities to directly experience the natural resources primarily from trails and beaches. Visitor use would be managed to preserve resources and their associated values and could involve controlled access. External threats to resources would be aggressively addressed. Modest facilities that support management and visitor use within this zone, such as a trailhead, could be placed on the periphery of the zone.

- *Geologic Resources.* Natural geologic processes, including natural shoreline processes, would be left unimpeded except when action is required for safety and to protect human health. Impacted areas would be restored to the greatest extent possible. Unique geologic features would be preserved, and paleontological resources would be undisturbed.
- *Water Resources.* Natural hydrologic systems and processes would be left unimpeded. Impacted areas would be restored to the greatest extent possible. Dynamic, sustainable,

hydrologic systems and processes that support the diverse native life unique to the region would be reestablished.
- *Marine Environment.* The natural physical processes of marine and coastal areas would be left unimpeded to the extent possible. Impacted areas would be restored to the greatest extent possible. Protection of marine areas that support the conservation of native species and biodiversity would be maximized.
- *Coastal Ecosystems: Vegetation.* Native vegetation and vegetation communities (including aquatic vegetation) would be preserved to the greatest extent possible with the goal of conserving native biodiversity. Exotic invasive plants could be present, but would be contained and actively managed with the goal of eradication in the park.
- *Coastal Ecosystems: Aquatic and Terrestrial Wildlife*. Native wildlife communities and ecosystem processes would be preserved and restored to the greatest extent possible. Exotic invasive animals would be managed with the goal of eradication in the park.

Description of "Park Operations Zone" (Vol. 1, p. 93)
This management zone would primarily support developed facilities for park and partners operations and maintenance functions. This zone would be managed to provide facilities that are safe, secured, and appropriate for functions required for park management. Access to these areas for visitors would be controlled and limited to organized meetings, programs, and access to park administration.

- *Geologic Resources.* Natural geologic processes, including natural shoreline processes, would be left unimpeded to the extent possible. Impacted areas would be restored to the greatest extent possible. Unique geologic features would be preserved, and paleontological resources would be protected while meeting operational needs. Avoidance and mitigation would be used to minimize impacts on geologic and paleontological resources. Where impacts are unavoidable, paleontological resources would, if necessary, be collected and properly cared for.
- *Water Resources.* Natural hydrologic systems and processes would be left unimpeded to the greatest extent possible. Previously impacted areas would be restored to the greatest extent possible. Potential impacts from park operations, including erosion, surface and groundwater contamination, and alteration of natural processes, would be avoided or minimized.
- *Marine Environment.* The natural physical processes of marine and coastal areas would be left unimpeded to the extent possible. Impacted areas would be restored to the greatest extent possible. Marine resources would be protected from impacts from park operations.
- Coastal Ecosystems: Vegetation. Native vegetation and vegetation communities (including aquatic vegetation) would be preserved to the greatest extent possible. Impacts from park operations on these areas and on adjacent vegetation would be minimized. Species that can withstand and support operational uses may be desired. Exotic invasive plants could be present, but would be suppressed and actively managed in the park.
- *Coastal Ecosystems: Aquatic and Terrestrial Wildlife.* Native wildlife communities would be protected to the greatest extent possible. Exotic invasive animals would be managed to the extent feasible, with emphasis on species that have inordinate impacts on native communities or are associated with human health risks.

Description of "Evolved Cultural Landscape Zone" (Vol 1, p. 68)
This management zone would preserve significant historic, archeological, architectural, and landscape features while being adaptively reused for contemporary park and partner needs. Cultural resources, as well as the surrounding natural resources that are often integral to the

historic site, would be preserved and interpreted. This zone could contribute to visitor enjoyment and exploration of the historic values and events while providing for other types of uses.

- *Geologic Resources.* Natural geologic processes, including natural shoreline processes, would be left unimpeded except when action is required for safety and to protect human health and important cultural resources. Impacted areas would be restored to the greatest extent possible. Geologic and paleontological features and resources would be protected from visitor use impacts.
- *Water Resources.* Natural hydrologic systems and processes would be left unimpeded, unless some alteration was required to protect cultural resources. Impacted areas would be restored to the greatest extent possible. Hydrologic systems and processes would be reestablished while incorporating cultural resource and visitor use objectives. Potential impacts from visitor use, including erosion, surface and groundwater contamination, and alteration of natural processes, would be avoided or minimized.
- *Marine Environment.* The natural physical processes of marine and coastal areas would be left unimpeded to the extent possible. Impacted areas would be restored to the greatest extent possible. Marine resources would be protected from visitor use impacts.
- *Coastal Ecosystems: Vegetation*. Native vegetation and vegetation communities (including aquatic vegetation) would be preserved in collaboration with, and where they complement, cultural landscape objectives. Nonnative species (contributing) could be desired and maintained to provide vegetation communities and patterns that support cultural landscape values and/or tolerate high levels of visitor use. These areas would be managed to minimize potential impacts to adjacent native vegetation. Exotic invasive plants that do not contribute to the cultural resource values, could be present, but would be suppressed and actively managed with the goal of eradication in the park.
- *Coastal Ecosystems: Aquatic and Terrestrial Wildlife*. Native wildlife and wildlife habitat would be preserved to the greatest extent possible while the integrity of cultural landscapes would be maintained. Consequently, wildlife habitat may appear more “groomed” in this zone to meet cultural landscape preservation goals. Exotic invasive animals would be managed to the extent feasible, with emphasis on species that have inordinate impacts on native communities or public safety.

3. Preferred Alternative Proposed Designation of Management Zones at Specific Geographic Locations within Study Area

The following is a description of the management zones and actions proposed in the GMP Update for specific GGNRA lands within each of the RSMP study reaches.

China Beach (Vol. 1, p. 212)
Diverse Opportunities Zone
Park managers would improve visitor facilities and access to support current uses.

Lands End (Vol. 1, p. 212)
Evolved Cultural Landscape Zone
Park managers would continue to enhance the landscape, integrating natural habitat restoration with cultural landscape preservation, and improving the trail system. This would include the California Coastal Trail and the secondary trails that access the shoreline, and would enhance scenic viewpoints and opportunities for bird watching. The area would continue to be managed for the preservation of dark night skies. Trail connections and directional signage to the community and adjacent park lands would also be improved.

Ocean Beach (Vol. 1, p. 213)
Diverse Opportunities and Natural Zones
The National Park Service would participate in multiagency efforts to knit the unique assets and experiences of the Ocean Beach corridor into a seamless and welcoming public landscape, planning for environmental conservation, sustainable infrastructure, and long-term stewardship.

The Park Service would continue to work with the City of San Francisco, California Coastal Commission, and the U.S. Army Corps of Engineers to address coastal erosion: relocating facilities out of vulnerable locations and restoring natural processes to maximize protection of the beach for its natural and recreational values.

Diverse Opportunities Zone (along O'Shaughnessy seawall)
Park managers would continue to provide for a diversity of recreational beach use and preserve the natural setting and resource values, including shorebird habitat. The vital community stewardship activities that are part of the successful management of the beach would be promoted.

The park would preserve the historic O'Shaughnessy seawall and collaborate with the City of San Francisco to enhance the Ocean Beach corridor with improved amenities that support enjoyment of the beach, including the promenade, parking, and restrooms.

The California Coastal Trail and other connections would be improved to link Ocean Beach to Lands End, Fort Funston, city neighborhoods, and other park lands including Golden Gate Park and Lake Merced.

Natural Zone (south of O'Shaughnessy seawall)
The area would be managed to protect shorebirds and threatened species and allow natural coastal and marine processes to occur, while providing for a variety of compatible recreational activities. Public safety activities would be continued.

Fort Funston (Vol. 1, p. 214)
Diverse Opportunities Zone (central area and southern beach)
This site would continue to support current recreational activities, landscape and trail improvements, natural habitat protection and restoration. New visitor facilities would be provided near the parking lot. These could include restrooms, group picnicking facilities, a visitor contact facility combining food service with park information, and other support structures. Battery Davis, the historic seacoast fortification, would be preserved and interpreted and its earthworks fenced and protected.

Natural Zone (corridors along the perimeter and northern beach)
Fort Funston's islands of native habitat would be extended to form a continuous habitat corridor that supports recovery of native dune habitat including endangered San Francisco *Lessingia* plants. The northern stretch of beach would be managed to protect shorebirds, coastal bluffs, and bank swallows and to allow natural coastal and marine processes to occur to the extent feasible, while providing for a variety of compatible recreational activities.

Park Operations Zone (southeast corner)
Operational facilities could be expanded to meet park needs, including public safety offices, nursery, stewardship center, satellite maintenance facilities, and staff or volunteer housing. The

existing environmental education center could remain in this zone or be relocated to another site better served by public transportation with appropriate facilities and outdoor settings.

San Francisco Offshore Ocean and Bay Environment (Vol. 1, p. 212)
<u>Scenic Corridor Zone</u>
The park would preserve the ocean and bay environment and accommodate public uses including surfing, boating, and noncommercial fishing. Park managers would protect the marine habitat, geologic resources and processes, and other natural features of the area.

Thornton State Beach to South of Mussel Rock (Vol. 1, p. 216)
<u>Natural Zone</u>
Park managers would preserve and enhance the natural and scenic values of the area; allow for natural coastal geologic processes to continue; and provide modest visitor access facilities (trails, trailheads) to beaches, scenic overlooks, and along the California Coastal Trail, where feasible. The beach, dunes, and cliffs extending from San Francisco's Ocean Beach south to Mussel Rock (a stretch of almost 5 miles) would be managed to protect shorebird habitat, allow natural shoreline processes to continue unimpeded, and provide improved or new trails for visitors to enjoy and view nature. Park staff would work with neighboring communities to mitigate concentrated urban runoff and landslide threat.

Mori Point (Vol. 1, p. 218)
<u>Natural Zone</u>
The land would be managed for ongoing restoration of natural habitats and to protect threatened and endangered species while improving the trail system for public enjoyment of the site and its exceptional views and landscapes. Access to Mori Point would be enhanced with modest trailhead and parking improvements. Trail connections to the community, Sweeney Ridge and the adjacent public lands, and the California Coastal Trail would be improved in partnership with other land managers. Collaboration with adjacent land managers would also contribute to expanded efforts to preserve listed species and their habitats, improving habitat connectivity across management boundaries

San Mateo County Offshore Ocean Environment (Vol. 1, p. 103 and 221)
Management of offshore areas could be extended to cover new segments of the San Mateo County coast. The park includes several coastal properties in San Mateo County. The western boundaries of these properties end at the line of mean high tide in the Pacific Ocean. The proposed boundary adjustment would place the new boundary 0.25 mile from the line of mean high tide to include offshore areas (about 2008 acres). This proposal would affect only properties the National Park Service currently manages; it would affect not areas within the boundary that are managed by others.

Ocean Beach Master Plan

The following recommendations and implementation actions come from the 2012 Draft Ocean Beach Master Plan:

Recommendation 1. Reroute Great Highway behind the Zoo via Sloat and Skyline

1.1. Reconfigure Sloat/Great Highway and Sloat/Skyline intersections

1.2. Maintain one lane out southbound from oceanside treatment plant (OTP) for trucks

1.3. Reconfigure Sloat Blvd, with parking along zoo boundary, permeable pavement, bikeway, and coastal access amenities

1.4. Pull L-Taraval south across Sloat, terminus at zoo gate

1.5. Introduce coastal trail to Fort Funston

1.6. Connect N-S to California Coastal Trail, linking Lake Merced all the way to Marin

1.7. Replace beach/zoo parking along armory road and using OTP roof

1.8. Reopen Armory Road: Skyline to zoo lot

Recommendation 2. Introduce a multi-purpose coastal protection /restoration / access system

2.1. Incrementally withdraw from bluff edge

2.2. Reinforce the Lake Merced (LM) tunnel in place, remove revetments and fill

2.3. Sand nourishment via Army Corps, develop and pursue Best Practices for beach nourishment

2.4. Cobble berm over LM tunnel covered by sand (via Army Corps sand nourishment) serves as wave dissipation zone; overwash occurs during severe storm events

2.5. Second cobble berm protects force mains, high ground at pump station, Fleishhacker Bldg

2.6. Terraced, vegetated seawall with cobble toe along oceanside treatment plant (OTP)

2.7. Create detention swale (through zoo) and constructed wetland

2.8. Fleishhaker Bldg renovated as warming hut and interpretive center

2.9. Interpretive elements explain stormwater infrastructure system to visitors

2.10. Conduct near-term pilot studies of dynamic coastal protection: skyline to zoo lot

Recommendation 3. Reduce width of Great Highway to provide amenities / managed retreat

3.1. Reduce great highway to 2 lanes + wide shoulder for cycling, emergency access

3.2. Reconfigure great highway / Sloat intersection following transport box to avoid erosion hot spot

3.3. Distributed parking at key access nodes

3.4. Restore existing restrooms, build new restrooms

3.5. Improve access at Judah, Taraval, Rivera and Noriega

3.6. Traffic calming + mitigation measure to lessen neighborhood traffic impacts

3.7. LID (low-impact design) to address stormwater management

Recommendation 4. Middle reach native dune restoration

4.1. Sand nourishment via Army Corps of Engineers along southern end of middle reach

4.2. Dune restoration in key locations, especially at Lincoln and Vicente

4.3. Sand ladders and modular boardwalks provide access while limiting impact

Recommendation 5. Better connection between Golden Gate Park and beach

5.1. Improve parking lot, preserve event/flexspace capacity

5.2. Maintain row of "watching the water" parking

5.3. Modify parking entrances, and improve pedestrian crossings at JFK/Beach Chalet

5.4. Provide vertical arrival element / overlook at ends of Golden Gate Park

5.5. Add east side bike lanes (in both directions), connect bike trail with GGP

5.6. Add abundant bike parking

5.7. Joint City/Federal Parking Management Plan

5.8. Introduce appropriate landscape site elements

Recommendation 6. Bicycle + pedestrian improvements north of balboa

6.1. Narrow Great Highway North of Balboa (from 4 to 2 lanes)

6.2. Keep diagonal Cliff House parking

6.3. Narrow Point Lobos Avenue from 4 lanes to 2, add 2-way separated bikeway on inland side. Separated bikeway along cliff to prevent bicycle/vehicular conflict on steep slope

6.4. Connect bike lane to bike trail to Lands End and add "bicycle box" at Pt Lobos and 49th

Coastal Zone Management Act Federal Consistency Determination/Certification

The Federal Consistency Unit of the California Coastal Commission implements the federal Coastal Zone Management Act (CZMA) of 1972 as it applies to federal activities, development projects, permits and licenses, and support to state and local governments. The following policies would be applicable to project segments within which federal action (i.e., funding or permitting) would be required for implementation (i.e., Baker Beach; Point Lobos; North, Middle, and South Ocean Beach; Fort Funston; Daly City; Mussel Rock; Manor District; Sharp Park; Hidden Cove; Linda Mar; and Shelter Cove).

- **Section 307(c)** Consistency of Federal activities with State management programs; Presidential exemption; certification
  - **(A)** Each Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone shall be carried out in a manner which is consistent to the maximum extent practicable with the

enforceable policies of approved State management programs. A Federal agency activity shall be subject to this paragraph unless it is subject to paragraph (2) or (3).

- **(C)** Each Federal agency carrying out an activity subject to paragraph (1) shall provide a consistency determination to the relevant State agency designated under section 1455(d)(6) of this title at the earliest practicable time, but in no case later than 90 days before final approval of the Federal activity unless both the Federal agency and the State agency agree to a different schedule.
- Any Federal agency which shall undertake any development project in the coastal zone of a state shall insure that the project is, to the maximum extent practicable, consistent with the enforceable policies of approved State management programs.
- **(A)** After final approval by the Secretary of a state's management program, any applicant for a required Federal license or permit to conduct an activity, in or outside of the coastal zone, affecting any land or water use or natural resource of the coastal zone of that state shall provide in the application to the licensing or permitting agency a certification that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program. At the same time, the applicant shall furnish to the state or its designated agency a copy of the certification, with all necessary information and data. Each coastal state shall establish procedures for public notice in the case of all such certifications and, to the extent it deems appropriate, procedures for public hearings in connection therewith. At the earliest practicable time, the state or its designated agency shall notify the Federal agency concerned that the state concurs with or objects to the applicant's certification. If the state or its designated agency fails to furnish the required notification within six months after receipt of its copy of the applicant's certification, the state's concurrence with the certification shall be conclusively presumed. No license or permit shall be granted by the Federal agency until the state or its designated agency has concurred with the applicant's certification or until, by the state's failure to act, the concurrence is conclusively presumed, unless the Secretary, on his own initiative or upon appeal by the applicant, finds, after providing a reasonable opportunity for detailed comments from the Federal agency involved and from the state, that the activity is consistent with the objectives of this chapter or is otherwise necessary in the interest of national security.

