MEETING NOTICE
AND AGENDA

SHORELINE PRESERVATION WORKING GROUP

The Shoreline Preservation Working Group may take action on any item appearing on this agenda.

Thursday, June 2, 2016

11:30 a.m. to 1 p.m.

SANDAG
7th Floor Conference Room
401 B Street, Suite 800
San Diego, CA 92101

Staff Contacts: Sarah Pierce Keith Greer
(619) 699-7312 (619) 699-7390
sarah.pierce@sandag.org keith.greer@sandag.org

AGENDA HIGHLIGHTS

• REGIONAL SHORELINE MONITORING PROGRAM ANNUAL REPORT

• EL NIÑO IMPACTS ON NOURISHED AND UNNOURISHED SOUTHERN CALIFORNIA BEACHES

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# SHORELINE PRESERVATION WORKING GROUP

**Thursday, June 2, 2016**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>RECOMMENDATION</th>
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<tbody>
<tr>
<td>1.</td>
<td>WELCOME AND INTRODUCTIONS</td>
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<tr>
<td>2.</td>
<td>PUBLIC COMMENTS/COMMUNICATIONS</td>
</tr>
</tbody>
</table>

Members of the public shall have the opportunity to address the Shoreline Preservation Working Group (Working Group) on any issue within the jurisdiction of SANDAG that is not on this agenda. Anyone desiring to speak shall reserve time by completing a “Request to Speak” form and giving it to the meeting coordinator prior to speaking. Public speakers should notify the meeting coordinator if they have a handout for distribution to working group members. Public speakers are limited to three minutes (or less) per person. Working Group members also may provide information and announcements under this agenda item.

| 3.       | APPROVAL OF MEETING MINUTES | APPROVE |

The Working Group is asked to review and approve the minutes from its December 3, 2015, meeting.

## CONSENT

| 4.       | SHORELINE MANAGEMENT “101” | INFORMATION |


## REPORTS

| 5.       | REGIONAL SHORELINE MONITORING PROGRAM ANNUAL REPORT | INFORMATION |

(Greg Hearon, Coastal Frontiers Corporation)

Greg Hearon will provide the Working Group with a presentation on the 2015 Regional Shoreline Monitoring Program Annual Report.

| 6.       | EL NIÑO IMPACTS ON NOURISHED AND UNNOURISHED SOUTHERN CALIFORNIA BEACHES | INFORMATION |

(Bonnie Ludka, Ph.D. Candidate, Dr. Timu Gallien, and Dr. Robert Guza, UC San Diego)

An article titled *Mid-El Niño Erosion at Nourished and Unnourished Southern California Beaches* was recently accepted for publication by the American Geophysical Union. Today, researchers from the Scripps Institution of Oceanography at UC San Diego are here to share their findings.

| 7.       | NEXT MEETING DATE AND ADJOURNMENT | INFORMATION |

The next meeting of the Working Group is scheduled for Thursday, September 1, 2016, from 11:30 a.m. to 1 p.m.


*+ next to an agenda item indicates an attachment*
DECEMBER 3, 2015, MEETING MINUTES

The meeting of the Shoreline Preservation Working Group (Working Group) was called to order by Councilmember Lorie Zapf (City of San Diego), Vice Chair of the Working Group, at 11:32 a.m.

1. WELCOME AND INTRODUCTIONS

The attendance sheet for the meeting is attached.

2. PUBLIC COMMENTS AND COMMUNICATIONS

There were no public comments.

3. APPROVAL OF MEETING MINUTES (APPROVE)

Councilmember Lisa Shaffer (City of Encinitas) requested that her name be corrected in Section 3 of the September 3, 2015, meeting minutes. This change has been made by SANDAG staff.

Action: Councilmember Bill Sandke (City of Coronado) motioned to approve the September 3, 2015, meeting minutes and Councilmember Shaffer seconded the motion. The Working Group approved the September 3, 2015, meeting minutes.

Yes: Commissioner Garry Bonelli (Unified Port of San Diego), Councilmember Esther Sanchez (City of Oceanside), Councilmember Sandke, Councilmember Shaffer, Walter Wilson (U.S. Navy), Councilmember Dwight Worden (City of Del Mar), and Councilmember Zapf; No: None; Abstain: None; Absent: City of Carlsbad, City of Imperial Beach, City of Solana Beach, County of San Diego.

REPORTS

4. LIVING SHORELINES – A SOFT SOLUTION FOR SEDIMENT RETENTION (INFORMATION)

Councilmember Zapf introduced the item and Sarah Pierce (SANDAG) provided a brief background on the topic. Ms. Pierce then introduced panel member Eileen Maher (Unified Port of San Diego) to discuss the Port’s oyster reef project.
Ms. Maher began by introducing the goals of the proposed oyster reef project and explained how this project could help protect the San Diego Bay from erosion while accommodating anticipated sea level rise. Phase I of the project included study site selection, oyster reef design, and development of a study plan. All study sites in south San Diego Bay were determined to have sufficient recruitment and settlement to support oyster reef restoration and the E Street marsh site was chosen as the study location.

Ms. Maher described the study design and presented photos of an oyster reef from San Francisco Bay, but noted that the array base proposed for the Port’s project would be shaped differently and would have a rock base with oyster shells on top. Councilmember Shaffer asked about the water depth where the arrays would be placed. Ms. Maher clarified that the oyster arrays would be placed at a depth that would leave them exposed at extreme low tides but under usual tidal flows much of the array would be under water. With Phase I of the project complete, the Port has moved onto Phase II of the project which includes finalizing engineering drawings, securing necessary permits, completing California Environmental Quality Act compliance, securing funding for construction, and project installation and post installation monitoring. Phase II of the oyster reef project is still in progress. The Port is continuing to build partnerships with the California Coastal Conservancy and United States Fish and Wildlife Service while applying for additional grant funding to implement the proposed Project.

Councilmember Worden asked about the cost of installing an oyster reef compared to traditional shoreline armoring or sand replenishment. Ms. Maher stated that the costs are about the same as armoring and modelling shows that this method should be as effective as armoring. Commissioner Bonelli asked about erosional data for this part of the San Diego Bay and Ms. Maher stated that Port staff looked at existing conditions rather than historic photos to determine the site’s erosion potential. Mr. Wilson added that it is important to remember that the long-term costs of this option are much less than that of sand replenishment. This type of project has a one-time cost and also helps to keep connectivity between the San Diego Bay and surrounding marshland.

Ms. Pierce thanked Ms. Maher for her presentation and introduced Brian Leslie (Moffat & Nichol) to discuss the Cardiff State Beach dune restoration project.

Mr. Leslie explained that this project aims to restore sand dunes along Cardiff State Beach to reduce the impacts of projected sea level rise and coastal flooding. With funding from the California Coastal Conservancy, a draft feasibility study has been completed that considers three project alternatives. In addition, a site-specific numeric model was used to evaluate longevity of the proposed project. Stakeholder groups were involved in selecting a preferred project alternative. Councilmember Shaffer asked Mr. Leslie to describe which stakeholder groups were engaged in the project’s outreach because other projects in the region with fencing components have encountered stakeholder pushback. Mr. Leslie noted that the project team had reached out to the Surfrider Foundation, California State Parks, California Coastal Conservancy, United States Fish and Wildlife Service, United States Army Corps of Engineers, and the California Coastal Commission, and planned to continue outreach efforts.

Mr. Leslie presented results from the site-specific numerical model. Results indicate that project alternatives would provide protection to Highway 101. Councilmember Shaffer asked if the dunes would prevent back flow and cause pooling along Highway 101 if the dunes were breached. Mr. Leslie responded that it was a possibility but the water would sheet-flow off the highway and...
percolate into the side of the dune. The project's preferred alternative includes a dune with “lumps and bumps” rather than a continuous berm. Mr. Leslie went on to describe the individual project elements including the rip-rap and cobble configuration, dune habitat, fencing and signage, and pedestrian improvements. Councilmember Worden asked if the fencing proposed for the project would be permanent. Mr. Leslie clarified that the fencing would be permanent but access points would be provided at various points along the dunes. Councilmember Worden asked if the existing parking along Highway 101 would be eliminated by this project. Mr. Leslie stated that existing parking would be organized either by striping or some other effort but parking along Highway 101 would remain parallel.

