

# memorandum

date June 4, 2012  
to San Francisco Littoral Cell CRSMP Stakeholder Advisory Group  
from Bob Battalio and Doug George  
subject General Updates for San Francisco Littoral Cell CRSMP

## **General Update and Information**

### ***Data Improvement***

Based on the feedback at the first SAG meeting, we worked with many agencies and groups to improve both the GIS database and non-GIS based data sources. The following list details those changes.

- Revised layers:
  1. Study Reach boundaries were aligned better with cities and existing management regions. Also, the inland boundary of the reaches was removed as this project is really extending from watersheds to the offshore zone.
  2. San Francisco parks were updated from Lisa Beyer, San Francisco Recreation and Park Department
  3. Discussed with GGNRA their analysis of the vegetation layers that were originally included; revision ongoing.
- New information:
  1. Pacifica sewer and storm drain system (From City of Pacifica)
  2. Dredge placement sites (From John Dangler, USACE)
  3. San Francisco-Pacifica Exclusionary Area delineation (From Leslie Abramson, GFNMS)
  4. Inclusion of California Geological Survey tsunami inundation map
  5. Analyzing the 2006 NOAA Environmental Sensitivity Map and the PRBO Beachwatch data regarding sensitive species and habitats in the ocean and on land for additional biological information

### ***Coastal Hazards***

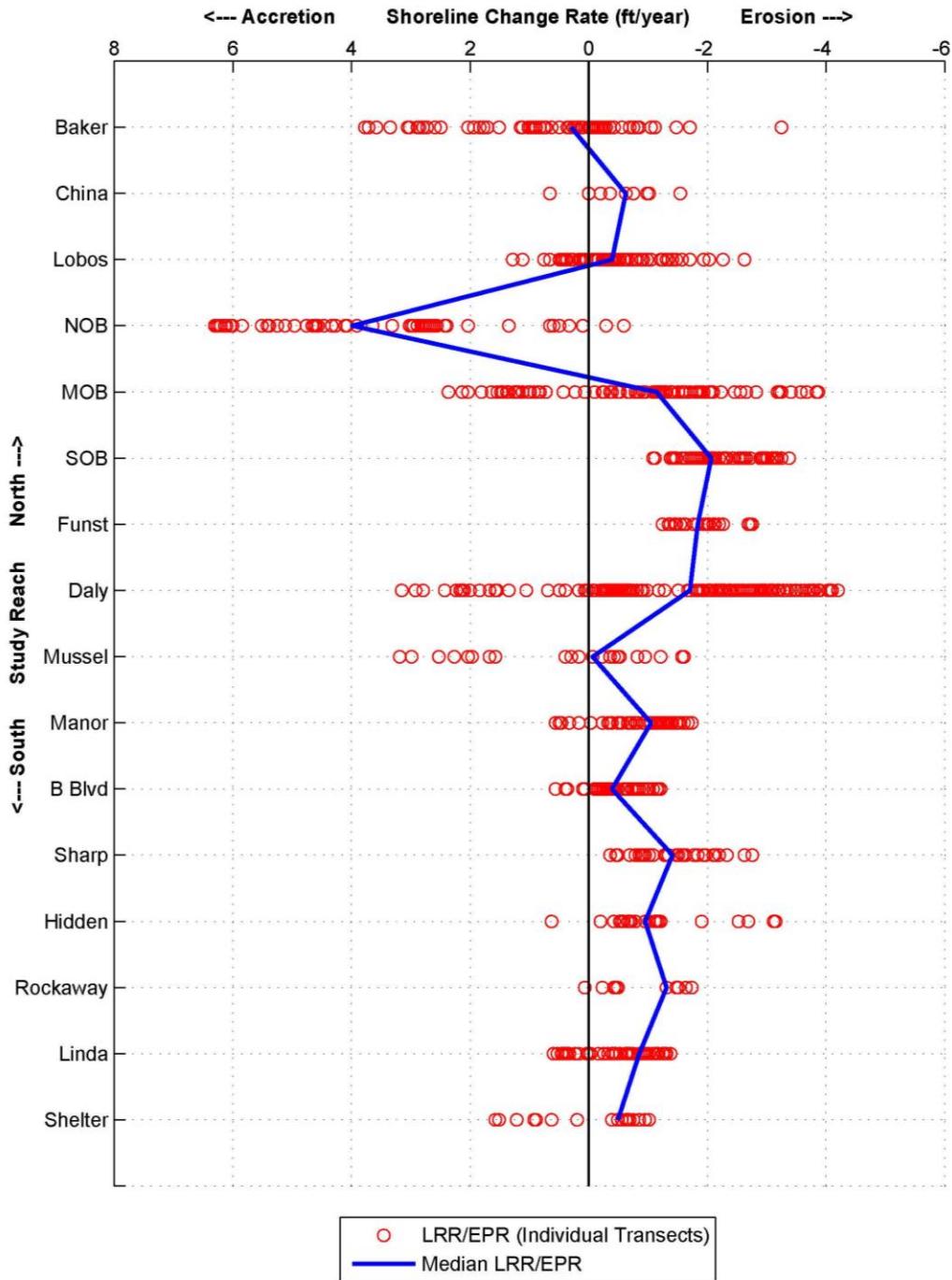
Using the new and revised information, three types of coastal hazards were investigated that are relevant to the CRSMP: shoreline erosion, sea level rise and tsunamis.

