Encinitas-Solana Beach Coastal Storm Damage Reduction Project

San Diego County, California

Appendix H

Potential Impacts to Nearshore Resources and Mitigation and Monitoring Plan

U.S. Army Corps of Engineers
Los Angeles District

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1 INTRODUCTION

The Encinitas-Solana Beach Coastal Storm Damage Reduction Project was developed by the United States Army Corps of Engineers, Los Angeles District (USACE) in coordination with the local sponsors (City of Encinitas and City of Solana Beach) to address shoreline erosion problems along 9 miles (mi) of coastline of both cities. A primary environmental concern for the project is the potential to impact nearshore reefs that support sensitive aquatic vegetation and represent special aquatic site. Specific concerns are the potential for sand elevation changes associated with beach nourishment to: 1) indirectly bury reefs and 2) degrade reef habitat from increased scour and/or sedimentation. Kelp beds, which occur in relatively deeper nearshore waters, are highly diverse habitats supporting many fish and invertebrate species. In addition, nearshore reefs with surfgrass support a variety of species and serve as nursery areas for juvenile lobster. Impacts to surfgrass are of additional concern since that habitat is slow to recover if substantially impacted and is currently infeasible to restore on a large scale if mitigation is required (Reed and Holbrook. 2003).

Approximately 480 acres of reef habitat occurs in the nearshore zone of the study area. The distribution of reef habitat is non-continuous and patchy, varying in size and relative quality that is influenced by the local geology and natural sand movement (MEC 2000, SAIC 2007, San Diego Nearshore Program http://nearshore.ucsd.edu/). Nearshore reefs are naturally exposed to changes in sand depth associated with seasonal on and offshore movement of sand within the littoral zone. The littoral zone is bounded by the backshore and offshore “depth of closure”, which ranges between approximately -13 and -30 feet (ft) Mean Lower Low Water (MLLW) off the cities of Encinitas and Solana Beach (Coastal Frontiers 2004).

Estimating impacts from beach nourishment projects is complex and includes inherent uncertainties. Sediment transport models (e.g., GENESIS) have been developed to predict the long shore fate and transport of sand in sandy beach areas, although local physical conditions and model assumptions may influence model performance. In addition, available models do not include assumptions for geologic characteristics (e.g., reefs, rock outcrops), and the influences of nearshore reefs on local sand movement are also poorly understood and likely complex because of reef geometry and orientation (e.g., channels between reefs may facilitate sand movement [AMEC 2005] and reef structure may retain sand [SAIC 2007]).

Despite these uncertainties, sediment transport modeling has been implemented within the region (e.g., Regional Beach Sand Project [RBSP] I and II). For the RBSP I and II, modeling was used to predict sedimentation in the nearshore region and identify areas of substantial deposition on nearshore reefs associated with the project. No irreversible, long-term impacts to sensitive marine resources were predicted based on modeling results, and all short-term impacts were considered within the range that would occur naturally, and post-construction physical and biological monitoring conducted in support of the RBSP I generally confirmed that modeling (working with conservative assumptions) was a useful tool for predicting potential impacts to nearshore reefs.

For this Project, sediment transport modeling was used to estimate potential impacts to nearshore resources. Additional data on nearshore reefs have been collected since the time of the RBSP I, and a more extensive record of beach profile data was available for inclusion into the USACE model. The beach profile monitoring stations provide an empirical record of seasonal sand elevation changes in the cross-shore direction from the backshore to approximate “depth of closure.”

2 PHYSICAL SETTING

The Cities of Encinitas and Solana Beach are located along the central coast of San Diego County, as shown in **Integrated Report Figure 1.5-1**. San Elijo Lagoon is the dividing feature separating Encinitas to the north from Solana Beach to the south. Encinitas is approximately 10 mi south of Oceanside Harbor and 17 mi north of Point La Jolla. Encinitas' shoreline is approximately 6 mi long and is bounded by Batiquitos Lagoon in the City of Carlsbad to the north and the City of Solana Beach to the south. The major portion of the shoreline within Encinitas can be characterized as consisting of narrow sand and cobble beaches backed by seacliffs. The southernmost segment at Cardiff, which is approximately 4,920 ft long, is a low-lying tidal spit that fronts the San Elijo Lagoon. The City of Solana Beach is approximately 20 mi north of San Diego and is bordered by the San Elijo Lagoon in the City of Encinitas to the north and the City of Del Mar to the south. Solana Beach's shoreline, which is approximately 2 mi in length, is comprised almost solely of narrow sand and cobble beaches fronting coastal bluffs.

2.1 <u>Reach Discretization</u>

To better characterize the coastal bluff and shoreline morphology, as well as, oceanographic conditions, the entire study area was divided into nine reaches as illustrated in **Integrated Report Figure 1.5-1**. The distinction between reaches is based on differences in seacliff geology, topography, coastal development, and beach conditions, and is described in detail in Chapter 1 of the Integrated Report.

3 BIOLOGICAL SETTING

3.1 <u>Data Sources</u>

Several data sources were used to characterize nearshore reef dimensions, physical characteristics, and biological resources, and include:

- 2009 and 2010 reef dives and intertidal surfgrass mapping within the study area were used to provide representative information on reef heights and habitat quality indicators (San Diego Association of Governments [SANDAG] 2011).
- 2006 reef dives and intertidal surfgrass mapping within the study area were used to provide representative information on reef heights and habitat quality indicators (SAIC 2007).
- 2004 light detection and ranging imagery (LiDAR) data were used to provide bathymetric information for portions of the study area.
- 2002 California State Conservancy and SANDAG San Diego Nearshore Program GIS layers of bathymetry, hard substrate, and aquatic vegetation mapping served as the basis for reef and sensitive resource acreage calculations.
    - Substrate GIS data enabled calculation of reef dimensions and acreage.
    - Vegetation GIS data enabled calculation of acreage by dominant and sensitive resource categories (i.e., surfgrass, giant kelp, understory algae).
- 2000 reef dives and intertidal surfgrass mapping produced for the 2001 RBSP were used to provide additional representative information on reef heights and habitat quality indicators.

3.2 Reef and Vegetation Footprints

The 2002 SANDAG seafloor map provides the best available data of nearshore habitat in the study area (**Figure 3.2-1**). Similarly, the 2002 SANDAG vegetation map provides the best available quantitative estimates of the vegetative indicator species (**Figure 3.2-2**). Those data include acreage estimates for various habitat types: surfgrass, giant kelp (kelp canopy), and understory algae. The understory category includes several species, including feather boa kelp and sea palm indicators. Indicator species were selected in coordination with resource agencies to be consistent with previous reef characterization surveys and monitoring conducted in the study area (USDN 1997a, b; MEC 2000, AMEC 2005). The indicators represent dominant species that are sensitive to varying degrees of sand scour and sedimentation, as follows:

- Persistent indicator species considered relatively sensitive to sand scour and sedimentation (sea fans, giant kelp).
- Persistent indicator species considered relatively tolerant of some sand influence (surfgrass, sea palm).
- Opportunistic indicator species considered relatively sand tolerant (feather boa kelp).

The USACE model area, which extends from the shoreline to approximately 1,600 ft offshore, includes approximately 480 acres of reef offshore Encinitas and Solana Beach. The combined total acreage of the vegetative categories is similar to that of bedrock on the substrate map (**Table 3.2-1**). While the amount of exposed reef may vary depending on time of year and environmental conditions (e.g., El Nino oceanographic events), the 2002 substrate and vegetation acreage estimates are considered representative for the impact analysis, and are further supported by subsequent sampling and monitoring from 2003 to 2010 (SANDAG 2011).

Table 3.2-1 Summary of Nearshore Resources within each Reach (in acres)

Reach #	Total bedrock substrate	Bedrock with surfgrass	Bedrock w/other indicators
1	99.3	24.2	71.8
2	23.1	6.1	16.3
3	31.5	3.6	26.5
4	28.1	1.8	25.0
5	65.8	13.0	50.5
6	128.1	27.5	95.5
7	36.8	2.1	33.9
8	31.9	3.7	26.2
9	30.1	0.7	27.0
TOTAL	**474.7**	**82.7**	**372.7**

Source: SANDAG 2002

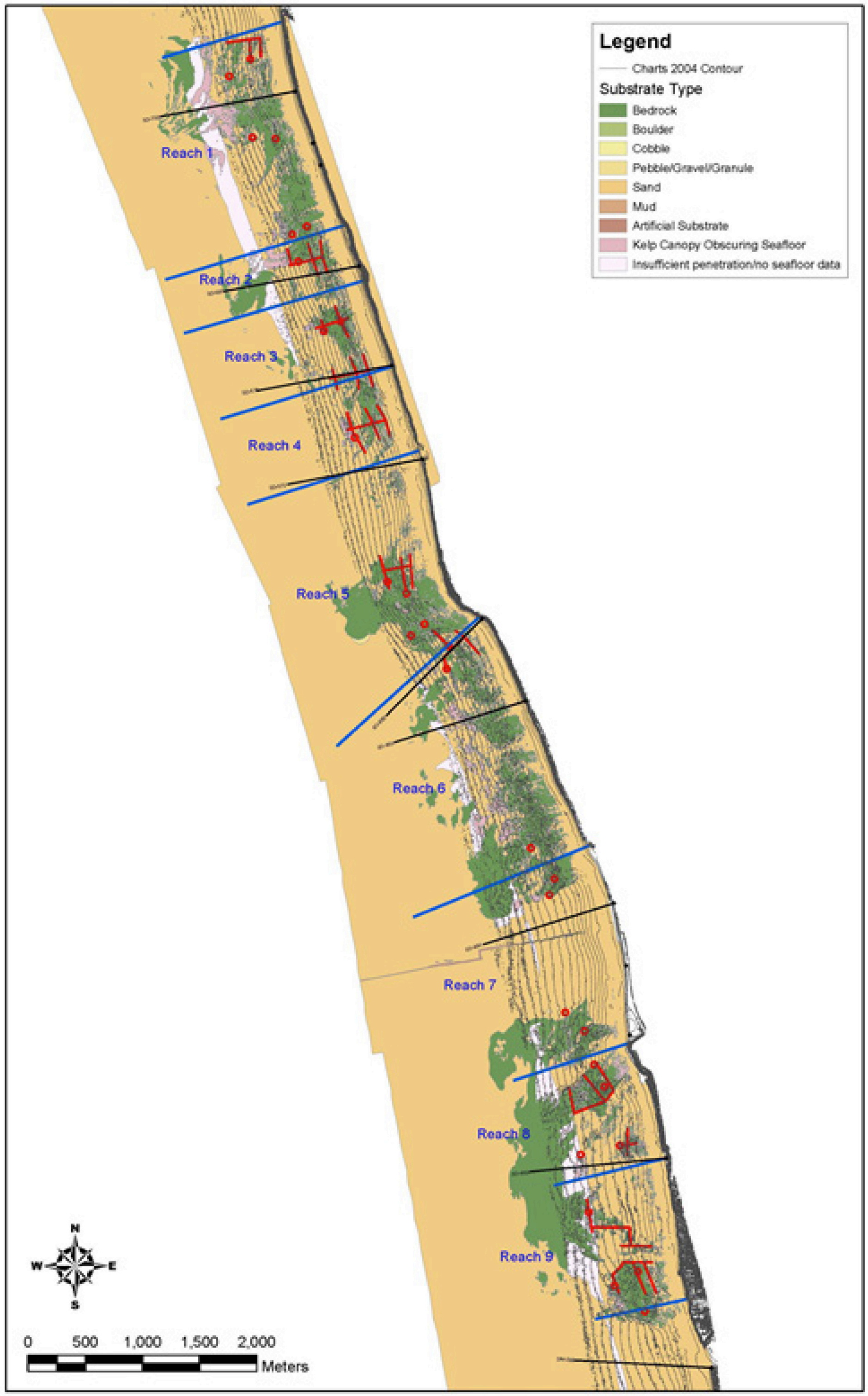


Figure 3.2-1 Seafloor Substrate off Encinitas and Solana Beach.

Source: SANDAG 2002

Figure 3.2-2 Marine Vegetation off Encinitas and Solana Beach.

Source: SANDAG 2002

Reef quality or the ability to support indicator species is directly correlated with reef elevation (i.e., height of the reef), as higher-relief reefs are more resistant to sedimentation and scour, and therefore, allows perennial species to persist. Reef heights in relatively higher quality areas include a greater percentage of heights >1 ft compared to relatively lower quality areas. Seventy percent of the 2006 survey transects had substrate heights that were predominantly <1 ft in relatively lower quality reef areas (SAIC 2007). In some cases, low-relief reefs may also support perennial indicator species, if other factors contribute to minimize the effects of sedimentation and scour. An example includes the presence of sand channels which allow sand to migrate on and off shore between low-relief reefs. A summary of reef elevation within the project area is provided in **Table 3.2-2**, with a further breakdown by surfgrass in **Table 3.2-3** and other indicator species in **Table 3.2-4**.

Table 3.2-2 Summary of Bedrock by Reef Elevation within each Reach (in acres).

	Reef Elevation (ft)			
Reach #	**(0 - 1)**	**(1 - 2)**	**(2 - 3)**	**(> 3)**
1	53.6	20.6	14.0	11.1
2	16.6	4.6	1.7	0.2
3	20.0	4.9	2.9	3.7
4	16.8	3.4	3.6	4.3
5	25.1	6.2	4.7	29.8
6	74.3	27.9	15.0	10.9
7	13.0	6.2	5.6	12.0
8	12.2	2.6	1.5	15.6
9	13.5	3.0	3.3	10.3
TOTAL	**245.1**	**79.4**	**52.3**	**97.9**

Source: SANDAG 2002

Table 3.2-3 Summary of Bedrock with Surfgrass by Reef Elevation within each Reach (in acres).

	Reef Elevation (ft)			
Reach #	**(0 - 1)**	**(1 - 2)**	**(2 - 3)**	**(> 3)**
1	9.5		4.3	4.0
2	4.9	1.0	0.2	0.0
3	2.1	0.8	0.3	0.4
4	1.4	0.2	0.2	0.0
5	3.8	2.1	1.6	5.5
6	13.6	5.6	4.4	3.9
7	0.7	0.3	0.3	0.8
8	0.0	0.0	0.0	3.7
9	0.0	0.0	0.0	0.7
TOTAL	**36.0**	**16.4**	**11.3**	**19.0**

Source: SANDAG 2002

Table 3.2-4 Summary of Bedrock with other Indicator Species by Reef Elevation within each Reach (in acres)

	Reef Elevation (ft)			
Reach #	**(0 - 1)**	**(1 - 2)**	**(2 - 3)**	**(> 3)**
1	41.6	13.7	9.5	7.0
2	11.0	3.6	1.5	0.2
3	16.6	4.0	2.6	3.3
4	14.3	3.1	3.3	4.3
5	19.9	3.9	2.9	23.8
6	56.9	21.3	10.4	6.9
7	11.8	5.8	5.2	11.1
8	10.7	2.4	1.4	11.7
9	11.5	2.9	3.2	9.4
TOTAL	**194.3**	**60.7**	**40.0**	**77.7**

Source: SANDAG 2002

The SAIC 2007 study also noted relationships between indicator species occurrence, reef heights, and depth distribution. Several examples include:

- Surfgrass, which primarily occurred at water depths ≤ 15 ft, was uncommon on reef heights < 1 ft and had denser cover on substrate heights ≥ 2 ft than on 1 ft heights.
- Giant kelp primarily occurred at water depths > 15 ft on reef heights ≥ 1 ft. Giant kelp had sparse occurrence on nearshore reefs. Primary giant kelp canopies occur offshore beyond the beach depth of closure (MEC 2000).
- Sea palm and feather boa understory algae mainly occurred at water depths < 26 ft, with greater number between 15 and 26 ft. Both species had greater cover on reef heights > 1 ft.
- Sea fan occurrence increased with depth, with most records at depths > 26 ft. Although sea fans mainly occurred on ≥ 1 ft substrate, there were more records on reefs < 1 ft in height than observed for other indicator species, most likely related to less sand influence with increasing depth.
- Hard substrate with opportunistic turf algae, sparse occurrence of opportunistic feather boa kelp, and/or lacking vegetation have been used to distinguish substantially sand influenced (scoured) reef (MEC 2000, SAIC 2007).

Figure 3.2-3 and **Figure 3.2-4** illustrate nearshore resources based on the 2002 SANDAG data for Encinitas and Solana Beach, respectively.

Photos of typical resources are shown in **Photo 3.2-1** to **Photo 3.2-4**.