California Coastal Commission and Local Coastal Programs

The Coastal Commission, in collaboration with local counties and cities, is the primary state agency responsible for planning and regulating the use of land and water within California’s coastal zone, in accordance with the specific policies of the California Coastal Act (CCA). In addition to development within the coastal zone, the Coastal Commission also has jurisdiction over projects requiring federal permits or approval in federal waters. The Coastal Commission was also established to assist local governments in implementing local coastal planning and regulatory powers by adopting Local Coastal Programs.

Local Coastal Programs (LCPs) are basic planning tools prepared and used by local governments to guide development in the coastal zone, in partnership with the Coastal Commission. LCPs contain the ground rules for future development and short-term and long-term conservation and protection of coastal resources. Each approved LCP specifies appropriate locations, types, and scales of new or changed uses of land and water. Each LCP includes one or more Land Use Plans (LUPs) with goals and regulatory policies and measures to implement the plan (such as zoning ordinances). While each LCP reflects unique characteristics of individual local coastal communities, regional and statewide interests and concerns must also be addressed to conform to CCA goals and policies.

Following adoption by a city council or county board of supervisors, an LCP is submitted to the Coastal Commission for review for consistency with CCA requirements. After an LCP has been certified by the Coastal Commission, the Commission's coastal permitting authority is transferred to the local government, which applies the requirements of the LCP in reviewing proposed new developments. All project proposals located within the coastal zone will be reviewed for consistency with the LCP or the CCA (where no certified LCP exists) and will require a coastal development permit. Any projects located on sovereign lands below MHW remain within the Coastal Commission appeal jurisdiction (as are lands between the ocean and the first public road). Therefore, in some cases, two permits may be necessary; one from the local jurisdiction with a certified LCP and one from the Coastal Commission. Beach nourishment projects being evaluated would require Coastal Commission approval pursuant to Section 30106 of the CCA, which regulates coastal development. The definition of development includes beach nourishment, removal, dredging, mining, or extraction of materials, and discharge or disposal of any dredged material.

The following cities of San Francisco, Daly City, Pacifica, and San Mateo County have certified LCPs. A summary of Coastal Act policies, along with relevant provisions of each LCP within the project area, is provided below.

California Coastal Act

The following policies from the California Coastal Act of 1976 relate to regional sediment management and would be applicable to project areas for which no LCP has been certified (i.e., state and federal lands, and uncertified areas of local jurisdictions), and modifications to existing LCPs.

ARTICLE 4. MARINE ENVIRONMENT

- **Section 30230 Marine resources; maintenance.**
  Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

- **Section 30231 Biological productivity; water quality.**
  The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the

protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface waterflow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.

- **Section 30233 Diking, filling or dredging; continued movement of sediment and nutrients.**
    - A) The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to the following:
        - (l) New or expanded port, energy, and coastal-dependent industrial facilities, including commercial fishing facilities.
        - (2) Maintaining existing, or restoring previously dredged, depths in existing navigational channels, turning basins, vessel berthing and mooring areas, and boat launching ramps.
        - (3) In open coastal waters, other than wetlands, including streams, estuaries, and lakes, new or expanded boating facilities and the placement of structural pilings for public recreational piers that provide public access and recreational opportunities.
        - (4) Incidental public service purposes, including but not limited to, burying cables and pipes or inspection of piers and maintenance of existing intake and outfall lines.
        - (5) Mineral extraction, including sand for restoring beaches, except in environmentally sensitive areas.
        - (6) Restoration purposes.
        - (7) Nature study, aquaculture, or similar resource dependent activities.
    - B) Dredging and spoils disposal shall be planned and carried out to avoid significant disruption to marine and wildlife habitats and water circulation. Dredge spoils suitable for beach replenishment should be transported for these purposes to appropriate beaches or into suitable longshore current systems.
    - C) In addition to the other provisions of this section, diking, filling, or dredging in existing estuaries and wetlands shall maintain or enhance the functional capacity of the wetland or estuary. Any alteration of coastal wetlands identified by the Department of Fish and Game, including, but not limited to, the 19 coastal wetlands identified in its report entitled, "Acquisition Priorities for the Coastal Wetlands of California", shall be limited to very minor incidental public facilities, restorative measures, nature study, commercial fishing facilities in Bodega Bay, and development in already developed parts of south San Diego Bay, if otherwise in accordance with this division.
    - D) For the purposes of this section, "commercial fishing facilities in Bodega Bay" means that not less than 80 percent of all boating facilities proposed to be developed or improved, where the improvement would create additional berths in Bodega Bay, shall be designed and used for commercial fishing activities.

- E) Erosion control and flood control facilities constructed on watercourses can impede the movement of sediment and nutrients that would otherwise be carried by storm runoff into coastal waters. To facilitate the continued delivery of these sediments to the littoral zone, whenever feasible, the material removed from these facilities may be placed at appropriate points on the shoreline in accordance with other applicable provisions of this division, where feasible mitigation measures have been provided to minimize adverse environmental effects. Aspects that shall be considered before issuing a coastal development permit for these purposes are the method of placement, time of year of placement, and sensitivity of the placement area.

- **Section 30235 Construction altering natural shoreline**
  Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply. Existing marine structures causing water stagnation contributing to pollution problems and fish kills should be phased out or upgraded where feasible.

ARTICLE 5. LAND RESOURCES

- **Section 30240 Environmentally sensitive habitat areas; adjacent developments**
  - A) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas.
  - Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.

- **Section 30251 Scenic and visual qualities**
  The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas. New development in highly scenic areas such as those designated in the California Coastline Preservation and Recreation Plan prepared by the Department of Parks and Recreation and by local government shall be subordinate to the character of its setting.

- **Section 30253 Minimization of adverse impacts**
  New development shall do all of the following:
  - A) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.
  - B) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.

- C) Be consistent with requirements imposed by an air pollution control district or the State Air Resources Board as to each particular development.
- D) Minimize energy consumption and vehicle miles traveled.
- E) Where appropriate, protect special communities and neighborhoods that, because of their unique characteristics, are popular visitor destination points for recreational uses.

City and County of San Francisco LCP

There are two segments of the City and County of San Francisco LCP: 1) the Balance of the City and County of San Francisco; and 2) the Olympic Club. The revised LUP and revised Implementation Program, incorporating the new Neighborhood Commercial zones, were effectively certified by the Commission on March 14, 1986. This Olympic Club segment includes all of the Olympic Club-owned golf course lands in southwestern San Francisco. The City is not working on this LCP, and there is no projected date for its completion. The following policies from the San Francisco Land Use Plan relate to regional sediment management:

- Policy 6.1. Continue Ocean Beach as a natural beach area for public recreation.
- Policy 6.2. Improve and stabilize the sand dunes where necessary with natural materials to control erosion.
- Policy 7.4. Protect the natural bluffs below Sutro Heights Park. Keep the hillside undeveloped in order to protect the hilltop landform, and maintain views to and from the park. Acquire the former Playland-at-the-Beach site north of Balboa if funds become available.
- Policy 9.1. Maximize the natural qualities of Fort Funston. Conserve the ecology of entire Fort and develop recreational uses which will have only minimal effect on the natural environment.
- Policy 9.2. Permit hanggliding but regulate it so that it does not significantly conflict with other recreational and more passive uses and does not impact the natural quality of the area.
- Policy 10.1. If the private golf course use is discontinued, acquire the area for public recreation and open space, if feasible.
- Policy 10.2. Maintain the existing public easement along the beach. Encourage the granting of an additional easement by the Olympic Country Club to the National Park Service for public use and maintenance of the sensitive bluff area west of Skyline Boulevard as part of the Golden Gate National Recreation Area.
- Policy 10.3. Protect the stability of the westerly bluffs by consolidating the informal trails along the bluff area into a formal trail system which would be clearly marked. Coordinate

the lateral trail system along the bluff with the San Mateo trail system south of the San Francisco boundary.

County of San Mateo LCP

The County of San Mateo LCP was certified on April 1, 1981. A multi-year comprehensive update of certain sections of the LCP pertaining to the "Urban Midcoast" is currently under review. The following policies from the County of San Mateo Land Use Plan relate to regional sediment management:

SENSITIVE HABITATS

- **Policy 7.3. Protection of Sensitive Habitats**
  a. Prohibit any land use or development which would have significant adverse impact on sensitive habitat areas.

  b. Development in areas adjacent to sensitive habitats shall be sited and designed to prevent impacts that could significantly degrade the sensitive habitats. All uses shall be compatible with the maintenance of biologic productivity of the habitats.

- **Policy 7.4. Permitted Uses in Sensitive Habitats**
  a. Permit only resource dependent uses in sensitive habitats. Resource dependent uses for riparian corridors, wetlands, marine habitats, sand dunes, sea cliffs and habitats supporting rare, endangered, and unique species shall be the uses permitted in Policies 7.9, 7.16, 7.23, 7.26, 7.30, 7.33, and 7.44, respectively, of the County Local Coastal Program on March 25, 1986.

  b. In sensitive habitats, require that all permitted uses comply with U.S. Fish and Wildlife and State Department of Fish and Game regulations.

MARINE HABITATS

- **Policy 7.22. Designation of Marine and Estuarine Habitats**
  Designate all areas containing marine and estuarine habitats as requiring protection, specifically including but not limited to: Fitzgerald Marine Reserve, San Gregorio Estuary, Pescadero Marsh, Pigeon Point, Franklin Point, Ano Nuevo Point, and Ano Nuevo Island Reserve.

- **Policy 7.23. Permitted Uses in Marine and Estuarine Habitats**
  In marine and estuarine habitats, permit only the following uses: (1) nature education and research, (2) consumptive uses as provided for in the Fish and Game Code and Title 14 of the California Administrative Code, (3) fishing and (4) fish and wildlife management.

VISUAL RESOURCES: NATURAL FEATURES—LANDFORMS

- **Policy 8.2. Beaches**
  Prohibit permanent structures on open sandy beaches except facilities required for public health and safety (i.e., beach erosion control structures).

- **Policy 8.3. Sand Dunes**

Prohibit development or uses that would alter the natural appearance of dunes, significantly hamper natural dune movement, conflict with the visual form of the dune ridgelines, destroy dune-stability vegetation, or require sand removal.

- **Policy 8.4. Cliffs and Bluffs**
  a. Prohibit development on bluff faces except public access stairways where deemed necessary and erosion control structures which are in conformity with coastal policies on access and erosion.

  b. Set back bluff top development and landscaping from the bluff edge (i.e., decks, patios, structures, trees, shrubs, etc.) sufficiently far to ensure it is not visually obtrusive when viewed from the shoreline except in highly developed areas where adjoining development is nearer the bluff edge, or in special cases where a public facility is required to serve the public safety, health, and welfare.

- **Policy 8.5. Location of Development**
  a. Require that new development be located on a portion of a parcel where the development (1) is least visible from State and County Scenic Roads, (2) is least likely to significantly impact views from public viewpoints, and (3) is consistent with all other LCP requirements, best preserves the visual and open space qualities of the parcel overall. Where conflicts in complying with this requirement occur, resolve them in a manner which on balance most protects significant coastal resources on the parcel, consistent with Coastal Act Section 30007.5. Public viewpoints include, but are not limited to, coastal roads, roadside rests and vista points, recreation areas, trails, coastal accessways, and beaches. This provision does not apply to enlargement of existing structures, provided that the size of the structure after enlargement does not exceed 150% of the pre-existing floor area, or 2,000 sq. ft., whichever is greater. This provision does not apply to agricultural development to the extent that application of the provision would impair any agricultural use or operation on the parcel. In such cases, agricultural development shall use appropriate building materials, colors, landscaping and screening to eliminate or minimize the visual impact of the development.

  b. Require, including by clustering if necessary, that new parcels have building sites that are not visible from State and County Scenic Roads and will not significantly impact views from other public viewpoints. If the entire property being subdivided is visible from State and County Scenic Roads or other public viewpoints, then require that new parcels have building sites that minimize visibility from those roads and other public viewpoints.

HAZARDS COMPONENT

- **Policy 9.3. Regulation of Geologic Hazard Areas**
  Apply the following regulations of the Resource Management (RM) Zoning Ordinance to designated geologic hazard areas:
  a. Section 6324.6 - Hazards to Public Safety Criteria.

  b. Section 6326.2 - Tsunami Inundation Area Criteria.

  c. Section 6326.3 - Seismic Fault/Fracture Area Criteria. Require geologic reports prepared by a certified engineering geologist consistent with "Guidelines for Geologic/Seismic Reports" (CDMG Notes #37) for all proposed development.

d. Section 6326.4 - Slope Instability Area Criteria.

- **Policy 9.8. Regulation of Development on Coastal Bluff Tops**
  a. Permit bluff and cliff top development only if design and setback provisions are adequate to assure stability and structural integrity for the expected economic life span of the development (at least 50 years) and if the development (including storm runoff, foot traffic, grading, irrigation, and septic tanks) will neither create nor contribute significantly to erosion problems or geologic instability of the site or surrounding area.

  b. Require the submittal of a site stability evaluation report for an area of stability demonstration prepared by a soils engineer or a certified engineering geologist, as appropriate, acting within their areas of expertise, based on an on-site evaluation.

- **Policy 9.12. Limiting Protective Shoreline Structures**
  a. Permit construction of shoreline structures such as retaining walls, groins, revetments, and breakwaters only in accordance with the following conditions when: (1) necessary to serve coastal-dependent uses, to protect existing development, or to protect public beaches in danger of erosion, (2) designed to eliminate or mitigate adverse impacts on local shoreline sand supply, and (3) non-structural methods (e.g., artificial nourishment) have been proved to be infeasible or impracticable.

  b. Protect existing roadway facilities which provide public access to beaches and recreational facilities when alternative routes are not feasible and when protective devices are designed in accordance with the requirements of this component and other LCP policies.

- **Policy 9.13. Limiting Shoreline Structures on Sandy Beaches**
  To avoid the need for future protective devices that could impact sand movement and supply, prohibit permanent structures on the dry sandy beach except facilities necessary for public health and safety, such as lifeguard towers.

- **Policy 9.14. Shoreline Structure Design**
  a. Require that all protective structures are designed to: (1) minimize visual impact by using appropriate colors and materials, (2) utilize materials which require minimum maintenance, and (3) provide public overlooks where feasible and safe.

  b. Require that shoreline protective structures not impede lateral access along beach areas and provide vertical access where feasible.

  c. Require that any shoreline alteration or structure project shall mitigate project impacts by adequate fish and wildlife preservation measures.

- **Policy 9.16. Geologic Reports for Shoreline Structures**
  Require that all applications involving shoreline structures shall be accompanied by a report prepared by a certified engineering geologist or a soils engineer, as appropriate, which analyzes the effect the project will have on physical shoreline processes.

SHORELINE ACCESS COMPONENT

- **Policy 10.17. Lateral Access (Shoreline Destinations) With Coastal Bluffs**

a. Provide access for the general public between the mean high tide line and the base of the bluff where there is adequate room for public use.

b. Because of scenic or recreational value, provide a pathway with a right-of –way at least 25 feet in width, which allows feasible unobstructed public access along the top of the bluff when no public access will be provided to the area between the mean high tide line and the base of the bluff because of safety and/or other considerations, and/or when the Site Specific Recommendations for Shoreline Destinations (Table 10.6) requires one.

c. Require bluff top setbacks, based upon site specific geologic and erosion conditions, to ensure safe and continued use.

- **Policy 10.18 Lateral Access (Shoreline Destinations) Without Coastal Bluffs** Provide access to and along the beach during normal tides, with a right-of-way at least 25 feet in width, between the mean high tide line and the first line of terrestrial vegetation. Measure the width of the access either from a fixed inland point seaward or from the mean high tide line landward.

City of Daly City LCP

The City of Daly City LCP was certified by the Commission on March 14, 1984. A comprehensive update is currently underway. The following policies from the City of Daly City Land Use Plan relate to regional sediment management:

HABITAT AREA POLICIES

- **Policy 2.** The development and use of Mussel Rock Park, Daisaku Ikeda Canyon, and Thornton State Beach shall include measures to protect and mitigate impacts on existing plant and animal communities. Designated sensitive habitat areas shall be limited to uses dependant on or compatible with such resources, such as organized nature study groups or other educational /research activities. Buffer areas, to be at least ten feet wide, shall be established and maintained between the canyons and the recreational areas to isolate these sensitive areas.

- **Policy 4.** Coasted improvements involving slope modification, grading, runoff, and drainage control shall be subject to review and assessment with regard to potential impacts on the stability of cliff and bluff vegetation.

HAZARD AREA POLICIES

- **Policy 2.** The inactive storm drains along the abandoned highway shall be removed in conjunction with any new development on accessways or recreation areas containing these drainpipes, unless it can be demonstrated that they are not contributing to the erosion of the bluffs.

- **Policy 3.** All native, drought resistant vegetation on the bluffs shall be protected as a significant bluff stabilizing factor. Any new planting shall be of similar species.

NEW DEVELOPMENT POLICIES

- **Policy 4.** Development of remaining vacant parcels along the bluff tops shall be prohibited, unless geologic and seismic constraints and public safety requirements can be mitigated.

- **Policy 5.** The re-use of vacant parcels which were once occupied by dwellings that have since been removed because of land failure shall be prohibited unless sufficient engineering, soils and geology data is presented to support the proposed redevelopment. Such properties shall be rezoned Open Space and Resource Protection.