Councilmember Sandke mentioned that no fencing has been installed adjacent to the dune project that was completed in the City of Coronado. Fencing may only be necessary as a temporary fixture to allow dune vegetation to become established. Mr. Leslie stated that the concern with the Cardiff State Beach project came from heavy foot traffic in the proposed project area. Councilmember Shaffer mentioned that heavy foot traffic may lead to more stakeholders being opposed to the fencing. Kathy Weldon (City of Encinitas) stated that the fence would also serve as an erosional barrier by preventing sand from blowing onto Highway 101. She added that the project's footprint could be minimized to avoid the area closest to the Chart House Restaurant and preclude objections from the public regarding parking or fencing issues. Marco Gonzalez (Coastal Environmental Rights Foundation) mentioned that any sidewalk between Seaside State Beach and the restaurants along Highway 101 would be heavily trafficked and the current project may need to be redesigned to accommodate anticipated high use. Julia Chunn-Heer (Surfrider Foundation) added that the proposed fencing along the dunes would be relatively low and could be crossed if a visitor did not want to walk to the nearest access point.

Mr. Leslie added that maintenance and monitoring of the dunes would be needed and that sediment from dredging the San Elijo Lagoon mouth could be used to replenish dune sand. The project would require roughly $2 million for completion. Mr. Gonzalez asked if the area near the Seaside State Beach parking lot would be included in the project's footprint. Mr. Leslie explained that a different group was planning to restore the area near Seaside State Beach into dune habitat and there had been discussion about linking the projects. Steve Aceti (California Coastal Coalition) asked if there were still discussions about moving the San Elijo Lagoon mouth. Keith Greer (SANDAG) said that the preferred alternative for the San Elijo Lagoon Restoration Project is to keep the lagoon mouth where it is and the final Environmental Impact Report should be completed soon. Councilmember Worden asked if this type of strategy could be used in bluff front areas. Chris Webb (Moffat & Nichol) replied that this would probably not be suitable in those areas because the ocean reaches the base of bluffs. Mr. Aceti asked about funding from the public beach restoration program (California Department of Boating and Waterways) and Mr. Greer mentioned that it would be looked into prior to next meeting. Ms. Maher was asked what the cost for the Port's oyster reef project was projected at. She replied that cost was $1.3 million and they have about $400,000 thus far.

Ms. Pierce thanked Mr. Leslie for his presentation and introduced Mr. Webb to discuss sand retention concepts.

Mr. Webb provided background on sand retention along the San Diego coastline and some historic examples of sand retention structures in the San Diego region. He then stated that for any project to move forward, it would likely need to be a reef that serves multiple purposes. Multi-purpose
reefs can dissipate wave energy, create surf spots, and create habitat for marine life. Submerged reefs have been created in Japan and Australia and similar projects have been proposed previously for south Carlsbad (North) and more recently for Solana Beach. Councilmember Shaffer asked if the salient that develops behind these submerged reefs would prevent sand from reaching regions south of the structure. Mr. Webb responded that a prefilled sand would accompany these structures which would force sediment around the salient to be deposited further downcoast offsetting impacts to neighboring beaches. Mr. Webb continued to explain that SANDAG had tried to acquire funding to determine if a pilot sand retention project would be feasible in the region; however, funding was not secured. He further stated that such a project would require testing, collaboration with organizations such as Scripps or other nonprofits, and would need to be fully removable in the event that the structure did not work.

Mr. Webb explained that the California coastline has multiple natural reefs that show similar sand build up as to what the models predict. Councilmember Zapf asked if sinking ships are considered to be reefs. Mr. Webb responded that they are, but to be used for the purpose of sand retention they would need to be placed close to shore which may be unsafe because debris from the ship could be released into the surf zone. Mr. Gonzalez added that artificial reef projects need to be submerged deep enough to avoid damage to passing ships. Mr. Webb explained that the concept they were contemplating would place the structure at a shallower depth and closer to shore so that it would still be exposed even at high tide. Mr. Aceti mentioned that ten years ago the California Coastal Commission required Southern California Edison to build kelp reefs off the coast of San Clemente, but it was confirmed that they are too far off shore to aid with sand retention. With projected sea level rise, Mr. Webb explained that these types of projects may be feasible adaptation strategies for near-term shoreline protection. Councilmember Worden asked if there are other removable materials that can be used in artificial reef projects that also work to create habitat. Mr. Webb stated that large rocks would be an appropriate material for sand retention since they can be placed and removed individually. Councilmember Worden asked if there were other strategies for sand retention that are habitat/natural based other than reefs. Mr. Webb responded that reef balls, large concrete structures with holes in them, are used elsewhere in the United States but they are used primarily for habitat creation rather than sand retention.

Ms. Chunn-Heer commented that with sea level rise this topic will need to be given more consideration but currently artificial sand retention structures are a long way from being viable multi-purpose reefs. Mr. Gonzalez added that these structures can create a ridable wave under ideal surf conditions but generally don’t create a viable surf spot on a day-to-day basis. Ms. Chunn-Heer explained that these types of projects do, however, generally work for sand retention. Mr. Gonzalez mentioned that these types of projects would have to be specific for each region they were located in since each site has a different suite of variables that influence the shoreline. Mr. Greer commented that these presentations were organized to address potential future options for sand retention that warrant consideration in the region. Councilmember Worden stated as a region, San Diego should be considering a pilot sand retention project and asked what the status of pursuing such a project was. Mr. Webb answered that no projects were being considered currently; however, there have been some preliminary discussions about reinitiating a pilot project effort in the region. Mr. Greer explained that short-term solutions to adapt to sea level rise need to be of low environmental impact, such as the oyster reefs and dune restoration but it is also necessary to research and develop longer term and alternative strategies. Councilmember Worden asked what the Working Group could do to promote the development of this strategy. Mr. Greer said that today was an informational item but as the FY 2017 budget is prepared by SANDAG staff, a
proposal to explore artificial reefs for sand retention could be considered as part of the budget. Shelby Tucker (SANDAG) added that consideration of this type of project is referenced in SANDAG’s Coastal Regional Sediment Management Plan and that if the Working Group supports moving forward on such an effort, it can be incorporated into the budget proposal for FY 2017.

5. UPCOMING MEETINGS (INFORMATION)

The next meeting of the Working Group is scheduled for Thursday, March 3, 2016, from 11:30 a.m. to 1:00 p.m.

6. ADJOURNMENT

Councilmember Zapf adjourned the meeting at 12:52 p.m.
SHORELINE PRESERVATION WORKING GROUP
MEETING ATTENDANCE FOR SEPTEMBER 3, 2015

<table>
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<tr>
<th>JURISDICTION/ORGANIZATION</th>
<th>NAME</th>
<th>ATTENDING</th>
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<tbody>
<tr>
<td>City of Carlsbad (Primary)</td>
<td>Councilmember Lorraine Wood</td>
<td>No</td>
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<tr>
<td>City of Coronado (Primary)</td>
<td>Councilmember Bill Sandke</td>
<td>No</td>
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<tr>
<td>(Alternate)</td>
<td>Councilmember Richard Bailey</td>
<td>No</td>
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<tr>
<td>City of Del Mar (Primary)</td>
<td>Councilmember Dwight Worden</td>
<td>Yes</td>
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<tr>
<td>City of Encinitas (Primary)</td>
<td>Councilmember Lisa Shaffer</td>
<td>Yes</td>
</tr>
<tr>
<td>(Alternate)</td>
<td>Councilmember Tony Kranz</td>
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<tr>
<td>City of Imperial Beach</td>
<td>Mayor Pro Tem Brian Bilbray</td>
<td>No</td>
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<tr>
<td>(Alternate)</td>
<td>Councilmember Robert Patton</td>
<td>No</td>
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<tr>
<td>City of Oceanside (Primary)</td>
<td>Councilmember Esther Sanchez</td>
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<tr>
<td>(Alternate)</td>
<td>Deputy Mayor Chuck Lowery</td>
<td>No</td>
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<tr>
<td>City of San Diego (Primary)</td>
<td>Councilmember Lorie Zapf, Vice Chair</td>
<td>Yes</td>
</tr>
<tr>
<td>(Alternate)</td>
<td>Council President Sheri Lightner</td>
<td>No</td>
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<tr>
<td>City of Solana Beach</td>
<td>Councilmember Mike Nichols</td>
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<tr>
<td>(Alternate)</td>
<td>Mayor Lesa Heebner</td>
<td>No</td>
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<tr>
<td>County of San Diego</td>
<td>Supervisor Dave Roberts, Chair</td>
<td>No</td>
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<tr>
<td>San Diego Unified Port District (Primary)</td>
<td>Commissioner Garry Bonelli</td>
<td>Yes</td>
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<tr>
<td>(Alternate)</td>
<td>Eileen Maher</td>
<td>Yes</td>
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<tr>
<td>United States Navy</td>
<td>Mitchell Perdue</td>
<td>No</td>
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<tr>
<td>(Alternate)</td>
<td>Walter Wilson</td>
<td>Yes</td>
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ADVISORY MEMBERS LISTED BELOW (ATTENDANCE NOT COUNTED FOR QUORUM PURPOSES)