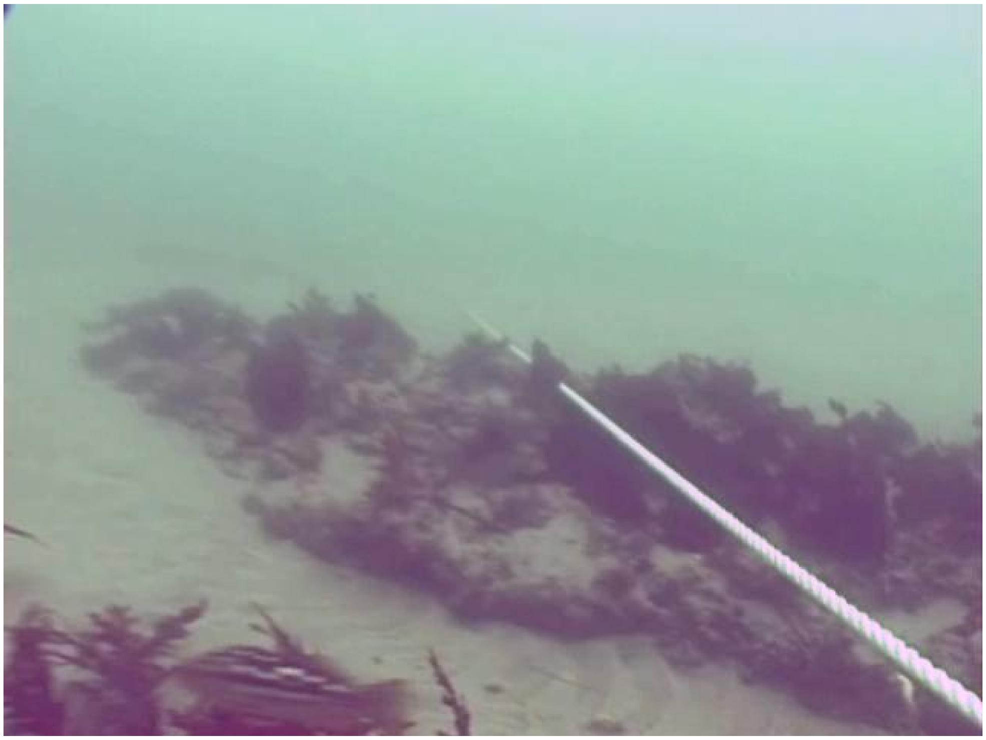


Photo 3.2-1 Low Relief Reef with Sand Scour

Source: SAIC, 2007

Photo 3.2-2 Low Relief Reef with Sand Scour at Leucadia

Source: SAIC, 2010

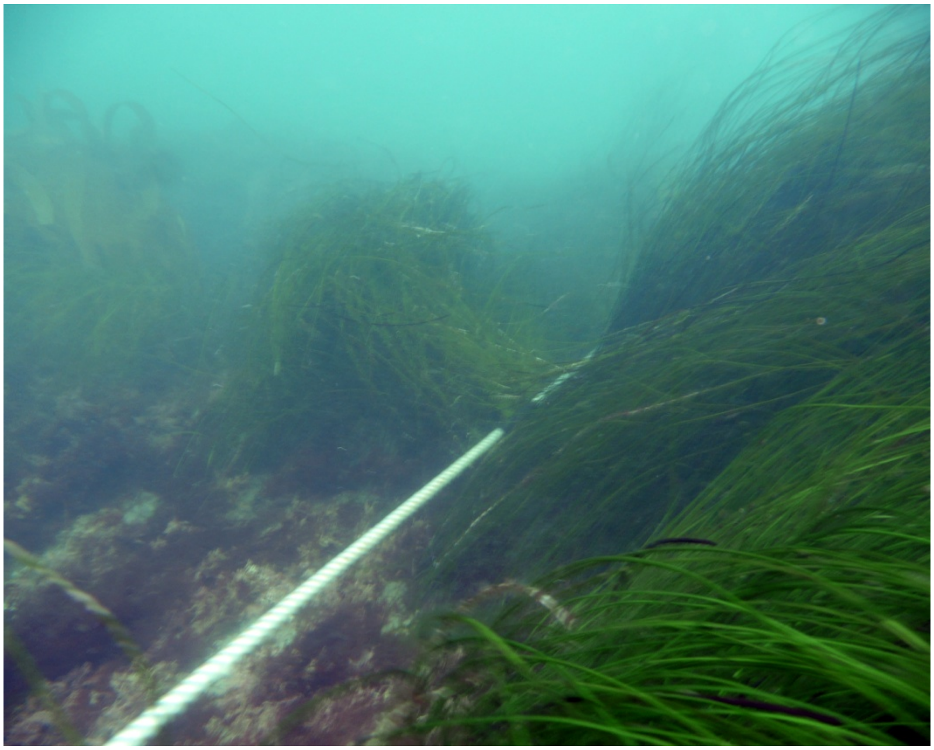


Photo 3.2-3 Subtidal Surfgrass

Source: SAIC, 2009

Photo 3.2-4 Surfgrass in Reach 8

Source: SAIC, 2006

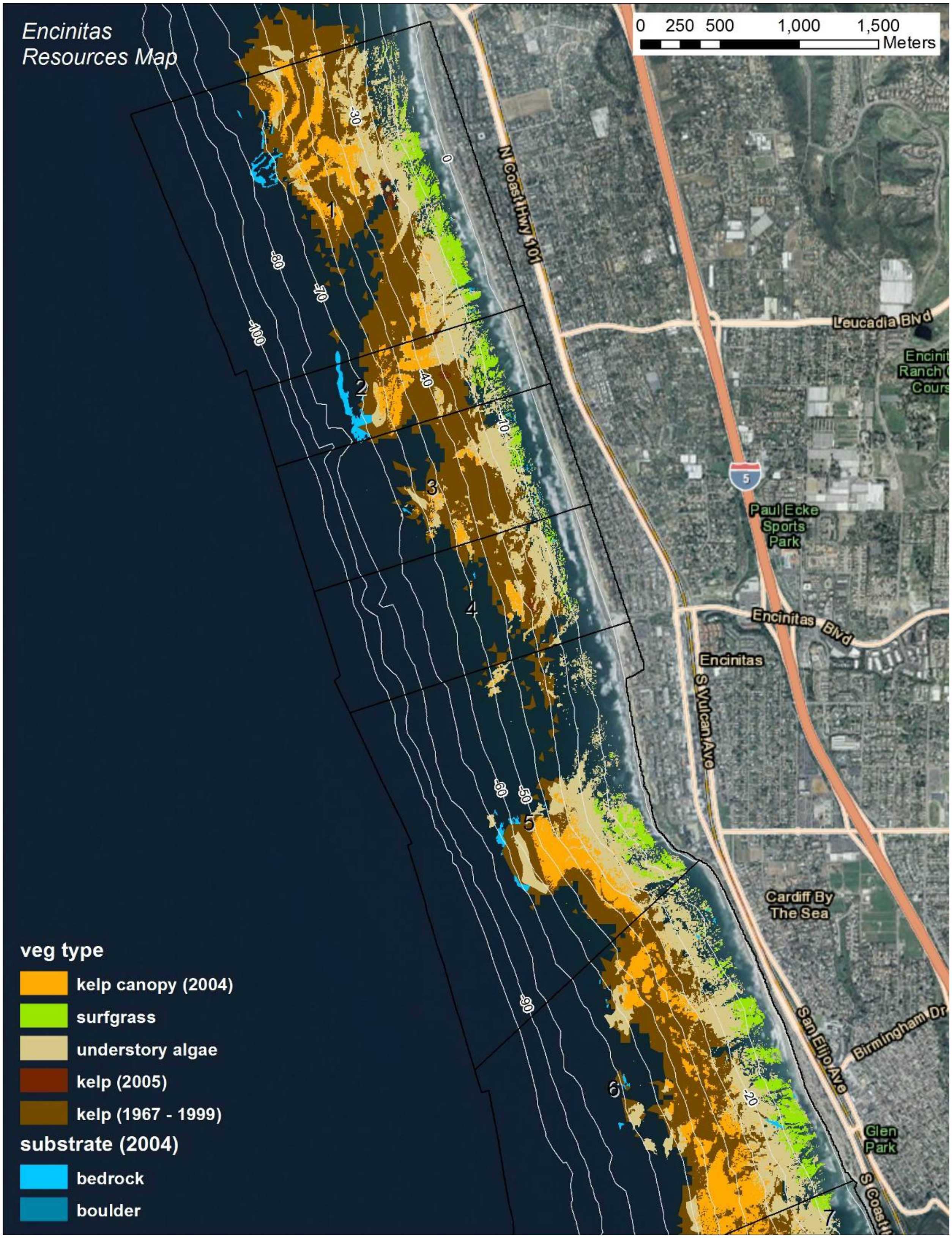


Figure 3.2-3 Nearshore Resources off Encinitas.

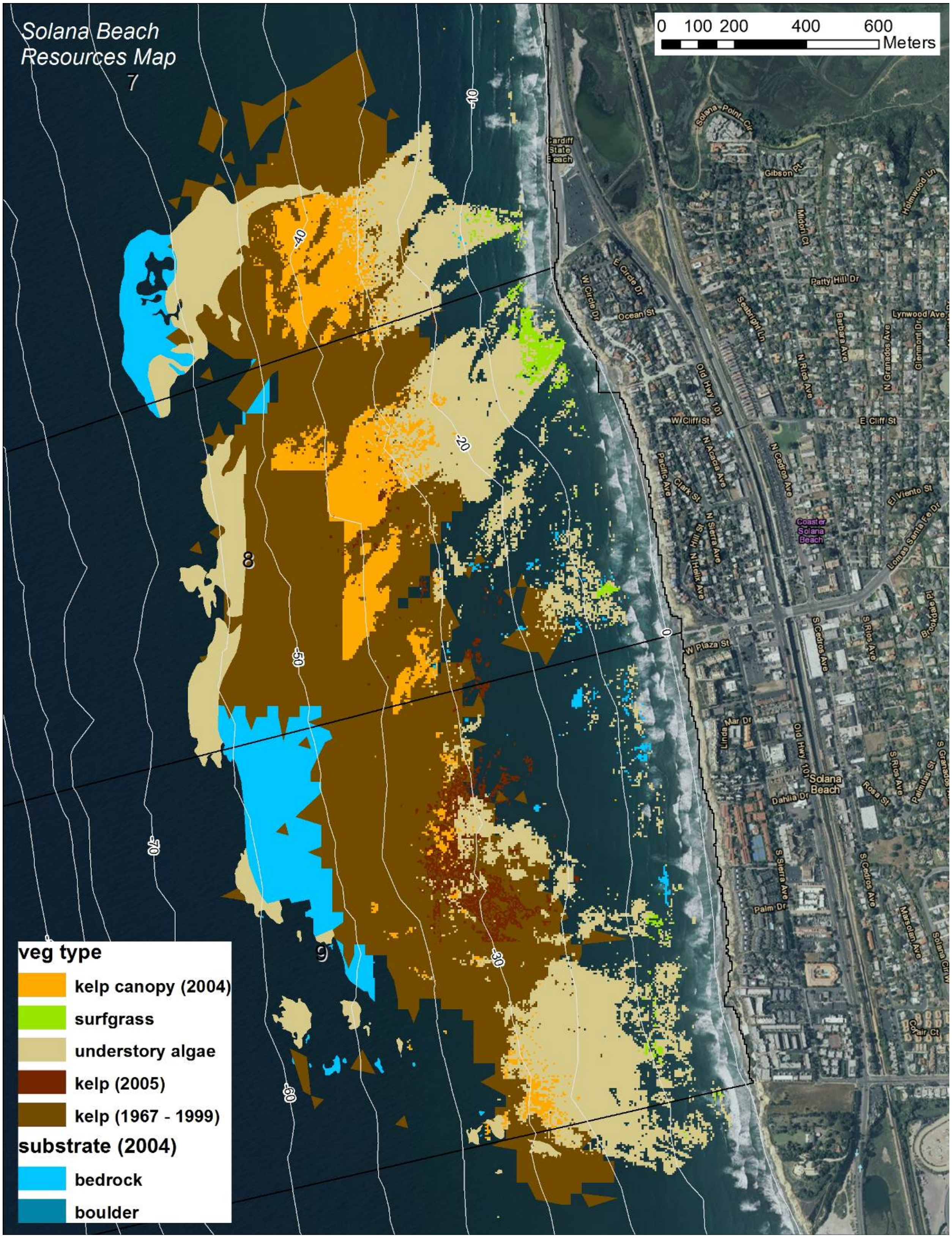


Figure 3.2-4 Nearshore Resources off Solana Beach.

4 METHODS

4.1 Sediment Transport Modeling

To support the cost-benefit analyses and to assist in selection of the NED Plan, beach fill plans were formulated to extend the mean sea level (MSL) seaward from the without project position in increments of 50-ft, with varying replenishment intervals and quantity to reestablish initial MSL position. Projected loss rates of the beach fill were estimated with the GENESIS shoreline modeling and consideration of the performance of prior beach fills in the project area.

Shoreline modeling positions were output at each model cell within the GENESIS model domain. For each profile, the average shoreline position was calculated including data from half the distance to the next downcoast profile through half the distance to the next upcoast profile. These averages were calculated for the spring and fall of year 2 for each profile in the study area, and each beach nourishment option including the without project condition. Profiles from DM-590 through SD-700 were utilized (**Figure 4.1-1**).

Net differences between each beach nourishment option and the without project condition were calculated. These net shoreline differences at each profile location were then converted into sand volumes using v/s ratios. These sand volumes were distributed across the profiles using the cross shore sand thickness distributions. Sand thicknesses were interpolated between the profiles where data were non-existent. In addition to sand thickness from beach nourishment, sand thickness was also added to each segment to keep pace with the low and high sea level rise scenarios as calculated with the Bruun Rule and described in Section 7.8.2 of the **Appendix B**.

Table 4.1-1 depicts the beach width options and sea level rise scenarios that were analyzed for potential nearshore habitat impacts. Any potential impact to nearshore resources were based on Year 2 estimated deposition per USACE direction and negotiations with resource and regulatory agencies. A detailed description of the modeling is provided in the **Appendix B** and model outputs for all the beach width options (50 ft, 100 ft, 150 ft, 200 ft, and 300 ft for both low and high sea level rise scenarios) are provided in **Appendix A of this document**.

Table 4.1-1 Summary of Beach Width Options and Sea Level Scenarios Analyzed

Sea Level Rise Scenario	Beach Width Option (ft)	
	Encinitas	Solana Beach
Low	50	50
	100	100
	150	150
	200	200
	N/A	250
	N/A	300
High	50	50
	100	100
	150	150
	200	200
	N/A	250
	N/A	300

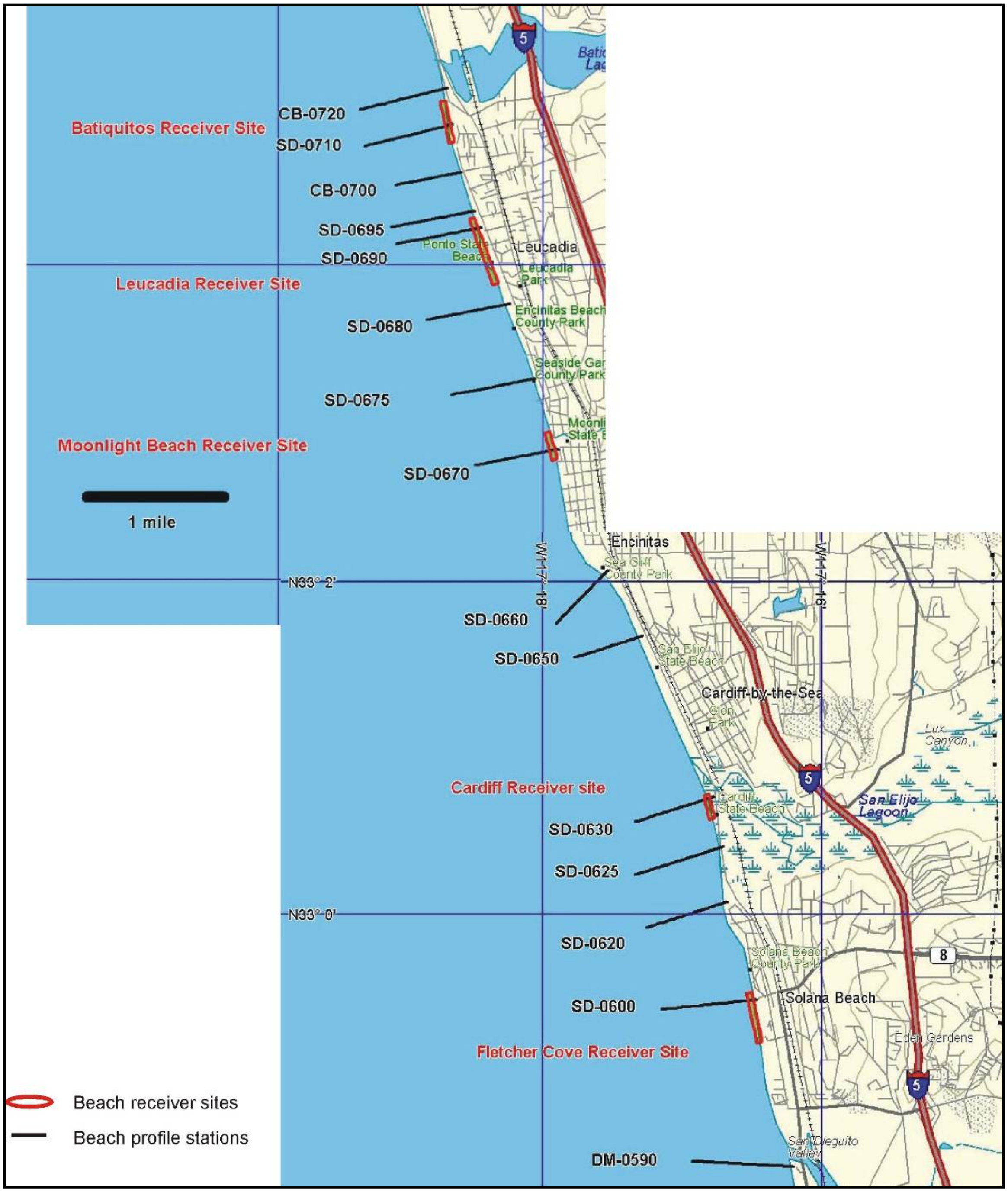


Figure 4.1-1 Locations of 2001 SANDAG RBSP receiver sites and beach profile monitoring stations.

4.2 GIS-Based Approach to Nearshore Habitat Impact Methodology

A GIS-based methodology was developed to automate what was done for previous efforts (i.e., SANDAG RBSP and the Encinitas-Solana Beach Shoreline Feasibility Study from 2005 through 2007), and was developed in coordination with three resource agencies (California Department of Fish and Game, National Marine Fisheries Service, and United States Fish and Wildlife Service), USACE, and the local sponsors. For the Encinitas-Solana Beach Shoreline Feasibility Study, the 2004 LiDAR data was used as base bathymetry upon which changes in sand thickness was added. It is conceded that data were collected at a snapshot in time, and it may be similar to a spring or fall profile, thereby not representing any long-term or average bathymetry.

The key assumptions on which this methodology relied include:

- Bathymetry baseline model year is 2004 for the lifetime of the project. This baseline is more precise and accurate than any other data set available, and is considered to be more representative of existing conditions than generating a new baseline based on erosion and accretion independent of the project without a firm knowledge of the underlying nearshore conditions.

- Substrate and vegetation data from the 2002 SANDAG Nearshore Habitat Inventory Survey is representative of existing conditions, and is supported with data collected in 2006, 2008, 2009, and 2010.

- The potential sensitive resources in the study area are similar to those analyzed for the previous studies (e.g., 2005 Encinitas-Solana Beach Shoreline Feasibility Study, RBSP I and II), and consist of Bedrock with Surfgrass and Bedrock with Other Indicator Species (i.e., kelps). Another unique resource of interest for Solana Beach, also included in the analysis was Tabletops Reef, which is a sand-influenced rocky intertidal platform located at the northern portion of the city.

The approach utilizes the same baseline data that was used for previous analyses regarding substrate, resources, etc.; however, the approach uses a 4-dimensional, GIS-based approach. The key steps to applying the GIS-based approach included:

1. Create a base bathymetric surface (i.e., 2004 LiDAR and 2002 Nearshore Inventory Surveys). This provides the baseline depth from which any increase in sedimentation can be measured (**Figure 4.4-1** and **Figure 4.4-2**).

2. Create a theoretical sand surface based on existing data (i.e., 2004 LiDAR and 2002 Nearshore Inventory Surveys). This surface ties in and is overlaid on the bathymetric surface to create a reference from which any increase in sedimentation can be measured. Therefore, the difference between the bathymetric surface and the sand surface denotes a change in elevation (presumably reef), and therefore provides reef elevations (**Figure 4.4-3**).

3. Overlay resource layers (e.g., substrate type and vegetation type) based on existing data (i.e., 2004 LiDAR and 2002 Nearshore Inventory Surveys). This layer provides a spatial representation (areal coverage) of the resources, a mosaic of habitat types (e.g., sandy areas, rocky reef) and resources (e.g., surfgrass, kelp) that also includes reef elevation (**Figure 4.4-4** and **Figure 4.4-5**).

4. Overlay cross-shore modeling results by creating a sand isopach. This isopach is a sand layer that denotes the model-based predictions of offshore sedimentation (**Figure 4.4-6**). When this layer is added to the baseline layers above, the areal coverage of any resource of interest can be calculated. The difference between this and the baseline data denotes potential burial or loss of the resource. Seasonal modeling results were provided for spring and fall seasons.

5. Establish burial criteria. For this project, a burial criteria of ≥ 12 inches (in) was used for several reasons:

    a. Similar criteria were used to assess impacts on biological resources for previous beach nourishment projects (e.g., RBSP I and II).

    b. Given the dynamic nature of the environment and natural seasonal sediment transport, rocky habitat less than 12 in (0.3m) typically supports ephemeral species due to sediment scour. Therefore, project-related impacts above and beyond this level were considered to have potential impacts on perennial/indicator species and habitat.

    c. Although this approach could use any numeric criteria, it should be noted that the high degree of natural variation, the level of resolution, and the margin of error of the baseline data, as well as the modeling results, brings into question the accuracy of fine-tuning a sediment criteria (i.e., any small incremental change in the criteria is overshadowed by the margin of error in baseline resolution, modeling results and natural variation).

6. Calculate acreage for potential impact areas that exceeds criteria for attribute(s) of interest (e.g., bedrock with surfgrass, bedrock with other indicators species, intertidal reef platform) (**Figure 4.4-7**).

7. To estimate sedimentation and impacts to resources based on “Natural Variation,” a sand layer was created from empirical data provided from the 1996 to 2008 coastal profile dataset (**Figure 4.4-8**). Due to the high degree of variation of the coastal profile data (most likely a sampling artifact), the standard deviation of the sand layer depth was used instead of the maximum values. This sand layer was overlaid onto the baseline layer similar to the modeled sedimentation results, and the same ≥ 12 in criteria was applied, and area impacted calculated.

8. Seasonal impacts were determined based on Year 2 results, and averaged to determine the Most Probable Impact. The potential Project-Related Impact was estimated by subtracting the Most Probable Impact from Natural Variation.

4.3 Mitigation Cost Estimate

To support the cost-benefit analyses and to assist in selection of the NED Plan and other project alternatives, costs to mitigate potential impacts were estimated. Numerous assumptions were used to estimate potential mitigation costs and include:

- No mitigation if no long-term impacts are discernible
- In-kind mitigation, except for intertidal reef platform (for Solana Beach only)
- Mitigation functional equivalent of 2:1 (refer to **Appendix M**)
- Reef mitigation cost based on Southern California Edison (SCE) San Onofre Mitigation Reef costs plus escalation and other costs ($500,000 per acre)
- Rounded to nearest $5,000
- Transplanting adult kelp plants and sporophytes
- Surfgrass mitigation includes both habitat creation and transplant
- Surfgrass transplant based on $250,000 per acre
- Surfgrass habitat creation cost based on Everest Consultant's estimate for high-relief reef ($2,000,000 per acre)

4.4 Construction Monitoring

While the Integrated Report relies on predicted impacts, actual impacts would be assessed by implementation of a construction monitoring program. If mitigation is implemented, mitigation monitoring would also be conducted. Section 6 provides information regarding the mitigation and monitoring for the project.