- **Policy 7.** A resource protection zone shall be established between the sea and the first public road paralleling the sea. All development within this zone shall be subject to strict environmental review.

City of Daly City Draft Coastal Land Use Plan Policies Identified for Consideration

Policies relevant to regional sediment management that have been identified by the City of Daly City as having the potential for inclusion in its comprehensive LCP update include the following:

- **Policy CST-5.** Protect the natural resources found in the Coastal Zone by conducting a rigorous environmental evaluation for all development proposals.
- **Policy CST-8.** Ensure that new development does not contribute to blufftop erosion and will not need a shoreline protective device for the duration of its economic life (suggests various amendments to zoning ordinance).
- **Policy CST-10.** Minimize the exposure of the public to coastal hazards by assuring that parcels where homes have been removed as the result of a landslide cannot be redeveloped as residential areas.
- **Policy CST-11.** Maintain the boundaries of the –RP Resource Protection Combining District containing all blufftop properties.

City of Pacifica LCP

The Commission certified the total LCP and zoning ordinance in June 1994. A Post-Certification categorical exclusion (E-94-1) was approved by the Commission with conditions on September 15, 1995, which excluded lot line and boundary adjustments, new single family residences and second units and minor grading, vegetation removal, temporary events and public works in certain areas. The following policies from the City of Pacifica Land Use Plan relate to regional sediment management:

- **Policy 14.**
  The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this policy, where there is no feasible less environmentally damaging alternative and where, feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to the following
  (6) Mineral extraction, including sand for restoring beaches, except in environmentally sensitive areas.

Dredging and spoils disposal shall be planned and carried out to avoid significant disruption to marine and wildlife habitats and water circulation. Dredge spoils suitable for beach replenishment should be transported for such purposes to appropriate beaches, or into suitable longshore current systems.

- **Policy 16.** Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply. Existing marine structures causing water stagnation contributing to pollution problems and fish kills should be phased out or upgraded where feasible.

- **Policy 18.** Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on such resources shall be allowed within such areas. Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade such areas, and shall be compatible with the continuance of such habitat areas.

- **Policy 24.** The scenic and visual- qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural landforms, to be visually compatible with the character of surrounding areas, and, where feasible to restore and enhance visual quality in visually degraded areas. New development in highly scenic areas –such as those designated in the California Coastline Preservation and Recreation Plan, prepared by the Department of Parks and Recreation and by local government, shall be subordinate to the character of its setting.

- **Policy 26.** New development shall:
    - Minimize risks to life and property, in areas of high geologic, flood, and fire hazard.
    - Assure stability and structural integrity and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area, or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.
    - Be consistent with requirements imposed by an air pollution control district or the State Air Resources Control Board as to each particular development.
    - Minimize energy consumption and vehicle miles traveled.
    - Where appropriate, protect special communities and neighborhoods which, because of their unique characteristics, are popular visitor destination points for recreational uses.

- **Policy 28.** Coastal-dependent developments shall· have priority over other developments on or near the shoreline. Except as provided elsewhere in this policy, coastal-dependent developments shall not be sited in a wetland.

Local Coastal Plan Conclusions

Geotechnical Policies
Pacifica's shoreline is subject to erosion, landsliding and other geotechnical problems of varying intensities. (See General Plan, Seismic Safety and Safety Element). Hillsides with slopes in excess of 35 percent present potential problems. In order to conserve the soil and to protect people from geotechnical hazards in these and adjacent areas, these criteria shall be applied:

- A geological report shall be prepared by a registered geologist before new development is permitted on bluff tops or steep (35% +/- slope) parcels. Items examined should include geologic and seismic stability, the appropriate hazard setback from bluff edges to protect structures during their economic life (i.e., net developable area), and specific recommendations for type of construction, drainage, landscaping, irrigation, beach access (if determined to be safe for the public) and mitigation of other identified problems.
- The "net developable area" of the site shall be the basis for determining intensity of use, i.e., number of units allowed under the land use and zoning designations.
- Unless no other buildable area exists on the parcel, development shall be prohibited on slopes in excess of 35 percent and on bluff faces, except for drainage improvement and necessary shoreline protection structures.

Protection of Natural Landforms Policies
Three prominent landforms dominate Pacifica's Coastal Zone: Mori Point, The Headlands and Point San Pedro. These promontories overlain with fragile coastal scrub vegetation visually represent the nature of the shoreline and the coastal character of Pacifica. Conclusions for the protection of these prominent topographic features include:

- Development shall be prohibited on prominent ridgelines, slopes in excess of 35 percent and highly visible tops of prominent landforms, unless there is no other buildable area on the parcel.
- If permitted, development shall be clustered and contoured into the existing natural slope and of a design, density, and scale -which is subordinate to the landform and minimize grading for access. (See Background Report of geotechnical data and 1979 General Plan for prominent ridgeline designations and above Geotechnical Sect ion).
- Grading shall be regulated to protect the appearance of the landform and to limit potential runoff.
- Native vegetation shall be protected. In areas disturbed by development, revegetation shall occur promptly with native or low maintenance natural vegetation to reduce erosion potential; landscaping plans should be required.
- Land divisions which would create parcels whose only buildable -areas would be on ridge tops or slopes in excess of 35 percent shall be prohibited.

Preservation and Enhancement of Coastal Views, Viewsheds, and Vegetation Policies

Before the City of Pacifica was incorporated, it was a series of coastal communities linked together by Highway 1. Today these coastal communities form distinct residential neighborhoods, each with its own character and atmosphere. Strung out along the coast, the public views (views from the public roadways and vista points) of Pacifica are an integral part of the current and future character of the coastline, coastal neighborhoods and their relationship with one another. A conclusion which supports this concept is:

- The individual qualities of each coastal neighborhood shall be protected by appropriate zoning, access, and design regulations.

Of primary concern in the Coastal Act are views of the coast from public roadways and other public viewing points, such as Mori Point, The Headlands and Tobin Station, the beaches, and local recreation areas. Except for the rocky outcroppings and developed areas, Pacifica's coastline is covered with vegetation which has little resistance, to human trampling. (See Conservation Element, General Plan). Overuse has resulted in high rates of erosion and ugly scarring. Conclusions, for planning for viewshed and vegetation protection include:

- New development within the viewshed shall not destruct the views to the sea from public roads, trails and vista points. Methods of achieving this could include height limitations, which keep structures below the sight line, clustering structures to protect view corridors , careful placement of landscaping to shield structures, but leave the view unobstructed; use of natural appearing materials and color on new buildings, limit outdoor lighting, undergrounding utility lines, maximizing views of the sea in aligning new roadways, bicycle and pedestrian paths, use of open work fences where fencing is necessary within the sight line.
- Views of the coast and coastal panorama from public roadways shall be protected by limiting the height and mass of permitted structures, as well as clustering structures to be unobtrusive and visually compatible with landforms. (See Local Coastal Background Report, Viewshed Map).
- Locations which offer open views of the coast shall be developed for public coastal viewing if this can be accomplished without, excessive damage to the moderately sensitive vegetation.
- Trails and beach accesses across native coastal vegetation shall be designed to protect the vegetation from trampling and scarring. Vegetative cover on steep slopes shall be left undisturbed.
- Motorcycles and other motorized vehicles shall be prohibited from areas covered with native coast al vegetation.

Shoreline Protection and Drainage Structure Policies

Erosion is a primary problem along the Pacifica coast. Studies by the U. S. Amy Corps of Engineers indicate that in many cases shoreline structures are not economically justified. (See LCP Background Report, Geology; General Plan Background Report, Geology). There are, however, a few areas in the City where shoreline protection may be necessary to protect major beach access or highly sensitive habitat. (See LCP Access Component Report, local Beach Resources and Management). For these areas, and other areas where protection from hazards may be needed in the future, the following conclusions are suggested:

- Dumping and other unengineered erosion protection shall be prohibited. Existing unauthorized rubble or protective devices shall be removed prior to any additional development in such areas.
- A qualified expert shall be engaged to analyze the impacts of proposed structures and prescribe appropriate mitigation, if necessary, prior to issuance of a permit. Impact evaluation shall include methods to minimize alteration of natural migration' and deposition of sand on shorelines within the littoral cell, sufficient engineering to protect threatened area, lateral and (if appropriate) vertical beach access, and structures as well as other impacts.

Special Area Policies

Several Special Areas have been designated in Pacifica's Coastal Plan, although each area has received its Special Area designation because of problems unique to it alone. (See Approved Background Report, May 19th, Coastal Environment Section). In each case, the community will best be served by retaining flexibility in the use of these sites. For, each area, the text (see Coastal Land Use Plan, pagesC-41-44, C-49-52, C-54-58) establishes the specific uses to be 'considered for the site and the factors which should direct the environmental and other technical studies which would precede site planning and application processing. In addition, an EIR would be required for proposed development on each of these sites. Conclusions regarding Special Areas are outlined below to underscore the fundamental factors indicated by the Coastal Act which should be considered in developing site plans, making specific land use allocations within the individual areas, and in issuing permits.

- Portions of Special Areas designated in, the land use description for commercial uses shall give priority to visitor-serving commercial uses. Their location should be proximate to beach/marina; their design should protect views and encourage a variety of coastal users. Appropriate neighborhood-serving uses shall be easily accessible but in less prominent locations.
- All development in Coastal Special Areas shall respect the views of, and from, the beach, promote and be centered on beach and water access and provide adequate parking and public facilities for beach users as well as shoppers and other recreationists. Building design in Special Areas shall blend into the contours and form of the site, be set back from view corridors, use materials which blend into the site and present a sense of unity and minimize alteration of landforms.
- Coastal resources, such as highly visible landforms and ridgelines, shall be protected through land use planning, site design and zoning.
- Slopes in excess of 35 percent, geologically or geotechnically remain undeveloped, sensitive habitats and hazardous areas shall remain undeveloped.
- Adequate open space shall be provided to protect the sense of openness now present on the site.
- Where mixed land uses are permitted, locational priority in terms of coastal access and visibility shall go to visitor-dependent uses, i.e., visitor-serving commercial uses, beach access, marina, access, public parking , vista points, etc.
- Development shall not be permitted in a Special Area without a detailed site plan for the entire area indicating uses, design, landscaping, grading, beach access, size and location of parking areas and designated beach parking, etc. The site plan shall also show where

and how the mitigations indicate in the Environmental Impact Report are integrated into the proposed development.

- The coastal permit shall be issued on the basis of the site plan. Projects maybe phased overtime as long as a balance of coastal-dependent and support services occur simultaneously, but the site plan and permit would require amendment if changes are to be made in use, design, grading, intensity, beach access, parking, etc.

City of Pacifica General Plan: Safety and Seismic Safety Element

- **Policy 1.** Prohibit development in hazardous areas, including flood zones, unless detailed site investigations ensure that risks can be reduced to acceptable levels and the structure will be protected for its design life. Development shall be designed to withstand a minimum of a 100-year hazard event, regardless of the specific nature of the hazard. This concept applies to both on-site and off-site hazards.

- **Policy 4.** Prohibit seawalls which are necessary as a mitigation measure for new development. Projects should not be approved which eventually will need seawalls for the safety of the structures and residents.

City of Pacifica LCP Update: Policy Issues Identified for Consideration

Policies relevant to regional sediment management that have been identified by the City of Pacifica as having the potential for inclusion in its comprehensive LCP update include the following:

Shoreline Protection

- **Policy 5.3-c** *Shoreline Protection. Continue to apply Coastal Zone regulations that prohibit new development that would require shoreline alterations following Section 30235 of the Coastal Act.

- **Policy 5.3-d** *Regional Sediment Management. Participate in regional approaches to protecting, enhancing and restoring coastal beaches and watersheds through the California Coastal Sediment Management Workgroup, with a goal of minimizing coastal erosion. Use regional information to develop a comprehensive shoreline protection program that identifies priorities for types of shoreline protection and programs for opportunistic beach nourishment using cleaned dredge material, clean material from flood control structures, clean excavation material and other innovative sources.

- **Policy 5.3-xx** *Pacifica State Beach. Continue to manage erosion and sedimentation at Pacifica State Beach according to the policies of the Pacifica State Beach General Plan. Structural protective measures shall be undertaken only if non-structural measures (i.e., relocation of facility, set back, redesign, or beach replenishment) are not feasible. If a protective structure is constructed (i.e. riprap, rock revetment, seawall, etc) the structure shall not:
  - Significantly reduce or restrict beach access
  - Adversely affect shoreline processes and sand supply;

- Significantly increase erosion on adjacent properties;
- Cause harmful impacts on vegetation, wildlife or fish habitats;
- Be placed further than necessary from the development requiring protection; or
- Create a significant visual intrusion.

- **Policy 5.3-xx** *Sharp Park Beach. Work with other public agencies, including GGNRA, San Francisco Recreation and Parks Department, and San Mateo County, to take a "natural management" approach over the long term. This should include no further armoring or heightening of the levee, in order to protect the beach from erosion and allow a barrier beach and lagoon system to reestablish itself.

Slope Failure and Erosion

- **Policy 8.1-b** Enforce LCP. Support the City's Local Coastal Program in accordance with the California Coastal Act, with an emphasis on avoiding rather than mitigating hazards.

- **Policy 8.1-d** Development in Hazardous Areas. Prohibit development in areas of high slope failure or liquefaction risk, unless detailed site investigations ensure that risks can be reduced to acceptable levels and the structure will be protected for its design life.

- **Policy 8.1-h** Restrictions on Mitigation Measures. Prohibit mitigation measures for potential geotechnical hazards if those measures could adversely affect surrounding property, including the use of public rights-of-way or adversely affect public health, safety, and welfare.

- **Policy 8.1-i** Erosion Prevention. Require erosion prevention of hillside areas by revegetation or other acceptable methods.

- **Policy 8.1-k** Maintain Restrictions on Hazardous Areas. Continue enforcing the existing Coastal Zone Combing District and Hillside Preservation District, regulations that restrict development in hazardous areas where access is impractical, or areas particularly prone to hillside and coastal erosion, landslides, seismic shaking, tsunami inundation, or flooding.

- **Policy 8.1-1** Soil Study. Any geotechnical studies required as a condition of development approval must include at least a preliminary study of expansive and creeping soils, as well as appropriate analysis of erosion, seismic, tsunami, and other geotechnical hazards. These studies must also be prepared and reviewed by registered geologists, registered engineered geologists, or registered soils engineers.

- **Policy 8.1-o** *New Development in Coastal Zone. Enforce the provisions of the California Coastal Act, including requiring new development, including additions to or remodels of existing development, within the Coastal Zone to:
    - Minimize risks to life and property in areas of high geologic, flood, and fire hazard.

- Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.
    - Not accelerate the need for a shoreline structure (e.g., the addition should not be further seaward than the existing structure) or increase the likelihood of a future seawall beyond the existing development's expected life.
    - Not violate required setback provisions.

- **Policy 8.l-p** Seawalls. Prohibit seawalls which are necessary as a mitigation measure for new development. Projects should not be approved which eventually will need seawalls for the safety of the structures and residents.

- **Policy 8.l-q ***Subdivision Limits in Coastal Zone. Update the Local Coastal Program and/or Zoning Ordinance to prohibit the division of coastal fronting property that creates hazardous or unbuildable parcels. Only allow new parcels to be created if they can be developed without ever requiring shoreline protection for the development. Development that is so hazardous that it may constitute a public nuisance should not be allowed.

- **Policy 8.l-r** *Coastal Development Regulations. Continue to enforce the Coastal Development Regulations, Article 44, of the City's Zoning Ordinance, including requirements for geotechnical and site stability surveys.

- **Policy 8.1-s** *TDR Program in Coastal Zone. Continue the City's Transfer of Residential Development Rights program to encourage the relocation of existing structures threatened by shoreline erosion, rather than constructing shoreline protective devices.

- **Policy 8.1-t** *Accessory Structures in Coastal Zone. Amend the Zoning Ordinance to require new accessory structures within the Coastal Zone to be constructed so they can be relocated should they become threatened by erosion.

- **Policy 8.1-u** *Wave Up-rush Studies. Update the Local Coastal Program and Zoning Ordinance to require wave uprush studies for new development at beach level and in low-lying areas.
    - At a minimum, the wave up-rush studies should consider the consequences of a low probability wave event (such as the 1% annual probability, also known as the 1 in 100 year event) with the following beach and water conditions:
        - Seasonally eroded beach with long-term erosion comparable to what could be expected to occur over the life of the proposed development.
        - High tide combined with the increase in mean sea level expected to occur over the life of the proposed development.
    - Development should be sited to avoid the zone of wave run-up. If complete avoidance is not practical, avoidance should be maximized and development should be designed, through features such as elevation, to protect against the consequences of unavoidable hazards.

- **Policy 8.1-v** *Regional Sediment Management. Participate in regional approaches to protecting, enhancing and restoring coastal beaches and watersheds through the

California Coastal Sediment Management Workgroup, with a goal of minimizing coastal erosion. See Chapter 5.