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<thead>
<tr>
<th>JURISDICTION/ORGANIZATION</th>
<th>NAME</th>
<th>ATTENDING</th>
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<tr>
<td>California Coastal Coalition</td>
<td>Steve Aceti</td>
<td>Yes</td>
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<tr>
<td>California Coastal Commission</td>
<td>Gabe Buhr</td>
<td>No</td>
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<tr>
<td>California Lobster and Trap Fisherman’s Association</td>
<td>August Felando</td>
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<tr>
<td>Coastal Environmental Rights Foundation</td>
<td>Marco Gonzalez</td>
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<tr>
<td>National Marine Fisheries Service</td>
<td>Bryant Chesney</td>
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<tr>
<td>Scripps Institution of Oceanography</td>
<td>Michele Okihiro</td>
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<td>Southern California Tribal Chairmen’s Association</td>
<td>Vacant</td>
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<tr>
<td>State Dept. of Boating &amp; Waterways</td>
<td>Steve Watanabe</td>
<td>No</td>
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<tr>
<td>State Dept. of Fish and Wildlife</td>
<td>Loni Adams</td>
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<td>Jurisdiction/Organization</td>
<td>Name</td>
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<tr>
<td>State Dept. of Parks and Recreation</td>
<td>Darren Smith</td>
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<td>State Lands Commission</td>
<td>Jane Smith</td>
<td>No</td>
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<tr>
<td>Surfrider Foundation</td>
<td>Julia Chunn-Heer</td>
<td>Yes</td>
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<tr>
<td>U.S. Army Corps of Engineers</td>
<td>Heather Schlosser</td>
<td>No</td>
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**Other Attendees**

- Nick Buhbe, Great Ecology
- Fernando Henriquez, Student
- Lawrence Honme, M&A
- Cindy Kinkade, AECOM
- Leslea Meyerhoff, City of Solana Beach
- Harold Meza, County of San Diego
- Carl Stiehl, City of Carlsbad
- Kasia Trojanowska, City of Carlsbad
- Chris Webb, Moffat & Nichol
- Kathy Weldon, City of Encinitas

**SANDAG Staff Members Listed Below**

- Keith Greer, SANDAG
- Katie Hentrich, SANDAG
- Michelle Martinez, SANDAG
- Sarah Pierce, SANDAG
- Rob Rundle, SANDAG
- Shelby Tucker, SANDAG
- Allison Wood, SANDAG
Introduction

The Shoreline Preservation Working Group (Working Group) was established in the late 1980s as the Shoreline Erosion Committee. The Working Group’s current status is that of a standing working group that advises the Regional Planning Committee (RPC) on shoreline management issues. Based on the Working Group’s input, the RPC makes policy recommendations to the San Diego Association of Governments (SANDAG) Board of Directors.

Its current role is to assist in the implementation of the Shoreline Preservation Strategy for the San Diego Region (Strategy), San Diego Forward: The Regional Plan, and the Coastal Regional Sediment Management (RSM) Plan.

The Working Group has contributed in the planning, collaboration, and implementation efforts to complete the pilot Regional Beach Sand Project (RBSP) in 2001 and the more recent RBSP with active construction completed at the end of 2012. In 2001, SANDAG’s Regional Beach Sand Retention Strategy (SRS) was prepared to understand how sand retention strategies can be used to complement beach nourishment projects. Additionally, the Working Group has managed the preparation of the Nearshore Habitat Inventory completed in 2003, and the Sand Compatibility and Opportunistic Use Program (SCOUlP) completed in 2006 in order to further the recommendations provided in the Strategy and RSM Plan. It also continues to be involved in the implementation of the Regional Shoreline Monitoring Program (Program).

Discussion

Shoreline Preservation Strategy for the San Diego Region

The Strategy was adopted by the SANDAG Board of Directors in 1993. The Strategy proposes an extensive beach building and maintenance program for the critical shoreline erosion areas in the region that includes sand nourishment, sediment management devices, and policies and regulations regarding the use of the shoreline and its development. The Shoreline Preservation Strategy is available at sandag.org/shoreline.
Coastal Regional Sediment Management Plan

The Coastal Sediment Management Workgroup (CSMW) is a task force made up of state, federal, and local/regional entities concerned about adverse impacts on our coastal habitats associated with our urbanizing society, and committed to regional sediment management as the means to best protect, restore, and enhance coastal habitats. Through grants, the CSMW collaborated with local entities as part of a larger state effort to develop a master plan for the State to guide efforts in addressing the political, environmental, and process related issues anticipated to arise when implementing sediment management. The California Coastal Sediment Management Master Plan (Sediment Master Plan) is available at www.dbw.ca.gov/csmw/smp.aspx.

In 2007, SANDAG was one of three agencies awarded a grant from the California Department of Boating and Waterways (DBW) for the preparation of an RSM Plan for the San Diego region. SANDAG staff worked with the Coastal Sediment Management Work Group (CSMW) and the Working Group to prepare the RSM Plan for adoption by the SANDAG Board in 2009. The completed document can be found on the SANDAG website at sandag.org/crsmp.

The RSM Plan was prepared as a comprehensive guidance and policy document that addresses how management of sediment targeted at coastal erosion can be implemented in an expeditious, cost-effective, and resource protective manner throughout the San Diego region. The RSM Plan builds upon the goals and objectives provided for in the Strategy, moving sediment management from being an ad hoc activity performed on a case-by-case basis to a more coordinated, long-term approach. Coordinated beneficial reuse of sediment resources within a regional context helps to restore natural processes and simultaneously address sediment imbalances.

The RSM Plan provides in-depth information about the regions’ coastal processes, potential coastal receiver areas for placement of sediment; habitat and sediment quality constraints; sediment sources from upland, coastal, and offshore; an approach for sediment management based on sediment type; solutions to decreasing amounts of sediment available in the region; economics; and recommendations for governance and implementation of the RSM Plan as well as other useful data and information.

Restoration of the region's beaches will require a long-term sustained effort. However, coordinated short- and long-term actions through the Working Group are necessary to initiate the RSM Plan recommendations. This includes smaller scale efforts through opportunistic beach replenishment, as well as larger-scale beach replenishment projects every five to ten years.

Sand Compatibility and Opportunistic Use Program

SANDAG worked through a grant from DBW on the SCOUP, which is a component of the Sediment Master Plan, as described above. The SCOUP provides local jurisdictions the opportunity to take advantage of opportunistic sand sources from local construction projects (that is, using surplus sand from upland construction, development, or dredging/excavation projects as determined by the city based upon sediment characterization and comparison protocols for appropriate quality) for beach nourishment within designated beaches in their area.
Additionally, the SCOUP identifies a program of monitoring, both for data collection over time and to track sand movement before and after new nourishment events. The SCOUP recommends reporting and provides a sample reporting template that may be modified by each city as appropriate. Project design features also are defined to address truck operations and other operational procedures to avoid impacts (e.g., specific haul routes, traffic control plan). These design features are equally applicable to each jurisdiction.