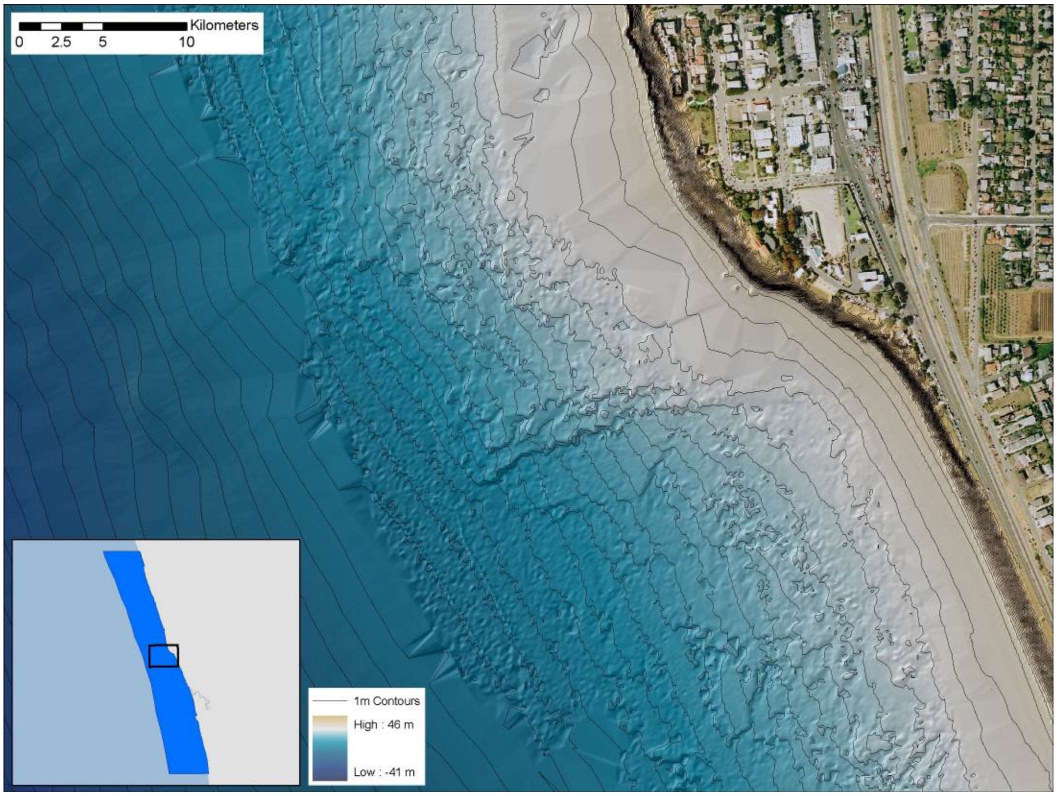


Figure 4.4-1 Close-up view of bathymetric contours.

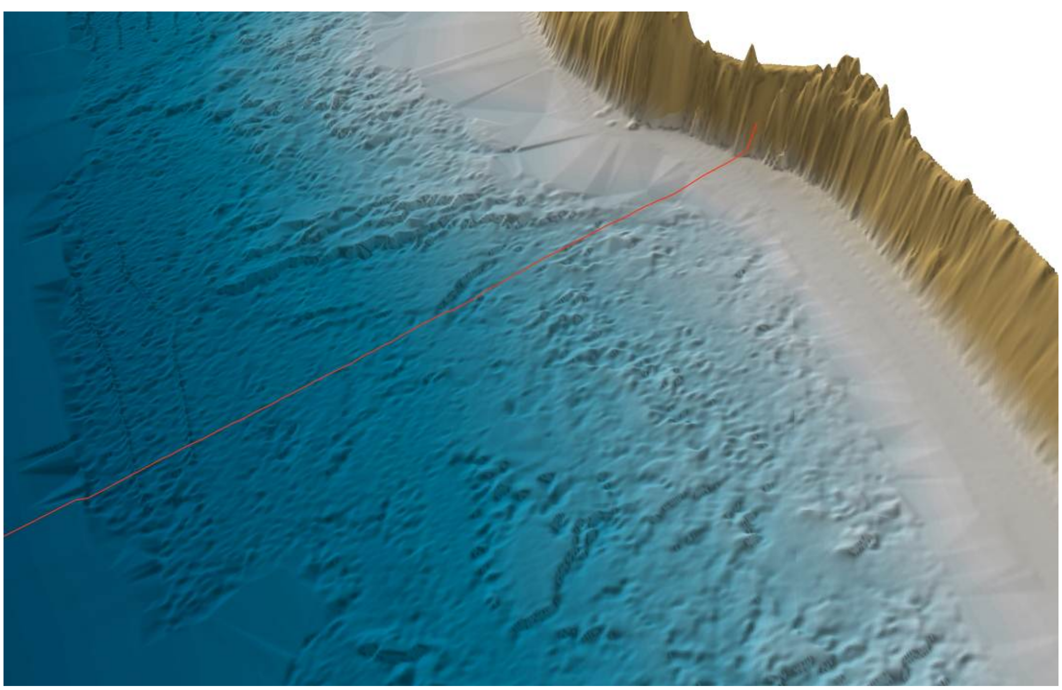


Figure 4.4-2 Oblique view of bathymetry with vertical exaggeration to enhance the reef habitat.

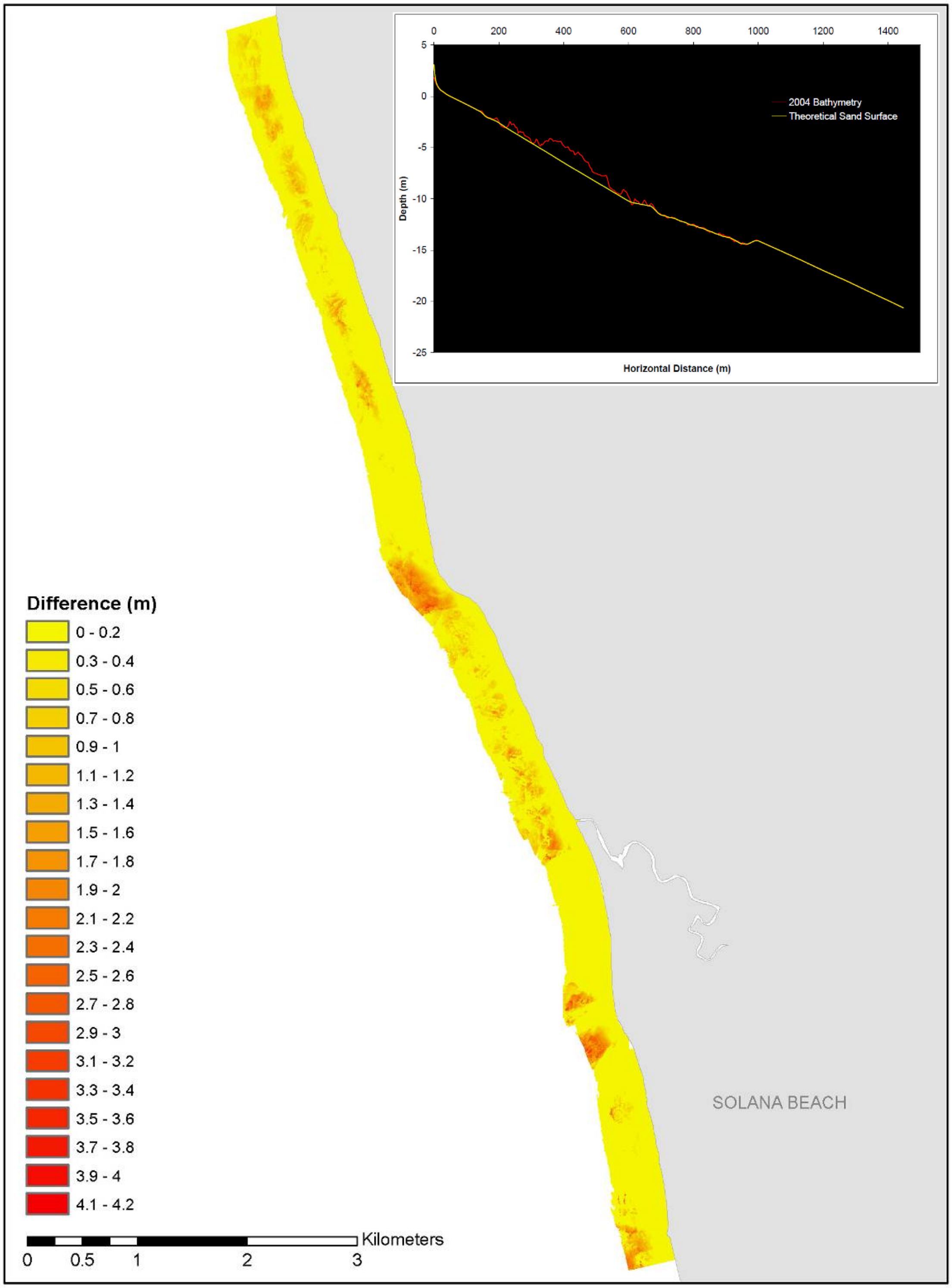
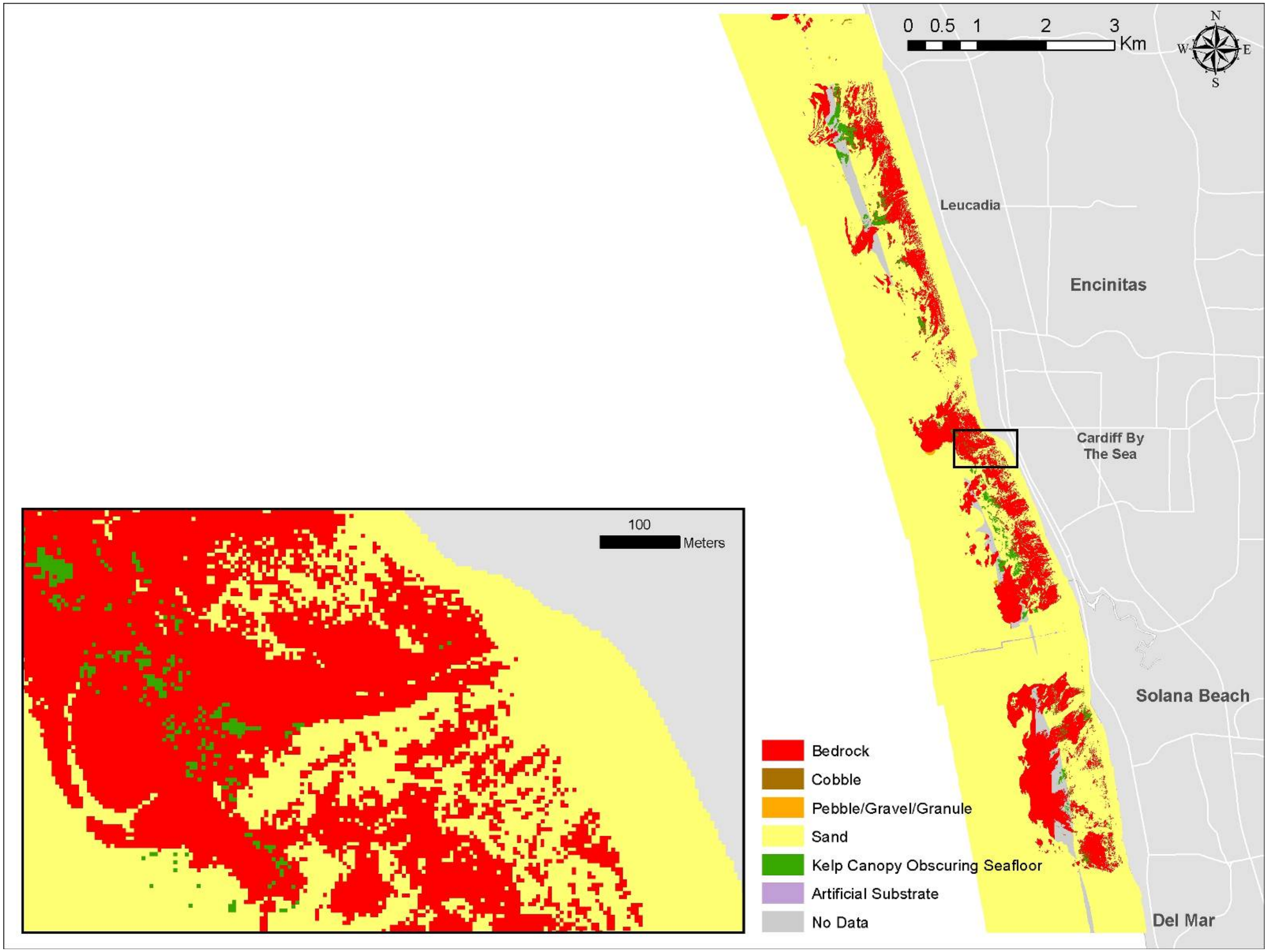


Figure 4.4-3 Theoretical sand surface subtracted from bathymetric surface. This difference denotes reef elevation.

1



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3 **Figure 4.4-4 Substrate coverage in study area based on 2004 LiDAR and 2002 vegetation surveys.**

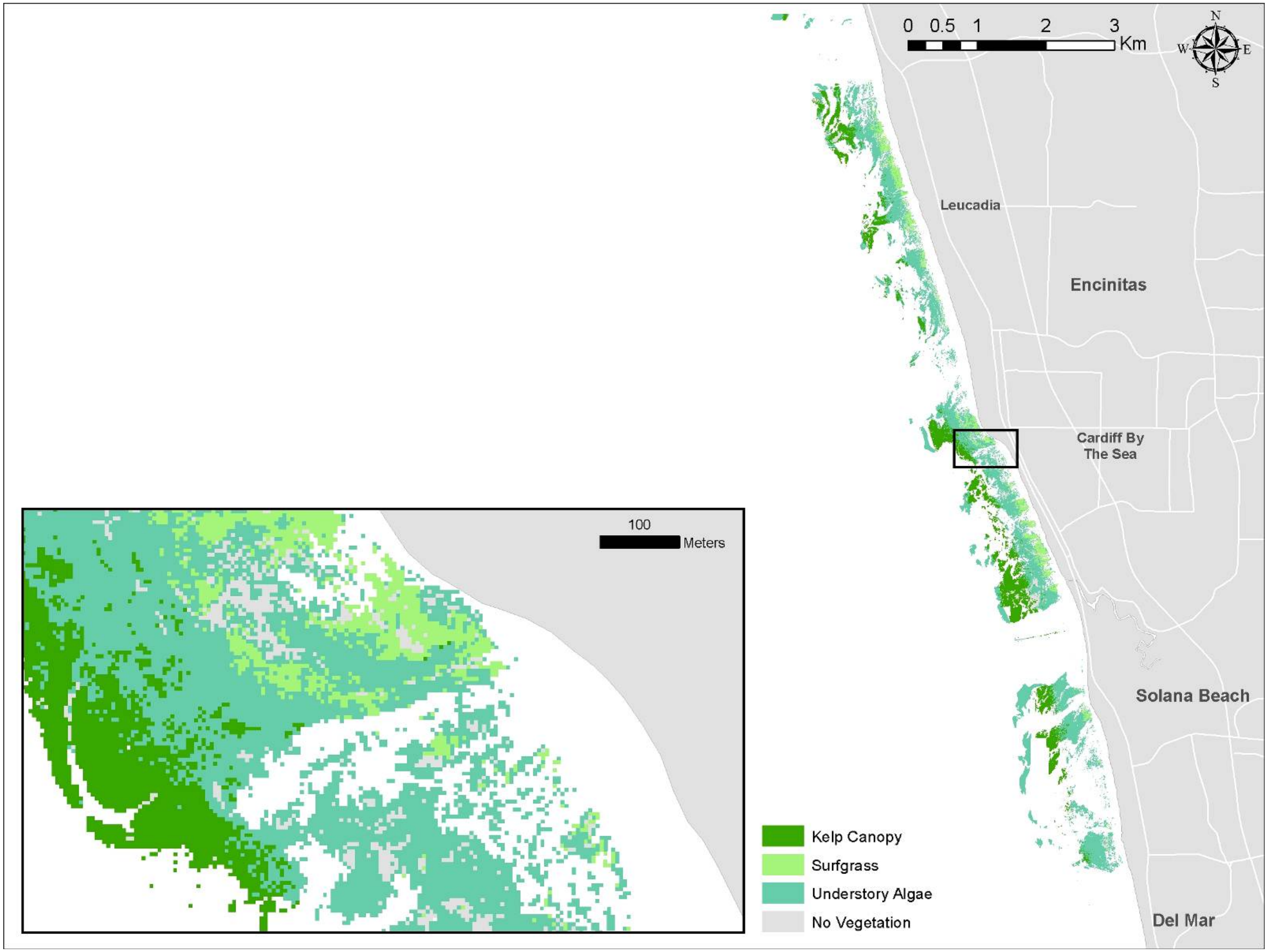

Figure 4.4-5 Vegetation coverage in study area based on 2002 vegetation survey.

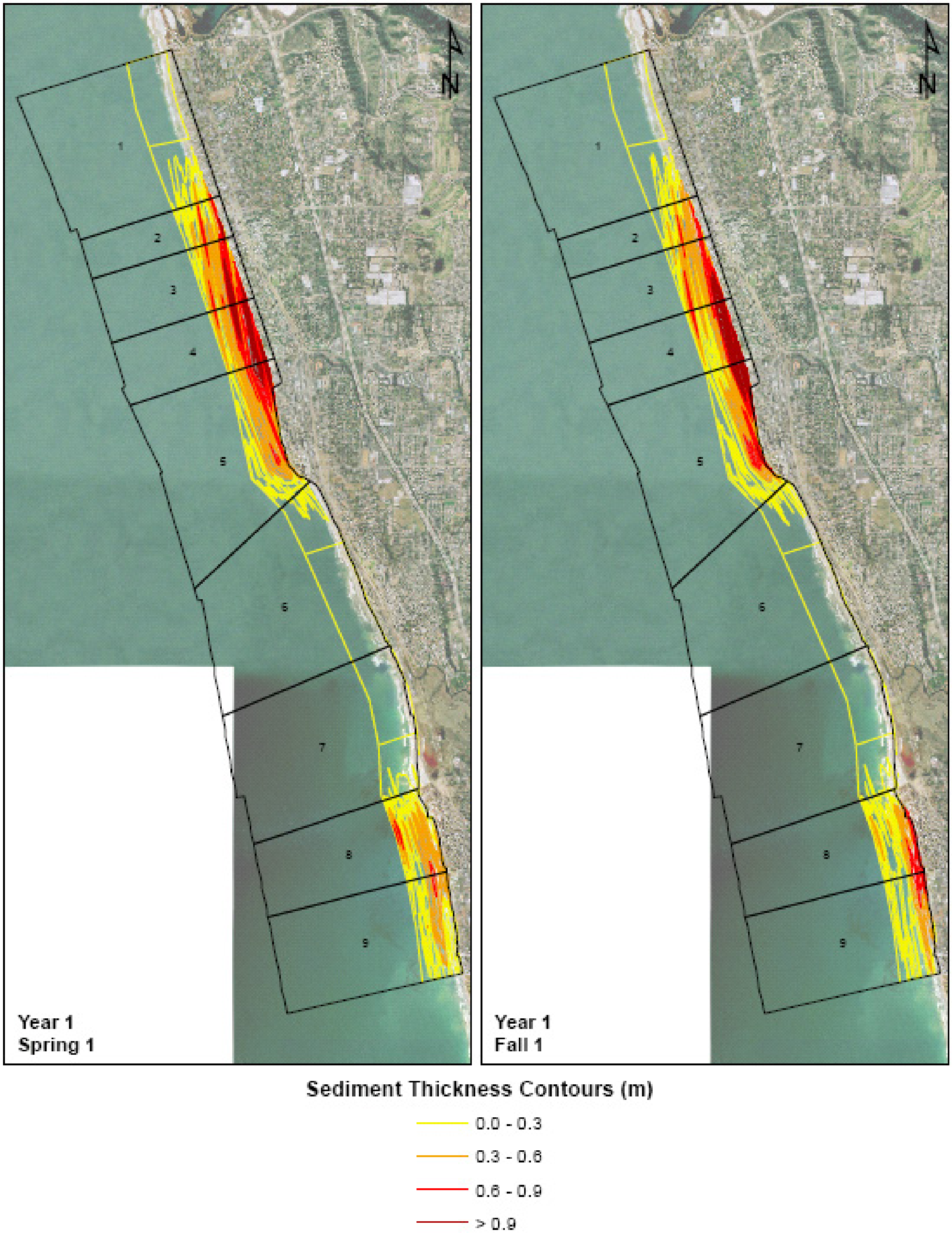

Figure 4.4-6 Example of estimated cross-shore sediment deposition.

Figure 4.4-7 Areas depicting sediment thickness on bedrock with surfgrass based on Fall-Year 1 model results.

Figure 4.4-8 "Natural Variation" sediment thickness based empirical coastal profile data collected from 1996 to 2008.

5 RESULTS

5.1 Estimated Impacts to Nearshore Resources

Estimated impacts by study reach for all beach width options and sea level rise scenarios are provided in **Appendix B of this document**. The impacts do not account for natural variation, which is a key step in assessing potential project-related impacts. **Table 5.2-1** through **Table 5.2-4** incorporate natural variation and summarize the potential impacts to nearshore reefs for all the beach width options and sea level rise scenarios, and **Figure 5.2-1** and **Figure 5.2-2** illustrate examples of year 2, high sea level, spring, modeled sedimentation results for Encinitas (100 ft beach width) and Solana Beach (300 ft beach width), respectively. The detailed methodology for these tables is in Section 4.2 and the data used to calculate the Most Probable Impact (Spring and Fall for Year 2) is in **Appendix B of this Appendix**.