- **Policy 8.1-w** Sea Level Rise Model. When an adequate model with sufficient local detail is available to project the impacts of sea level rise, take into account potential erosion caused by sea level rise by the year 2050 in the determination of developable area and the assessment of whether coastline-altering structures would be needed in the future to protect new development.

- **Policy 8.1-xx** Shoreline Protective Structures**.** Use non-structural measures such as setback, redesign, relocation or beach replenishment) wherever feasible to protect existing development. Prioritize critical infrastructure, including Highway 1, for protection.

Flooding and Drainage

- **Policy 8.2-a** Development in Hazardous Areas. Any new development in 100-year floodplains and tsunami hazard zones must be designed to withstand a minimum of a l00-year hazard event,

- **Policy 8.2-b** Sea Level Rise Adaptation. Establish policies to minimize the risk to persons and property posed by potential sea level rise.

- **Policy 8.2-d** Municipal Code Update to Flood Damage Prevention. Update the Flood Damage Prevention chapter of the City's Municipal Code to take the latest Flood Insurance Rate Maps into account in defining areas of special flood hazard. This should remove portions of the Rockaway Quarry site from the area due to recent channelization and riparian restoration work.

- **Policy 8.2-n** *Sea Level Rise Surveys. Conduct a survey of sea level rise, every five to ten years, that includes frequency and extent of coastal flooding and the rate of coastal erosion, with a focus of at risk areas, and make the findings publicly available on the City's website.

- **Policy 8.2-0** *Managed Retreat. Incorporate "managed retreat" strategies into master planning for public land and large development projects in the Coastal Zone.

- **Policy 8.2-xx** Flood Control Structures. Flood control devices that alter streams shall incorporate the best mitigation measures feasible, and are only permitted where no other method for protecting existing structures in the flood plain is feasible and where such protection is necessary for public safety or to protect existing development.

- **Policy 8.2-xx** *Infrastructure. Evaluate existing public infrastructure, including the wastewater and stormwater distribution systems, for vulnerability to coastal flooding and erosion and identify areas in need of protection. In assessment of alternatives, relocation of infrastructure away from hazards is preferred over the long term.

*Policies specific to the Coastal Zone

Pacifica State Beach General Plan

The following policies of the *Pacifica State Beach General Plan* are applicable to regional sediment management:

RESOURCE ELEMENT

- **Monitoring Erosion and Sand Loss Policies**
  Establish a monitoring program to document sea cliff retreat, landslides, beach elevation, and beach width.

  Regulate human activities within the sand dune areas to prevent destruction of the natural dune environment.

  Revegetate destabilized areas within the sand dunes with native plants.

- **Shoreline Protective Device Policy**
  Structural protective measures shall be undertaken only if non structural measures (i.e., relocation of facility, setback, redesign, or beach replenishment are not feasible. If a protective structure is constructed (i.e., riprap, rock revetment, seawall, etc.), the structure shall not:
  1) Significantly reduce or restrict beach access;
  2) Adversely affect shoreline processes and sand supply;
  3) Significantly increase erosion on adjacent properties;
  4) Cause harmful impacts on vegetation, wildlife, or fish habitats;
  5) Be placed further than necessary from the development requiring protection; or
  6) Create a significant visual intrusion.

- **Coastal Dune Management Policy**
  The dune system at Pacifica State Beach shall be managed for its perpetuation and preservation through development of a dune management plan. Visitor activities and use patterns within the dunes shall be analyzed prior to designating routes of travel in order to prevent destruction of the dune system. Patterns and rates of sand deposition and exotic species control shall also be elements of this plan. Areas destabilized by human activities shall be revegetated with native plants from local populations.

LAND USE & FACILITIES ELEMENT

- **Existing Facilities Policy**
  Restrooms- Locate the restroom building further inland, out of 100-year flood zone, when complete replacement of existing restroom structure becomes necessary.

- **Natural Resources Policy**
  Preserve and restore sand dunes where possible.

- **Proposed Facilities Policies**

- Parking- Remove existing sand wall and construct more extensive wall from the restroom/pump facility to the Taco Bell restaurant.
- Restrooms- Locate new restroom further inland if the existing restroom structure requires complete replacement.
- Natural resources - Remove man-made earthfill berm north of Taco Bell to enhance and enlarge sandy beach. Import sand to this area to provide a higher sand elevation for protection of inland facilities.
- Restore sand dunes and revegetate with native grasses.

Appendix E
Potential Funding Sources Assessment

ESA

POTENTIAL FUTURE FUNDING SOURCES
SAN FRANCISCO LITTORAL CELL
COASTAL REGIONAL SEDIMENT MANAGEMENT PLAN

DRAFT

April 2013

Prepared by staff of the San Francisco Estuary Partnership

TABLE OF CONTENTS

This chapter provides a brief overview of some of the existing state and federal funding sources as well as potential sources for local revenue streams to implement future coastal erosion mitigation projects in association with the San Francisco Littoral Cell (Region) Coastal Regional Sediment Management Plan (CRSMP).[1] In 2002, the California Department of Boating and Waterways (CDBW) and the State Coastal Conservancy (SCC) estimated the cost[2] to protect and restore California beaches and found that:

> The State of California needs to invest $120 million in one-time beach nourishment costs and $27 million in annual beach maintenance costs. These projects would directly replenish 24 miles of heavily-used public beaches and collaterally benefit more than twice that length due to alongshore sand transport. Through cost-sharing partnerships with the U.S. Army Corps of Engineers, federal funding for these shoreline projects could reduce the state's burden to $42 million (65% reduction) and $13.5 million (50% reduction) for restoration and maintenance costs, respectively (CDBW and SCC 2002, p. xvii).

This statewide estimate gives a scope to the gravity of the future cost to implement the San Francisco Littoral Cell CRSMP and other California CRSMPs.

This summary of known options is provided as an initial overview for review by locals who may choose to undertake projects. Further research would be needed to determine applicability of a potential source for a given project and the optimum mixture of revenue streams and funding sources. Successful implementation of the CRSMP will require a combination of local, state, and federal funding sources, and coordination with applicable agencies to develop funding plans further. The relative contribution of each source will reflect the prevailing political climate and the state of the economy and financial/budgetary constraints, priorities, and opportunities working within each individual funding and revenue source.

According to our analysis, several potential funding sources rise to the top as best candidates to fund future projects. Geologic Hazard Abatement District assessments, funding through the California Department of Boating and Waterways Public Beach Restoration Program and U.S. Army Corps of Engineers Continuing Authorities Program, and increasing the transient occupancy tax appear to be the most feasible for the Region. Table 1 summarizes feasibility and factors to consider for each. We recommend further exploration of these potential sources in particular when a project is being considered.

---

[1] For the purposes of this report the acronym CRSMP refers only to the Coastal Regional Sediment Management Plan for the San Francisco Littoral Cell. There are other CRSMPs in California, including Southern Monterey Bay, Central Coast, Los Angeles County, and San Diego Region. These other CRSMPs are referenced by their geographic location.

[2] Note that costs estimated in 2002 will be significantly larger today due to inflation. For example, assuming environmental conditions are static (for the purposes of analysis) total one-time beach nourishment costs have increased from $120 million in 2002 to approximately $156 million in 2013.

Table 1: Top Funding Sources and Revenue Measures

Ranking	Top Funding Source or Revenue Measure (Increase in)	Feasibility/Factors to Consider
1	Geologic Hazard Abatement Districts	• Used elsewhere for coastal erosion projects • Formation must be abandoned if more than 50% of property owners object • Funds can be raised through supplemental property assessments collected on property tax bills
2	California Department of Boating and Waterways Public Beach Restoration Program	• Little competition for funding in Northern California, • Funding inconsistent • Each project requires legislative earmark
3	U.S. Army Corps of Engineers Continuing Authorities Program	• Continued funding subject to political climate • Only certain authority sections would apply to Region
4	Transient Occupancy Tax	• As a specialty tax only 39% passage rate from 2002 - 09 (65% passage rate as general tax) • Consistent and substantial funds • More politically feasible, as fees are generally placed on nonresidents
5	Sales Tax	• Consistent and substantial funds • 2/3 vote approval required for funds to be dedicated to coastal protection as a specialty tax

SECTION 1: STATE FUNDING SOURCES

1.1 CALIFORNIA DIVISION OF BOATING AND WATERWAYS

California's shore protection program is operated through the California Division of Boating and Waterways (CDBW) which has dedicated funds from the state gasoline tax.[3] CDBW cosponsors the construction of beach erosion control projects with local and federal agencies; improving present knowledge of oceanic forces, beach erosion and shoreline protection; and using this knowledge to prevent future erosion.

The beach erosion control statutes (Sections 65 through 67.4 of the California Harbors and Navigation Code[4]) authorize the CDBW to study erosion problems; act as shore protection advisor to all agencies of government; and plan, design, and construct protective works when funds are provided by the Legislature. The federal Rivers and

[3] The percentage of the tax CDBW receives is equivalent to estimates of the percentage of gasoline consumption by recreational boaters.
[4] Available online at: http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hnc&group=00001-01000&file=65-67.4

Harbors Act of 1962, as amended, authorizes the CDBW to participate in beach erosion control projects undertaken by the U.S. Army Corps of Engineers (Corps). In addition to construction projects, the CDBW sponsors research projects to further the knowledge and understanding of coastal processes and to enhance boating safety and access.

In 1999, the California Public Beach Restoration Act[5] was passed and directed responsibility to the CDBW to implement the Public Beach Restoration Program (PBRP) and distribute state funding assistance to local and regional governments for beach nourishment/restoration projects. The PBRP may fund up to 100% of project construction costs for beach nourishment at state parks and state beaches operated and maintained by a local or regional public entity. If the project is located at a non-state beach then the PBRP may fund 75 to a maximum of 85 percent of the project cost (i.e., the local sponsor provide a 15 to 25 percent match). The City of San Francisco received 1,000,000 in fiscal year 2000-01 for beach nourishment at Ocean Beach through the PBRP.

Every project funded through the PBRP must be funded through the state budget as an earmark. There is no sunset on the PBRP and funding for the program has varied over time (ranging from $0 to $12.2 million) (Sterrett 2013).[6] Since the CDBW grant programs are limited fiscally, securing funding for a project would likely require project proponents to approach state legislators and request funds be earmarked for a nourishment project. The Southern Monterey CRSMP (PWA 2008) discussed the feasibility of securing funds for the Monterey Region, raising the point that Northern California funding potentials are often underutilized: "while there is intense competition due to the large number of projects in the south, *the only major project area competing for funding in the northern part of the state is Ocean Beach in San Francisco* (p. 143; emphasis added)."

In many cases, state money has been used to leverage federal Corps funding. To apply for PBRP funding, a project must protect or restore public lands or facilities and contain:

1. Completed feasibility study with the following requirements: statement of the problem; analysis of project alternatives; defined scope of project; proposed preliminary design; and favorable benefit to cost analysis;
2. Resolution of fiscal support from the local agency's governing body; and
3. Draft environmental document (CEQA clearance required prior to Legislative review of budget item) (CDBW 2013).

[5] Available online at: http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hnc&group=00001-01000&file=69.5-69.9
[6] PBRP funding for fiscal year 2011-2012 was $1.1 million and for fiscal year 2012-2013 was $350,000.

1.2 CALIFORNIA COASTAL COMMISSION BEACH SAND REGIONAL MITIGATION FUND

For Coastal Development Permits associated with shoreline armoring the California Coastal Commission (CCC) may include special conditions for the permittee to submit fees to go into a regional fund for shoreline restoration projects. The in-lieu fee program is a means to mitigate for the impacts of the shoreline protective devices on shoreline processes and beach sand supply, to be paid by the permittee in-lieu of placing sand on the beach.[7] For example, in Southern Monterey County mitigation fees from the construction of a seawall at Ocean Harbor House were used to fund dune acquisition (PWA 2008, p. 144). There is no cost-share requirement, but funds must be used for a nourishment project and not for planning or design.

The San Diego Association of Governments (SANDAG) entered into a cooperative agreement with the CCC to establish a Public Recreation Impact Mitigation Fund (PRIMF). The PRIMF is funded by fees collected by the CCC on Coastal Development Permits that adversely impact beach sand supply, coastal processes, and coastal recreation. SANDAG's role is to collect, hold, and administer funds collected by the CCC. The PRIMF fund is used to implement projects that provide public recreational improvements, including but not limited to beach nourishment, public beach access, bluff top access, viewing areas, public restrooms, public beach parking, and public trail amenities.

For the Region, a similar cooperative agreement between the Association of Bay Area Governments (ABAG) and state agencies with jurisdiction over resources affecting coastal sediment management (e.g., CCC, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board) could be established to fund beach restoration projects. The role of ABAG could be to collect funds mandated by the CCC (or other state agency), hold the funds in an interest-bearing account, process requests for funds, distribution such funds, and monitor and track projects implemented.

1.3 CALIFORNIA DEPARTMENT OF PARKS AND RECREATION

The California State Parks implements a Habitat Conservation Fund[8] established by the California Wildlife Protection Act of 1990[9] and Proposition 17 which allocates

[7] Pursuant to Section 30235 of the California Coastal Act, the CCC is required to approve shoreline protective devices when there is an existing structure in danger from erosion: "revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply."
[8] For more information see: http://www.parks.ca.gov/?Page_id=21361

approximately $2 million each year for grants to cities, counties, and districts to protect fish, wildlife, and native plant resources, to acquire or develop wildlife corridors and trails, and to provide for nature interpretation and other programs which bring urban residents into park and wildlife areas.

Potential project proposal for the Habitat Conservation Fund could include wetlands restoration combined with a larger coastal project that includes beach environments. Another example project could be coastal land acquisition for beach restoration that includes habitat for anadromous fish and/or any rare, endangered, threatened, or fully protected animal or plant. There is a dollar for dollar match required from local, private, or other non-state sources. The Habitat Conservation Fund is funded annually through 2019/2020 and recent filing dates were in October of each year.

1.4 CALIFORNIA STATE COASTAL CONSERVANCY

The State Coastal Conservancy (SCC) may fund property acquisition and project planning, design, and/or construction in accordance with Division 21 of the Public Resources Code.[10] Regional planning, research, monitoring, and assessments will generally be considered only when directly tied to the furtherance of on-the-ground projects. Government agencies (federal, state, local, and special districts) and certain nonprofit organizations are eligible for funding. Projects should meet the goals and objectives[11] in the SCC's Strategic Plan,[12] and be consistent with the purposes of the funding source which is typically bond funds (Proposition 84[13] is the source of the majority of the SCC current funding).

A hypothetical project could remove coastal artificial fill, and create/reshape beach and coastal dune habitat. Such a project would have multiple benefits including mitigating

---

[9] Chapter 9, Fish and Game Code Section 2780 through 2799.6. Other legislation that impacts the program includes Fish and Game Code Section 2720 – 2729, Government Code Section 7550 – 7550.6 and 13340, and Public Resources Code Section 5900 through 5903, 5096.310, 21000, and 33216.

[10] Available online at: http://scc.ca.gov/about/enabling-legislation/

[11] Coastal erosion mitigation projects would help accomplish several goals and objectives in the Strategic Plan 2013-2018 including: 1) Objective 5B: restore or enhance coastal habitats, including coastal wetlands and intertidal areas, stream corridors, dunes, coastal sage scrub, coastal terraces, forests and coastal prairie. 2) Objective 7D: implement adaptation pilot projects that reduce hazards from sea level rise and extreme storm events, and which protect natural resources and maximize public benefits. 3) Goal 11: protect and enhance natural habitats and connecting corridors, watersheds, scenic areas, and other open-space resources of regional importance in the Bay Area.

[12] Available online at: http://scc.ca.gov/files/2013/03/SCC-Strategic-Plan-2013-18.pdf

[13] Chapter 10 of Proposition 84 under "Miscellaneous Provisions," requires the Coastal Conservancy, in evaluating potential projects to be funded with Proposition 84 money that involve acquisition or restoration for the purpose of natural resource protection, to give priority to projects that demonstrate one or more of the designated characteristics listed in Section 75071 of the Public Resources Code (available online at: http://www.leginfo.ca.gov/cgi-bin/displaycode?section=prc&group=75001-76000&file=75070-75079). While most of the six characteristics are habitat and water quality based, most all coastal erosion mitigation projects would satisfy Section 75071 criteria (e), "properties for which there is a non-state matching contribution toward the acquisition, restoration, stewardship or management costs. Matching contributions can be either monetary or in the form of services, including volunteer services."

coastal erosion, providing habitat and nesting habitat for sensitive bird species (snowy plover and bank swallows), and enhancing recreational opportunities. There are no established minimum or maximum grant amounts. No match is required although projects with a match could be preferred. The SCC will base the size of awards on project needs, benefits and competing demands for existing funding. The SCC has been supporting the SPUR's Ocean Beach Master Plan and is interested in helping communities implement projects that mitigate beach erosion issues. However, as of March 2013 the SCC only had a small amount of remaining Proposition 84 funds to distribute (Hutzel 2013).