As a pilot program based on application of the SCOUP, SANDAG developed environmental documentation to enable the City of Oceanside to obtain federal, state, and local permits for placement of sand on its local beaches. SANDAG then developed environmental documentation and permits (i.e., Mitigated Negative Declaration) to enable the cities of Coronado, Encinitas, Imperial Beach, Oceanside, and Solana Beach to obtain program-level permits from all pertinent resource agencies to allow for the streamlined placement of beach compatible material from upland sources in their cities. The City of Carlsbad has an almost identical program, which was developed separately and prior to SCOUP.

All cities involved in the SCOUP have received permits and have worked to take advantage of opportunistic sources as they have become available. The SCOUP permits covered a five-year period. The cities of Encinitas and Solana Beach have renewed their SCOUP permits and the City of Oceanside is working to obtain renewal of their SCOUP permits. It should be noted that renewal of the permits prior to their expiration requires substantially less effort than if they are allowed to lapse. The permit renewal process can be an excellent time to make minor edits/updates to the individual cities’ programs such as access, placement types, and monitoring requirements.

### Regional Beach Sand Retention Strategy

The SRS was prepared in 2001 to provide additional information on how sand retention strategies can be used to complement beach nourishment projects. The SRS evaluates both hard and soft retention structures that are most appropriate for the region’s shoreline. It also evaluates the use of natural features such as bays and points along the coast as potential features to retain sand. The SRS contains some preliminary designs and cost estimates for sand retention strategies that are consistent with Shoreline Preservation Strategy policies. The findings in this document may help to determine where and how retention structures can be used to enhance regional beach nourishment projects.

### Regional Shoreline Monitoring Program

The Regional Shoreline Monitoring Program provides physical measurements of the region’s beaches essential to the design and evaluation of efforts to manage the region’s shoreline. The Program is a comprehensive effort that monitors and measures the impacts of beach erosion over time, documents the benefits of sand replenishment projects, and helps to improve the design and effectiveness of beachfills. Success of the Program depends on a continuation of the basic components, which include beach monitoring (transects and aerial photography) and lagoon entrance monitoring (closure and maintenance records and aerial photography).
Since the Program began in 1996, efforts have been made to maintain consistency in the data collected to document changes to the shoreline over time, providing vital information to decision-makers when planning beach replenishment efforts such as the 2001 and 2012 RBSPs, as well as lagoon restoration and maintenance dredging projects. The results of the Program have provided useful data to a variety of resource agencies and organizations in the San Diego region and across the county.

As part of the 2001 RBSP, the existing Program was enhanced to include regulatory permit monitoring requirements. Once all permit-related monitoring requirements had been completed, in 2006 SANDAG continued a modified monitoring program and utilized the valuable lessons learned in planning for the 2012 RBSP. Similarly, the Program has been enhanced as required by permits for the 2012 RBSP. Moreover, time to obtain and analyze monitoring data and lessons learned from the 2012 RBSP is necessary to develop future projects.

Next Steps

Restoration of the region’s beaches will require a long-term sustained effort. Coordinated beneficial reuse of sediment resources within a regional context helps to restore natural processes and simultaneously address sediment imbalances. Therefore coordinated short- and long-term actions through the Working Group are necessary to initiate the RSM Plan recommendations for smaller-scale efforts through opportunistic beach nourishment, as well as larger-scale beach nourishment projects every five to ten years.

SANDAG will continue the baseline Program, monitor the results of the 2012 RBSP, and coordinate with coastal cities on renewing their SCOUP permits and implementing their projects (such as the U.S. Army Corps of Engineers Encinitas-Solana Beach Coastal Storm Damage Reduction Project). Additionally, SANDAG will continue to seek funding for future projects.

More information on SANDAG Regional Shoreline Management programs, plans, and projects can be found on the SANDAG website at sandag.org/shoreline.

Attachments: 1. Shoreline Preservation Working Group Charter  
2. SANDAG Committee & Working Group Guidelines  
3. Basic Rules of Order for Committee Proceedings

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PURPOSE

The Shoreline Preservation Working Group (Working Group) was formed as a committee in the 1980s and currently advises the Regional Planning Committee on issues related to the implementation of the Shoreline Preservation Strategy (Strategy) adopted in 1993, the Coastal Regional Sediment Management (RSM) Plan adopted in 2009, and San Diego Forward: The Regional Plan (which merges the Regional Comprehensive Plan [RCP] adopted in 2004 and the 2050 Regional Transportation Plan and Sustainable Communities Strategy adopted in 2011).

The Strategy proposes an extensive beach building and maintenance program for the critical shoreline erosion areas in the region. It contains a comprehensive set of recommendations on the beach building program and on financing and implementation. The RSM Plan incorporates the goals and objectives laid out in both the Strategy and RCP. It is a guidance and policy document that addresses how management of sediment targeted at coastal erosion can be implemented throughout the San Diego region.

The Working Group has technical expertise and background knowledge of regional shoreline issues, which is useful in applying the principles and goals laid out in the Strategy, the RSM Plan, and San Diego Forward: The Regional Plan. Continuing to support the region’s ongoing and future beach nourishment efforts is a top priority for the Working Group. Additionally, in 1996, the San Diego Association of Governments (SANDAG) enacted a Regional Shoreline Monitoring Program and the Working Group will continue to oversee and implement this program. The Working Group also will monitor the region’s lagoon efforts and projects as part of the larger effort for effective management of sediment resources.

GUIDING PRINCIPLES

- Commitment to unified approach for local decisions on sand replenishment and management of sediment resources
- Address local needs and maximize positive regional impacts
- Encourage cooperation and coordination
- Promote opportunities for beach sand replenishment

LINE OF REPORTING

The Working Group, established by the Board of Directors, advises the Regional Planning Committee (RPC) on issues related to the implementation of the Strategy, the RSM Plan, and San Diego Forward: The Regional Plan. Based on the Working Group’s input, the RPC makes policy recommendations to the SANDAG Board of Directors. Regular updates on Working Group activities should be made to the RPC to update them on current programs and projects and further strengthen the connection between the two groups.
RESPONSIBILITIES

The Working Group’s main responsibilities are to make recommendations to the RPC on issues related to the implementation of the adopted Strategy, the RSM Plan, and San Diego Forward: The Regional Plan focusing on future beach nourishment opportunities and the shoreline monitoring program.

MEMBERSHIP

The Working Group has 11 voting members, which are elected officials from coastal cities, the County of San Diego, and a representative from the San Diego Unified Port District and the U.S. Navy. Additionally, the Working Group has several non-voting advisory members which are representatives from community groups and organizations, environmental groups, state and federal agencies, and other interested stakeholders. Voting members of the Working Group and their alternates are selected by the bodies they represent. Non-voting members of the Working Group also are selected by the bodies they represent and are categorized as either Technical or Community Advisors and provide added knowledge and input to the Working Group. In the event of a lack of participation by a member of the Working Group or the group/agency the member represents, the RPC will consider for approval any potential modifications to the membership roster in order to achieve a quorum and full participation.

MEETING TIME AND LOCATION

The Working Group meetings are generally held quarterly at 11:30 a.m. on the first Thursday of the month. Meetings are normally held in the 7th floor conference room at the SANDAG offices. Additional meetings also may be scheduled as deemed necessary by the Working Group Chair.

SELECTION OF THE CHAIR

The Working Group’s Chair and Vice-Chair are selected by the Chair of the SANDAG Board of Directors and shall serve until replaced.

DURATION OF EXISTENCE

The Working Group was originally created as a committee in the 1980s. The Working Group’s current status is that of a standing working group. An evaluation of the group’s work will be conducted annually as part of the SANDAG Executive Committee’s annual committee/working group review process.
SANDAG COMMITTEE & WORKING GROUP GUIDELINES

I. PURPOSE

SANDAG thanks you for your willingness to serve on one of its committees, stakeholder groups, task forces, or working groups. SANDAG’s committees and working groups are created by SANDAG’s Board of Directors, Policy Advisory Committees (Transportation Committee, Executive Committee, Borders Committee, Regional Planning Committee or Public Safety Committee), or staff to allow stakeholders in the region to reach consensus and provide input to the Board and Policy Advisory Committees. These guidelines are intended to provide you with information regarding your responsibilities as a member of one of SANDAG’s committees, task forces, or working groups (“committees”).