For Encinitas, modeling estimates indicate no project-related impact (i.e., no impacts greater than Natural Variation) to nearshore resources at beach widths up to 100 ft for both low and high sea level rise scenarios (**Table 5.2-1** and **Table 5.2-2**). Impacts to nearshore resources were predicted for beach widths at 150 ft or greater for both low and high sea level rise scenarios (**Table 5.2-1** and **Table 5.2-2**). This included predicted impacts to both reefs supporting surfgrass (ranging from 2.0 acres for the 150 ft beach width at low sea level rise scenario, up to 4.6 acres for the 200 ft beach width at the high sea level rise scenario) and other indicator species (ranging from 9.5 acres for the 150 ft beach width at low sea level rise scenario, up to 23.2 acres for the 200 ft beach width at the high sea level rise scenario).

For Solana Beach, modeling estimates indicate no project-related impact to nearshore resources at beach widths up to 50 ft for both low and high sea level rise scenarios (**Table 5.2-3** and **Table 5.2-4**). Impacts to nearshore resources were predicted for beach widths at 100 ft or greater for both low and high sea level rise scenarios, but only impacts to reefs supporting other indicator species and intertidal reef platform (i.e., Tabletops Reef) were predicted (**Table 5.2-1** and **Table 5.2-2**). No impacts to reefs supporting surfgrass were predicted possibly due to high natural variation and the occurrence of high-relief reefs that support surfgrass which would not be affected by increased sedimentation.

Table 5.2-1 Estimated year 2 impact to surfgrass and other indicator species (0.3 m criteria) incorporating natural variation (in acres) by beach width option for Encinitas for the low sea level rise scenario

Low Sea Level Rise	Most Probable Impact*	Impact Associated with Natural Variation (NV)**	Project-Related Impact***
50 ft Beach Width			
Reefs with Surfgrass	0.4	2.1	(-1.7)
Reefs with Other Indicators	1.0	8.2	(-7.2)
100 ft Beach Width			
Reefs with Surfgrass	1.8	2.1	(-0.3)
Reefs with Other Indicators	6.7	8.2	(-1.5)
150 ft Beach Width			
Reefs with Surfgrass	4.1	2.1	**2.0**
Reefs with Other Indicators	17.7	8.2	**9.5**
200 ft Beach Width			
Reefs with Surfgrass	5.5	2.1	**3.4**
Reefs with Other Indicators	30.7	8.2	**22.5**

Table 5.2-2 Estimated year 2 impact to surfgrass and other indicator species (0.3 m criteria) incorporating natural variation (in acres) by beach width option for Encinitas for the high sea level rise scenario.

High Sea Level Rise	Most Probable Impact*	Impact Associated with Natural Variation (NV)**	Project-Related Impact***
50 ft Beach Width			
Reefs with Surfgrass	0.4	2.1	(-1.7)
Reefs with Other Indicators	1.1	8.2	(-7.1)
100 ft Beach Width			
Reefs with Surfgrass	1.9	2.1	(-0.2)
Reefs with Other Indicators	7.4	8.2	(-0.8)
150 ft Beach Width			
Reefs with Surfgrass	4.2	2.1	**2.1**
Reefs with Other Indicators	18.8	8.2	**10.6**
200 ft Beach Width			
Reefs with Surfgrass	6.7	2.1	**4.6**
Reefs with Other Indicators	31.4	8.2	**23.2**

Notes for Table 5.2-1 and Table 5.2-2:
*Most Probable Impact based on averaged Year 2 results.
**“Natural Variation” was determined using the standard deviation of empirical coastal profile data collected by Coastal Frontiers from 1996 to 2008.
***Project-related impact equals Most Probable Impact minus Natural Variation. Negative number denotes estimated impact less than “Natural Variation”.

Table 5.2-3 Estimated year 2 impact to intertidal reef platform, surfgrass, and other indicator species (0.3 m criteria) incorporating natural variation (in acres) by beach width option for Solana Beach for the low sea level rise scenario.

Low Sea Level Rise	Most Probable Impact*	Impact Associated with Natural Variation (NV)**	Project-Related Impact***
50 ft Beach Width			
Intertidal Reef Platform	0.0	0.0	0.0
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	0.7	4.0	(-3.3)
100 ft Beach Width			
Intertidal Reef Platform	0.1	0.0	**0.1**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	5.6	4.1	**1.5**
150 ft Beach Width			
Intertidal Reef Platform	0.3	0.0	**0.3**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	10.6	4.1	**6.5**
200 ft Beach Width			
Intertidal Reef Platform	0.4	0.0	**0.4**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	12.1	4.1	**8.0**
250 ft Beach Width			
Intertidal Reef Platform	0.4	0.0	**0.4**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	14.7	4.1	**10.6**
300 ft Beach Width			
Intertidal Reef Platform	0.4	0.0	**0.4**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	16.9	4.1	**12.8**

Table 5.2-4 Estimated year 2 impact to intertidal reef platform, surfgrass, and other indicator species (0.3 m criteria) incorporating natural variation (in acres) by beach width option for Solana Beach for the high sea level rise scenario.

High Sea Level Rise	Most Probable Impact*	Impact Associated with Natural Variation (NV)**	Project-Related Impact***
50 ft Beach Width			
Intertidal Reef Platform	0.0	0.0	0.0
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	0.9	4.1	(-3.2)
100 ft Beach Width			
Intertidal Reef Platform	0.1	0.0	**0.1**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	6.0	4.1	**1.9**
150 ft Beach Width			
Intertidal Reef Platform	0.3	0.0	**0.3**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	11.0	4.1	**6.9**
200 ft Beach Width			
Intertidal Reef Platform	0.4	0.0	**0.4**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	13.1	4.1	**9.0**
250 ft Beach Width			
Intertidal Reef Platform	0.4	0.0	**0.4**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	14.9	4.1	**10.8**
300 ft Beach Width			
Intertidal Reef Platform	0.4	0.0	**0.4**
Reefs with Surfgrass	0.0	0.4	(-0.4)
Reefs with Other Indicators	17.1	4.1	**13.0**

Notes:
*Most Probable Impact based on averaged Year 2 results.
**Natural Variation was determined using the standard deviation of empirical coastal profile data collected by Coastal Frontiers from 1996 to 2008.
***Project-related impact equals Most Probable Impact minus Natural Variation. Negative number denotes estimated impact less than "Natural Variation".

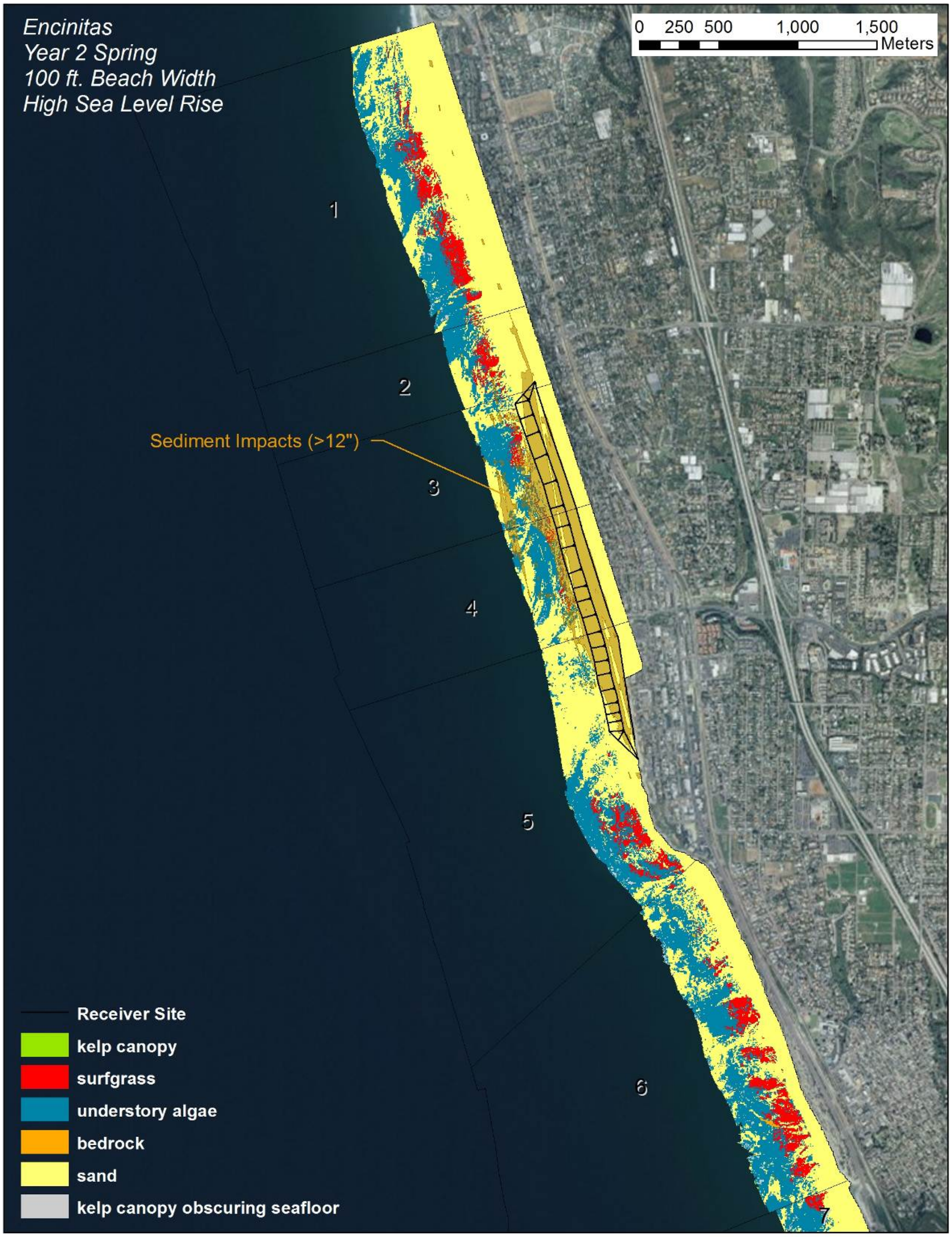

Figure 5.2-1 Example of year 2 (spring) modeled sedimentation results for Encinitas (100 ft beach width and high sea level rise).

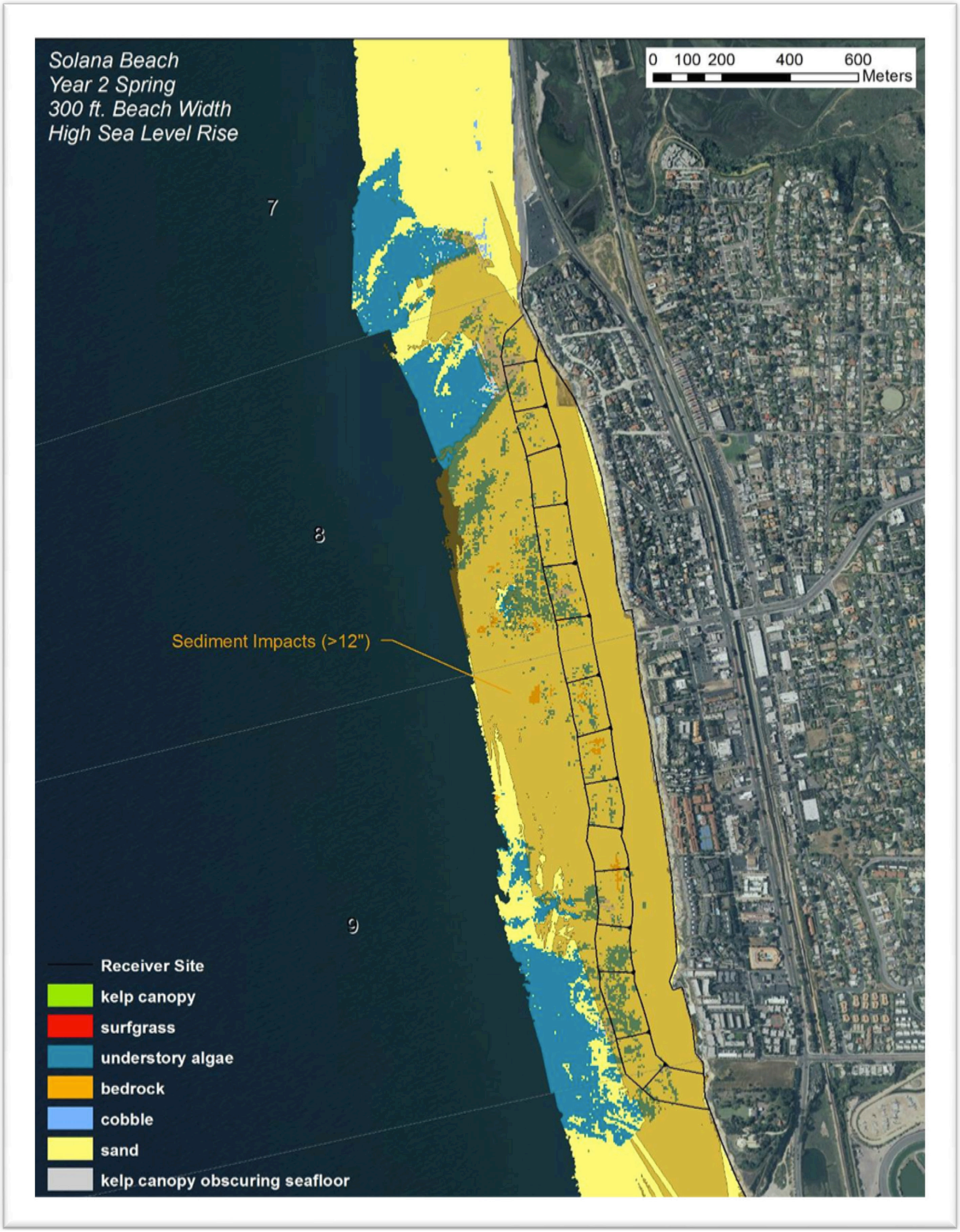

Figure 5.2-2 Example of year 2 (spring) modeled sedimentation results for Solana Beach (300 ft beach width and high sea level rise).

6 MITIGATION AND MONITORING

To assist in the cost-benefit analyses and in the selection of the NED Plan and other potential project alternatives, potential impacts to nearshore reefs and indicator species were assessed based on USACE model predictions for a variety of beach width options and sea level rise scenarios. To accommodate the need to conduct multiple model runs, a GIS-based approach was developed to utilize the existing spatial data available (e.g., LiDAR, multibeam bathymetry, and multi-spectral aerial imagery). To assess specifically potential project-related impacts, natural sediment variation was incorporated into the model based on 12 years of empirical coastal profile data.

The model predicted no project-related impact to nearshore reefs supporting surfgrass or other indicator species at Encinitas for both high and low sea level rise scenarios with beach widths of 100 ft or less; however, impacts to these resources were predicted for beach widths of 150 ft or greater. At Solana Beach, no project-related impacts to nearshore reefs supporting surfgrass were predicted for all beach width options and sea level rise scenarios. However, impacts to nearshore reefs supporting other indicator species (kelps) were predicted for beach widths greater than 50 ft for both low and high sea level rise scenarios. Costs to mitigate potential impacts and conduct monitoring were estimated based on recent similar mitigation projects (i.e., Wheeler North Kelp Reef). These costs were one metric used in the cost-benefit analysis to determine the NED Plan and other potential project alternatives.

Regarding potential impacts associated with renourishment, the need for renourishment was based on the equilibrium beach width that will be implemented (e.g., if a 100 ft beach width is proposed for the initial placement, renourishment volume will be based on maintaining a 100 ft beach width).

Therefore, no additional impacts are anticipated from renourishment, as any impact to nearshore resources would be expected during the initial beach fill. Renourishment events require substantially less sand to maintain beach widths than the initial fill volume. Impacts from those reduced volumes are expected to be less than those from the initial fill. Impacts from the initial fill will be mitigated as needed by the construction reef habitat features. Any impacts associated with renourishment would have been mitigated for following the initial fill. In addition, an adaptive monitoring program is proposed for the project to also account for potential cumulative impacts associated other beach nourishment activities (e.g., opportunistic programs, lagoon maintenance).

Due to inherent uncertainties associated with estimating impacts based on model predictions, a monitoring program would be implemented to assess actual impacts during the two years following construction. Delaying the identification of mitigation requirements for two years allows sand to migrate and to reach steady state conditions. Waiting for two years allows time for temporary impacts to end thus preventing the project from mitigating for short-term impacts that do not warrant mitigation. Reef features are naturally exposed to periodic burial, so that short-term burial resulting from the project is not a loss. Monitoring of the near shore resources will begin prior to construction to establish baseline conditions and resume immediately following construction. Mitigation would be triggered only if certain conditions occur during, and persist through, the two year post-construction monitoring period. Temporal loss for impacted resources due to the two-year waiting period are considered when establishing the mitigation functional equivalent described in **Appendix M**. The impact assessment methodology discussed in this appendix, the mitigation functional equivalent discussed in **Appendix M**, and the two-year waiting period to measure long-term impacts were established in conjunction with federal and state resource agencies, including the NMFS, CDFG, Coastal Commission, and USFWS. If mitigation is implemented, mitigation monitoring would also be conducted. This section provides information regarding mitigation and monitoring for nearshore biological resources regardless of which project alternative is selected, and includes:

1. A pre- and post-construction monitoring program for rocky reef/surfgrass habitat in the project area to determine if project mitigation would be necessary;

2. A preliminary mitigation implementation plan, if mitigation is determined to be necessary; and

3. A preliminary mitigation monitoring plan, if mitigation is determined to be necessary.

The final mitigation and monitoring plans will be prepared during the pre-construction engineering design (PED) phase of the project. The details of these plans will be finalized in consultation with knowledgeable, experienced, and qualified marine ecologists, with monitoring performed by knowledgeable, experienced, and qualified marine biologists. These knowledgeable, experienced, and qualified marine ecologists may come from a variety of agencies, organizations, institutions, or community centers of practice and expertise, such as – the University of California, USACE Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Service (NMFS) Southwest Fisheries Sciences Center, U.S. Geological Survey (USGS) Western Ecological Research Center, other Federal and state agencies, as well as, consulting marine ecologists. California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (USFWS), and NMFS staff will also be involved with the review process.

6.1 Pre- and Post-Construction Monitoring Program

The project has been designed to avoid or minimize impacts to sensitive biological resources to the maximum extent practicable. This was done by selecting fill alternatives that limit fill volume while achieving project objectives. Encinitas, for example, was able to select a beach width that avoids losses of rocky and surf grass habitats while still achieving shoreline protection objectives. Solana Beach selected an alternative that resulted in no impacts to surf grass resources while impacting minimal reef resources. Fill footprints for both cities avoid any direct impacts to sensitive resources; all estimated impacts are the result of indirect burial. However, for several alternatives, potential project impacts have been identified using a conservative coastal engineering model. Prior to the implementation of construction of the project, the extent of reef habitat and vegetation throughout and adjacent to the entire predicted equilibrium footprint will be mapped using remote sensing techniques such as multi-spectral aerial photography and/or interferometric side scan sonar. Multi-spectral aerial photography utilizes an airplane to capture multispectral reflectance characteristics that allow the identification and separation of various bottom substrates and vegetation, while interferometric side scan sonar is a type of technology used to interpret seabed features, material, and textures from acoustic backscatter response intensity, as well as, bathymetry. When the techniques are combined, data sets include bathymetry, bottom substrate type, and vegetation type information. Results from similar methodologies were used for this study to provide the baseline data (i.e., SANDAG 2002), and the proposed mapping provides the most cost-effective approach for surveying the large study area. This pre-construction monitoring is to establish baseline conditions to compare post-construction conditions against. All data would be geo-rectified, and habitat types digitized as a theme over an aerial image to calculate the coverage of various habitat types and show its distribution. Diver surveys would also be conducted to ground truth or verify remote sensing data. The diver surveys would be at a level appropriate to effectively ensure that data were representative (e.g., 20 random locations for each substrate or habitat type). The proposed mapping would be repeated during years one and two post-construction to determine what long-term impacts result from the project that require mitigation. Based on the data collected, a decision will be made as to whether, and to what extent, mitigation is necessary.

The general approach for assessing impacts would be similar to that used to identify potential project-related impacts to eelgrass as per the Southern California Eelgrass Mitigation Policy (SCEMP; NMFS 1991). The project area and control site(s) will be surveyed prior to construction, and annually for two years following construction.