1.5 STATE LEGISLATURE

While the State of California does fund beach nourishment projects on a case-by-case basis, very few beach nourishment projects actually receive state funds, and the legislative procedure can take up to 18 months. Typically, funding is requested through the annual budget cycle for each project. State funding of beach fill projects comes from a variety of programs and sources (see Sections 1.1 to 1.4) and in state budget for fiscal year 2011-2012 the Legislature allocated $1.1 million to be administered as grants through the Public Beach Restoration Program (PBRP). Efforts could be made to lobby the Legislature to earmark specific coastal erosion mitigation projects when funds are deposited in the PBRP. As discussed in Section 1.1, project earmarked through the PBRP must first meet the application requirements (i.e., feasibility study, local agency resolution, and draft CEQA documentation).

1.6 BOND RESOURCES

Proposition 84 (the "Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act of 2006") provides $5.4 billion for clean water, flood protection, and protection of California's coast, including beaches. The SCC distributes Proposition 84 grant funds for property acquisition and project planning, design, and/or construction for a variety of coastal projects including coastal erosion mitigation projects (see Section 1.4).

Absent a new state funding source, little bond money will be available for coastal erosion mitigation projects moving forward. However, the California Water Bond (also referred to as the Safe, Clean, and Reliable Drinking Water Supply Act) could potentially provide funding sources for beach nourishment projects. The California Water Bond will be on the November 4, 2014 ballot and will allow the state government to borrow $11.1 billion to overhaul the state's water system.). Efforts could be made to lobby the Legislature to include general language in the California Water Bond for spending towards coastal erosion mitigation projects and/or specific earmarks for individual beach nourishment projects.

SECTION 2: FEDERAL FUNDING SOURCES

2.1 U.S. ARMY CORPS OF ENGINEERS

The U.S. Army Corps of Engineers (Corps) funds shoreline restoration projects including project study, design, construction, land purchase, and land management. Funding mechanisms within the Corps consist of two major programs: the Continuing Authorities Program (CAP) and the General Investigations (GI) approach. For smaller projects, the Corps may act directly under CAP without authorization from Congress. CAP includes a number of standing authorities to study and construct certain types of projects. Projects under these authorities can be conducted without obtaining a project-specific study or construction authorization or project-specific appropriations; these activities can be performed at the discretion of the Corps. Projects that are larger in scope require congressional authorization and would fall under GI (i.e., a project larger than the CAP program funding limits. See Table **2**.).

2.1.1 Continuing Authorities Program

The CAP establishes a process by which the Corps can respond to a variety of water resource problems without the need to obtain specific congressional authorization for each project. This decreases the amount of time required to budget, develop, and approve a potential project for construction. All projects are cost shared between the federal government and a non-federal sponsor. A non-federal partner is a legally constituted public body, such as a city, state, county, or conservancy district that is capable of financing the project and providing for operation and maintenance of the project once completed. Federal regulatory Sections 14, 103, 111, 204, and 206 could potentially provide funding for beach nourishment projects in the Region (see Table 2 for summary). Any project funded under one of these Sections has two phases: feasibility and design, and implementation. In general, a study of a prospective project will be initiated by the Corps after receipt of a written request submitted from an authorized sponsoring agency (provided federal funds are available).

Table 2: Select Corps Continuing Authorities Program Relevant to Coastal Erosion Mitigation Projects (adapted from Carter and Stern 2011)

Authority	Eligible Activities	Max. Federal Construction Cost Share	Per-Project Federal Limit (in $ millions)	Annual Federal Program Limit (in $ millions; as of 11')	Potential Applicability to CRSMP
Sec. 14	Streambank and shoreline erosion of public works and nonprofit services	65%	$1.5M	$15M	High
Sec. 103	Beach erosion and hurricane storm damage reduction	65%	$5M	$30M	Low
Sec. 111	Prevention or mitigation of shore damage caused by	Same portion as	$5M	n.a.	Low

	federal navigation projects	project causing damage			
Sec. 204, Sec. 207, Sec. 993	Regional sediment management/beneficial use of dredged material	65%	$5M	$30M	Low
Sect. 206	Aquatic ecosystem restoration	65%	$5M	$50M	Moderate

2.1.1.1 Section 14 Emergency Streambank and Shoreline Protection

Section 14 of the 1946 Flood Control Act, as amended, authorizes the Corps to implement shoreline protection projects that protect public facilities including water and sewage treatment facilities, and roads that are in imminent danger of erosion. Private property is not eligible. The first $100,000 for the feasibility phase is provided by the federal government; costs above $100,000 are cost-shared 50% federal and 50% non-federal. If the project advances to the design and implementation phase all costs are shared 65% federal and 35% non-federal. The maximum federal contribution is $1.5 million.

2.1.1.2 Section 103 Beach Restoration and Shoreline Protection

Section 103 of the 1962 Rivers and Harbors Act, as amended, authorizes the Corps to develop and construct small projects such as revetments, groins, jetties, and sometimes beach nourishment for the purpose of shore protection and beach restoration. As of October 2012, it is Department of the Army policy that unless projects are justified by "high priority outputs" (such as commercial navigation and flood control) they will not be funded. Therefore, shoreline protection/beach restoration projects whose justification relies primarily upon recreational benefits are currently not being budgeted for (Corps 2012). Department of the Army policy could change with the level of federal budgetary constraints and national priorities. The first $100,000 for the feasibility phase is provided by the federal government; costs above $100,000 are cost-shared 50% federal and 50% non-federal. If the project advances to the design and implementation phase all costs are shared 65% federal and 35% non-federal. Total federal project funding is limited to $3 million.

2.1.1.3 Section 111 Mitigation of Shoreline Damage Caused by Federal Navigation Projects

Section 111 of the 1968 River and Harbor Act, as amended, provides authority for the Corps to develop and construct projects for the purpose of preventing or mitigating damages (such as shoreline erosion or accretion) caused or directly influenced by a federal navigation project. Section 111 authority may not be used to prevent or mitigate shore damage caused by non-federal navigation projects. A Section 111 study is required which to estimate what percentage of shore damage (or interruption to the littoral flow of beach material along a shoreline) was caused by the federal navigation project. The first $100,000 for the feasibility phase is provided by the federal government; costs above $100,000 are cost-shared 50% federal and 50% non-federal.

If the project advances to the design and implementation phase all cost sharing will be applied at the same proportion of the original project which caused the shore damage. This is not considered a likely source of funding for the Region.

2.1.1.4 Section 204 Regional Sediment Management

Section 204 of the Water Resources Development Act of 1992, as amended, authorizes the Corps to implement projects for the protection, restoration and creation of aquatic and ecologically related habitats, including wetlands, or to reduce storm damage to property, in connection with dredging for the construction or operations and maintenance of an existing authorized federal navigation project. Section 204 allows the reuse of dredged material from federal projects for beach nourishment. The full cost for the feasibility phase is provided by the federal government. If the project advances to the design and implementation phase all costs are shared 65% federal and 35% non-federal. Any cost associated with operation, maintenance, repair, rehabilitation and replacement of the project in the future is at 100% non-federal cost. Total federal project funding is limited to $5 million; the annual national appropriations limit is $30 million.

A related mechanism for potential future sand sources from dredging operations to be used in beach nourishment projects is the Long Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region (LTMS). The LTMS is a collaborative partnership between regulatory agencies, resource agencies, and stakeholders to maximize the beneficial reuse of dredged material. Approximately 300,000 cubic yards of dredged material are available annually which can be beneficially used in upland, wetland, aquatic environments, and potentially in the future, on beaches.

2.1.1.5 Section 206 Aquatic Ecosystem Restoration

Section 206 of the Water Resources Development Act of 1996 authorizes the Corps to implement ecosystem restoration projects that will improve the environmental quality, are cost-effective, and are in the public interest. Although Section 206 is not directly related to beach nourishment, it may be possible to combine the goals of habitat restoration and coastal erosion mitigation into a project that qualifies for Section 206 funding. For example, beach nourishment could be an element of a larger project to improve ocean/creek interface transitional habitat for anadromous fish (e.g., improve steelhead habitat in San Pedro Creek and provide beach nourishment at Pacifica State Beach). The first $100,000 for the feasibility phase is provided by the federal government; costs above $100,000 are cost-shared 50% federal and 50% non-federal. If the project advances to the design and implementation phase all costs are shared 65% federal and 35% non-federal. A significant portion of the 35% non-federal share can be in the form of credit for in-kind services and the provision of lands, easements, and rights-of-way.

2.1.2 General Investigations

In addition to CAP funding, it is possible to get GI funding for larger projects that do not fit within the CAP program, or are above the maximum cost. This type of funding requires congressional authorization through either a Senate Resolution (Environment and Public Works Committee) or House Resolution (Transportation and Infrastructure Committee). Alternatively authorization could be accomplished through language in the Water Resources Development Act which, in theory, is passed by Congress and signed by the president every two years. The General Investigations process follows these general steps:

- Congressional study authorization is obtained in Water Resources Development Act or a committee resolution.
- The Corps performs a reconnaissance study using appropriated funds.
- The Corps performs a feasibility study if the reconnaissance study is favorable and funds are appropriated.
- Congressional construction authorization is pursued. The Corps can perform preconstruction engineering and design while construction authorization.
- Congress authorizes construction, and the Corps constructs the project using appropriated funds.

Table 3 provides a summary of the average duration and federal/non-federal cost share requirements for each phase described above.

Table 3: Corps Project Phases, Average Duration, and Federal Cost Share (adapted from Carter and Stern 2011 and PWA 2008)

	Reconnaissance	Feasibility	Preconstruction Engineering and Design (PED)	Construction	Operation and Maintenance
Avg. Duration (years)	9-12 months	1-3 years	1-2 years	Varies	Authorized project duration
Federal Share of Costs	100%	Up to 50%; average cost $700k to $1.5 million or more	Varies by project funding source; typically 65-75%	Varies by project funding source; typically 65-75%	Varies

SECTION 3: LOCAL FUNDING SOURCES

In November, 1996, California voters approved Proposition 218, “The Right to Vote on Taxes Act.” Together with its tax limitation predecessors, Proposition 13 (1978) and Proposition 62 (1986), Proposition 218 substantially expanded restrictions on local government revenue-raising including taxes, assessments, and property related fees. Article XIII of the California State Constitution requires majority voter approval for locally imposed general taxes and a two-thirds supermajority requirement for special taxes.

While a general tax[14] faces a lower threshold of voter approval (i.e., majority), general taxes are not designated for a specific purpose and instead the revenues go into the city's General Fund to provide for a variety of public services (e.g., fire, police, libraries, parks). It is unlikely that an increase in a general tax would provide a reliable funding source for implementation of the CRSMP as coastal erosion mitigation projects would have to compete with other priorities of the General Fund.

In 1982, the state Supreme Court (*City and County of San Francisco v. Farrell*) defined the term special tax as any tax earmarked for a specific purpose. It is assumed that any tax designed specifically to implement the CRSMP (as its sole purpose or as an element of a larger beach protection and restoration tax) would be considered a special tax and require 2/3 supermajority voter approval. This 2/3 approval rate for a special tax includes, but is not limited to, local special taxes (sales tax, property tax, transient occupancy tax, utility users tax, and "other," such as parking tax, business license tax, property transfer tax, and other special taxes) and government issued general obligation bonds by cities, counties, or special districts (e.g., Mello-Roos districts; see below). Table 4 provides a summary of the approval requirements for different types of local taxes. Table 5 provides a summary of the passage rate for local revenue measures from 2001-2010.

Table 4: Approval Requirements for Local Taxes (adapted from League of California Cities 2013)

	City	County	Special District	School District	Approval Required
General Tax	X	X	—	—	majority
Special Tax	X	X	X	—	2/3 supermajority
Property Tax	X	X	X	X	2/3 supermajority
General Obligation Bond	X	X	X	X	2/3 supermajority
School Bond[1]	—	—	—	X	55%

X = may propose
— = cannot propose
The types of taxes that may be proposed are further limited in law.
1. 55% School Bond is included for completeness only. This type of bond cannot be used to implement the CRSMP.

Table 5: Summary Data on Local Revenue Measures Passed (2001-2010) (adapted from League of California Cities 2010)

	Total # of Measures	Total # Passing	Passing %
City Majority Rule	360	243	68%
County Majority Rule	38	20	53%
City 2/3 Vote	205	98	48%
County 2/3 Vote	75	31	41%
Special District (2/3)	223	99	44%
School Bond 2/3 Vote	26	8	31%

[14] A general tax is any tax imposed for general government purposes. Sales tax authorizations that provide revenue towards a city general fund are considered a general tax.

School Property Tax 2/3	147	90	61%
School Bond 55%	414	341	82%
Total	1488	930	63%

3.1 LOCAL GENERAL TAXES: GENERAL PURPOSE ADD-ON SALES TAXES

Cities and counties have the authority to raise a portion of the sales tax and use the proceeds for "quality of life" issues. Even a small increase (e.g., 0.25%) could provide a source of money coastal erosion mitigation projects (see Table 6).

Table 6: Revenue from Sales Tax Increase (adapted from League of California Cities 2011a)

	Sales Tax (2008-2009)	Current Tax Rate[1]	Revenue from 0.25% increase[2]
Pacifica	$722,935	8.5%	$21,907
Daly City	$7,991,913	8.5%	$242,179
San Francisco	$100,340,799	8.75%	$2,951,199
Regional Total	$109,055,647	-	$3,215,285

1. In 2008-2009 tax rates were: Pacifica 8.25%; Daly City 8.25%; and San Francisco 8.50%.
2. Based on sales tax data from 2008-2009.

There have been 102 general-purpose, majority-vote add-on sales tax measures since 2001 to add a ¼, ½, ¾ or 1 percent tax rate. More than half (nearly 6 out of 10) were successful. When considering data on all sales/use tax ballot measures in California from 2003-2007, there does not seem to be a relationship between the size of the hike and the success rate, though half percent hikes were by far the most successful (League of California Cities 2009 as cited BEACON 2009). Data has shown that a proposal to increase a general purpose tax is more likely to succeed than a special tax. Generally the additional hurdle of the two-thirds vote exceeds the appeal of dedicating a tax to a specific purpose. A quarter-cent increase devoted to a variety of issues including coastal protection might be the most successful strategy, since it would allow for a coalition of interest groups to organize cooperatively and support the tax.

3.2 PROPERTY TAX FEES: MELLO-ROOS AND GEOLOGICAL HAZARD ABATEMENT DISTRICTS

Property tax fees have been imposed by many cities and counties to help finance general obligation bonds for local flooding and stormwater management programs. This type of tax could be used to cover implementation of coastal erosion mitigation measures within the Region. The two possible mechanisms to be discussed here are Mello-Roos Districts and Geological Hazard Abatement Districts (GHADs).

3.2.1 Mello-Roos Districts

Bond proceeds in Mello-Roos Districts are for the purpose of "public land improvements." Public improvements are defined within the context of a "Community Facilities District", which allows the special district to finance public facilities and services. This is limited to any real or tangible property which will be owned or operated by a public entity and which has an estimated useful life of five years or more may be constructed, expanded, rehabilitated, or acquired under the Mello-Roos Community Facilities Act.[15] A Community Facilities District has the power to issue debt and collect taxes to pay for that debt. The taxes are secured by a continuing lien and are levied annually against property within the district. Revenue from bonds sold are used to finance projects with a specific benefit to the district, such as schools, parks, roads, police and fire protection services, and water, sewer, and drainage facilities.

The Mello-Roos Community Facilities Act encourages consideration of other agencies' facilities and includes authorization to combine the needs of different governmental units in a single Community Facilities District (a local agency cannot form a district that extends beyond its own territorial limits). This can be done through a Joint Community Facilities Agreement or a Joint Exercise of Powers Agreement ("Joint Powers Agreement"). If such a district boundary was established for the Region it would require either a Joint Powers Agreement with the agencies into whose territory the Community Facilities District boundary extends (e.g., City of Pacifica, Daly City, and San Francisco or some combination thereof). There are some restrictions on including agricultural and other use-restricted land in a Community Facilities District.

It takes a 2/3 majority vote of residents within a given boundary to establish and to approve a special tax in a Mello-Roos District. Currently only San Francisco has Mello-Roos Districts (4 separate San Francisco City and County Redevelopment Agency Districts). Public improvements within the context of community facilities districts are considered to be notably broader than improvements financed by traditional assessment districts. However, it is unclear if some but not all coastal erosion mitigation project alternatives would qualify as a public facility or service under the Mello-Roos Community Facilities Act (e.g., seawall as opposed to beach nourishment or managed retreat alternatives). It is necessary to further investigate if specific coastal zones and coastal erosion mitigation projects would qualify under the Mello-Roos Community Facilities Act.

3.2.2 Special Geological Hazard Abatement Districts

Geologic Hazard Abatement Districts (GHAD) enabled by the Beverly Act of 1979 (Senate Bill 1195)[16] have been developed in several parts of California, to create a local taxing authority for cities and counties to help homeowners raise funds needed to finance the prevention, mitigation, abatement or control of a geologic hazard. A geologic

[15] California Code, Chapter 2.5: The Mello-Roos Community Facilities Act of 1982 (Section 53311. - 53368.3)
[16] Division 17 of the Public Resources Code Section 26500-26654

hazard is defined as “an actual or threatened landslide, land subsidence, soil erosion, earthquake, fault movement, or any other natural or unnatural movement of land or earth.”[17] GHADs may also be used to finance the mitigation or abatement of structural hazards that are partly or wholly caused by geologic hazards. A GHAD may be successful in areas where there is a specific hazard to property owners (e.g., areas in a landslide hazard zone in Southern San Francisco and Daly City).