II. ROLE AS A REPRESENTATIVE

You were most likely asked to serve on a SANDAG committee due to your experience and/or position as an elected official or as a representative of a public agency, regional interest group, or community stakeholder. SANDAG assumes that persons sent to represent a group of people on a SANDAG committee have the appropriate level of authority and understanding to serve in a representative capacity for their organization. If you were selected as the representative of a public agency, regional interest group, or other community stakeholder, SANDAG encourages you to provide input regarding the interests of the organization you represent and assumes that you will communicate information obtained at SANDAG meetings to the appropriate persons in your organization. If you are unable to continue as a SANDAG committee or working group member, please notify SANDAG’s project manager and the organization that you represent. SANDAG will work with you and your organization to ensure that a new representative is selected. If desired, the organization you represent may select one or two alternates to serve in your stead if you are unable to attend a meeting or vote.

Sometimes persons are asked to serve on a SANDAG committee because of their individual qualifications rather than because of the entity or special interest that person represents. In that event, the individual member’s vote does not have to be consistent with the opinion of any organization of which he/she may be an employee or member. Additionally, persons who are selected for their individual qualifications instead of in a representative capacity may not have an alternate.

III. ADVISORY CAPACITY

As a member of one of SANDAG’s committees or working groups it is important to work toward consensus with other members on particular issues and then provide recommendations to SANDAG’s Board, Policy Advisory Committees and/or staff regarding those issues. The advice and recommendations provided by committee members will be taken into account by the Board, Policy Advisory Committee or staff in the decision-making process. Staff will place items on committee agendas, after discussion with the Chair and/or members that need to be addressed by the committee to meet SANDAG’s needs. These items will have first priority. Other items may be added to the agenda by a Chair or other member if time and other resources permit and the items are within the subject matter jurisdiction of the committee. Please remember that SANDAG’s Board has sole authority to take action on behalf of SANDAG, make a final determination on behalf of SANDAG, and/or take a position on behalf of SANDAG, unless it has specifically delegated that authority in writing.
IV. CONDUCT

As an official member of a SANDAG committee, you should either sit at the conference room table located in the room being used for the meeting or a nameplate or some other device should be used to delineate your status. Attendees who are not members of the committee should request permission to speak from the Chair of the committee or working group. The Chair should recognize requests from non-members to speak and ask them to identify themselves if they have not already been introduced.

SANDAG has implemented policies that apply to all persons at SANDAG including committee members. These policies include prohibitions against harassment, discrimination, and violence. A copy of these policies can be obtained upon request to the Office of General Counsel or on SANDAG’s Web site. Persons who violate the policies will receive at least a warning and may be asked to leave SANDAG’s premises.

A committee member is prohibited from using his/her title as a member of any of SANDAG’s committees when stating his/her position on an issue if: a) he/she is making the statement outside of a committee meeting, and b) his/her position conflicts with official Board policy. Persons who violate this prohibition may be removed from office by the Chair of the Board.

V. CONFLICTS OF INTEREST

Potential conflicts of interest are a consequence of the many and varied roles that SANDAG committee members play in our community. One of the goals of these Guidelines is to manage real or perceived conflicts of interest. SANDAG has determined that a system of self-disclosure will be the most effective since conflicts of interest must be dealt with on a case by case basis. Discussion and disclosure generally can resolve issues related to conflict of interest.

A conflict of interest occurs when there is a divergence between an individual's professional, private, or personal relationships or interests and his/her obligations to SANDAG as a committee member such that an independent observer might reasonably question whether the individual's actions or decisions are determined by considerations of personal benefit, gain or advantage. A conflict of interest or the appearance of it depends on the situation, and not necessarily on the character or actions of the individual. The appearance of a conflict of interest can be as damaging or detrimental as an actual conflict. Thus, individuals are asked to report potential conflicts to the SANDAG Office of General Counsel so that appearances can be separated from reality.

Potential conflicts of interest are not unusual and must be addressed. For example, conflicts of interest can arise out of the fact that some SANDAG committees assist SANDAG in shaping requests for proposals and specification documents that are in turn used as criteria for competitive selection of consultants. Representatives from private sector organizations may be selected to serve as a member of one of SANDAG’s committee or working groups by virtue of their experience in a particular industry. Therefore, it is expected that situations may arise where a committee or working group member is asked for input on the scoping of a project for which their organization may later want to submit a bid or proposal. This situation presents a potential conflict of interest if the committee member will be rewarded for their participation in SANDAG activities because the member or his/her organization eventually receives consulting fees or an unfair advantage during the competitive procurement process.

It is wrong for an individual's actions or decisions made in the course of his or her SANDAG activities to be determined by considerations of personal financial gain. Such behavior calls into question the professional objectivity and ethics of the individual, and it also reflects negatively on SANDAG. As a SANDAG committee member you must respect SANDAG's status as a recipient of public funds and conduct your affairs in ways that will not compromise SANDAG's integrity.
All SANDAG committee members have an affirmative duty to disclose any potential financial interest to the SANDAG project manager assigned to the committee. Notification of the actual or potential conflict should be given to the project manager or the Office of General Counsel. Members with an actual or potential conflict of interest should be asked to leave all meetings or portions of meetings where the conflict may arise. If a member must leave their office due to a conflict of interest he/she may continue to attend the meeting(s) as a member of the public.

VI. SANDAG’s RESOURCES

Except in a purely incidental way, SANDAG’s resources, including but not limited to, facilities, materials, personnel, or equipment may not be used in external activities by a committee member unless written approval has been received in advance from the Executive Director or his/her designee. Such permission shall be granted only when the use of SANDAG’s resources is determined to further SANDAG’s mission.

VII. CONFIDENTIAL INFORMATION

Proprietary or other confidential information that a SANDAG committee member may be exposed to at SANDAG may never be used in external activities unless written approval is given in advance by SANDAG’s Executive Director or his/her designee.

VIII. RULES OF PROCEDURE FOR MEETINGS

Those SANDAG committees that qualify as “legislative bodies” are required to comply with California’s open meeting laws, which are known as the Brown Act. The staff liaison to each SANDAG committee is required to know whether his/her committee is subject to the Brown Act and can answer questions regarding how this affects the procedures used during meetings. Generally, the Brown Act requires that meetings be open to the public, that meetings be noticed in accordance with statutory deadlines, that the decision-making process of the members be carried out in a public meeting venue, and that the public be allowed to comment at the meeting. Questions regarding the applicability and implementation of Brown Act requirements should be referred to the SANDAG project manager or the Office of General Counsel.

SANDAG committees are also required to comply with Robert’s Rules of Order. This publication provides procedures for matters such as making motions, amending and substituting motions, adjourning meetings, selecting a Chair, and voting. A summary of the most used aspects of Robert’s Rules is attached to these Guidelines in a document entitled “Basic Rules of Order.” Business cannot be conducted at a committee without the presence of at least a quorum of voting members. A quorum is a majority of the voting members. For example, a seven member committee would require at least four voting members for a quorum. In order to take action, at least a majority of the quorum most vote in favor of the action in question. So, if four members of a seven member committee attend a meeting, it would take at least three votes to pass a motion. Questions regarding Robert’s Rules or other matters of procedure can be directed to the staff project manager or the Office of General Counsel.

IX. CHANGES TO MEMBERSHIP OR RESPONSIBILITIES

Once the SANDAG Board or a SANDAG Policy Advisory Committee has approved the membership roster of a committee, the committee cannot change its membership without going back to the Board or Policy Advisory Committee for approval of the recommended change. If, however, the Board or Policy Advisory Committee in question has delegated authority regarding membership changes to the committee, the committee may make changes without additional approvals. The responsibilities of SANDAG committees are set forth in
committee charters, which are available from the SANDAG project manager. Any changes to responsibilities will require a change to the charter and approval by the responsible Policy Advisory Committee or the Board.

X. AD HOC GROUPS

Committees may form ad hoc groups to provide advice to the entire membership of the committee. Committees may not form standing groups without permission from the Board or a Policy Advisory Committee. If a committee is subject to the Brown Act, any ad hoc group the committee forms will be subject to the Brown Act unless the following requirements are met: 1) the group is composed of less than a majority of voting members, 2) only voting members serve on the group, and 3) the group solely provides advice and does not make decisions. Ad Hoc groups should use the words “Ad Hoc” when naming the group.