Seasonal monitoring may be required for grunion (if suitable habitat is identified in any of the sand placement areas). The season for grunion is identified as March 15 to September 1. A cultural resource survey of the mitigation sites would be needed prior to mitigation construction. A cultural resource survey of the borrow site would also be performed prior to construction. Water quality monitoring will be performed during construction on a weekly basis. Pre- and post-construction monitoring of the nearshore environmental will be conducted to allow for identification of project-related impacts for purposes of delineating mitigation requirements.

Given the relatively high natural variation of sediment transport that occurs in the nearshore zone, multiple control sites be mapped to provide a level of natural variability. Potential control areas, chosen for their similarity to potential impact sites, in the general project area include North Carlsbad (in the vicinity of Tamarack Boulevard) and South Carlsbad (north of Palomar Airport Road). By sampling control sites, changes in the sediment cover would be put into a regional perspective and natural variation taken into account. If this was not measured, any increase in sediment cover in the project area would be considered project related. This is similar to the eelgrass mapping/impact assessments, whereby changes at the project site are compared with reference areas. This is necessary if there is a reduction in eelgrass at the project site, that may be the result of a natural decline measured relative to the reference area. Pre-construction (baseline) areal coverage will be compared to Year 2 (post-construction) areal coverage, taking into account any natural variation at control areas to identify potential project-related impacts.

The City of Encinitas and the City of Solana Beach have been performing annual fall and spring beach profile surveys to monitor shoreline changes. The survey included transects historically monitored by the Cities. Data would be obtained from the back beach seaward, offshore of the presumed depth of closure. Beach profile data would be acquired to wading depth along transects located within or adjacent to the nourishment site.

The expected monitoring schedule includes:

Pre-construction baseline monitoring (year prior to construction):

- Spring Survey
- Fall Survey

Post-construction (annually for two years following construction):

- Spring Survey
- Fall Survey

6.2 Mitigation

If mitigation were required based on results of the second annual post-construction monitoring, rocky reef and surfgrass mitigation shall each be conducted at an equivalent functional value to the impacted area. Because it will take at least two years to identify impacts, some temporal loss of habitat, if impacts were to occur, is unavoidable. Delaying the identification of mitigation requirements for two years allows sand to migrate and to reach steady state conditions. Waiting for two years allows time for temporary impacts to end thus preventing the project from mitigating for short-term impacts that do not warrant mitigation. Recovery of impacted habitats may also occur as sand is redistributed within the littoral cell; some observed burial of reef or surfgrass habitat would be temporary because sand would be expected to move out of the project area. Additionally, if impacts are substantially different than predicted were to occur, future beach fills would be modified as part of the adaptive management plan for this project. The decision point for determination of mitigation is after the second annual post-construction monitoring. Any loss of nearshore habitat (greater than 1 foot over historical sedimentation) relative to the reference sites would require mitigation. Temporal loss of habitat are mitigated by using a mitigation functional equivalent that includes this temporal loss as one of the factors used in the calculation (see **Appendix M**). A functional equivalent of 2:1 is proposed for rocky reef resources.

Mitigation would be implemented in the project area at sites to be determined by the USACE and the two cities in consultation with the various resource and regulatory agencies noted previously (NMFS, USFWS, Coastal Commission, CDFG). Since potential impacts were identified for Solana Beach for the project alternatives carried forward, potential mitigation areas offshore of Solana Beach were identified (approximately 26 acres) and includes areas that consist primarily of sandy bottom habitat (**Figure 6.2-1**). No estimated project-related impacts were predicted for Encinitas under the alternatives that were carried forward, and therefore no potential mitigation areas were identified offshore of Encinitas. However, it should be noted that if mitigation is required for impacts that occur at Encinitas, there are options including the nearshore resources and the Swami's State Marine Conservation Area.

Reef habitat mitigation shall consist of shallow-water, mid-water, or deep-water reef at a 2:1 functional equivalent to the area of reef impacted. Shallow-water reef would be the type of reef replanted for any surfgrass mitigation, mid-water reef would be located inshore of the existing kelp beds, and deep-water reef would be located offshore of the existing kelp beds. The mid-water reef would be the first priority chosen for use for mitigation as it is most like the reef being impacted and is thus closer to an in-kind mitigation. However, deep-water reef mitigation may be required if insufficient area in the mid-water depth is available for all required mitigation.

Mid-water reef would be constructed on the offshore/outer edge of the existing reef; mid-water reef would be constructed at approximately -30 ft Mean Lower Low Water (MLLW); and deep water reef would be constructed at approximately -40 ft MLLW along the outside edge of the existing reefs. Shallow-water reef shall be constructed with a final top elevation of -10 to -14 ft MLLW. Construction of a reef that is shallower than -10 to -14 ft MLLW is not proposed because construction methods would not be practical (e.g., a barge with the reef construction materials would not be able to operate in this shallow of water). Although the surfgrass mitigation reef would be deeper than the impacted area, if surfgrass transplants are successful, the slightly deeper reef would replace the lost surfgrass resource. If surf grass transplants are not successful, the shallow-water reefs will be vegetated with kelp to serve as out of kind mitigation for surf grass losses, if any. No surf grass losses are predicted for either city.

Mid-water reef is the preferred reef mitigation as it is closest to in-kind replacement in terms of water depth and expected habitat. Mid-water reef also has some sand-retention value for adjacent beaches, similar to natural reefs. Mid- and deep-water reef shall be constructed in a fashion similar to the SCE Wheeler North Reef, which was constructed as mitigation for the impacts of the San Onofre Nuclear Generating Station. For example, if the monitoring shows 1 acre of reef impact and 1 acre of surfgrass impact, 2 acres of shallow-water reef would be constructed and 2 acres of mid- or deep-water reef would be constructed.

Although several studies currently are being conducted to determine how to successfully transplant surfgrass, and may show success, success rates to date have not been consistent (Reed and Holbrook 2003, Reed et al. 1999). Due to the absence of an established, successful method for mitigation of surfgrass loss, proposed mitigation currently is focused upon restoration of the rocky reef that surfgrass currently uses as habitat and an experimental transplant that allows for one attempt to transplant surf grass followed by out of kind kelp transplant, which does have a history of success. However, if it is determined that surfgrass has been affected by the project, and not due to natural variation, an experimental surfgrass transplant shall be implemented in addition to the construction of a shallow-water rocky reef.

Currently, surfgrass transplant success is much higher for subtidal than for intertidal conditions and, therefore, surfgrass mitigation efforts for this project will focus on subtidal transplants only. The methodology for the surfgrass transplant shall be the transplant of sprigs from a donor bed to the new reef using the method developed by Bull et al. (2004). To harvest sprigs, an unbranched terminal end of an actively growing rhizome is carefully removed from the perimeter of a bed with a knife. The rhizome of each sprig should contain several lateral shoots and a terminal shoot. Sprigs are then transplanted by attaching the cut end of the rhizome to the reef using marine epoxy. An alternative transplant method could be proposed, if evidence can be presented that the alternative method has as great or greater chance of success as the sprig transplant method. To avoid harvesting effects to the subject surfgrass bed, donor material will be taken from a larger area of surfgrass in the vicinity of the study area.

A portion of the shallow-water reef shall be test planted with surfgrass. The transplant will be conducted in the late summer/early fall, the time of year when most surfgrass seeds are released and germinate in southern California. A test area equal to approximately 25 percent of the surfgrass impact area (not to exceed 0.1 acre) will be test planted. Success of the transplant shall be determined after six months based on survivorship, percentage change in the number of leaves and the amount of areal coverage. The experimental transplant will be considered successful if the sprigs survive and there is a net increase in number of leaves and areal coverage. If the transplants survive, surfgrass grows. If the test transplant is successful, the remainder of the surfgrass impact area will be planted on the shallow-water reef with surfgrass. If the surfgrass transplant is not successful, two acres of shallow-water kelp (e.g., *Egregia menziesii* and *Eisenia arborea*) will be transplanted on the two acres of shallow-water reef built during the project mitigation.

6.2.1 Surfgrass Mitigation Monitoring Plan

Surf grass mitigation will be monitored for five years after the transplant is completed. This would be a part of the post-construction monitoring program to be performed for the project. Permanent transects shall be established on the mitigation reef containing the surfgrass bed (if the experimental surfgrass transplant is successful) and at a reference site (control area) of similar depth. The same number of transects would be established in the control area as in the mitigation area, and transects will be at similar depths. Transects should be monitored at the following intervals, if successful:

Post-mitigation implementation*:

Year One

- within one month after completion
- 3 months after completion
- 6 months after completion
- 1 year after completion

Years Two through Five

- Spring survey
- Fall survey

*This time line follows full mitigation, which occurs only if the experimental transplant is successful. This is not after the experimental transplant, which is only monitored once, six months after transplant.

Success Criteria

The mitigation functional equivalent established in Appendix M results in the creation of mitigation reefs that are functionally equivalent to the rocky reef habitats permanently lost. This includes temporal loss of habitat value during the two-year monitoring period and design and construction time for the mitigation features. Success criteria would include determining if measured parameters are significantly different than the control transects. Success criteria for the mitigation reef itself would include no complete permanent burial of the reef. Because of the predominantly sandy bottom environment in the project area, placement of the deep water rocky reef would be considered successful if a characteristic invertebrate and fish community were to become established. On each surfgrass transect, the following parameters will be monitored at a minimum: 1) surfgrass density (i.e., number of shoots per square meter), 2) percent cover of surfgrass, sand, and rock, 3) sand depth, and 4) identification and quantity of flora and fauna. The line intercept method is recommended for measuring percent cover and sand depth. With this method, a tape measure is deployed and at pre-determined or random numbers, data are collected, Specific success criteria will be developed during the PED phase. General success criteria will consist of the following:

1. Approximately 50% - 60% of the fish, invertebrates, and algae species found at the reference site occur at the mitigation site two years post-mitigation.

2. Approximately 50% - 60% of surfgrass survival at the mitigation site two years post-mitigation implementation.

An estimated cost to implement the mitigation and mitigation monitoring is provided in Table 6.2-1through Table 6.2-4and is dependent on the estimated level of impact. Key assumptions are also provided Section 4.4.

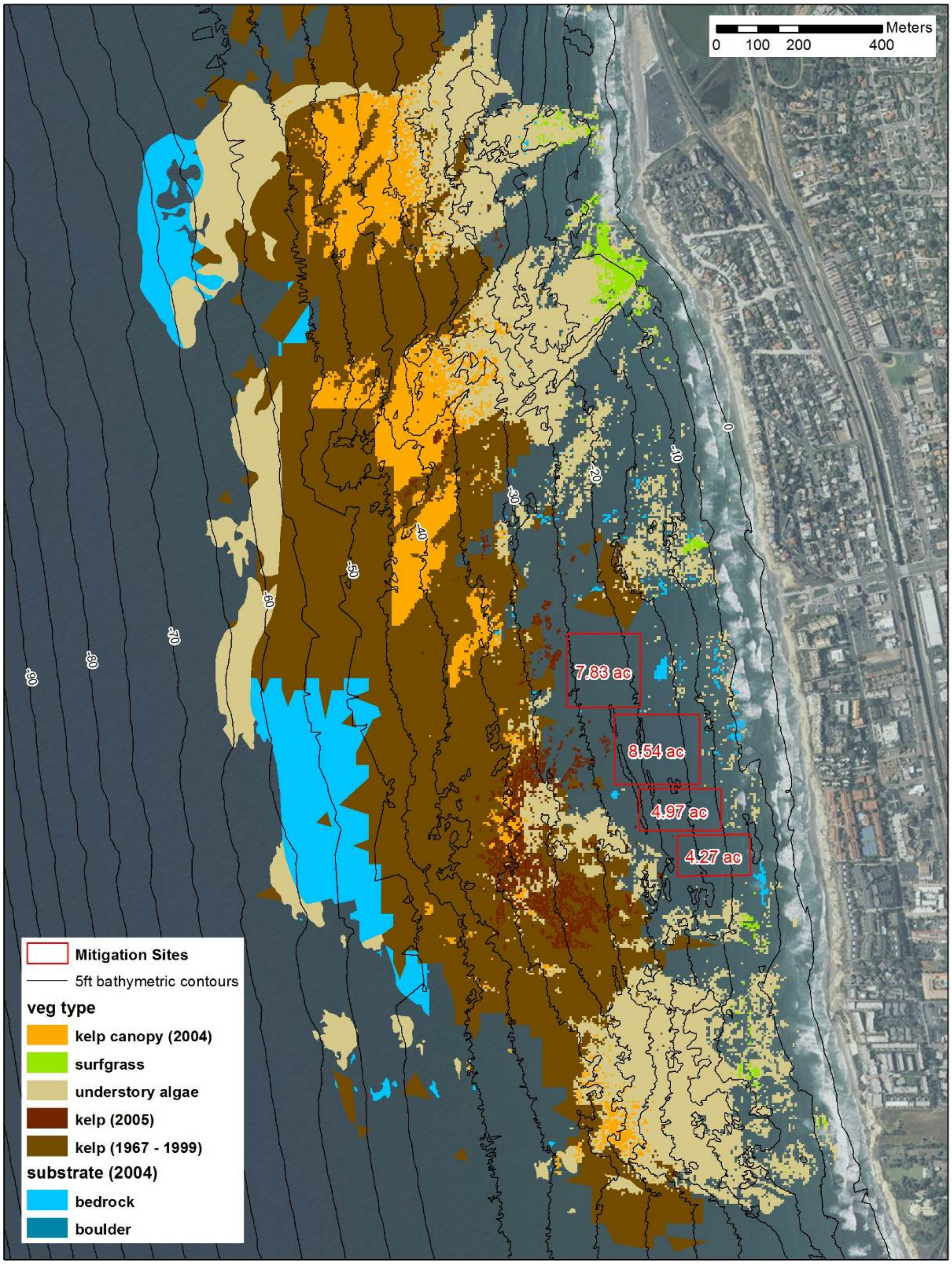

Figure 6.2-1 Potential mitigation areas off Solana Beach.

Table 6.2-1 Mitigation estimate for Encinitas for the low sea level rise scenario.

Beach Width Option (ft)	Resource	Project-Related Impact (Acres)	Mitigation Required?	Estimated Construction Monitoring Cost*	Surfgrass Transplanting Cost*	Reef Mitigation*	Estimated Kelp Transplanting Cost*	Estimated Mitigation Monitoring Cost*	Sub-Total Mitigation Cost*	Total Mitigation Cost**
50	Reefs with Surfgrass	(-1.7)	No	$75,000	N/A	N/A	N/A	N/A	N/A	$150,000
	Reefs with Other Indicators	(-7.2)	No		N/A	N/A	N/A	N/A	N/A	
100	Reefs with Surfgrass	(-0.3)	No	$75,000	N/A	N/A	N/A	N/A	N/A	$150,000
	Reefs with Other Indicators	(-1.5)	No		N/A	N/A	N/A	N/A	N/A	
150	Reefs with Surfgrass	**2.0**	**Yes**	$75,000	$500,000	$4,000,000	N/A	$75,000	$4,500,000	$18,870,000
	Reefs with Other Indicators	**9.5**	**Yes**		N/A	4,750,000	$35,000		$4,785,000	
200	Reefs with Surfgrass	**3.4**	**Yes**	$75,000	$850,000	$6,800,000	N/A	$75,000	$7,650,000	$38,190,000
	Reefs with Other Indicators	**22.5**	**Yes**		N/A	$11,250,000	$45,000		$11,295,000	

*Assumes 1:1 mitigation functional equivalent (used for cost-estimation purposes)
**Assumes 2:1 mitigation functional equivalent

Table 6.2-2 Mitigation estimate for Encinitas for the high sea level rise scenario.

Beach Width Option (ft)	Resource	Project-Related Impact (Acres)	Mitigation Required ?	Estimated Construction Monitoring Cost*	Surfgrass Transplanting Cost*	Reef Mitigation*	Estimated Kelp Transplanting Cost*	Estimated Mitigation Monitoring Cost*	Sub-Total Mitigation Cost*	Total Mitigation Cost**
50	Reefs with Surfgrass	(-1.7)	No	$75,000	N/A	N/A	N/A	N/A	N/A	$150,000
	Reefs with Other Indicators	(-7.1)	No		N/A	N/A	N/A	N/A	N/A	
100	Reefs with Surfgrass	(-0.2)	No	$75,000	N/A	N/A	N/A	N/A	N/A	$150,000
	Reefs with Other Indicators	(-0.8)	No		N/A	N/A	N/A	N/A	N/A	
150	Reefs with Surfgrass	**2.1**	**Yes**	$75,000	$525,000	$4,200,000	N/A	$75,000	$4,725,000	$20,430,000
	Reefs with Other Indicators	**10.6**	**Yes**		N/A	$5,300,000	$40,000		$5,340,000	
200	Reefs with Surfgrass	**4.6**	**Yes**	$75,000	$1,150,000	$9,200,000	N/A	$75,000	$10,350,000	$44,300,000
	Reefs with Other Indicators	**23.2**	**Yes**		N/A	$11,600,000	$50,000		$11,650,000	

*Assumes 1:1 mitigation functional equivalent (used for cost-estimation purposes)
**Assumes 2:1 mitigation functional equivalent

Table 6.2-3 Mitigation estimate for Solana Beach for the low sea level rise scenario.

Beach Width Option (ft)	Resource	Project-Related Impact (Acres)	Mitigation Required?	Estimated Construction Monitoring Cost**	Reef Mitigation**	Estimated Kelp Transplanting Cost**	Estimated Mitigation Monitoring Cost**	Total Mitigation Cost***
50	Intertidal Reef Platform	0.0	No	$75,000	N/A	N/A	N/A	$150,000
	Reefs with Surfgrass	(-0.4)	No		N/A	N/A	N/A	
	Reefs with Other Indicators	-3.3	No		N/A	N/A	N/A	
100	Intertidal Reef Platform	**0.1**	**Yes**	$75,000	$50,000*	N/A	$75,000	$1,920,000
	Reefs with Surfgrass	(-0.4)	No		N/A	N/A		
	Reefs with Other Indicators	**1.5**	**Yes**		$750,000	$10,000		
150	Intertidal Reef Platform	**0.3**	**Yes**	$75,000	$150,000*	N/A	$75,000	$7,270,000
	Reefs with Surfgrass	(-0.4)	No		N/A	N/A		
	Reefs with Other Indicators	**6.5**	**Yes**		$3,300,000	$35,000		
200	Intertidal Reef Platform	**0.4**	**Yes**	$75,000	$200,000*	N/A	$75,000	$8,800,000
	Reefs with Surfgrass	(-0.4)	No		N/A	N/A		
	Reefs with Other Indicators	**8.0**	**Yes**		$4,000,000	$50,000		
250	Intertidal Reef Platform	**0.4**	**Yes**	$75,000	$200,000*	N/A	$75,000	$11,630,000
	Reefs with Surfgrass	(-0.4)	No		N/A	N/A		
	Reefs with Other Indicators	**10.6**	**Yes**		$5,400,000	$65,000		
300	Intertidal Reef Platform	**0.4**	**Yes**	$75,000	$200,000*	N/A	$75,000	$13,650,000
	Reefs with Surfgrass	(-0.4)	No		N/A	N/A		
	Reefs with Other Indicators	**12.8**	**Yes**		$6,400,000	$75,000		

*Based on out-of-kind mitigation cost
**Assumes 1:1 mitigation functional equivalent (used for cost-estimation purposes)
***Assumes 2:1 mitigation functional equivalent

Table 6.2-4 Mitigation estimate for Solana Beach for the high sea level rise scenario.