GHADs have been developed in several parts of California to manage coastal processes including Capitola (in 1997 for the construction of a 1,250 feet long and 24 feet high seawall) and in Malibu. Residents in Broad Beach, Malibu approved a GHAD in 2011 to combat ongoing beach erosion that threatened beach homes. The project will widen the heavily eroded beach to 100 feet in width through beach nourishment using both offshore and onshore sources, as well as bury an existing rock revetment. It is expected to cost approximately $12-13 million.

GHADs are more likely to be used for coastal armoring than for nourishment although a combination of the two may be feasible (e.g., Malibu Broad Beach GHAD). A GHAD may be proposed by one of two means: (1) a petition signed by owners of at least 10 percent of the real property in the district, or (2) by resolution of a local legislative body. A proposal for a GHAD must be accompanied by a "plan of control", prepared by a certified engineering geologist, "which describes in detail a geologic hazard, its location and the area affected thereby, and a plan for the prevention, mitigation, abatement, or control thereof."[18] A GHAD may include lands in more than one municipality (city or county) and the lands may be publicly or privately owned. Lands within a GHAD do not be contiguous as long as all lands included within a GHAD boundary are specially benefited by the proposed actions in the plan of control.

Once GHAD formation proceedings are initiated, the legislative body provides notice to property owners within the proposed district and sets a hearing date. If at the hearing more than 50% of the property owners object the GHAD formation, formation proceedings must be abandoned. If there are few objections, the legislative body may form the GHAD, initially appointing five property owners to the board of directors. Thereafter, the GHAD may issue bonds, purchase and dispose of property, acquire property by eminent domain, levy and collect assessments, sue and be sued, and construct and maintain improvements. For most GHADs, the primary source of funding is through property assessments collected at the same time, and in the same manner, as general taxes on property.

3.3 TRANSIENT OCCUPANCY TAX

Transient occupancy taxes (TOTs) are hotel taxes levied on visitors. Several coastal cities in Southern California utilize TOTs for funding beach improvements including Encinitas and Solana Beach. The San Diego Association of Governments Shoreline

[17] Public Resources Code Section 26507
[18] Public Resources Code Section 26509

Preservation Working Group has seriously considered using TOTs as a dedicated funding sources for beach replenishment projects covering the entire coast of San Diego County.

The authority to levy a TOT is granted to the legislative bodies of both cities and counties by California Revenue and Taxation Code 7280.[19] State law authorizes a city or county board of supervisors, upon approval of a majority of the voting electorate, to impose a tax on those who, for a period of up to 30 days, occupy a room or rooms or other living space in a hotel, inn, tourist home or house, motel, or other lodging. Generally, a ballot measure will authorize the city council or board of supervisors to enact an ordinance to increase the TOT rate and for the County Tax Collector to collect such tax.

The cities of San Francisco, Daly City, and Pacifica all currently implement TOTs at rates of 10-14%. In November 2010, Pacifica voters approved Measure R to increase their TOTs from 10 to 12% (estimated to add approximately $160,000 per year to the General Fund of Pacifica). TOT revenues in all three cities go into their respective General Fund and help pay for such services as public safety, emergency services, road repair, beach maintenance, and recreation. Table 7 provides a summary of TOT revenues from 2008-2009 (the most current comprehensive available data) and the projected revenues that would result from a 1-2% increase in the TOT. Table 7 represents a general estimate of the amount of revenue that could be raised assuming a perfectly inelastic demand for hotels and tourists.

Table 7: Current TOT Revenues and Projected Future Revenues with TOT Rate Increase (adapted from League of California Cities 2011b)

	Current TOT (of 03/15/11)	TOT in 08'- 09'	Revenue in 08'-09'	Additional Revenue from 1% Increase in TOT (from 08'-09')	Additional Revenue from 2% Increase in TOT (from 08'-09')
Pacifica	12%	10%	$843,226	$84,322	$168,645
Daly City	10%	10%	$496,291	$49,629	$99,258
San Francisco	14%[1]	14%	$200,459,524	$14,318,537	$28,637,075
Regional Total	-	-	$201,799,041	$14,452,489	$28,904,978

1. The TOT rate in San Francisco ranges from 14-16% and includes a 14% Transient Occupancy Tax, plus a Tourism Improvement District tax of 1% or 2% (with the majority of funding going towards the expansion of the Moscone Center) depending on which district the property is located.

TOT can be either specialty (i.e., earmarked for a particular purpose such as coastal erosion mitigation), making these measures special taxes requiring two-thirds voter approval) or they can be general (i.e., going to General Fund to provide municipal services). In California from 2002 through 2009, 65 percent of TOT ballot measures passed (see Table 8). TOTs can generate substantial funds for beach nourishment and

[19] Available online at: http://www.leginfo.ca.gov/cgi-bin/displaycode?section=rtc&group=07001-08000&file=7280-7283.51

because they tax visitors (as opposed to residents); TOTs are generally a politically feasible way to increase municipal revenues.

Table 8: TOT Measures Passage Rates 2002-2009 (adapted from League of California Cities 2010)

	Pass	Fail <55%	Fail 55%+[1]
New/Increase/Expand General Tax	60	32	-
New/Increase/Expand Special Tax	7	5	6
Validate/Extend	13	-	-
TOTAL	80	43	
1. Measure received more than 55 % "yes votes" but failed to garner the required 2/3 voter approval.			

SECTION 4: OTHER FUNDING SOURCES

4.1 SUPPLEMENTAL ENVIRONMENTAL PROJECTS

Supplemental Environmental Projects (SEP) allow a discharger to undertake an environmentally beneficial project as restitution for polluting water under the Regional Water Quality Control Board (Regional Water Board)'s enforcement process. For example, an unauthorized sewage or oil spill along the coast could result in a Regional Water Board enforcement action and monetary fines levied against the discharger. The discharger may elect to suspend part of the fine by undertaking one or more SEPs. SEPs must be related to the location or nature of the violation and should remediate or reduce the probable overall environmental or public health impacts or risks to which the violation contributed, or reduce the likelihood that similar violations will occur in the future.

SEPs are opportunistic in that funding for an SEP arises when a violation occurs and the Regional Water Board is successful in enforcement against the responsible party. Therefore, funding through SEPs is dependent upon the frequency and magnitude of future violations, the ability of Regional Water Board to successfully bring enforcement actions, and the willingness of dischargers to elect to fund an SEP instead of paying an ACL liability or fine. The San Francisco Estuary Partnership provides project oversight for active SEPs, to ensure that projects are completed according to agreements between the Regional Water Board and dischargers. SFEP also assists in connecting projects to potential SEP opportunities.

Because only a few SEPs may be approved in any given year, chances are low that any one project will be selected. In order to minimize the effort involved for project proponents, SFEP requests only a simple concept proposal initially. If a project is selected by a discharger for consideration, the project proponent develops a broader proposal including a detailed project description, budget, milestones, description of benefit, and performance measures.[20] A full proposal must demonstrate consistency with the State Water Board SEP Policy.[21] While SEPs are limited as a potential future funding source, implementation of the CRSMP should include the submission of concept proposals for beach nourishment and coastal erosion mitigation projects as potential future SEPs.

4.2 SALES TAX ON SPORTING GOODS

A specialty sales tax could be limited to sporting goods associated with beach recreation (e.g., saltwater fishing and surfing equipment) and used to pay for coastal erosion mitigation projects. The State of Texas appropriates a portion of the sales taxes generated by sporting goods to support parks and recreation. However, due to the relatively lower recreational use of Northern California beaches (when compared to Southern California), implementing a sales tax solely on sporting goods is not likely to generate the funding needed to implement coastal erosion mitigation projects.

4.3 RENTAL CAR FEES

A fee could be levied on rental car leases within the Region to provide funding for regional sediment management activities. This fee could be levied on a cost per day basis (e.g., $0.25/day) or as a percentage of the rental price. In 2012, the voters of San Mateo County narrowly passed Measure T, which required car rental companies in the county to pay 2.5% of their gross receipts to the County.

4.4 PARKING FEES

A fee could be levied on beach parking within the Region to provide funding for regional sediment management activities. Installation of the parking fee machines and implementation of a fee schedule constitutes development under the California Coastal Act Section 30106 (as both installation of a structure and a change in intensity of use and of access to water) and would requires a Coastal Development Permit from the CCC. The CCC generally opposes parking fees since it can limit public access to the coast. However, a proposal to use beach parking fees to further beach restoration may be more likely to be approved by the CCC (BEACON 2009 p. 65).

Currently, the CCC has approved Coastal Development Permits for beach parking fees at State Parks in Southern California. This is consistent with recent legislative direction

[20] For more information (including templates for a concept and full proposal) see: http://www.sfestuary.org/our-projects/stewardship/sep/

[21] Available online at: http://www.waterboards.ca.gov/water_issues/programs/enforcement/docs/rs2009_0013_sep_finalpolicy.pdf

(in California Assembly Bill 1589, "The California State Parks Stewardship Act of 2012") to State Parks to create new revenue streams to fund facility management and operations throughout the State Park system.[22] The CCC also postponed several applications for Coastal Development Permits for initiation of parking fees at several State Beach (i.e., San Onofre State Beach in San Diego County and San Clemente State Beach and Crystal Cove State Park in Orange County) at their February 2013 meeting, indicating ongoing stakeholder interest in this issue.

Parking fees produce a significant source of revenue for many cities such as Huntington Beach and Newport Beach. Other CRSMPs have explored the use of parking fees to fund beach nourishment, but to date parking fees in California have only been used for beach maintenance (e.g., funding of beach rangers, lifeguards, operations and maintenance of facilities). The City of Pacifica received approval form the CCC in November, 2012, to implement parking fees at Pacifica State Beach (also known as Linda Mar Beach). The proposed fees would be $3 for a period of less than 4 hours, $6 for a period of more than 4 hours (or all day), or $50 for an annual pass, and the City estimates that annual net fee revenues from the 189 parking spaces would be in the range of about $300,000. Pacifica State Beach is the most highly used beach in all of San Mateo County, and it is a particularly popular surfing destination on the peninsula (CCC 2012). Therefore, the annual net fee revenue generated from other beaches in the Region may be significantly less. The CCC indicated whatever funds generated by the parking fee program need to be dedicated to expenses incurred as a consequence of the management and operation of the Pacifica State Beach. The City of Pacifica will use the revenues generated to employ two new beach rangers to manage and watch over the beach area and to perform other duties including to actively maintain the beach area, parking lots, restrooms and showers; to enforce beach regulations, such as those related to littering and keeping dogs on leash; as well as to protect the coastal sand dunes and snowy plover habitat.

Implementing parking fees in the Region could be difficult due to concerns about negative impacts on public access. Even if beach users were educated on the use of parking fees for beach restoration, widespread use of parking fees have low political feasibility because of public expectations of free parking at local beaches. Nonetheless, if implementation of the parking fees at Pacifica State Beach (set to begin in May/June 2013) proves successful it could offer a model for implementing parking fees elsewhere in the Region.

4.5 PROPERTY TAX ASSESSMENT

The State of California also allows local governments to increase property taxes for certain reasons. Property tax assessments need a majority approval and are voted upon only by affected property owners with votes weighted by assessment liability. Local governments levy assessments in order to fund improvements that benefit real

---

[22] Coastal State Parks in the Region include Gray Whale Cove and Pacifica State Beach in Pacifica and Thornton State Beach in Daly City.

property. For example, with the majority approval of affected property owners, a municipality may create a street lighting assessment district to fund improvements to street lighting in a city or county.

Under Proposition 218, improvements funded with assessments must provide a direct benefit to the property owner. An assessment cannot be levied for facilities or services that provide general public benefits (e.g., schools or public safety). While many coastal erosion mitigation projects would provide direct benefits some property owners (e.g., Daly City properties directly affected by landslide hazards), it is assumed that such projects would fit into the latter category of providing general public benefits. Therefore, property tax assessment is likely not a potential future funding source to implement the CRSMP.

4.6 PROPERTY TRANSFER TAX

Real estate transfer taxes (RETTs) are assessed on real estate when a property changes hands. Daly City and Pacifica currently levy a RETT of $1.10 per $1000 on all sales of private property in the county. San Francisco’s RETT ranges from $5 - $25 depending on the price of the property. Revenue raised from a RETT may be added to the jurisdiction’s General Fund or earmarked for specific uses such as beach nourishment. In Florida, state law requires that at least $30 million of revenues from the real estate documentary stamp tax (Florida’s equivalent to California’s real estate transfer tax) must go for beach nourishment projects. Increase in the real estate transfer tax would need a two-thirds majority vote approval as required under Proposition 218 if it went directly to fund implementation of the CRSMP (i.e., specialty tax); a simple majority approval would be required as a general tax with revenue going to the city General Fund.

REFERENCES

BEACON (Beach Erosion Authority for Clean Oceans and Nourishment). 2009. Coastal Regional Sediment Management Plan, Central Coast from Pt. Conception to Pt. Mugu.

Carter, N.T., and C. V. Stern. 2011. Army Corps of Engineers Water Resource Projects: Authorization and Appropriations. Congressional Research Service. August 19, 2011.

CCC (California Coastal Commission). 2012. Staff Report: Regular Calendar City of Pacifica Application No. 2-12-019.

CDBW (California Department of Boating and Waterways). 2013. Fact Sheet: Beach Erosion & Public Beach Restoration Programs. No date.

CDBW and SCC (California Department of Boating and Waterways and State Coastal Conservancy). 2002. California Beach Restoration Study. Sacramento, California.

Corps (U.S. Army Corps of Engineers). 2012. Program Fact Sheet: Beach Restoration and Shoreline Protection, Section 103 of the 1962 River and Harbor Act, as amended. US Army Corps of Engineers Buffalo District. October 2012.

Hutzel, A. 2013. Inquiry on Grant Funding Opportunities at California Coastal Conservancy. Personal contact. Email dated March 4, 2013.

League of California Cities. 2010. An Overview of Local Revenue Measures in California Since 2001. Updated March 15, 2010.

League of California Cities. 2009. California Local Government Finance Almanac. Available online at: http://www.californiacityfinance.com/ (accessed March 18, 2013). Cited in BEACON (Beach Erosion Authority for Clean Oceans and Nourishment). 2009. Coastal Regional Sediment Management Plan, Central Coast from Pt. Conception to Pt. Mugu.

League of California Cities. 2011a. Local Sales & Use Tax Revenues. May 2011. Available online at: http://www.californiacityfinance.com/SUT09p.xlsx (accessed March 18, 2013).

League of California Cities. 2011b. Transient Occupancy Tax by City. Current rates, revenues, per capita, and % of general revenues and summary statistics. Through FY08-09. May' 11. Available online at: www.californiacityfinance.com/TOT09p.xlsx (accessed March 18, 2013).

League of California Cities. 2013. Local Super-Majority Voting Rules and Results. Rev February 19, 2013.

PWA (Philip Williams & Associates, Ltd.). 2008. Coastal Regional Sediment Management Plan for Southern Monterey Bay. Prepared for Association of Monterey Bay Area Governments. Prepared with Ed Thornton, Jenifer Dugan, and Halcrow Group. November 3, 2008.

Sterrett, K. 2013. Question on CDBW Beach Restoration Program. Personal contact. Email dated March 5, 2013.

Appendix F
Economic Analysis

ESA

APPENDIX F
Economics Analysis

Introduction

Economics plays an important role in decision making when choosing between coastal options. The analysis below is meant to provide background on the important economic considerations for beaches and coastal armoring choices. However, this analysis should not be read as a full feasibility study since the data sources are limited. Instead, the economic analysis should point policy-makers in the right direction and help narrow policy options.

The sections below will provide an overview of recreational beaches in the study area followed by a discussion of the economic benefits derived from these beaches and how different policy scenarios will alter these benefits. The estimated costs of each proposal are also given.

Figure F-1
Surfboards lined up at Linda Mar Beach before a Surf Class

Qualitative Descriptions of Recreational Opportunities: SF CRSMP

- **Ocean Beach, San Francisco** extends for several miles along the western (Pacific) coast of San Francisco. The beach is popular for walking, engaging in sand activities such as Frisbee throwing and surfing including. Swimming/wading is rare due to the cold weather and rip tides. There are relatively few amenities on the beach although visitors are close to restaurants and other businesses just across the Great Highway and there are a number of restaurants/shops at the north end near Seal Rock. Visitors are spread throughout the entire beach with concentrations at the north and south ends.