## **Shoreline Erosion**

The shoreline erosion analysis combines a review of existing analyses and additional analysis to address gaps in existing datasets. Sandy shorelines and bluff erosions were considered separately. The USGS National Assessment of Shoreline Change for sandy shorelines (Hapke et al., 2006) and cliff edges (Hapke et al., 2007) provided the basis for most of the erosion rates in the study area. No erosion rates were reported for the Baker Beach, China Beach, or Point Lobos reaches, and the majority of the reaches backed by cliffs did not have erosion rates. The most recent shoreline used in this analysis was extracted from 1998 LiDAR surveys, which captured the highly eroded coast after the 1997/1998 El Niño. Additional shoreline change analysis was conducted to fill the data gaps at Baker Beach, China Beach, Point Lobos, Hidden Cove, and Shelter Cove as well as to include the 2010 shoreline for the entire study area to account for recent trends.

Shoreline and bluff erosion rate estimates from a number of other reports and coastal development permit applications were also reviewed. Many estimates exist for the three Ocean Beach reaches (Moffatt and Nichol, 1995; Hansen and Barnard, 2010; ESA PWA, 2011) and in the Manor District, where significant development exists close to the cliff edge. The estimates for bluff retreat at the Manor District are from permit applications for construction of coastal armoring, when applicants are required to calculate the volume of sand that will be retained as a result of a new structure.

Most of the reaches show a median of erosion over the past 60 years, with the exception of North Ocean Beach that shows accretion at a median of 4 ft/year (Figure 1). The highest rates of median erosion are observed at Middle Ocean Beach, South Ocean Beach, Fort Funston, and Daly City that show rates of approximately 2 ft/year. However, large ranges of shoreline movement are seen within reaches, indicating variability on a local and temporal scale. The areas of rapid erosion will likely become targets for implementation options, where appropriate. Where the variability is small and the reach is short (e.g., Linda Mar), a singular implementation option may address the erosion conditions.



**Figure 1: Shoreline Change Rates by Study Reach**  
**Linear Regression Rates (LRR) and End Point Rates (EPR) for cross-shore transects**  
**constructed from the Digital Shoreline Analysis System (DSAS).**

### Sea Level Rise

The US Army Corps of Engineers (USACE) issued circular EC 1165-2-212 in October 2011 which provides guidance for the incorporation of direct and indirect physical effects of projected future sea level rise (USACE, 2011). Planning studies and engineering designs should evaluate alternatives against a range of local sea level rise projections which are defined by “low”, “intermediate” and “high” rates of local sea

level rise. The “low” local sea level rise projection is the historic sea level trend as observed at a long-term gauge. The USACE recommends using curves developed in the 1987 NRC study Responding to Changes in Sea Level (NRC, 1987) to calculate the “medium” and “high” sea level rise estimates (based on NRC Curves I and III, respectively).