XI. FORMATION OF NEW COMMITTEES

New committees that will meet for more than six months may only be formed with approval from the SANDAG Board or a Policy Advisory Committee. New committees of this type may be proposed by a Board member, Policy Advisory Committee Member, or staff. Each new committee must have a charter that is approved by the Board or a Policy Advisory Committee at the time formation of the committee is approved. The charter must contain the information in the SANDAG Charter Outline.
BASIC RULES OF ORDER FOR COMMITTEE PROCEEDINGS

ALL SANDAG committee, committee, task force, stakeholders or working group (hereinafter collectively referred to as “committee”) members should use the following guidelines regarding rules of order during a SANDAG procedure.

1) The Presiding Officer or Chair of the committee shall call the meeting into order and dismiss the meeting when all prescribed business is concluded. The order of business should be as follows:
   1. Reading and approval of minutes
   2. Public and committee member comments
   3. Consent items on agenda
   4. Items on the agenda for discussion
   5. Adjournment

2) All SANDAG committee, committee or working groups must have a quorum (majority) of members who must be present at the meetings in order to legally transact business.

3) All motion procedures should be as follows:
   1. Person making motion must be a member of the committee (other than Chair)
   2. Person requests recognition by the Chair (or Chair calls for a motion)
   3. The Chair recognizes the member by name or title; member then has the floor
   4. Member makes the motion in words member wishes the committee’s final official statement of action to be
   5. Member passes the motion to the Chair as soon as motion is made
   6. Another member seconds the motion
   7. The Chair restates the motion
   8. The motion is then open for debate and discussion
      • All discussion and debate must relate to the motion, if no debate is necessary than the Chair may call for a direct vote
   9. When all debates and discussions have been heard, the Chair will call for the motion to be voted upon or a member may “call for the question” if they feel sufficient discussion has occurred.

4) Members vote on the motion by a show of hands or by stating “aye” or “no.” The result should be stated by the Chair.

5) Adding an issue not on the agenda is done as follows:
   1. After a motion is seconded, the Chair may call for a vote on the motion to add the issue if:
      (1) The issue requires immediate action
      (2) The need for action on the issue came to the attention of the committee subsequent to the posting of the agenda
   2. In order for the issue to be heard before the committee, two-thirds of the voting members must be present and two-thirds of those voting members present must vote in favor of adding the issue to the agenda.
6) Ways to **amend** a motion:

1. **After** a motion has been made and **before** the question has been stated by the chair, any member can suggest **modifications**
   - The motion maker can accept or reject these modifications as they wish
   - This method should be limited to minor changes where it is unlikely that members will disagree

2. **After** a motion has been made and **after** the question has been stated by the chair, the **maker** of the motion can request **unanimous** consent to modify the motion
   - If any member objects the modification must be introduced in the form of a **motion to amend**

3. If the above options do not apply, then members other than the maker can make a motion to amend the proposed motion
   - Proposed changes to the **wording** (inserting, striking, and substituting words) and limited changes to the **meaning** of the motion can be made
   - If someone wants to substantially modify the wording, he/she can make a **substitute** motion
   - Amended and substitute motions must be **voted on before** the original motion
   - Amended and substitute motions must be:
     - **seconded**,  
     - are **debatable**, and
     - require a **majority** vote for adoption
   - If the amended or substitute motion **passes** the original motion is dropped, however, if the amended or substitute motion **fails** a vote can then be taken on the original motion

7) When the normal **Chair** is **not present**, ways to appoint a temporary Chair:

1. The Chair can appoint a temporary Chair if there is not one already approved of in advance
2. A temporary Chair is elected by the committee
   - (1) Can be nominated by: the Chair or by a committee member
   - (2) A vote takes place immediately and terminates upon the arrival of the pre-elected Chair or vice-chair

8) Filling **vacancies** with **alternates**:

1. If the Chair is not present, the vice-chair takes his/her place
2. If members were not selected for their individual qualifications then a certain number of alternates equal to the number of members can be selected by the members or the groups they represent if the committee so desires
2015 REGIONAL BEACH MONITORING PROGRAM

ANNUAL REPORT

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Available for review at: www.sandag.org/shoreline
Mid-El Niño erosion at nourished and unnourished southern California Beaches


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Wave conditions in southern California during the 2015-16 El Niño were similar to the 2009-10 El Niño, previously the most erosive (minimum beach widths and subaerial sand levels) in a seven-year record. As of February 2016, Torrey Pines Beach had eroded slightly below 2009-10 levels, threatening the shoulder of a major highway. However, Cardiff, Solana and Imperial Beaches, nourished with imported sand in 2012, were on average 1-2 m more elevated and more than 10 m wider than in 2009-10. Monthly subaerial sand elevation observations showed that the nourished beaches remained consistently wider than unnourished beaches under similar wave conditions. In contrast to a 2001 nourishment at Torrey Pines built with native sized sand that was removed from the beach face during a single storm [Yates et al., 2009], these relatively coarse grained nourishments protected shorelines for several years, and during the significant wave attack of the 2015-16 El Niño, as of February 2016.
1. Introduction

California’s wave climate and beaches are altered substantially by the El Niño Southern Oscillation (ENSO), with greater wave energy flux and erosion during the warm phase El Niño [Dingler and Reiss, 2002; Sallenger et al., 2002; Barnard et al., 2011, 2015; Revell et al., 2011]. While Pacific coastal regions are threatened by predicted long-term relative sea level rise averaging half a meter by the end of the century [Carson et al., 2016], ENSO is superimposed on this long-term trend, modifying regional coastal sea levels by a few decimeters on interannual time scales [Enfield and Allen, 1980; Huyer and Smith, 1985; Ryan and Noble, 2002; Hamlington et al., 2015]. Most significantly, ENSO modulates the locations of storms responsible for large wave events [Allan and Komar, 2006; Barnard et al., 2015] that can raise nearshore water levels through wave set up by a meter or more [Longuet-Higgins and Stewart, 1962; Bowen et al., 1968; Guza and Thornton, 1981]. Furthermore, regions exposed to anomalously energetic wave conditions experience intensified beach erosion, compounding flood risk and potentially depressing multi-billion dollar tourist economies [Pendleton et al., 2012; WorleyParsons, 2013; Alexandrakis et al., 2015].

The 1982-83 and 1997-98 El Niños were the highest sea surface temperature anomalies in the eastern equatorial Pacific since 1950, and the 2015-16 El Niño ranks alongside them [Climate Prediction Center, 2016]. Seven years of hourly wave data and monthly sand levels at Torrey Pines Beach, CA show that the winter 2015-16 conditions in southern California are similar to the 2009-10 El Niño. As of 29 February, 2015-16 winter significant wave heights had exceeded 2 m for 364 hours, comparable to the to 360 hours of exceedance by 28 February of winter 2009-10. (Non-El Niño winters totaled less than 200
hours of 2 m exceedance.) Furthermore, at Torrey Pines the 2015-16 beach was slightly narrower and subaerial sand levels were slightly lower than in 2009-10.

Imported sand, mechanically placed on the beach, modifies the impact of the 2015-16 El Niño at the other monitored sites. This coastal management technique, known as beach nourishment, widens and elevates the beach to mitigate flooding and erosion, and promotes tourism and recreation. “Soft” sand based coastal management techniques (e.g. beach nourishment, shore nourishment [Hamm et al., 2002], scraped berms [Gallien et al., 2015]) are often preferred to hard structures (e.g. groins, jetties, breakwaters) that can stifle the sediment supply to adjacent coastlines [Bruun, 1995]. Beach nourishment is a primary erosion mitigation strategy worldwide, and non-opportunistic placements (placements not benefiting from sand available from a pre-existing project, e.g. a harbor dredging) are expensive [Clayton, 1991; Haddad and Pilkey, 1998; Trembanis and Pilkey, 1998; Valverde et al., 1999; Hanson et al., 2002; Cooke et al., 2012; Luo et al., 2015].