  This study divides Ocean Beach into three reaches: North Ocean Beach (NOB), Middle Ocean Beach (MOB), and South Ocean Beach (SOB). The north end is much wider while the south end is narrower and eroding, including the parking lot at Sloat Blvd. Recreational amenities/access are similar throughout, though surfing is most popular at the north and south ends. Visitors can reach the beach by car or mass transit (there are a number of bus and MUNI lines that reach the beach). The parking lot at Sloat can get full but parking on Sloat Blvd. across the street is ample.

- **Daly City** has an extensive shoreline with sandy beaches below steep bluffs, though much of it is difficult to access since many parts have been fenced off due to concerns about landslides/ erosion. The study divides Daly City into two reaches; the southern reach is adjacent to landfill.
- **Fort Funston**, at the north end (just south of San Francisco) is the most popular destination. Fort Funston is particularly popular for dog walkers. It was also a noted hang-gliding site. The vast majority (over 90%) of visitors are on trails on the bluff above the beach.
- **Thornton State Park** has a small parking lot at the west end of John Daly Blvd. However, access to the beach is restricted, so that visitors can only look down on the bluff. There are coastal trails that run through the park but on most days the beach has few visitors.
- The **City of Pacifica** has a number of beaches with differing recreational amenities
- **Mussel Rock** provides a parking lot and coastal access (trails) with few amenities. Most visitors stay on the bluff above.
- The **Manor District** has a couple of access points, notably an access point to a sandy beach just off of Esplanade Avenue. The beach is popular for walking.
- **Beach Boulevard** is largely fenced off due to coastal erosion and has little or no access. Much of the length contains a trailer park and other residential uses as well as some industrial buildings. Access is extremely limited.
- **Sharp Park** has a pier, bathroom facilities and a very popular coastal trail that runs south of the pier between the beach and the Sharp Park golf course all the way to Rockaway Beach. The park is particularly popular with fishermen, most of whom are on the pier, though some fish off of the beach. The rip tides and cold weather limit swimming/wading and most walkers prefer the coastal trail, though the beach acts as an added amenity for all visitors. There is ample parking across the street.
- As the name implies, **Hidden Cove** is more difficult to access. One must climb a relatively steep bluff from either Rockaway Beach to the south or Sharp Park to the north. There is no official access down to the beach and we did not observe any unofficial trails.
- **Rockaway Cove** is a small beach adjacent to two hotels and a number of other small businesses. It is popular with walkers and also provides an important amenity for visitors to the Best Western Lighthouse and the Pacifica Motor Lodge. There is ample parking and access is just off of route 1.
- **Linda Mar Beach** is popular with surfers, walkers and also a popular wading site when the weather is warm. The beach is just off of Route 1 and has ample parking and restroom facilities. The Taco Bell just off the beach is very popular and provides nice views of the beach.
- **Shelter Cove** is a small cove beach just south of Linda Mar. To access the beach one must drive through a residential neighborhood. Parking is very limited. The stairway down to the cove is well maintained.

The socioeconomic estimates in this study are based on severely limited data about attendance, spending, etc. Where possible, existing studies/data were used. In other cases, field counts were used or data (e.g., on spending) from other studies was applied.

Figure F-2
Hidden Cove (Pacifica) is indeed hidden from view unless one hikes up a trail from Sharp Park or Rockaway Cove. However the view of the beach is spectacular.

Attendance and Beach Amenities

Estimates for Ocean Beach attendance were obtained from a detailed survey data conducted by the San Francisco Public Utilities Commission (SFPUC) from 1998-2000 and confirmed by a number of independent observations of Ocean Beach and conversations with people familiar with recreational use patterns. Although this data is over a decade old, attendance at Ocean Beach has remained relatively stable over time, as has San Francisco's population. The one area that was adjusted was surfing, particularly south of Sloat Blvd., which has increased significantly since the survey was taken.

The SFPUC survey was conducted at a number of specific sites at Ocean Beach and these site estimates were translated into the three reaches--North Ocean Beach (NOB), Middle Ocean Beach (MOB) and South Ocean Beach (SOB) used throughout the analysis. The SFPUC survey was well thought out and detailed, so we are confident in these estimates. The main area of uncertainty concerns potential increases in recreational activity as well as yearly differences. Beach attendance varies depending upon the weather, though the weather at Ocean Beach is reasonably consistent from year to year.

For other sites far less data was available. Research Assistants counted people at each of the other beaches four times in February including weekdays and weekends and sunny and windy/cloudy days. Since attendance in this area is less seasonal than many other areas counting in February is less of a limitation. Nevertheless, the estimates made from these counts have a high error band.

Table F-1 below presents selected amenity and access data for the beaches in our study. None of the beaches has lifeguards, camping, volleyball or some of the amenities popular in southern California Beaches. Most of these beaches are more popular for walking and swimming is uncommon at all of these beaches, indeed it is dangerous at many beaches. On the other hand surfing has become increasingly popular at Ocean Beach, at Linda Mar Beach and other sites. The beaches also provide an additional amenity to people who never set foot on the sand and this should be accounted for.

Table F-1 also rates each beach in terms of access. Beaches close to major roads and public transportation rank more highly than beaches which are harder to get to. A could of beaches have very low access, indeed access is restricted for most of Daly City’s coastline due to the possibility of landslides, though these stretches can be accessed by coastal trails above and below. Hidden Cove has no trails down to the beach and hence also has low access.

Many of the beaches have parking lots nearby. “Official” spots are next to the beach and generally designated for beach use. Many other beaches (e.g., South Ocean Beach) have ample street parking nearby. In general, parking is adequate at all of the beaches except perhaps during peak times.

TABLE F-1
AMENITIES AND ACCESS OF BEACHES WITHIN STUDY

Beach	Access out of 10	Restrooms	Showers	Public Transportation	Number of Official Parking Spots	Parking Fee	Free Street Parking	% Available for Beach Tourism
Baker Beach	7	Y	N	Y	187	0	100	100%
China Beach	5	Y	Y	N	37	0	50	20%
North Ocean Beach	8	Y	N	Y	>500	0	>500	40%
Middle Ocean Beach	8	Y	N	Y	0	0	>500	40%
South Ocean Beach	9	Y	N	Y	65	0	40	30%
Fort Funston	7	Y	N	N	260	0	30	100%
Thornton Beach	3	N	N	N	24	0	0	100%
Mussel Rock	3	N	N	N	60	0	25	0%
Manor District	5	N	N	N	0	0	80	10%
Beach BLVD	5	Y	N	N	0	0	79	30%
Sharp Park	5	Y	N	N	33	0	100	30%
Hidden Cove	1	N	N	N	50	0	20	60%
Rockaway Cove	7	N	N	N	55	0	0	0%
Linda Mar	8	Y	Y	N	136	0	10	60%
Shelter Cove	4	Y	Y	N	0	0	6	0%

Figure F-3
Sign Posted on fence in Daly City. Access to Thornton Beach is now severely limited.

Figure F-4
Access to this Beach in the Manor Park area of Pacifica is also restricted even though the Beach below the High Tide Line is not Private Property.

Table F-2 below presents estimates of attendance and economic impact (spending and selected local taxes) for beaches in the study area. These attendance estimates are based on rather limited data (except for Ocean Beach) and have a relatively large error band around them. Another difficulty is that for some beaches, people will walk adjacent to the beach or on the pier, but not set foot on the sand. For example, the pier at Sharp Park is extremely popular with fisherman throughout the year and the adjacent path (which follows the coast and goes next to the golf course) is also popular. Few people set foot on the beach and the waves are posted as dangerous. Similarly Linda Mar is a popular site and the Taco Bell there is popular—with a deck that looks out on the beach. However, Linda Mar is also popular with surfers, surf schools and on hot summer days some swimmers.

Economic Impact estimates used spending per visitor per day from King and Symes (2004) updated for inflation. It should be noted that King and Symes' data were collected at southern California beaches and the spending patterns may not be exactly the same. For example, gas and auto costs may be lower since people drive shorter distances to go to these beaches. On the other hand, some other costs may be higher. Since none of the beaches charge parking fees, that element of King and Symes' estimates was omitted. Local tax rates were applied for estimates of tax revenue generated.

Parking availability and Amenities were estimated from site visits and publically available data including:

- Site visits including interviews with people knowledgeable about beach amenities/habits;
- Google Earth and Google Maps was used to estimate available parking;
- The California Coastal Access Guide (2003);
- Street parking capacity was evaluated based on observed capacity from previous high-season parking habits and interviews with people familiar with beach parking patterns. After speaking to residents and local beach users, it was determined that visitors are willing to park from two to five blocks away on a busy summer day. Each beach was evaluated separately and the information was used to construct geographical zones that encompass the area used for beach parking. The number of parking spaces was counted using Google Maps and/or during site visits. The percentage of parking in the geographical zone that is available for beach use is also based on observed parking habits.

Access

- A beach is considered to have bus/MUNI access if a stop is within three blocks.
- The general access rating is based on accessibility by auto, public transportation and by foot. Beaches closer to major roads were considered more accessible.

TABLE F-2
ATTENDANCE AND ECONOMIC IMPACT OF SELECTED BEACHES

Beach	Estimated Yearly Attendance	% Overnight Visitors	Estimated Total Annual Spending	Total Sales Tax	State Portion	Local Sales Tsx	State Sales Tax Revenues	Local Sales Tax Revenue	Transient Occupancy Tax	Estimated TOT Revenues
Baker Beach	150,000	20%	$ 8,542,946	8.50%	6.25%	2.25%	$ 207,530	$ 74,711	14%	$ 96,506
China Beach	25,000	10%	$ 1,515,842	8.50%	6.25%	2.25%	$ 34,131	$ 12,287	14%	$ 7,792
North Ocean Beach	160,000	40%	$ 7,934,651	8.50%	6.25%	2.25%	$ 227,218	$ 81,798	14%	$ 199,479
Middle Ocean Beach	140,000	10%	$ 8,488,714	8.50%	6.25%	2.25%	$ 191,134	$ 68,808	14%	$ 43,636
South Ocean Beach	40,000	10%	$ 2,425,347	8.50%	6.25%	2.25%	$ 54,610	$ 19,660	14%	$ 12,467
Fort Funston	150,000	20%	$ 8,542,946	8.25%	6.25%	2.00%	$ 207,530	$ 66,410	10%	$ 66,790
Thornton Beach	5,000	10%	$ 303,168	8.25%	6.25%	2.00%	$ 6,826	$ 2,184	10%	$ 1,113
Mussel Rock	10,000	10%	$ 606,337	8.25%	6.25%	2.00%	$ 13,652	$ 4,369	10%	$ 2,226
Manor District	8,000	10%	$ 485,069	8.25%	6.25%	2.00%	$ 10,922	$ 3,495	10%	$ 1,781
Beach BLVD	40,000	10%	$ 2,425,347	8.25%	6.25%	2.00%	$ 54,610	$ 17,475	10%	$ 8,905
Sharp Park	120,000	10%	$ 7,276,041	8.25%	6.25%	2.00%	$ 163,829	$ 52,425	10%	$ 26,716
Hidden Cove	5,000	10%	$ 303,168	8.25%	6.25%	2.00%	$ 6,826	$ 2,184	10%	$ 1,113
Rockaway Cove	40,000	10%	$ 2,425,347	8.25%	6.25%	2.00%	$ 54,610	$ 17,475	10%	$ 8,905
Linda Mar	150,000	10%	$ 9,095,051	8.25%	6.25%	2.00%	$ 204,787	$ 65,532	10%	$ 33,395
Shelter Cove	25,000	10%	$ 1,515,842	8.25%	6.25%	2.00%	$ 34,131	$ 10,922	10%	$ 5,566
Total/Average	**1,068,000**		**$ 61,885,815**				**$ 1,472,346**	**$ 499,736**		**$ 513,390**

Economic Benefits and Costs of Management Scenarios

The economic analysis for this study also estimated the benefits of beach recreation under different scenarios as well as the impacts on property behind the beach when storms and coastal erosion lead to a loss of land, buildings, roads and infrastructure, which has already been an issue in Pacifica.

The benefits of beach recreation were estimated using the CSBAT model, which has been employed in other CRSMPs. A similar methodology was used here. Basically, increasing or decreasing beach width increases (or decreases) economic value in two ways: 1) numerous studies show that visitors prefer wider beaches up to about 250-300 ft; 2) in cases where beaches are crowded, wider beaches reduce overcrowding. For more details on this methodology, the reader is referred to appendix X.

The different management scenarios are outlined in detail in sections xxx-yyy of this report and the reader is referred back to those sections. Tables F-3 – F-5 present the benefits and costs of the different management scenarios.

Analysis of Assets at Risk in the Upland Developed Areas

Upland erosion places land, structures and infrastructure at risk to economic damages. The general approach was to employ GIS spatial analysis techniques to evaluate if modeled upland erosion would intersect with these assets. The GIS data was provided by ESA PWA, and represented the best publically available data at the time the analysis was conducted.

In order to simplify the presentation of results, we categorized damages according to private property (e.g., residential homes, commercial establishments), public property (e.g., parks, post offices) and public infrastructure (e.g., sewers, streets). The following assumptions were used when translating erosion inputs to damage functions:

- Developed public parcels and private parcels face a complete loss of structure and land value when intersecting an erosion hazard zone;
- Public infrastructure face a complete loss of structure and land value when intersecting an erosion hazard zone; and
- Undeveloped public parcel and private parcel losses are a function of the percent of parcel (e.g., parcel surface area at risk/total parcel surface area) within the erosion hazard zone.

To estimate losses we first identified the base value for all assets that were identified at risk erosion.

Values for private and public parcels were secured from assessor data secured from the County of San Mateo and the County of San Francisco.

Assessor data is recorded for tax purposes, and public properties are in many cases exempt from property taxes. As a result public lands and public structures are often recoded as having no value (i.e., $0). The assessor data did not include attributes for the structures at risk, so we were not able to infer the value of public structures at risk. However, most public land identified at risk is undeveloped. In certain cases this land has been purchased by and land trusts or various government entities, indicating that this land does in fact have economic value. To estimate the value of this undeveloped public land, we analyzed past sales transactions for identified parcels at risk embedded in the assessor data, while also including proximate parcels such as Mori Point. Based on this analysis, we estimate an average value of $10 per square foot in 2010 dollars.

To adjust the value of land, structures and infrastructure the following factors were applied:

- A discount rate of 4 percent was applied to all land, structures and infrastructure at risk.
- A constant depreciation factor of 25 percent was applied for all structures at risk. This is consistent with the USACE's use of depreciation replacement values, and in line with past guidance provided by the USACE. The underlying rationale for using a constant depreciation factor is that most structures reach a constant state where the annual maintenance spending and the annual rate of depreciation are equal. This is especially the case for projects where planning horizon is greater than 20-25 years as is the case in this analysis.[1]
- A 1.6 percent annualized increase was applied to property value (from 2013-2050), representing the average annual growth in GDP (Frankhauser 1994).[2] This value is slightly lower than the annualized 2 percent maximum increase in assessed property value as outlined in Proposition 13.[3]
- This analysis does not account for changes in construction costs for public infrastructure over the period of analysis; the USACE Civil Works Construction Cost Index only goes out to 2025.

Tables F-6 to F-11 present the results of our analysis. Please keep in mind that these results are preliminary and should not be considered a formal feasibility study.

---

[1] It is also possible, that with sufficient foresight, the growing risk to structures and land in market prices, reflecting the growing risk and further reducing associated hazard losses.

[2] This value was be revised if necessary when in receipt of more recent work by Neumann et al. (2005) that applies the Yohe et al. (1999) method that accounts for changes in national gross domestic product, construction costs, and household income.

[3] In California, Proposition 13 results in property being reassessed only when it changes ownership (improvements are also added to the structure value). Future increase to a property's assessed value are capped at two percent, which leads to a discrepancy between assessed value and actual market value since property values in the study area have risen at a far greater rate than two percent a year over the past several decades. In effect, Proposition 13 results in assessed property values that may be far below their respective market value, especially for properties that have not changed hands for many years.