Beach Width Option (ft)	Resource	Project-Related Impact (Acres)	Mitigation Required?	Estimated Construction Monitoring Cost**	Reef Mitigation**	Estimated Kelp Transplanting Cost**	Estimated Mitigation Monitoring Cost**	Total Mitigation Cost***
	Intertidal Reef Platform	0.0	No		N/A	N/A	N/A	
50	Reefs with Surfgrass	(-0.4)	No	$75,000	N/A	N/A	N/A	$150,000
	Reefs with Other Indicators	(-3.2)	No		N/A	N/A	N/A	
	Intertidal Reef Platform	**0.1**	**Yes**		$50,000*	N/A		
100	Reefs with Surfgrass	(-0.4)	No	$75,000	N/A	N/A	$75,000	$2,320,000
	Reefs with Other Indicators	**1.9**	**Yes**		$950,000	$10,000		
	Intertidal Reef Platform	**0.3**	**Yes**		$150,000*	N/A		
150	Reefs with Surfgrass	(-0.4)	No	$75,000	N/A	N/A	$75,000	$7,670,000
	Reefs with Other Indicators	**6.9**	**Yes**		$3,500,000	$35,000		
	Intertidal Reef Platform	**0.4**	**Yes**		$200,000*	N/A		
200	Reefs with Surfgrass	(-0.4)	No	$75,000	N/A	N/A	$75,000	$9,810,000
	Reefs with Other Indicators	**9.0**	**Yes**		$4,500,000	$55,000		
	Intertidal Reef Platform	**0.4**	**Yes**		$200,000*	N/A		
250	Reefs with Surfgrass	(-0.4)	No	$75,000	N/A	N/A	$75,000	$11,630,000
	Reefs with Other Indicators	**10.8**	**Yes**		$5,400,000	$65,000		
	Intertidal Reef Platform	**0.4**	**Yes**		$200,000*	N/A		
300	Reefs with Surfgrass	(-0.4)	No	$75,000	N/A	N/A	$75,000	$13,860,000
	Reefs with Other Indicators	**13.0**	**Yes**		$6,500,000	$80,000		

*Based on out-of-kind mitigation cost
**Assumes 1:1 mitigation functional equivalent (used for cost-estimation purposes)
***Assumes 2:1 mitigation functional equivalent

6.2.2 Compensatory, Mid-Water, or Deep-Water Reef Mitigation Monitoring Plan

Similar to the Surfgrass Mitigation Monitoring Plan, permanent transects shall be established in the rocky reef area containing the kelp on the mitigation reef and at a reference site (control area) of similar depth. The same number of transects would be established in the control area as in the mitigation areas and transects would be at similar depths. On each kelp transect, the following parameters would be monitored at a minimum: 1) kelp density (number of kelp plants per square meter) of each age class, 2) holdfast diameter of each adult kelp plant on the transect, 3) number of stipes of each adult kelp plant on the transect, and 4) identification and quantity of associated flora and fauna. Transects should be monitored at the following intervals:

Post-compensatory mitigation implementation:

Year One

- within one month after completion
- 3 months after completion
- 6 months after completion
- 1 year after completion

Years Two through Five

- Spring survey
- Fall survey

<u>Success Criteria</u>

Success criteria of kelp would include determining if the measured parameters are significantly different than the reference transects. Success criteria for the mitigation reef itself (if it is not planted with kelp) would include no complete permanent burial of the reef. Because of the predominantly sandy bottom environment in the project area, placement of the deep water rocky reef would be considered successful if a characteristic invertebrate and fish community were to become established. On each kelp transect, the following parameters should be monitored and evaluated at a minimum: 1) kelp density (number of kelp plants per square meter) of each age class, 2) holdfast diameter of each adult kelp plant on the transect, 3) number of stipes of each adult kelp plant on the transect, and 4) identification and quantity of associated flora and fauna. Specific success criteria will be developed during the PED phase. General success criteria will consist of the following:

1. Approximately 50% - 60% of the fish, invertebrates, and algae found at the reference site occur at the mitigation site two years post-mitigation.

2. Approximately 50% - 60% of kelp survival at the mitigation site two years post-mitigation implementation.

Key assumptions are also provided Section 4.4.

7 REFERENCES

AMEC 2005. Regional Beach Sand Project, Year 4 (2004-2005) Post-Construction Monitoring Report for Intertidal, Shallow Subtidal, and Kelp Forest Resources and Comprehensive Analysis Report (2001-2005). Prepared for San Diego Association of Governments. Available at: http://www.sandag.org.

Bull, J.S., D.C. Reed, and S.J. Holbrook. 2004. An Experimental Evaluation of Different Methods of Restoring *Phyllospadix torreyi* (Surfgrass). Restoration Ecology 12(1): 70-79.

Coastal Frontiers Corporation. 2004 Regional Beach Monitoring Program, Annual Report. Prepared for San Diego Association of Governments (SANDAG). Available at: http://www.sandag.org.

MEC Analytical Systems, Inc. (MEC). 2000. Appendix D to the SANDAG Regional Beach Sand Project EIR/EA. Evaluation of Impacts to Marine Resources and Water Quality from Dredging of Sands from Offshore Borrow Sites and Beach Replenishment at Oceanside, Carlsbad, Leucadia, Encinitas, Cardiff, Solana Beach, Del Mar, Torrey Pines, Mission Beach, and Imperial Beach, California. Prepared for KEA Environmental, Inc.

National Marine Fisheries Service. 1991. Southern California Eelgrass Mitigation Policy. R.S. Hoffman, ed. (1991, as amended, Version #11).

Reed, D.C. and S.J. Holbrook. 2003. An experimental evaluation of methods of surfgrass (*Phyllospadix torreyi*) restoration using early life history stages. MMS OCS Study 2003-034. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-30758. 96 pages.

Reed, D.C., S.J. Holbrook, and S.E. Worcester. 1999. Development of Methods for Surfgrass (*Phyllospadix* spp.) Restoration Using Early Life History Stages. MMS OCS Study 99-0019. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-30758. 79 pages.

San Diego Association of Governments (SANDAG). 2011. Environmental Assessment/Final Environmental Impact Report for the San Diego Regional Beach Sand Project II – Biology Technical Appendix.

Science Applications International Corporation (SAIC). 2007. Coastal Reef Habitat Survey of Encinitas and Solana Beach, California. Prepared for the City of Encinitas.

U.S. Department of the Navy, Southwest Division (USDN). 1997a. Environmental Assessment for Beach Replenishment at South Oceanside and Cardiff/Solana Beach, California.

U.S. Department of the Navy, Southwest Division (USDN). 1997b. Environmental Assessment for Beach Replenishment at North Carlsbad, South Carlsbad, Encinitas, and Torrey Pines, California.

Appendix A
Year 2 Sediment Transport Model Predictions

Year 2 Sand Thickness (feet)
Beach Width = 50'

Distance Offshore (m)	DM565		DM560		DM580		DM590		SD595		SD600		SD610		SD620		SD625		SD630		SD650		SD660		SD670		SD675		SD680		SD690		SD695		SD700		SD710	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
0	0.0	0.0	0.0	0.0	0.03	0.01	0.01	0.01	0.01	0.03	1.29	1.88	0.67	2.25	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.012	0.005	0.74	0.65	0.00	0.00	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00
10	0.0	0.0	0.0	0.0	0.02	0.02	0.19	0.12	0.07	0.22	0.43	1.09	0.73	2.04	0.08	0.08	0.01	0.02	0.04	0.04	0.00	0.00	0.00	0.01	0.766	0.873	1.78	1.65	0.68	0.52	0.05	0.04	0.04	0.04	0.00	0.00	0.02	0.02
20	0.0	0.0	0.0	0.0	0.02	0.04	0.18	0.12	0.15	0.30	1.02	1.67	0.71	1.63	0.13	0.16	0.01	0.03	0.04	0.05	0.00	0.00	0.00	0.01	0.504	0.821	1.11	1.20	**0.55**	0.45	0.03	0.02	0.03	0.03	0.00	0.00	0.02	0.03
30	0.0	0.0	0.0	0.0	0.01	0.04	0.16	0.12	0.13	0.34	0.79	1.35	0.61	1.36	0.16	0.22	0.03	0.05	0.04	0.05	0.00	0.00	0.00	0.01	0.828	1.234	0.97	1.29	0.43	0.42	0.01	0.01	0.02	0.02	0.00	0.00	0.02	0.03
40	0.0	0.0	0.0	0.0	0.02	0.04	0.16	0.13	0.16	0.38	0.97	1.53	0.50	1.24	0.11	0.16	0.02	0.04	0.04	0.06	0.00	0.00	0.00	0.01	0.572	0.976	1.38	1.97	0.33	0.36	0.01	0.01	0.02	0.02	0.00	0.00	0.02	0.04
50	0.0	0.0	0.0	0.0	0.02	0.04	0.13	0.12	0.17	0.35	0.99	1.57	0.48	1.17	0.06	0.13	0.02	0.03	0.04	0.05	0.00	0.00	0.00	0.01	0.462	0.824	1.36	2.22	0.31	0.34	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.03
60	0.0	0.0	0.0	0.0	0.02	0.04	0.08	0.09	0.20	0.37	0.89	1.47	0.41	0.98	0.05	0.12	0.02	0.02	0.03	0.04	0.00	0.00	0.00	0.01	0.406	0.735	0.88	1.91	0.32	0.35	0.01	0.02	0.01	0.02	0.00	0.00	0.01	0.02
70	0.0	0.0	0.0	0.0	0.03	0.04	0.07	0.10	0.22	0.36	0.73	1.33	0.47	0.91	0.05	0.12	0.02	0.02	0.03	0.04	0.00	0.00	0.00	0.00	0.375	0.613	0.91	1.87	0.27	0.33	0.01	0.02	0.02	0.03	0.00	0.00	0.00	0.01
80	0.0	0.0	0.0	0.0	0.03	0.04	0.08	0.11	0.21	0.33	0.68	1.28	0.69	1.04	0.07	0.13	0.01	0.02	0.03	0.04	0.00	0.00	0.01	0.01	0.574	0.766	0.99	1.91	0.20	0.29	0.02	0.03	0.02	0.03	0.00	0.00	0.00	0.01
90	0.0	0.0	0.0	0.0	0.03	0.04	0.12	0.16	0.17	0.28	1.01	1.58	1.07	1.24	0.08	0.14	0.01	0.02	0.03	0.03	0.00	0.00	0.01	0.01	0.627	0.781	1.06	2.00	0.22	0.32	0.01	0.02	0.01	0.02	0.00	0.00	0.01	0.02
100	0.0	0.0	0.0	0.0	0.02	0.03	0.19	0.22	0.15	0.30	1.23	1.70	1.14	1.17	0.09	0.15	0.01	0.02	0.02	0.03	0.00	0.00	0.01	0.01	0.670	0.798	1.01	1.96	0.13	0.26	0.02	0.03	0.01	0.01	0.00	0.00	0.01	0.02
110	0.0	0.0	0.0	0.0	0.01	0.03	0.24	0.27	0.10	0.30	1.05	1.46	1.10	0.96	0.09	0.16	0.01	0.03	0.03	0.04	0.00	0.00	0.01	0.01	0.572	0.724	0.44	1.31	0.09	0.22	0.03	0.03	0.02	0.01	0.00	0.00	0.02	0.04
120	0.0	0.0	0.0	0.0	0.02	0.04	0.17	0.23	0.18	0.46	1.01	1.42	1.68	1.34	0.10	0.18	0.01	0.03	0.03	0.04	0.00	0.00	0.01	0.00	0.656	0.836	0.43	1.11	0.16	0.30	0.02	0.02	0.03	0.01	0.00	0.00	0.02	0.04
130	0.0	0.0	0.0	0.0	0.02	0.04	0.13	0.22	0.21	0.55	1.02	1.39	0.78	0.62	0.12	0.19	0.01	0.02	0.03	0.04	0.00	0.00	0.01	0.00	0.748	0.946	0.51	0.92	0.22	0.36	0.02	0.01	0.02	0.01	0.00	0.00	0.02	0.04
140	0.0	0.0	0.0	0.0	0.03	0.04	0.12	0.22	0.19	0.54	1.12	1.36	1.27	1.20	0.13	0.17	0.02	0.02	0.04	0.04	0.00	0.00	0.01	0.00	0.642	0.840	0.85	0.93	0.20	0.33	0.01	0.01	0.02	0.01	0.00	0.00	0.02	0.04
150	0.0	0.0	0.0	0.0	0.04	0.05	0.13	0.22	0.14	0.48	1.28	1.27	1.04	0.85	0.13	0.16	0.03	0.03	0.04	0.05	0.00	0.00	0.01	0.00	0.658	0.814	1.38	1.03	0.19	0.30	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.03
160	0.0	0.0	0.0	0.0	0.04	0.04	0.19	0.26	0.16	0.40	1.42	1.17	0.81	0.41	0.13	0.14	0.04	0.03	0.04	0.04	0.00	0.00	0.00	0.00	0.637	0.722	1.68	0.90	0.22	0.22	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.03
170	0.0	0.0	0.0	0.0	0.03	0.04	0.22	0.27	0.27	0.36	1.42	0.94	0.66	0.37	0.13	0.12	0.04	0.03	0.03	0.04	0.00	0.00	0.01	0.01	0.618	0.618	1.78	0.65	0.23	0.21	0.01	0.01	0.01	0.01	0.01	0.00	0.02	0.02
180	0.0	0.0	0.0	0.0	0.03	0.03	0.15	0.22	0.32	0.30	1.38	0.80	0.89	0.45	0.13	0.10	0.04	0.02	0.04	0.03	0.00	0.00	0.00	0.00	0.568	0.477	2.24	0.78	0.20	0.18	0.01	0.01	0.01	0.01	0.01	0.00	0.02	0.01
190	0.0	0.0	0.0	0.0	0.04	0.03	0.11	0.18	0.39	0.22	1.20	0.61	1.21	0.75	0.13	0.07	0.03	0.02	0.04	0.03	0.00	0.00	0.00	0.00	0.550	0.383	1.85	0.60	0.18	0.20	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.01
200	0.0	0.0	0.0	0.0	0.04	0.03	0.08	0.14	0.46	0.18	1.09	0.48	0.83	0.43	0.14	0.08	0.03	0.02	0.03	0.03	0.00	0.00	0.01	0.01	0.536	0.323	1.44	0.62	0.18	0.21	0.02	0.01	0.01	0.01	0.00	0.00	0.01	0.01
210	0.0	0.0	0.0	0.0	0.04	0.02	0.13	0.14	0.54	0.22	1.00	0.36	1.30	0.85	0.15	0.08	0.03	0.01	0.03	0.02	0.00	0.00	0.01	0.00	0.527	0.299	1.15	0.54	0.17	0.26	0.02	0.02	0.02	0.01	0.00	0.00	0.01	0.01
220	0.0	0.0	0.0	0.0	0.04	0.02	0.14	0.10	0.53	0.16	0.88	0.23	1.09	0.75	0.14	0.08	0.03	0.01	0.03	0.02	0.00	0.00	0.01	0.00	0.406	0.159	0.83	0.39	0.24	0.14	0.02	0.02	0.01	0.01	0.00	0.00	0.03	0.01
230	0.0	0.0	0.0	0.0	0.03	0.01	0.15	0.08	0.50	0.14	0.81	0.20	0.90	0.59	0.13	0.08	0.03	0.01	0.03	0.02	0.00	0.00	0.00	0.00	0.448	0.184	0.76	0.52	0.13	0.08	0.03	0.04	0.02	0.01	0.00	0.00	0.03	0.01
240	0.0	0.0	0.0	0.0	0.03	0.01	0.10	0.06	0.45	0.14	0.80	0.30	0.62	0.42	0.13	0.08	0.02	0.01	0.03	0.02	0.00	0.00	0.01	0.01	0.343	0.124	0.72	0.43	0.20	0.23	0.03	0.02	0.02	0.01	0.00	0.00	0.02	0.00
250	0.0	0.0	0.0	0.0	0.03	0.01	0.12	0.07	0.50	0.17	0.73	0.29	0.60	0.50	0.14	0.08	0.02	0.01	0.02	0.01	0.00	0.00	0.01	0.00	0.325	0.126	0.53	0.25	0.55	0.46	0.03	0.02	0.02	0.01	0.00	0.00	0.03	0.01
260	0.0	0.0	0.0	0.0	0.03	0.01	0.14	0.08	0.43	0.17	0.66	0.27	0.72	0.62	0.12	0.08	0.02	0.01	0.02	0.01	0.00	0.00	0.01	0.00	0.296	0.114	0.57	0.18	0.34	0.29	0.02	0.03	0.01	0.01	0.00	0.00	0.03	0.01
270	0.0	0.0	0.0	0.0	0.02	0.01	0.13	0.07	0.36	0.10	0.68	0.34	1.18	1.06	0.11	0.06	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.473	0.318	0.53	0.20	0.26	0.21	0.02	0.02	0.01	0.01	0.00	0.00	0.02	0.01
280	0.0	0.0	0.0	0.0	0.02	0.01	0.07	0.05	0.33	0.08	0.58	0.25	1.08	0.71	0.11	0.05	0.02	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.241	0.111	0.84	0.45	0.18	0.15	0.01	0.02	0.01	0.01	0.00	0.00	0.02	0.01
290	0.0	0.0	0.0	0.0	0.02	0.01	0.04	0.04	0.40	0.17	0.65	0.39	1.03	0.77	0.10	0.04	0.02	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.246	0.159	0.91	0.80	0.11	0.13	0.01	0.01	0.02	0.03	0.00	0.00	0.02	0.01
300	0.0	0.0	0.0	0.0	0.02	0.01	0.06	0.06	0.38	0.17	0.65	0.41	0.64	0.54	0.10	0.03	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.215	0.120	0.47	0.63	0.21	0.17	0.01	0.02	0.02	0.02	0.00	0.00	0.02	0.01
310	0.0	0.0	0.0	0.0	0.02	0.01	0.06	0.05	0.31	0.16	0.52	0.36	0.71	0.66	0.06	0.05	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.231	0.111	0.64	0.60	0.13	0.11	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.01
320	0.0	0.0	0.0	0.0	0.02	0.01	0.09	0.07	0.15	0.09	0.64	0.55	0.86	0.63	0.19	0.22	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.326	0.169	0.78	0.51	0.13	0.06	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
330	0.0	0.0	0.0	0.0	0.02	0.01	0.07	0.06	0.18	0.10	0.61	0.56	0.82	0.60	0.10	0.14	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.251	0.146	0.63	0.38	0.14	0.11	0.03	0.02	0.02	0.02	0.00	0.00	0.02	0.01
340	0.0	0.0	0.0	0.0	0.01	0.01	0.08	0.04	0.12	0.09	0.60	0.50	0.58	0.31	0.04	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.261	0.130	0.30	0.27	0.12	0.08	0.01	0.02	0.02	0.02	0.00	0.00	0.01	0.01
350	0.0	0.0	0.0	0.0	0.01	0.01	0.07	0.04	0.19	0.25	0.61	0.50	0.87	0.40	0.07	0.05	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.200	0.101	0.31	0.24	0.12	0.12	0.01	0.01	0.02	0.01	0.00	0.00	0.02	0.01
360	0.0	0.0	0.0	0.0	0.01	0.01	0.05	0.02	0.20	0.23	0.63	0.57	1.17	0.67	0.04	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.285	0.167	0.33	0.37	0.24	0.12	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.01
370	0.0	0.0	0.0	0.0	0.01	0.01	0.03	0.01	0.35	0.30	0.62	0.57	0.76	0.48	0.04	0.04	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.230	0.209	0.40	0.49	0.17	0.19	0.02	0.01	0.01	0.01	0.00	0.00	0.01	0.01
380	0.0	0.0	0.0	0.0	0.01	0.01	0.03	0.01	0.22	0.19	0.56	0.54	0.49	0.45	0.07	0.06	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.151	0.133	0.40	0.45	0.24	0.24	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
390	0.0	0.0	0.0	0.0	0.01	0.00	0.05	0.03	0.26	0.23	0.50	0.46	0.68	0.45	0.11	0.13	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.123	0.086	0.43	0.48	0.17	0.15	0.01	0.02	0.02	0.03	0.00	0.00	0.01	0.01
400	0.0	0.0	0.0	0.0	0.01	0.01	0.02	0.02	0.19	0.20	0.40	0.35	0.33	0.32	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.134	0.080	0.70	0.80	0.16	0.14	0.01	0.01	0.01	0.02	0.00	0.00	0.01	0.00
410	0.0	0.0	0.0	0.0	0.01	0.00	0.03	0.02	0.25	0.23	0.36	0.33	0.62	0.58	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.221	0.134	1.06	1.29	0.10	0.09	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00
420	0.0	0.0	0.0	0.0	0.00	0.00	0.03	0.02	0.23	0.20	0.32	0.32	0.40	0.45	0.07	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.119	0.080	0.82	1.01	0.15	0.11	0.01	0.01	0.01	0.02	0.00	0.00	0.01	0.00
430	0.0	0.0	0.0	0.0	0.00	0.01	0.03	0.02	0.16	0.14	0.31	0.29	0.36	0.38	0.06	0.06	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.131	0.090	0.49	0.62	0.13	0.09	0.01	0.01	0.01	0.02	0.00	0.00	0.00	0.00
440	0.0	0.0	0.0	0.0	0.01	0.01	0.03	0.02	0.07	0.04	0.56	0.53	0.30	0.31	0.09	0.06	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.142	0.087	0.62	0.69	0.08	0.05	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
450	0.0	0.0	0.0	0.0	0.00	0.01	0.04	0.04	0.04	0.08	0.41	0.37	0.24	0.25	0.06	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.131	0.076	0.65	0.65	0.05	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
460	0.0	0.0	0.0	0.0	0.00	0.00	0.04	0.03	0.03	0.06	0.30	0.25	0.18	0.18	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.094	0.036	0.51	0.52	0.06	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
470	0.0	0.0	0.0	0.0	0.00	0.00	0.04	0.03	0.02	0.05	0.38	0.37	0.12	0.11	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.092	0.036	0.35	0.27	0.09	0.04	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00
480	0.0	0.0	0.0	0.0	0.00	0.00	0.02	0.02	0.01	0.04	0.40	0.41	0.06	0.04	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.064	0.032	0.31	0.29	0.07	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
490	0.0	0.0	0.0	0.0	0.00	0.00	0.03	0.02	0.00	0.03	0.30	0.30	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.048	0.016	0.32	0.40	0.06	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00