The wave-driven redistribution of beach nourishment sand is an important component of the complex cost-benefit analysis, but is poorly understood. On the U.S. Gulf and East Coasts, hurricanes most significantly redistribute nourishments [Browder and Dean, 2000; Gares et al., 2006; Elko and Wang, 2007]. However on the U.S. West Coast, tropical storms are rare and extreme erosion is dominated by repeated storms during El Niño [Barnard et al., 2015]. Elko et al. [2005] report increased nourishment erosion rates on the U.S. Gulf Coast during the 1997-98 winter El Niño. Our detailed observations of nourishment influence in the more severely affected southern California, during the 2015-16 El Niño, are unique.
In 2001, approximately 1.6 million $m^3$ of sand was placed on 12 San Diego County beaches [Coastal Frontiers, 2015] at a total cost of $17.5 million; the first non-opportunistic nourishments in the region [Griggs and Kinsman, 2016]. The entire Torrey Pines pad, constructed with a sand grain size similar to native, washed offshore in a single storm [Seymour et al., 2005], partially returned to the beach face the following summer, and then became too dispersed to track [Yates et al., 2009]. An additional 1.15 million $m^3$ of sand was placed on 8 San Diego County beaches in 2012 [Coastal Frontiers, 2015] at a total cost of $28.5 million [Griggs and Kinsman, 2016]. Based on comparatively sparse observations that included all the nourishments [Coastal Frontiers, 2015], Griggs and Kinsman [2016] stated that “Overall, the sand added to the relatively narrow San Diego County beaches [during the 2001 and 2012 nourishment campaigns] had a very short life span on the exposed subaerial beach.” We present uniquely comprehensive observations showing that the impacts of three of the relatively coarse-grained nourishments placed in 2012 (Table 1) have remained detectable on the beach face for several years, and maintained a more seaward shoreline during the 2015-16 El Niño than the 2009-10 El Niño. February 2016 photos show the extreme erosion at Torrey Pines, unnourished since 2001 (Figure 1b), compared with Cardiff and Imperial Beach, both nourished in 2012 (Figure 1a,c).

2. Wave Observations

Waves are characterized with observations from the Torrey Pines Datawell directional wave buoy (NDBC 46225), located 12 km offshore of Torrey Pines Beach in 550m water depth [CDIP, 2016]. A few gaps in the observations during low waves (3% of the total record) are filled with a regional wave model. Although waves differ between the beaches
Ludka et al., 2015, wave observations at the Torrey Pines buoy are broadly representative. Waves are seasonal, with relatively low waves in summer (e.g. zero occurrences of wave heights above 2 m, Figure 2b). Winter wave heights are larger, and elevated above 2 m most often during the 2009-10 and 2015-16 El Niños. The maximum wave height of 5.5 m was observed on 1 Feb 2016.

A simple 1D beach state model [Ludka et al., 2015] based on an equilibrium beach hypothesis [Wright and Short, 1984; Wright et al., 1985] previously calibrated on these beaches, characterizes the erosion potential of the observed waves, providing a comparison of different winters. The instantaneous beach state change rate, $dA/dt$, is assumed proportional to the instantaneous energy $E$ and energy disequilibrium $\Delta E$

$$\frac{dA}{dt} = C^{\pm} E^{1/2} \Delta E \quad (1)$$

where $C^{\pm}$ are empirical change rate coefficients for beach face accretion ($C^+$ for $\Delta E < 0$) and erosion ($C^-$ for $\Delta E > 0$). The factor $E^{1/2}$ insures small changes in $A$ when $E$ is small. The sign of $dA/dt$ is determined by the sign of the energy disequilibrium,

$$\Delta E = E - E_{eq}, \quad (2)$$

where

$$E_{eq} = aA + b. \quad (3)$$

For a given beach state, $A$, the equilibrium energy $E_{eq}$ is the wave energy that causes no profile change. Using modeled hourly waves at each site, and sand levels that excluded nourishments, reef, canyon and shoal sections of beach, the best-fit model four free parameters ($C^{\pm}$, $a$ and $b$) are similar on these beaches. A single set of optimized free...
parameters for alongshore uniform sandy reaches at all study beaches reasonably predicts profile evolution [Ludka et al., 2015].

Waves at the Torrey Pines buoy are used with existing optimized equilibrium model parameters to solve (1) and (2) for the beach state, $A$ (Figure 2c), quantifying the time-integrated wave erosion potential, and neglecting site specific effects including beach nourishments, bedrock, cliffs, self-armoring of the eroded beach with cobbles, and riprap bordering Hwy 101. Modeled beach face erosion was extreme during the 2009-10 El Niño ($A = -1.03$) and was exceeded ($A = -1.17$) on Feb 2, 2016 (Figure 2c), suggesting that the 2015-16 El Niño had more erosion potential than the 2009-10 El Niño.

3. Sand Level Observations

Subaerial sand elevations at four San Diego County beaches were monitored monthly at low tide with a GPS-equipped vehicle [Seymour et al., 2005] driving shore-parallel tracks with $\sim 10$ m spacing. Quarterly beach and bathymetry surveys have 100 m shore-perpendicular transects, but only the subaerial portions of these surveys are considered in this analysis. Alongshore survey spans vary between 1.7 and 4.1 km depending on the site (Table 1, Figure 3). During the monitoring, three beaches were nourished with between 68,000-344,000 m$^3$ of coarse-grained sand ($D_{50} \sim 0.5-0.6$ mm), over subaerial alongshore spans between 500-1500 m (Table 1, dotted black lines Figure 3).

Temporal fluctuations in beach width (Figure 2a) are estimated from changes in the cross-shore location of the mean sea level contour (MSL = +0.77 m NAVD88), averaged over the survey alongshore span. If a survey does not include observations of MSL on more than 2/3 of the alongshore span, it is not considered. Beach widths vary seasonally.
due to seasonal fluctuations in wave energy, with punctuated erosion during El Niño. On average, all four beaches were relatively narrow during the 2009-10 El Niño. In February of 2016, Cardiff, Solana, and Imperial Beach, nourished in Fall 2012, were wider than 2009-10 by 10 m or more. Torrey Pines, nourished in 2001 [Seymour et al., 2005; Yates et al., 2009], was eroded slightly below 2009-10 levels.

Plan view sand level difference maps (Figure 3) between the 2016 and 2010 surveys with minimum beach width (observed thus far, Figure 2a), show the subaerial beach was relatively elevated over the entire alongshore span at Imperial, Cardiff and Solana Beaches. Relative sand levels were most elevated, by 1-2 m, at Imperial Beach, the site of the largest nourishment. Cardiff and Solana were elevated above 2010 by about 1 m.

In contrast, at Torrey Pines, the subaerial beach was similar to, and in many locations slightly eroded relative to, 2009-10 levels.

Cross-shore profile evolution at the 2012 nourishment sites corroborate that these beaches were wider and more elevated in 2015-16 (thick red lines, Figure 4A,B,D,E) than in the 2009-10 El Niño (thick dashed black line, Figure 4A,B,D,E). The fall 2012 nourishment widened and elevated the subaerial beach (compare thin black dotted pre-nourish and thin light orange Nov 2012 profiles, Figure 4A,B,D). After placement, the pads retreated (Figure 4A,B,D), with partial recovery in the summer months (Nov 2015 Figure 4A,D, Figure 2a). As the nourishment pads retreated (Figure 4D), adjacent regions accreted (Figure 4E). Alongshore transport was especially pronounced at Imperial Beach; the southern region (Figure 4E) became (perhaps surprisingly) more elevated relative to Feb 2010 levels than the original placement region (Figure 4D). In contrast, on 27
January 2016 (when $A = -0.57$, Figure 2c) Torrey Pines was eroded similar to 2009-10 El Niño levels (Figure 4C). Additional results of ongoing monitoring will be reported later.

4. Discussion

The 2015-16 and 2009-10 El Niños were the most energetic and erosive winters in the seven year record from 2009-2016 in southern California (black line Figure 2a, Figure 2b,c). Observations during extreme winters are essential to understand the impact of successive energetic storms on sand levels, and the equally important recovery between storms.

No existing numerical model accurately simulates erosion, recovery, and the potentially increased erosion resistance of the dense cobble layers (Figure 1b) often exposed on San Diego county beaches [Ludka et al., 2015].