TABLE F-3
ECONOMIC ANALYSIS OF MIDDLE OCEAN BEACH (SAN FRANCISCO)

Scenario	Option 1 Nourishment Only (Baseline)	Option 4 Hold the Line
PV Recreational Benefits	$25,482,917	$18,048,091
PV Recreational Benefits over Baseline (current width)	$0	-$7,434,826
PV Cost of Action	-$47,996,688	-$25,142,526
PV Cost over Baseline	$0	$22,854,163
PV Public/Infrastructure Loss	-$5,048,292	-$8,264,943
PV Public/Infrastructure Gain/Loss over Baseline	$0	-$3,216,651
PV Private Property Loss	$0	$0
PV Private Property Gain/Loss over Baseline	$0	$0
Net Benefits	-$27,562,063	-$15,359,377
Net Benefits over Baseline	**$0**	**$12,202,686**
PV Direct Economic Impact	$131,137,839	$99,476,134
PV Direct Economic Impact over Baseline	$0	-$31,661,704
PV Sales and Transient Occupancy Taxes	$9,355,175	$7,096,477
PV Sales and Transient Occupancy Taxes over Baseline	$0	-$2,258,698

TABLE F-4
ECONOMIC ANALYSIS OF SOUTH OCEAN BEACH (SAN FRANCISCO)

Scenario	Option 1 Nourishment Only (Baseline)	Option 2 Nourishment and Reefs
PV Recreational Benefits	$6,724,274	$7,823,773
PV Recreational Benefits over Baseline (current width)	$0	$1,099,499
PV Cost of Action	-$22,271,069	-$82,531,760
PV Cost over Baseline	$0	-$60,260,691
PV Public/Infrastrcuture Loss	-$31,380,031	-$30,407,677
PV Public/Infrastructure Gain/Loss over Baseline	$0	$972,354
PV Private Property Loss	$0	$0
PV Private Property Gain/Loss over Baseline	$0	$0
Net Benefits	-$46,926,826	-$105,115,665
Net Benefits over Baseline	**$0**	**-$58,188,838**
PV Direct Economic Impact	$37,722,972	$42,736,785
PV Direct Economic Impact over Baseline	$0	$5,013,813
PV Sales and Transient Occupancy Taxes	$2,691,100	$3,048,778
PV Sales and Transient Occupancy Taxes over Baseline	$0	$357,678

TABLE F-5
ECONOMIC ANALYSIS OF DALY CITY (SECT. 2)

Scenario	Option 1 Nourishment Only	Option 2 Nourishment and Reefs	Option 4 No Action (Baseline)
PV Recreational Benefits	$2,932,394	$2,954,200	$1,489,282
PV Recreational Benefits over Baseline (current width)	$1,443,112	$1,464,918	$0
PV Cost of Action	-$108,328,456	-$171,564,510	$0
PV Cost over Baseline	-$108,328,456	-$171,564,510	$0
PV Public/Infrastrcuture Loss	-$39,217,369	-$39,217,369	-$39,217,369
PV Public/Infrastructure Gain/Loss over Baseline	$0	$0	$0
PV Private Property Loss	-$151,407,315	-$151,407,315	-$151,407,315
PV Private Property Gain/Loss over Baseline	$0	$0	$0
Net Benefits	-$296,020,747	-$359,234,994	-$189,135,402
Net Benefits over Baseline	**-$106,885,344**	**-$170,099,592**	**$0**
PV Direct Economic Impact	$16,223,277	$16,223,277	$9,435,497
PV Direct Economic Impact over Baseline	$6,787,781	$6,787,781	$0
PV Sales and Transient Occupancy Taxes	$1,119,254	$1,119,254	$650,961
PV Sales and Transient Occupancy Taxes over Baseline	$468,293	$468,293	$0

TABLE F-6
ECONOMIC ANALYSIS OF DALY CITY (SECT. 3)

Scenario	Option 3 Armor (Baseline)	Option 4 Managed Retreat
PV Recreational Benefits	$0	$0
PV Recreational Benefits over Baseline (current width)	$0	$0
PV Cost of Action	-$14,937,894	$0
PV Cost over Baseline	$0	$0
PV Public/Infrastrcuture Loss	$0	-$21,000,000
PV Public/Infrastructure Gain/Loss over Baseline	$0	$0
PV Private Property Loss	$0	$0
PV Private Property Gain/Loss over Baseline	$0	$0
Net Benefits	-$14,937,894	-$21,000,000
Net Benefits over Baseline	**$0**	**$0**
PV Direct Economic Impact	$0	0
PV Direct Economic Impact over Baseline	$0	0
PV Sales and Transient Occupancy Taxes	$0	0
PV Sales and Transient Occupancy Taxes over Baseline	$0	0

TABLE F-7
ECONOMIC ANALYSIS OF MANOR DISTRICT (PACIFICA)

Scenario	Option 1 Nourishment Only	Option 2 Nourishment and Reefs	Option 3 Armor	Option 4 Hybrid (Baseline)
PV Recreational Benefits	$1,885,067	$1,893,222	$597,086	$1,885,067
PV Recreational Benefits over Baseline (current width)	$0	$8,155	-$1,287,981	$0
PV Cost of Action	-$60,790,083	-$88,086,462	-$55,551,281	-$59,155,250
PV Cost over Baseline	-$1,634,833	-$28,931,212	$3,603,969	$0
PV Public/Infrastrcuture Loss	-$6,024,263	-$3,415,912	-$3,788,387	-$3,558,391
PV Public/Infrastructure Gain/Loss over Baseline	-$2,465,872	$142,479	-$229,996	$0
PV Private Property Loss	-$35,710,133	-$34,591,889	-$35,100,305	-$32,969,338
PV Private Property Gain/Loss over Baseline	-$2,740,795	-$1,622,551	-$2,130,967	$0
Net Benefits	-$100,639,412	-$124,201,041	-$93,842,887	-$93,797,913
Net Benefits over Baseline	**-$6,841,500**	**-$30,403,128**	**-$44,974**	**$0**
PV Direct Economic Impact	$9,602,383	$9,602,383	$3,902,573	$9,602,383
PV Direct Economic Impact over Baseline	$0	$0	-$5,699,810	$0
PV Sales and Transient Occupancy Taxes	$677,991	$ 677,991	$275,547	$677,991
PV Sales and Transient Occupancy Taxes over Baseline	$0	$0	-$402,444	$0

TABLE F-8
ECONOMIC ANALYSIS OF BEACH BLVD. (PACIFICA)

Scenario	Option 1 Sand Placement	Option 2 Sand Placement with Art. Reef	Option 3 Armor	Option 4 Hybrid (Baseline)
PV Recreational Benefits	$10,136,528	$11,276,265	$2,378,664	$10,136,528
PV Recreational Benefits over Baseline (current width)	$0	$1,139,738	-$7,757,863	$0
PV Cost of Action	-$74,179,735	-$98,822,356	-$45,150,310	-$70,277,392
PV Cost over Baseline	-$3,902,343	-$28,544,965	$25,127,082	$0
PV Public/Infrastrcuture Loss	-$2,249,797	-$2,237,904	-$4,505,908	-$3,672,817
PV Public/Infrastructure Gain/Loss over Baseline	$1,423,020	$1,434,913	-$833,091	$0
PV Private Property Loss	-$4,820,464	-$4,820,389	-$8,547,141	-$6,966,872
PV Private Property Gain/Loss over Baseline	$2,146,407	$2,146,483	-$1,580,270	$0
Net Benefits	-$71,113,469	-$94,604,384	-$55,824,696	-$70,780,553
Net Benefits over Baseline	**-$332,916**	**-$23,823,831**	**$14,955,857**	**$0**
PV Direct Economic Impact	$53,660,375	$58,666,965	$17,458,878	$53,660,375
PV Direct Economic Impact over Baseline	$53,660,375	$58,666,965	$17,458,878	$0
PV Sales and Transient Occupancy Taxes	$3,788,775	$ 4,142,273	$1,232,711	$3,788,775
PV Sales and Transient Occupancy Taxes over Baseline	$3,788,775	$4,142,273	$1,232,711	$0

TABLE F-9
ECONOMIC ANALYSIS OF SHARP PARK (PACIFICA)

Scenario	Option 1 Sand Placement	Option 2 Sand Placement with Art. Reef	Option 3 Hold the Line (Baseline)	Option 4 Hybrid
PV Recreational Benefits	$11,143,890	$11,113,470	$5,481,339	$3,285,411
PV Recreational Benefits over Baseline (current width)	$5,662,551	$5,632,131	$0	-$2,195,928
PV Cost of Action	-$50,719,280	-$47,078,993	-$30,660,292	$0
PV Cost over Baseline	-$20,058,988	-$16,418,702	$0	$30,660,292
PV Public/Infrastrcuture Loss	-$552,574	-$531,882	-$525,338	-$487,882
PV Public/Infrastructure Gain/Loss over Baseline	-$27,236	-$6,544	$0	$37,456
PV Private Property Loss	$0	$0	$0	$0
PV Private Property Gain/Loss over Baseline	$0	$0	$0	$0
Net Benefits	-$40,127,963	-$36,497,405	-$25,704,291	$2,797,529
Net Benefits over Baseline	**-$14,423,672**	**-$10,793,115**	**$0**	**$28,501,820**
PV Direct Economic Impact	$51,868,801	$51,727,212	$29,497,726	$20,719,203
PV Direct Economic Impact over Baseline	$22,371,075	$22,229,486	$0	-$8,778,523
PV Sales and Transient Occupancy Taxes	$3,662,278	$ 3,652,281	$2,082,733	$1,462,912
PV Sales and Transient Occupancy Taxes over Baseline	$1,579,545	$1,569,548	$0	-$619,821

TABLE F-10
ECONOMIC ANALYSIS OF ROCKAWAY BEACH (PACIFICA)

Scenario	Option 1 Sand Placement	Option 4 Hybrid (Baseline)
PV Recreational Benefits	$9,303,981	$2,985,428
PV Recreational Benefits over Baseline (current width)	$6,318,553	$0
PV Cost of Action	-$24,031,395	-$10,069,430
PV Cost over Baseline	-$13,961,965	$0
PV Public/Infrastrcuture Loss	-$939,806	-$1,471,512
PV Public/Infrastructure Gain/Loss over Baseline	$531,706	$0
PV Private Property Loss	-$2,229,754	-$2,231,453
PV Private Property Gain/Loss over Baseline	$1,699	$0
Net Benefits	-$17,896,974	-$10,786,967
Net Benefits over Baseline	**-$7,110,006**	**$0**
Benefit/Cost Ratio		
PV Direct Economic Impact	$92,305,589	$37,920,134
PV Direct Economic Impact over Baseline	$54,385,455	$0
PV Sales and Transient Occupancy Taxes	$7,870,151	$3,233,143
PV Sales and Transient Occupancy Taxes over Baseline	$4,637,008	$0

TABLE F-11
ECONOMIC ANALYSIS OF LINDA MAR BEACH (PACIFICA)

Scenario	Option 1 Sand Placement	Option 4 No Action (Baseline)
PV Recreational Benefits	$33,831,255	$20,973,327
PV Recreational Benefits over Baseline (current width)	$12,857,927	$0
PV Cost of Action	-$28,486,920	$0
PV Cost over Baseline	-$28,486,920	$0
PV Public/Infrastrcuture Loss	-$5,555,838	-$12,316,873
PV Public/Infrastructure Gain/Loss over Baseline	$6,761,035	$0
PV Private Property Loss	-$816,552	-$1,951,916
PV Private Property Gain/Loss over Baseline	$1,135,363	$0
Net Benefits	-$1,028,055	$6,704,539
Net Benefits over Baseline	**-$7,732,594**	**$0**
PV Direct Economic Impact	$180,818,062	$122,912,580
PV Direct Economic Impact over Baseline	$57,905,482	$0
PV Sales and Transient Occupancy Taxes	$13,415,254	$9,119,130
PV Sales and Transient Occupancy Taxes over Baseline	$4,296,124	$0

This page intentionally left blank

APPENDIX F-1
Units at Risk

NUMBER OF PARCELS AT RISK TO EROSION

	Baseline	Option 1	Option 2	Option 3	Option 4
Middle Ocean Beach					
Commercial	0	0	N/A	N/A	0
Governmental	2	2	N/A	N/A	2
Residential	0	0	N/A	N/A	0
Unknown Vacant Land	0	0	N/A	N/A	0
Total	**2**	**2**	**N/A**	**N/A**	**2**
South Ocean Beach					
Commercial	0	0	0	N/A	0
Governmental	5	5	5	N/A	5
Residential	0	0	0	N/A	0
Unknown Vacant Land	0	0	0	N/A	0
Total	**5**	**5**	**5**	**N/A**	**5**
Manor District					
Commercial	1	1	1	0	1
Governmental	18	18	18	0	19
Residential	57	65	60	0	55
Unknown Vacant Land	8	9	8	0	7
Total	**84**	**93**	**87**	**0**	**82**
Beach Blvd					
Commercial	5	5	5	0	5
Governmental	17	17	17	0	20
Residential	31	31	31	0	41
Unknown Vacant Land	5	5	5	0	6
Total	**58**	**58**	**58**	**0**	**72**
Sharp Park					
Commercial	0	0	0	0	0
Governmental	2	2	2	2	2
Residential	0	0	0	0	0
Unknown Vacant Land	0	0	0	0	0
Total	**2**	**2**	**2**	**0**	**2**

NUMBER OF PARCELS AT RISK TO EROSION

	Baseline	Option 1	Option 2	Option 3	Option 4
Rockaway Cove					
Commercial	3	3	N/A	N/A	3
Governmental	1	1	N/A	N/A	1
Residential	0	0	N/A	N/A	0
Unknown Vacant Land	2	4	N/A	N/A	4
Total	**6**	**8**	**N/A**	**N/A**	**8**
Linda Mar					
Commercial	1	1	N/A	N/A	2
Governmental	14	14	N/A	N/A	15
Residential	1	1	N/A	N/A	6
Unknown Vacant Land	4	8	N/A	N/A	9
Total	**20**	**24**	**N/A**	**N/A**	**32**

DALY CITY ASSETS AT RISK TO LANDSLIDES

Parcels	**2010**	**2050**
Commercial	7	9
Governmental	35	36
Residential	814	1388
Unknown Vacant Land	22	23
Total	**878**	**1456**
Length of Streets at Risk	25216	58503
Length of Trails at Risk	0	0
Length of Pipelines at risk	2191	2386
Number of Pumpstations at Risk	0	0
Numebr of Outfalls at Risk	0	0
Length of Sewers at Risk	0	0
Streets	25216	58503
Pipelines	2191	2386

UTILITIES AT RISK

	length	length	length	number	length	number
	Streets	***Trails***	***Pipelines***	***Outfalls***	***Sewers***	***Pumpstations***
Middle Ocean Beach				no data for SF		
Baseline	5591	10577	2787	0	6249	
Option 1	6743	10577	4258	0	8228	
Option 2	N/A	N/A	N/A	N/A	N/A	
Option 3	N/A	N/A	N/A	N/A	N/A	
Option 4	11717	10577	7046	0	11891	
South Ocean Beach				no data for SF		
Baseline	610	338	211	2	2156	
Option 1	729	346	1513	2	3308	
Option 2	0	293	1195	2	3132	
Option 3	N/A	N/A	NA	N/A	N/A	
Option 4	5580	525	4450	2	5225	
Manor District						
Baseline	2463	4548	1527	1	3671	
Option 1	2793	4867	1710	3	4224	
Option 2	2741	4821	1969	3	4104	
Option 3	0	0	183	2	0	
Option 4	2463	4548	1710	3	3649	
Beach Blvd						
Baseline	375	1653	355	1	129	
Option 1	375	1653	943	9	729	
Option 2	375	1653	587	9	729	
Option 3	0	0	0	0	0	
Option 4	3205	2373	943	10	3510	
Sharp Park						
Baseline	0	3355	495	0	0	
Option 1	0	3552	1341	2	0	
Option 2	0	3425	1371	2	0	
Option 3	0	3959	2033	2	0	
Option 4	0	3361	1341	2	0	
Rockaway Cove						
Baseline	886	630	452	1	18	
Option 1	886	630	652	3	18	
Option 2	N/A	N/A	N/A/	N/A	N/A	
Option 3	N/A	N/A	N/A	N/A	N/A	
Option 4	1036	1249	652	5	781	
Linda Mar						
Baseline	588	1424	954	0	3111	0
Option 1	588	1424	2324	7	3111	1
Option 2	N/A	N/A	N/A	N/A	N/A	N/A
Option 3	N/A	N/A	N/A	N/A	N/A	N/A
Option 4	3914	4025	2324	7	6129	3

	Commercial	Governmental	Residential	Unknown Vacant Land	Total
Middle Ocean Beach					
Baseline	0	2	0	0	2
Option 1	0	2	0	0	2
Option 2	N/A	N/A	N/A	N/A	N/A
Option 3	N/A	N/A	N/A	N/A	N/A
Option 4	0	2	0	0	2
South Ocean Beach					
Baseline	0	5	0	0	5
Option 1	0	5	0	0	5
Option 2	0	5	0	0	5
Option 3	N/A	N/A	N/A	N/A	N/A
Option 4	0	5	0	0	5
Manor District					
Baseline	1	18	57	8	84
Option 1	1	18	65	9	93
Option 2	1	18	60	8	87
Option 3	0	0	0	0	0
Option 4	1	19	55	7	82
Beach Blvd					
Baseline	5	17	31	5	58
Option 1	5	17	31	5	58
Option 2	5	17	31	5	58
Option 3	0	0	0	0	0
Option 4	5	20	41	6	72
Sharp Park					
Baseline	0	2	0	0	2
Option 1	0	2	0	0	2
Option 2	0	2	0	0	2
Option 3	0	2	0	0	0
Option 4	0	2	0	0	2
Rockaway Cove					
Baseline	3	1	0	2	6
Option 1	3	1	0	4	8
Option 2	N/A	N/A	N/A	N/A	N/A
Option 3	N/A	N/A	N/A	N/A	N/A
Option 4	3	1	0	4	8
Linda Mar					
Baseline	1	14	1	4	20
Option 1	1	14	1	8	24
Option 2	N/A	N/A	N/A	N/A	N/A
Option 3	N/A	N/A	N/A	N/A	N/A
Option 4	2	15	6	9	32