Year 2 Sand Thickness (feet)

Beach Width = 100'

Distance Offshore (m)	DM565		DM560		DM580		DM590		SD595		SD600		SD610		SD620		SD625		SD630		SD650		SD660		SD670		SD675		SD680		SD690		SD695		SD700		SD710	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
0	0.00	0.00	0.00	0.00	0.12	0.03	0.02	0.02	0.03	0.05	2.47	3.60	1.28	4.30	0.01	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.03	0.01	1.47	1.28	0.00	0.00	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.08	0.11	0.48	0.30	0.15	0.47	0.82	2.09	1.39	3.90	0.16	0.16	0.02	0.03	0.06	0.06	0.00	0.00	0.01	0.02	1.72	1.96	3.53	3.27	1.79	1.38	0.08	0.07	0.06	0.07	0.00	0.01	0.03	0.03
20	0.00	0.00	0.00	0.00	0.08	0.17	0.44	0.30	0.31	0.64	1.94	3.19	1.35	3.12	0.26	0.34	0.01	0.04	0.06	0.07	0.00	0.00	0.01	0.03	1.13	1.84	2.21	2.38	1.44	1.19	0.04	0.04	0.05	0.05	0.00	0.00	0.03	0.05
30	0.00	0.00	0.00	0.00	0.07	0.19	0.39	0.29	0.28	0.71	1.51	2.57	1.17	2.60	0.34	0.46	0.04	0.07	0.05	0.08	0.00	0.00	0.01	0.02	1.86	2.77	1.92	2.56	1.14	1.11	0.02	0.02	0.04	0.04	0.00	0.00	0.02	0.05
40	0.00	0.00	0.00	0.00	0.08	0.19	0.40	0.31	0.35	0.81	1.85	2.93	0.96	2.37	0.23	0.32	0.03	0.05	0.06	0.09	0.00	0.00	0.01	0.02	1.28	2.19	2.75	3.91	0.86	0.96	0.01	0.02	0.03	0.03	0.00	0.00	0.03	0.05
50	0.00	0.00	0.00	0.00	0.10	0.18	0.33	0.29	0.36	0.74	1.89	3.00	0.91	2.23	0.13	0.28	0.02	0.04	0.05	0.07	0.00	0.00	0.01	0.02	1.04	1.85	2.70	4.40	0.82	0.91	0.02	0.02	0.02	0.02	0.00	0.00	0.01	0.04
60	0.00	0.00	0.00	0.00	0.10	0.17	0.19	0.23	0.42	0.79	1.69	2.81	0.79	1.87	0.10	0.25	0.02	0.03	0.04	0.06	0.00	0.00	0.01	0.01	0.91	1.65	1.75	3.78	0.85	0.93	0.02	0.03	0.02	0.04	0.00	0.00	0.01	0.03
70	0.00	0.00	0.00	0.00	0.12	0.17	0.17	0.24	0.46	0.77	1.39	2.54	0.90	1.75	0.10	0.25	0.02	0.03	0.05	0.06	0.00	0.00	0.01	0.01	0.84	1.37	1.81	3.71	0.72	0.86	0.02	0.03	0.03	0.05	0.00	0.00	0.01	0.02
80	0.00	0.00	0.00	0.00	0.14	0.18	0.20	0.28	0.45	0.71	1.31	2.45	1.33	1.98	0.14	0.26	0.02	0.03	0.05	0.06	0.00	0.00	0.01	0.01	1.29	1.72	1.97	3.78	0.53	0.77	0.03	0.04	0.03	0.04	0.00	0.00	0.01	0.02
90	0.00	0.00	0.00	0.00	0.12	0.17	0.30	0.39	0.35	0.60	1.94	3.01	2.04	2.38	0.17	0.30	0.01	0.03	0.04	0.05	0.00	0.00	0.03	0.03	1.41	1.75	2.11	3.97	0.57	0.85	0.01	0.03	0.02	0.03	0.00	0.00	0.01	0.02
100	0.00	0.00	0.00	0.00	0.07	0.14	0.47	0.53	0.32	0.64	2.34	3.25	2.18	2.24	0.19	0.32	0.01	0.03	0.03	0.05	0.00	0.00	0.03	0.02	1.50	1.79	2.01	3.90	0.35	0.68	0.03	0.04	0.02	0.02	0.00	0.00	0.01	0.04
110	0.00	0.00	0.00	0.00	0.03	0.12	0.59	0.66	0.21	0.63	2.00	2.79	2.11	1.84	0.19	0.33	0.02	0.04	0.04	0.05	0.00	0.00	0.02	0.02	1.28	1.62	0.87	2.59	0.25	0.59	0.04	0.04	0.03	0.01	0.00	0.01	0.03	0.05
120	0.00	0.00	0.00	0.00	0.07	0.16	0.41	0.57	0.38	0.96	1.93	2.72	3.21	2.56	0.20	0.36	0.02	0.04	0.04	0.05	0.00	0.00	0.02	0.01	1.47	1.87	0.85	2.21	0.43	0.79	0.04	0.02	0.05	0.01	0.01	0.01	0.03	0.06
130	0.00	0.00	0.00	0.00	0.08	0.17	0.31	0.54	0.45	1.17	1.94	2.66	1.48	1.18	0.25	0.38	0.02	0.03	0.05	0.06	0.00	0.00	0.02	0.01	1.68	2.12	1.01	1.82	0.59	0.96	0.03	0.02	0.04	0.02	0.01	0.01	0.03	0.06
140	0.00	0.00	0.00	0.00	0.13	0.20	0.30	0.54	0.40	1.15	2.13	2.60	2.43	2.29	0.27	0.36	0.03	0.03	0.05	0.06	0.00	0.00	0.01	0.01	1.44	1.88	1.70	1.85	0.52	0.88	0.02	0.01	0.03	0.01	0.01	0.01	0.03	0.05
150	0.00	0.00	0.00	0.00	0.17	0.23	0.32	0.54	0.29	1.02	2.44	2.43	2.00	1.63	0.27	0.32	0.04	0.04	0.05	0.06	0.00	0.00	0.01	0.01	1.48	1.82	2.75	2.04	0.50	0.78	0.02	0.01	0.01	0.01	0.01	0.00	0.03	0.05
160	0.00	0.00	0.00	0.00	0.16	0.20	0.47	0.64	0.33	0.84	2.71	2.23	1.55	0.78	0.27	0.28	0.05	0.04	0.05	0.06	0.00	0.00	0.00	0.01	1.43	1.62	3.34	1.79	0.58	0.58	0.02	0.02	0.01	0.01	0.01	0.00	0.03	0.04
170	0.00	0.00	0.00	0.00	0.15	0.17	0.55	0.67	0.57	0.76	2.71	1.80	1.27	0.72	0.28	0.25	0.05	0.04	0.05	0.05	0.00	0.00	0.02	0.02	1.39	1.39	3.53	1.30	0.62	0.55	0.01	0.02	0.02	0.01	0.01	0.00	0.03	0.02
180	0.00	0.00	0.00	0.00	0.14	0.12	0.38	0.54	0.68	0.63	2.65	1.53	1.71	0.85	0.28	0.20	0.05	0.03	0.05	0.05	0.00	0.00	0.01	0.01	1.27	1.07	4.44	1.54	0.54	0.47	0.01	0.02	0.01	0.02	0.01	0.01	0.03	0.01
190	0.00	0.00	0.00	0.00	0.17	0.11	0.28	0.44	0.82	0.46	2.30	1.16	2.31	1.44	0.27	0.15	0.05	0.03	0.05	0.04	0.00	0.00	0.01	0.01	1.23	0.86	3.67	1.19	0.46	0.52	0.02	0.02	0.02	0.02	0.01	0.00	0.03	0.01
200	0.00	0.00	0.00	0.00	0.19	0.12	0.20	0.34	0.97	0.38	2.09	0.92	1.59	0.82	0.29	0.16	0.05	0.03	0.05	0.04	0.00	0.00	0.01	0.01	1.20	0.72	2.87	1.23	0.47	0.55	0.02	0.02	0.02	0.02	0.00	0.00	0.02	0.01
210	0.00	0.00	0.00	0.00	0.19	0.10	0.31	0.35	1.14	0.46	1.91	0.68	2.48	1.62	0.30	0.17	0.04	0.02	0.04	0.03	0.00	0.00	0.01	0.01	1.18	0.67	2.28	1.07	0.45	0.68	0.02	0.03	0.03	0.02	0.00	0.00	0.02	0.01
220	0.00	0.00	0.00	0.00	0.17	0.09	0.35	0.26	1.11	0.33	1.68	0.44	2.08	1.44	0.29	0.16	0.04	0.02	0.04	0.03	0.00	0.00	0.01	0.01	0.91	0.36	1.64	0.78	0.64	0.37	0.03	0.04	0.03	0.01	0.00	0.00	0.04	0.01
230	0.00	0.00	0.00	0.00	0.15	0.06	0.36	0.21	1.06	0.30	1.55	0.39	1.72	1.13	0.27	0.16	0.04	0.02	0.04	0.02	0.00	0.00	0.01	0.01	1.01	0.41	1.51	1.03	0.35	0.21	0.05	0.06	0.03	0.02	0.00	0.00	0.04	0.01
240	0.00	0.00	0.00	0.00	0.14	0.05	0.26	0.15	0.96	0.31	1.54	0.56	1.19	0.79	0.27	0.16	0.03	0.02	0.04	0.02	0.00	0.00	0.02	0.01	0.77	0.28	1.44	0.86	0.53	0.60	0.05	0.03	0.03	0.01	0.00	0.00	0.03	0.01
250	0.00	0.00	0.00	0.00	0.13	0.05	0.29	0.17	1.06	0.36	1.39	0.56	1.15	0.95	0.28	0.17	0.03	0.02	0.03	0.02	0.00	0.00	0.02	0.01	0.73	0.28	1.04	0.49	1.45	1.21	0.04	0.03	0.04	0.02	0.00	0.00	0.04	0.01
260	0.00	0.00	0.00	0.00	0.12	0.05	0.35	0.20	0.90	0.36	1.27	0.51	1.38	1.19	0.26	0.16	0.03	0.02	0.03	0.02	0.00	0.00	0.01	0.00	0.66	0.26	1.14	0.36	0.90	0.76	0.04	0.05	0.01	0.01	0.00	0.00	0.04	0.02
270	0.00	0.00	0.00	0.00	0.11	0.04	0.32	0.16	0.76	0.22	1.30	0.65	2.26	2.03	0.23	0.12	0.03	0.02	0.03	0.02	0.00	0.00	0.01	0.00	1.06	0.71	1.05	0.40	0.68	0.55	0.02	0.03	0.01	0.02	0.00	0.00	0.03	0.02
280	0.00	0.00	0.00	0.00	0.10	0.04	0.17	0.12	0.69	0.16	1.12	0.47	2.07	1.36	0.22	0.09	0.02	0.02	0.03	0.02	0.00	0.00	0.02	0.02	0.54	0.25	1.67	0.90	0.47	0.40	0.02	0.03	0.02	0.02	0.00	0.00	0.03	0.01
290	0.00	0.00	0.00	0.00	0.09	0.04	0.09	0.09	0.85	0.36	1.25	0.74	1.97	1.48	0.22	0.08	0.02	0.02	0.03	0.02	0.00	0.00	0.02	0.01	0.55	0.36	1.80	1.58	0.30	0.35	0.02	0.02	0.04	0.05	0.00	0.01	0.03	0.01
300	0.00	0.00	0.00	0.00	0.09	0.05	0.15	0.14	0.80	0.37	1.24	0.79	1.23	1.04	0.20	0.07	0.02	0.01	0.02	0.02	0.00	0.00	0.02	0.02	0.48	0.27	0.93	1.25	0.55	0.45	0.02	0.02	0.04	0.03	0.00	0.01	0.03	0.01
310	0.00	0.00	0.00	0.00	0.09	0.06	0.16	0.13	0.66	0.33	0.99	0.68	1.36	1.26	0.12	0.10	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.52	0.25	1.27	1.19	0.35	0.30	0.01	0.01	0.02	0.00	0.00	0.00	0.03	0.01
320	0.00	0.00	0.00	0.00	0.08	0.05	0.22	0.17	0.32	0.20	1.22	1.05	1.65	1.21	0.40	0.45	0.01	0.01	0.02	0.01	0.00	0.00	0.02	0.02	0.73	0.38	1.55	1.00	0.33	0.17	0.02	0.02	0.03	0.02	0.00	0.00	0.02	0.01
330	0.00	0.00	0.00	0.00	0.07	0.05	0.18	0.14	0.38	0.20	1.17	1.08	1.58	1.14	0.21	0.28	0.01	0.01	0.02	0.01	0.00	0.00	0.02	0.01	0.56	0.33	1.25	0.75	0.37	0.28	0.04	0.03	0.04	0.03	0.00	0.00	0.02	0.01
340	0.00	0.00	0.00	0.00	0.07	0.04	0.20	0.10	0.26	0.18	1.14	0.95	1.10	0.60	0.08	0.07	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.59	0.29	0.60	0.53	0.32	0.20	0.01	0.03	0.04	0.04	0.00	0.00	0.02	0.01
350	0.00	0.00	0.00	0.00	0.06	0.03	0.17	0.09	0.40	0.53	1.16	0.96	1.66	0.77	0.14	0.10	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.45	0.23	0.61	0.48	0.33	0.32	0.02	0.02	0.03	0.02	0.00	0.00	0.02	0.01
360	0.00	0.00	0.00	0.00	0.05	0.03	0.11	0.05	0.42	0.49	1.20	1.09	2.23	1.27	0.08	0.05	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.64	0.37	0.65	0.74	0.64	0.33	0.02	0.01	0.03	0.01	0.00	0.00	0.02	0.01
370	0.00	0.00	0.00	0.00	0.04	0.03	0.07	0.02	0.73	0.64	1.19	1.09	1.44	0.92	0.09	0.08	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.51	0.47	0.80	0.97	0.44	0.49	0.03	0.01	0.01	0.01	0.00	0.00	0.02	0.01
380	0.00	0.00	0.00	0.00	0.03	0.03	0.08	0.03	0.45	0.40	1.07	1.03	0.94	0.85	0.14	0.12	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.34	0.30	0.80	0.90	0.62	0.64	0.01	0.02	0.01	0.02	0.00	0.00	0.01	0.01
390	0.00	0.00	0.00	0.00	0.02	0.02	0.12	0.08	0.55	0.49	0.96	0.88	1.30	0.87	0.23	0.26	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.28	0.19	0.85	0.95	0.46	0.39	0.02	0.02	0.03	0.04	0.00	0.00	0.01	0.01
400	0.00	0.00	0.00	0.00	0.03	0.03	0.06	0.04	0.39	0.41	0.76	0.67	0.63	0.61	0.11	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.30	0.18	1.39	1.59	0.43	0.38	0.01	0.02	0.01	0.03	0.00	0.00	0.01	0.01
410	0.00	0.00	0.00	0.00	0.03	0.02	0.06	0.05	0.53	0.49	0.68	0.63	1.18	1.10	0.12	0.07	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.50	0.30	2.10	2.56	0.27	0.24	0.01	0.01	0.01	0.02	0.00	0.00	0.01	0.00
420	0.00	0.00	0.00	0.00	0.02	0.02	0.07	0.06	0.49	0.43	0.62	0.62	0.76	0.86	0.15	0.11	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.27	0.18	1.63	2.00	0.39	0.29	0.02	0.01	0.01	0.04	0.00	0.00	0.01	0.01
430	0.00	0.00	0.00	0.00	0.02	0.02	0.08	0.06	0.34	0.29	0.60	0.55	0.69	0.73	0.12	0.12	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.29	0.20	0.98	1.23	0.35	0.23	0.01	0.01	0.02	0.03	0.00	0.00	0.00	0.00
440	0.00	0.00	0.00	0.00	0.03	0.03	0.06	0.05	0.15	0.09	1.08	1.01	0.58	0.60	0.18	0.12	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.32	0.20	1.24	1.38	0.22	0.13	0.01	0.01	0.01	0.02	0.00	0.00	0.01	0.01
450	0.00	0.00	0.00	0.00	0.02	0.03	0.11	0.09	0.09	0.16	0.79	0.70	0.46	0.47	0.13	0.06	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.29	0.17	1.29	1.29	0.14	0.08	0.01	0.01	0.01	0.02	0.00	0.00	0.01	0.01
460	0.00	0.00	0.00	0.00	0.01	0.02	0.09	0.07	0.07	0.13	0.58	0.48	0.34	0.34	0.05	0.06	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.21	0.08	1.02	1.03	0.16	0.07	0.02	0.02	0.01	0.02	0.00	0.00	0.00	0.01
470	0.00	0.00	0.00	0.00	0.01	0.01	0.09	0.07	0.04	0.11	0.73	0.70	0.23	0.21	0.04	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.21	0.08	0.69	0.53	0.23	0.12	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00
480	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.04	0.02	0.08	0.76	0.79	0.11	0.09	0.02	0.03	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.14	0.07	0.62	0.58	0.20	0.08	0.03	0.02	0.00	0.01	0.00	0.00	0.00	0.00
490	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.06	-0.01	0.06	0.58	0.57	-0.01	0.00	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.11	0.04	0.64	0.79	0.16	0.08	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00

Year 2 Sand Thickness (feet)

Beach Width = 150'