These scenarios were adjusted to local San Francisco historical trends of sea level rise; there was not reliable vertical land movement data to also incorporate. Three planning horizons of 2025, 2050 and 2100 were selected for use in determining coastal hazard zones for the CRSMP (Table 1).

**TABLE 1 – Sea Level Rise Estimates  
(in meters, with 2000 as the baseline)**

USACE (2011)*			
Year	“Low” (Historic Trend)	“Intermediate” (NRC Curve I)	“High” (NRC Curve III)
<b>2025</b>	0.05	0.08	0.17
<b>2050</b>	0.10	0.19	0.47
<b>2100</b>	0.20	0.52	1.51

\* Using a historic SLR trend of 2.01 mm/year (as measured at the San Francisco NOAA tide gauge).

However, the sea level rise scenarios do not include increased risks from storm events. As part of a study for the Ocean Protection Council (OPC), PWA calculated the 100-year storm total water level for each of the along-shore wave transformation points. Total water level is defined as high water from tides plus wave runup. Each erosion hazard zone is associated with one wave transformation point. The total water levels were estimated by selecting the maximum total water level from a 100-year time series of total water levels (with sea level rise removed). This time series was calculated using wave and water level outputs generated by global climate modeling efforts at Scripps Institute of Oceanography (Cayan et al, 2008).

Existing coastal hazard zones were determined with shoreline erosion rate while future coastal hazard zones were generated by combining shoreline erosion rates, sea level rise scenarios, and the 100-year storm wave elevations. A 30’ buffer zone was added to account for uncertainty in the erosion rates.

### **Tsunamis**

The California Geological Survey (CGS) released tsunami inundation maps in 2009. The maximum inland extent of a tsunami was produced from a number of extreme, yet realistic, tsunami sources (e.g., earthquakes throughout the Pacific Basin). The maps were prepared to assist cities and counties in identifying their tsunami hazard. As part of determining coastal hazards for the CRSMP, the maps were incorporated into the GIS database as provided from CGS.

### **Infrastructure Risk Analysis**

The intricate network of coastal roads, pipelines, trails and other utilities from San Francisco to Pacifica were overlaid with seven of the coastal hazard zones described above to determine what infrastructure is at risk. In addition, the number and area of parcels impacted in the hazard zones were compiled.

Summary tables by jurisdiction are provided below (Tables X1-X3) but these data are also available by individual reach to focus CRSMP activities. These data will be used to inform the economic cost/benefit analysis when implementation options are considered to reduce the coastal hazard risks.

### ***Policy Analysis***

ESA PWA investigated coastal management policies and regulations that would influence the implementation of the CRSMP from the following jurisdictions:

- 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 were examined for pertinent measures that could influence sediment management efforts within the project area.

- *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*

Applicable provisions of these documents were extracted for the USACE and CSMW (see <http://www.sfestuary.org/userfiles/CoastalPolicyMatrix20120604.pdf>). The lengthy compilation is meant to inform the project team about the feasibility of the recommended implementation options.

### ***Preliminary Biological Analysis***

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 (Table 2). Review of indicator species (including special-status species) supplements the general approach of describing discrete ecogeomorphic coastal zones for identification of biological resources. Activities that could impact these indicator species either by increasing or decreasing their habitats are being assessed. The actions surrounding beach nourishment (dredging, transportation, placement) generally have immediate negative consequences. There are also spatial and temporal restrictions on beach nourishment activities during mating, breeding, and rearing seasons for different species.

**TABLE 2 – INDICATOR SPECIES IN THE SAN FRANCISCO LITTORAL CELL CRSMP STUDY AREA**

Animals	Vegetation
<b>Steelhead</b>	Beach saltbush, <i>Atriplex leucophylla</i>
<b>California red-legged frog</b>	Beach wildrye, <i>Elymus mollis</i>
<b>San Francisco garter snake</b>	Pacific wildrye, <i>Elymus pacificus</i>
<b>Leatherback sea turtle</b>	Mock-heather, dune golden heather, <i>Ericameria ericoides</i>
<b>Bank swallow</b>	Silvery beach-pea, <i>Lathyrus littoralis</i>
<b>Western snowy plover</b>	Native coastal dune annual forbs
<b>Marine mammals</b>	Dune tansy, <i>Tanacetum bipinnatum</i>
	Perennial coastal wetland plants species
	Hemiparasitic and holoparasitic perennial coastal scrub forbs