As future El Niños and rising sea levels threaten coastal infrastructure, coastal managers must decide whether to protect, accommodate or retreat [Nicholls, 2011]. Beach nourishment is an important protection method worldwide, yet the wave-driven redistribution of nourishment sand is poorly understood. We observed three relatively coarse-grained nourishments that partially remained on the beach face for several years (Figure 4A,B,D,E). This evolution differed dramatically from a 2001 Torrey Pines nourishment with approximately 160,000 m$^3$ of imported sand with grain size similar to the native $D_{50} \sim 0.2$ mm. This 500 m-long subaerial pad of native-grain-size sand completely washed offshore during a single storm with an unexceptional maximum significant wave height of 3.2 m during a neap tide (1 m range) [Seymour et al., 2005]. While these contrasting nourishment behaviors occurred on different southern California beaches, these beaches have been shown to respond similarly to incident wave conditions when not influenced by nourishment.
Therefore, these results suggest that a larger than native grain size distribution is a primary factor in nourishment evolution in southern California, as at sites with different wave climates [Dean, 1991; Kana and Mohan, 1998].

Of the 20 total San Diego County beach nourishments in 2001 and 2012, we monitored only four in detail. In total 2.75 million $m^3$ of sand was placed [Coastal Frontiers, 2015], with total cost of about $44$ million [Smith, 2016]. Future nourishments in southern California will be expensive (e.g. $160,000,000$ over 50 yrs to nourish a several $km$ reach in San Diego County [Diehl, 2015]). Accurately assessing the evolution and impact of previous nourishment projects, in the context of long-term, high resolution, large scale monitoring, is essential. Based on comparatively sparse observations that included all the nourishments, Griggs and Kinsman [2016] concluded that “Most of the 2,600,000 $m^3$ sand added to the beaches of San Diego County during [the 2001 and 2012 nourishments] was essentially eroded from the exposed subaerial beach during the first year following nourishment.” It should be anticipated that nourishment sand will leave the original placement region and analysis should include the impact of the nourishment sand on the surrounding region over many years [Stive et al., 2013; de Schipper et al., 2016]. While the assessment by Griggs and Kinsman [2016] is consistent with the observed evolution of the native-grain-sized 2001 Torrey Pines nourishment that completely washed offshore in a single storm [Seymour et al., 2005], it does not consider that sand partially returned to the beach face the following summer [Yates et al., 2009]. While much of the sand placed in 2012 was indeed eroded from the original placement regions in the first year, the backbeach portions of the Cardiff and Imperial nourishment berms remained intact.
for several years (Figure 4A,D). Furthermore, much of the sand eroded from the original placement regions accreted adjacent subaerial regions (Figure 4D,E). Sand that was moved offshore in winters, partially returned in summers. Notably, at Solana, Cardiff and Imperial Beaches the (alongshore averaged) beach remained wider than pre-nourishment under similar wave conditions, including the energetic El Niño, observed thus far (Figure 2a).

The San Diego County nourishments were placed to increase tourism and recreation and reduce flooding and erosion. These public beaches are heavily used and include California State Beaches at Cardiff and Torrey Pines. The nourishments were expected to reduce Highway 101 closures at Cardiff and Torrey Pines by protecting it from flooding and erosion (Figure 1b). Owners and patrons of beachfront restaurants at Cardiff (Figure 1a) and homeowners at Imperial Beach (Figure 1c) desired protection from wave overtopping. Detailed monitoring is crucial in order to estimate the extent that these goals were achieved, and to weigh the benefits against the monetary expense and potential negative ecological [Speybroeck et al., 2006; Baker, 2016; Wooldridge et al., 2016] and groundwater impacts [Hargrove, 2015]. Repetitive nourishments, perhaps augmented with retention structures, will be costly. Future El Niños, coupled with sea level rise, will inevitably increase pressure on already sparse sand resources [Roelvink, 2015]. Detailed monitoring of beach sand levels and storm damage over decades will be needed to inform coastal management during changing conditions.

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fornia beach sites will be posted here in accordance with the AGU data policy. This study was supported by the United States Army Corps of Engineers and the California Department of Parks and Recreation, Division of Boating and Waterways Oceanography Program (program manager R. Flick). Bonnie Ludka was also supported by a National Science Foundation Graduate Research Fellowship, NOAA grant NA10OAR4170060, California Sea grant project #R/RCC-01, through NOAA’s National Sea Grant College Program, and the NOAA/ Southern California Coastal Ocean and Observing System. The statements, findings, conclusions and recommendations are those of the authors and do not necessarily reflect the views of the aforementioned organizations. B. Woodward, K. Smith, B. Boyd, R. Grenzeback, G. Boyd, and L. Parry built, operated and maintained the surveying system. Lifeguard Captain Robert Stabenow ensured safe access to Imperial Beach. Kathy Weldon, City of Encinitas Shoreline Management Division Manager, facilitated work at Cardiff. Kathleen Ritzman, Scripps Assistant Director, was essential to maintaining funding and survey continuity.

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<table>
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<th>Beach</th>
<th>Mean Beach Width [m]</th>
<th>Survey Alongshore Span [km]</th>
<th>Nourishment Alongshore Span [km]</th>
<th>Reported 2012 Nourishment Volume ([m^3])(^a)</th>
<th>Reported Nourishment Grain Size [mm](^a)</th>
<th>Native Grain Size [mm](^b)</th>
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\(^a\) Coastal Frontiers [2015]

\(^b\) At MSL. Cardiff, Torrey and Imperial from Ludka et al. [2015]. Solana from Group Delta Consultants [1998]
Figure 1. Low-tide photos at (a) Cardiff, (b) Torrey Pines, and (c) Imperial Beach on 25 Feb 2016. Cardiff and Imperial Beaches, nourished in 2012, were relatively sandy and wide. Torrey Pines, unnourished since 2001, was primarily cobble, narrow, and backed by the eroding shoulder of Hwy 101.
Figure 2. (a) Beach width fluctuation (about the mean, Table 1) versus time for four southern California beaches (legend). Each dot is an average over several km alongshore (Table 1, Figure 3). (b) Hours per month the observed significant wave height ($H_s$) exceeds 2 m (combined swell and seas, 0.04-0.25 Hz) at the Torrey Pines buoy (NDBC 46225) versus time. Red indicates El Niño winters. (c) Beach state estimated using observed waves and published model coefficients [Ludka et al., 2015]. The model, insensitive to initial conditions after a brief transient, is initialized with $A = 0$ on 1 January 2009.

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Figure 3. Sand elevation differences (color bar) between the winter 2016 and 2010 surveys with minimum beach widths. (a) Cardiff 23 Feb 2016 - 12 Feb 2010, (b) Solana 23 Feb 2016 - 12 Feb 2010, (c) Torrey Pines 27 Jan 2016 - 8 Feb 2010, (d) Imperial 25 Feb 2016 - 02 Feb 2010. Horizontal scale (bottom right) changes with panel. Black dotted lines outline the 2012 nourishment placement regions at (a) Cardiff (b) Solana and (d) Imperial Beach. (c) Torrey Pines, unnourished since 2001, has the smallest elevation difference, mostly less than 0.5 m of relative erosion (red). (d) Imperial Beach received the most imported sand in 2012 and almost the entire subaerial beach is elevated 1-2 m above the 2010 El Niño survey. (a) Cardiff and (b) Solana are elevated above 2010 by about 1 m. Black lines mark the locations of transect locations A-E in Figure 4.
Figure 4. Sand level versus cross-shore distance at representative times (legend) at transects labeled in Figure 3. Erosion during the 2009-10 El Niño was extreme (thick dashed black lines). The recent profile (thick red line) at (C) Torrey is similar to Feb 2010, but at sites nourished in 2012 (A,B,D,E), the recent profile is elevated above Feb 2010. The pre-nourished profile is a thin black dotted line. At transects located in the original placement region (A,B,D), the nourished pad is evident in the Nov 2012 profile and retreats over time, with partial recovery in summer/fall as in Nov 2015 (A,D). As the Imperial Beach nourishment pad retreated (D), the southward region accreted (E).