Table X1: Summary of San Francisco Infrastructure At-Risk

Data Category	Unit	Risk Scenarios (see Table 1)							Data Source
		existing	tsunami	2025H	2050H	2100H	2100M	2100L	
<b>Combined Storm and Sewer System</b>									
Combined Sewer Discharge Pts	Count	2	3	4	4	4	4	4	City of SF
Combined Sewer Pipes	Length (miles)	1.5	6.0	3.9	5.1	7.0	6.5	6.4	City of SF
Wastewater Treatment	Count	1	0	1	1	1	1	1	City of SF
<b>Transportation</b>									
Parking Lots	Count	1	9	4	4	10	10	9	City of SF
Streets	Length (miles)	1.2	11.2	5.1	6.9	13.1	11.3	10.4	City of SF
Trails	Length (miles)	4.1	4.1	5.7	7.1	10.7	9.7	9.4	GGNPC 2012
<b>Parcels</b>									
Parcels	Count	68	1046	73	147	928	632	583	San Francisco County
Parcels	Area (acres)	200	261	200	256	546	440	407	San Francisco County

Note: This table summarizes data from Reach 1 (Baker Beach) to Reach 7 (Fort Funston).

Table X2: Summary of Daly City Infrastructure At-Risk

Data Category	Unit	existing	tsunami	Risk Scenarios (see Table 1)					Data Source
				2025H	2050H	2100H	2100M	2100L	
<b>Drainage and Waste System</b>									
Outfalls	Count	1	0	1	1	1	1	1	City of Pacifica
Pacifica Pipelines	Length (feet)	92	0	40	276	3533	3036	2743	City of Pacifica
Solid_waste_fac	Count	2	0	2	2	2	2	2	SWIS 2011
<b>Transportation</b>									
Streets	Length (miles)	0.13	0.00	0.12	0.46	3.20	2.58	2.37	San Mateo County Public Works
<b>Parcels</b>									
Parcels	Count	74	14	50	90	375	306	284	San Mateo County
Parcels	Area (acres)	215	47	197	222	319	304	299	San Mateo County

Note: This table summarizes data from Reach 8 (Daly City) to Reach 9 (Mussel Rock).



Table X3: Summary of Pacifica Infrastructure At-Risk

Data Category	Unit	existing	tsunami	Risk Scenarios (see Table 1)					Data Source
				2025H	2050H	2100H	2100M	2100L	
<b>Storm Drainage System</b>									
Outfalls	Count	22	24	26	26	28	27	27	City of Pacifica
Pipelines	Length (feet)	4417	14581	8370	10464	18812	16845	16172	City of Pacifica
Pump Stations	Count	0	5	3	3	5	5	5	City of Pacifica
<b>Sewer System</b>									
Pacifica Sewers	Length (feet)	5696	24982	12440	18498	39554	35268	33909	City of Pacifica
Pump Stations	Count	1	8	5	5	8	8	8	City of Pacifica
<b>Transportation</b>									
Streets	Length (miles)	1.93	4.03	2.47	3.49	7.55	6.58	6.28	San Mateo County Public Works
Trails_GGNPC	Length (miles)	0.17	0.00	0.35	0.48	0.94	0.85	0.82	GGNPC 2012
Trails_Palmetto2Mori	Length (miles)	1.45	1.15	1.46	1.88	2.48	2.41	2.38	CA State Coastal Conservancy
Trails_ReinaDelMar2PSB	Length (miles)	0.02	1.06	0.64	0.94	1.27	1.20	1.17	CA State Coastal Conservancy
Trails (Total)	Length (miles)	1.64	2.20	2.44	3.29	4.69	4.45	4.37	
<b>Parcels</b>									
Parcels	Count	274	442	317	416	754	719	707	San Mateo County
Parcels	Area (acres)	397	275	396	528	1133	1023	990	San Mateo County

Note: This table summarizes data from Reach 10 (Manor District) to Reach 16 (Shelter Cove).