Distance Offshore (m)	DM565		DM560		DM580		DM590		SD595		SD600		SD610		SD620		SD625		SD630		SD650		SD660		SD670		SD675		SD680		SD690		SD695		SD700		SD710	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
0	0.00	0.00	0.00	0.00	0.20	0.05	0.04	0.03	0.05	0.09	3.51	5.11	1.82	6.08	0.02	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.05	0.02	2.04	1.79	0.01	0.00	0.14	0.14	0.00	0.00	0.01	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.12	0.17	0.84	0.52	0.25	0.78	1.17	2.96	1.97	5.51	0.29	0.28	0.02	0.03	0.10	0.09	0.00	0.00	0.02	0.05	2.85	3.25	4.91	4.56	3.03	2.34	0.13	0.11	0.10	0.11	0.01	0.01	0.03	0.04
20	0.00	0.00	0.00	0.00	0.13	0.27	0.78	0.53	0.51	1.05	2.76	4.53	1.92	4.41	0.46	0.59	0.02	0.05	0.09	0.11	0.00	0.00	0.02	0.06	1.88	3.05	3.08	3.31	2.44	2.01	0.08	0.06	0.08	0.08	0.00	0.00	0.03	0.06
30	0.00	0.00	0.00	0.00	0.11	0.31	0.69	0.51	0.46	1.18	2.14	3.66	1.65	3.68	0.59	0.79	0.05	0.09	0.08	0.12	0.00	0.00	0.02	0.06	3.08	4.59	2.67	3.56	1.92	1.88	0.03	0.03	0.06	0.06	0.00	0.00	0.03	0.06
40	0.00	0.00	0.00	0.00	0.12	0.31	0.70	0.55	0.57	1.33	2.62	4.16	1.35	3.35	0.40	0.56	0.04	0.07	0.10	0.14	0.00	0.00	0.02	0.05	2.13	3.63	3.83	5.45	1.46	1.62	0.02	0.03	0.05	0.05	0.00	0.00	0.03	0.07
50	0.00	0.00	0.00	0.00	0.16	0.30	0.58	0.52	0.59	1.23	2.69	4.27	1.29	3.15	0.23	0.48	0.03	0.05	0.09	0.12	0.00	0.00	0.02	0.04	1.72	3.06	3.76	6.14	1.38	1.54	0.03	0.04	0.03	0.04	0.00	0.00	0.02	0.05
60	0.00	0.00	0.00	0.00	0.17	0.27	0.34	0.41	0.69	1.30	2.41	3.99	1.12	2.65	0.18	0.44	0.03	0.05	0.07	0.10	0.00	0.00	0.02	0.03	1.51	2.73	2.44	5.27	1.44	1.58	0.03	0.04	0.04	0.06	0.00	0.00	0.01	0.04
70	0.00	0.00	0.00	0.00	0.19	0.27	0.29	0.43	0.76	1.26	1.98	3.60	1.28	2.47	0.18	0.43	0.03	0.04	0.08	0.10	0.00	0.00	0.02	0.02	1.39	2.28	2.53	5.16	1.21	1.46	0.03	0.05	0.05	0.08	0.00	0.00	0.01	0.03
80	0.00	0.00	0.00	0.00	0.22	0.29	0.36	0.50	0.74	1.16	1.86	3.48	1.88	2.80	0.25	0.46	0.03	0.04	0.07	0.09	0.00	0.00	0.03	0.04	2.13	2.85	2.74	5.27	0.90	1.29	0.05	0.07	0.05	0.07	0.00	0.00	0.01	0.02
90	0.00	0.00	0.00	0.00	0.19	0.27	0.54	0.68	0.58	0.99	2.75	4.28	2.89	3.36	0.30	0.52	0.02	0.04	0.06	0.08	0.00	0.00	0.07	0.06	2.33	2.91	2.94	5.54	0.97	1.44	0.02	0.05	0.04	0.05	0.00	0.00	0.01	0.03
100	0.00	0.00	0.00	0.00	0.11	0.23	0.83	0.94	0.53	1.06	3.33	4.61	3.09	3.17	0.33	0.55	0.02	0.04	0.05	0.07	0.00	0.00	0.06	0.04	2.49	2.97	2.80	5.43	0.59	1.15	0.05	0.07	0.04	0.03	0.00	0.00	0.02	0.04
110	0.00	0.00	0.00	0.00	0.06	0.19	1.05	1.17	0.35	1.04	2.84	3.97	2.98	2.61	0.34	0.58	0.03	0.05	0.06	0.08	0.00	0.00	0.06	0.04	2.13	2.69	1.21	3.62	0.42	1.00	0.07	0.07	0.05	0.02	0.01	0.01	0.04	0.07
120	0.00	0.00	0.00	0.00	0.11	0.26	0.72	1.01	0.63	1.58	2.75	3.87	4.54	3.62	0.35	0.63	0.02	0.05	0.07	0.08	0.00	0.00	0.06	0.03	2.44	3.11	1.18	3.08	0.73	1.34	0.06	0.04	0.07	0.02	0.01	0.01	0.03	0.07
130	0.00	0.00	0.00	0.00	0.13	0.27	0.55	0.95	0.74	1.92	2.76	3.77	2.10	1.67	0.44	0.67	0.02	0.04	0.07	0.09	0.00	0.00	0.05	0.02	2.78	3.52	1.41	2.54	0.99	1.63	0.05	0.03	0.06	0.03	0.01	0.01	0.03	0.07
140	0.00	0.00	0.00	0.00	0.21	0.33	0.53	0.96	0.66	1.89	3.03	3.69	3.45	3.24	0.47	0.63	0.04	0.04	0.08	0.10	0.00	0.00	0.03	0.02	2.39	3.12	2.36	2.58	0.88	1.48	0.03	0.02	0.04	0.02	0.01	0.01	0.04	0.06
150	0.00	0.00	0.00	0.00	0.28	0.37	0.57	0.96	0.48	1.68	3.46	3.46	2.82	2.31	0.47	0.56	0.06	0.06	0.08	0.10	0.00	0.00	0.03	0.02	2.45	3.03	3.83	2.84	0.84	1.33	0.03	0.02	0.02	0.01	0.01	0.01	0.04	0.06
160	0.00	0.00	0.00	0.00	0.26	0.33	0.82	1.12	0.55	1.39	3.86	3.17	2.19	1.10	0.48	0.49	0.07	0.06	0.08	0.10	0.00	0.00	0.01	0.03	2.37	2.69	4.66	2.49	0.98	0.98	0.03	0.03	0.02	0.02	0.01	0.00	0.04	0.05
170	0.00	0.00	0.00	0.00	0.25	0.27	0.96	1.19	0.93	1.25	3.85	2.56	1.79	1.01	0.48	0.43	0.07	0.05	0.08	0.08	0.00	0.00	0.04	0.05	2.30	2.30	4.91	1.81	1.05	0.94	0.03	0.03	0.03	0.02	0.01	0.01	0.04	0.03
180	0.00	0.00	0.00	0.00	0.23	0.19	0.67	0.96	1.12	1.03	3.76	2.17	2.42	1.21	0.48	0.35	0.07	0.04	0.08	0.07	0.00	0.00	0.02	0.01	2.11	1.78	6.19	2.15	0.91	0.80	0.02	0.03	0.02	0.03	0.01	0.01	0.03	0.01
190	0.00	0.00	0.00	0.00	0.28	0.18	0.49	0.78	1.35	0.75	3.26	1.65	3.27	2.04	0.48	0.27	0.07	0.04	0.08	0.07	0.00	0.00	0.02	0.02	2.05	1.43	5.12	1.66	0.78	0.89	0.03	0.03	0.03	0.03	0.01	0.01	0.04	0.02
200	0.00	0.00	0.00	0.00	0.31	0.19	0.36	0.60	1.60	0.63	2.97	1.30	2.25	1.16	0.51	0.28	0.06	0.04	0.07	0.06	0.00	0.00	0.03	0.03	1.99	1.20	4.00	1.71	0.79	0.94	0.04	0.04	0.04	0.03	0.01	0.01	0.03	0.01
210	0.00	0.00	0.00	0.00	0.31	0.17	0.55	0.62	1.87	0.76	2.72	0.97	3.51	2.29	0.53	0.29	0.06	0.03	0.07	0.05	0.00	0.00	0.03	0.02	1.96	1.11	3.18	1.49	0.77	1.15	0.04	0.06	0.05	0.04	0.00	0.00	0.02	0.01
220	0.00	0.00	0.00	0.00	0.28	0.14	0.61	0.45	1.84	0.55	2.38	0.63	2.95	2.03	0.51	0.29	0.05	0.02	0.06	0.04	0.00	0.00	0.03	0.02	1.51	0.59	2.28	1.08	1.08	0.63	0.05	0.06	0.04	0.02	0.00	0.00	0.05	0.02
230	0.00	0.00	0.00	0.00	0.25	0.10	0.64	0.37	1.74	0.49	2.21	0.55	2.43	1.60	0.48	0.28	0.05	0.02	0.06	0.04	0.00	0.00	0.02	0.01	1.67	0.68	2.11	1.43	0.59	0.36	0.08	0.10	0.04	0.04	0.00	0.00	0.05	0.02
240	0.00	0.00	0.00	0.00	0.22	0.08	0.45	0.27	1.58	0.50	2.18	0.80	1.68	1.12	0.48	0.27	0.05	0.02	0.06	0.03	0.00	0.00	0.04	0.03	1.28	0.46	2.00	1.20	0.90	1.02	0.08	0.06	0.05	0.02	0.00	0.00	0.03	0.01
250	0.00	0.00	0.00	0.00	0.20	0.07	0.51	0.30	1.75	0.60	1.98	0.80	1.63	1.34	0.49	0.30	0.04	0.02	0.05	0.03	0.00	0.00	0.04	0.02	1.21	0.47	1.45	0.68	2.45	2.05	0.07	0.06	0.06	0.04	0.00	0.01	0.05	0.01
260	0.00	0.00	0.00	0.00	0.19	0.08	0.63	0.35	1.49	0.59	1.80	0.72	1.95	1.69	0.45	0.28	0.04	0.02	0.05	0.03	0.00	0.00	0.03	0.01	1.10	0.42	1.58	0.50	1.51	1.29	0.06	0.08	0.02	0.02	0.00	0.00	0.05	0.02
270	0.00	0.00	0.00	0.00	0.18	0.07	0.56	0.29	1.25	0.36	1.85	0.92	3.20	2.87	0.40	0.22	0.03	0.02	0.05	0.03	0.00	0.00	0.02	0.01	1.76	1.18	1.47	0.55	1.16	0.93	0.04	0.05	0.02	0.03	0.00	0.00	0.04	0.02
280	0.00	0.00	0.00	0.00	0.17	0.06	0.29	0.22	1.15	0.27	1.59	0.67	2.93	1.93	0.38	0.17	0.03	0.02	0.05	0.03	0.00	0.00	0.05	0.04	0.90	0.41	2.32	1.25	0.80	0.68	0.03	0.04	0.04	0.03	0.00	0.00	0.03	0.01
290	0.00	0.00	0.00	0.00	0.15	0.07	0.16	0.16	1.41	0.59	1.78	1.05	2.79	2.09	0.38	0.14	0.03	0.02	0.04	0.03	0.00	0.00	0.04	0.03	0.91	0.59	2.50	2.20	0.50	0.59	0.04	0.03	0.06	0.09	0.00	0.01	0.03	0.01
300	0.00	0.00	0.00	0.00	0.15	0.08	0.27	0.24	1.32	0.61	1.76	1.12	1.74	1.47	0.36	0.12	0.03	0.02	0.04	0.03	0.00	0.00	0.04	0.06	0.80	0.45	1.30	1.74	0.94	0.77	0.04	0.04	0.06	0.06	0.00	0.01	0.04	0.02
310	0.00	0.00	0.00	0.00	0.14	0.09	0.28	0.23	1.09	0.55	1.41	0.96	1.92	1.78	0.22	0.17	0.02	0.02	0.04	0.02	0.00	0.00	0.03	0.03	0.86	0.41	1.77	1.66	0.58	0.50	0.02	0.02	0.03	0.01	0.00	0.00	0.03	0.02
320	0.00	0.00	0.00	0.00	0.13	0.08	0.38	0.29	0.53	0.33	1.74	1.50	2.34	1.71	0.70	0.79	0.02	0.02	0.03	0.02	0.00	0.00	0.04	0.05	1.21	0.63	2.16	1.40	0.57	0.29	0.04	0.03	0.04	0.04	0.00	0.00	0.03	0.02
330	0.00	0.00	0.00	0.00	0.12	0.08	0.33	0.25	0.63	0.33	1.66	1.53	2.23	1.61	0.36	0.49	0.01	0.02	0.03	0.02	0.00	0.00	0.04	0.02	0.94	0.54	1.74	1.04	0.63	0.47	0.07	0.05	0.06	0.05	0.00	0.00	0.03	0.02
340	0.00	0.00	0.00	0.00	0.11	0.06	0.35	0.17	0.43	0.30	1.62	1.35	1.56	0.84	0.15	0.12	0.01	0.01	0.02	0.02	0.00	0.00	0.02	0.02	0.97	0.48	0.83	0.74	0.55	0.34	0.02	0.05	0.06	0.07	0.00	0.00	0.02	0.01
350	0.00	0.00	0.00	0.00	0.10	0.06	0.31	0.16	0.66	0.88	1.65	1.36	2.35	1.08	0.24	0.18	0.01	0.01	0.02	0.01	0.00	0.00	0.03	0.03	0.75	0.37	0.86	0.67	0.56	0.54	0.03	0.03	0.06	0.03	0.00	0.00	0.03	0.02
360	0.00	0.00	0.00	0.00	0.07	0.04	0.20	0.09	0.69	0.80	1.71	1.55	3.16	1.80	0.14	0.08	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.01	1.06	0.62	0.91	1.03	1.08	0.55	0.03	0.02	0.04	0.02	0.00	0.00	0.02	0.01
370	0.00	0.00	0.00	0.00	0.06	0.05	0.12	0.03	1.21	1.05	1.69	1.55	2.04	1.30	0.16	0.13	0.01	0.01	0.01	0.01	0.00	0.00	0.03	0.03	0.85	0.78	1.12	1.36	0.75	0.83	0.05	0.02	0.02	0.02	0.00	0.00	0.02	0.02
380	0.00	0.00	0.00	0.00	0.05	0.04	0.13	0.05	0.75	0.66	1.53	1.47	1.33	1.21	0.25	0.22	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.56	0.50	1.11	1.25	1.05	1.08	0.02	0.03	0.02	0.03	0.00	0.00	0.02	0.01
390	0.00	0.00	0.00	0.00	0.04	0.03	0.22	0.15	0.90	0.81	1.36	1.25	1.84	1.23	0.40	0.46	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.46	0.32	1.18	1.32	0.77	0.66	0.03	0.04	0.04	0.07	0.00	0.00	0.01	0.01
400	0.00	0.00	0.00	0.00	0.05	0.04	0.10	0.07	0.65	0.68	1.08	0.95	0.89	0.86	0.20	0.08	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.50	0.30	1.94	2.22	0.74	0.64	0.02	0.03	0.02	0.04	0.00	0.00	0.01	0.01
410	0.00	0.00	0.00	0.00	0.04	0.03	0.11	0.09	0.87	0.81	0.97	0.90	1.67	1.56	0.21	0.12	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.82	0.50	2.93	3.56	0.45	0.40	0.02	0.02	0.01	0.04	0.00	0.00	0.01	0.01
420	0.00	0.00	0.00	0.00	0.03	0.03	0.13	0.10	0.81	0.70	0.88	0.88	1.07	1.22	0.27	0.19	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.44	0.30	2.27	2.79	0.66	0.49	0.03	0.02	0.02	0.06	0.00	0.00	0.01	0.01
430	0.00	0.00	0.00	0.00	0.04	0.04	0.14	0.10	0.57	0.47	0.85	0.79	0.98	1.03	0.20	0.20	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.49	0.33	1.36	1.71	0.59	0.39	0.02	0.02	0.03	0.05	0.00	0.00	0.01	0.01
440	0.00	0.00	0.00	0.00	0.05	0.05	0.11	0.08	0.24	0.15	1.53	1.44	0.81	0.85	0.31	0.22	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.02	0.53	0.32	1.72	1.92	0.38	0.23	0.02	0.02	0.02	0.03	0.00	0.00	0.01	0.01
450	0.00	0.00	0.00	0.00	0.03	0.04	0.19	0.16	0.16	0.26	1.12	0.99	0.65	0.67	0.23	0.11	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.49	0.28	1.79	1.79	0.23	0.14	0.02	0.02	0.02	0.03	0.00	0.00	0.01	0.01
460	0.00	0.00	0.00	0.00	0.02	0.03	0.16	0.13	0.11	0.22	0.82	0.68	0.48	0.49	0.08	0.09	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.35	0.13	1.42	1.44	0.27	0.12	0.04	0.03	0.02	0.03	0.00	0.00	0.00	0.01
470	0.00	0.00	0.00	0.00	0.01	0.02	0.16	0.12	0.07	0.18	1.04	1.00	0.32	0.30	0.06	0.07	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.34	0.13	0.96	0.73	0.39	0.20	0.06	0.04	0.01	0.02	0.00	0.00	0.00	0.01
480	0.00	0.00	0.00	0.00	0.01	0.01	0.09	0.07	0.03	0.14	1.08	1.12	0.15	0.12	0.04	0.05	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.24	0.12	0.86	0.80	0.33	0.14	0.05	0.04	0.01	0.01	0.00	0.00	0.00	0.00
490	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.10	-0.01	0.10	0.82	0.81	-0.01	0.00	0.01	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.01	0.18	0.06	0.90	1.10	0.27	0.14	0.04	0.03	0.01	0.01	0.00	0.00	0.00	0.00

Year 2 Sand Thickness (feet)

Beach Width = 200'

Distance Offshore (m)	DM565		DM560		DM580		DM590		SD595		SD600		SD610		SD620		SD625		SD630		SD650		SD660		SD670		SD675		SD680		SD690		SD695		SD700		SD710	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
0	0.00	0.00	0.00	0.00	0.24	0.06	0.06	0.04	0.07	0.13	4.46	6.50	2.33	7.79	0.02	0.01	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.06	0.02	2.57	2.25	0.01	0.01	0.24	0.24	0.00	0.00	0.01	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.15	0.21	1.23	0.77	0.37	1.13	1.49	3.77	2.53	7.06	0.44	0.43	0.03	0.05	0.15	0.14	0.00	0.01	0.05	0.09	4.00	4.56	6.17	5.73	4.33	3.35	0.24	0.20	0.13	0.14	0.01	0.01	0.04	0.05
20	0.00	0.00	0.00	0.00	0.16	0.33	1.14	0.77	0.73	1.52	3.51	5.76	2.45	5.66	0.70	0.90	0.03	0.07	0.14	0.17	0.00	0.01	0.05	0.12	2.63	4.29	3.87	4.16	3.49	2.87	0.14	0.12	0.12	0.11	0.00	0.01	0.04	0.07
30	0.00	0.00	0.00	0.00	0.13	0.38	1.02	0.74	0.66	1.70	2.72	4.65	2.12	4.72	0.90	1.22	0.07	0.13	0.13	0.19	0.00	0.00	0.05	0.11	4.33	6.44	3.36	4.48	2.74	2.69	0.06	0.06	0.09	0.08	0.00	0.00	0.03	0.07
40	0.00	0.00	0.00	0.00	0.15	0.37	1.03	0.81	0.82	1.92	3.34	5.29	1.73	4.30	0.61	0.86	0.05	0.10	0.15	0.21	0.00	0.00	0.04	0.10	2.99	5.10	4.81	6.84	2.09	2.31	0.04	0.05	0.06	0.07	0.00	0.00	0.04	0.08
50	0.00	0.00	0.00	0.00	0.19	0.36	0.85	0.76	0.85	1.77	3.42	5.42	1.65	4.04	0.35	0.74	0.04	0.07	0.13	0.18	0.00	0.00	0.04	0.08	2.41	4.30	4.72	7.71	1.98	2.20	0.05	0.07	0.04	0.05	0.00	0.00	0.02	0.06
60	0.00	0.00	0.00	0.00	0.20	0.32	0.50	0.60	1.00	1.87	3.06	5.07	1.43	3.40	0.27	0.67	0.04	0.06	0.11	0.15	0.00	0.00	0.04	0.05	2.12	3.84	3.07	6.62	2.05	2.26	0.05	0.08	0.05	0.08	0.00	0.00	0.02	0.05
70	0.00	0.00	0.00	0.00	0.23	0.32	0.43	0.63	1.09	1.83	2.51	4.58	1.64	3.17	0.28	0.66	0.04	0.06	0.12	0.15	0.00	0.00	0.04	0.04	1.96	3.20	3.17	6.49	1.73	2.09	0.05	0.10	0.07	0.10	0.00	0.00	0.01	0.03
80	0.00	0.00	0.00	0.00	0.27	0.35	0.53	0.73	1.07	1.68	2.36	4.42	2.40	3.59	0.38	0.71	0.03	0.06	0.11	0.14	0.00	0.00	0.07	0.07	3.00	4.00	3.45	6.62	1.29	1.85	0.08	0.13	0.06	0.10	0.00	0.00	0.01	0.03
90	0.00	0.00	0.00	0.00	0.23	0.33	0.79	1.00	0.84	1.43	3.50	5.44	3.70	4.31	0.46	0.79	0.02	0.05	0.09	0.12	0.00	0.00	0.14	0.12	3.28	4.08	3.69	6.96	1.39	2.06	0.04	0.09	0.05	0.07	0.00	0.00	0.01	0.03
100	0.00	0.00	0.00	0.00	0.14	0.27	1.22	1.38	0.76	1.53	4.23	5.87	3.95	4.06	0.51	0.84	0.02	0.05	0.08	0.11	0.01	0.00	0.13	0.08	3.50	4.17	3.52	6.83	0.84	1.64	0.09	0.12	0.05	0.04	0.00	0.01	0.02	0.05
110	0.00	0.00	0.00	0.00	0.07	0.23	1.54	1.71	0.51	1.50	3.61	5.04	3.82	3.34	0.52	0.89	0.04	0.07	0.09	0.12	0.01	0.00	0.12	0.07	2.99	3.78	1.53	4.54	0.59	1.44	0.12	0.12	0.07	0.03	0.01	0.01	0.04	0.08
120	0.00	0.00	0.00	0.00	0.14	0.32	1.05	1.48	0.91	2.29	3.50	4.92	5.82	4.64	0.53	0.96	0.03	0.07	0.10	0.13	0.01	0.00	0.12	0.05	3.43	4.37	1.48	3.86	1.05	1.92	0.11	0.08	0.10	0.03	0.01	0.01	0.04	0.08
130	0.00	0.00	0.00	0.00	0.16	0.33	0.81	1.40	1.07	2.78	3.51	4.80	2.69	2.14	0.68	1.02	0.03	0.06	0.11	0.14	0.01	0.00	0.09	0.04	3.91	4.94	1.77	3.19	1.41	2.33	0.09	0.05	0.09	0.03	0.01	0.01	0.04	0.08
140	0.00	0.00	0.00	0.00	0.25	0.39	0.78	1.40	0.95	2.74	3.85	4.69	4.41	4.16	0.72	0.96	0.05	0.06	0.12	0.15	0.01	0.00	0.07	0.04	3.35	4.39	2.97	3.25	1.25	2.12	0.06	0.03	0.06	0.02	0.01	0.01	0.05	0.08
150	0.00	0.00	0.00	0.00	0.33	0.44	0.84	1.41	0.69	2.43	4.40	4.39	3.62	2.96	0.72	0.86	0.08	0.08	0.13	0.16	0.00	0.00	0.06	0.05	3.44	4.25	4.81	3.57	1.20	1.89	0.06	0.04	0.03	0.02	0.01	0.01	0.05	0.07
160	0.00	0.00	0.00	0.00	0.32	0.39	1.21	1.65	0.79	2.01	4.90	4.03	2.81	1.41	0.73	0.75	0.10	0.08	0.13	0.15	0.00	0.00	0.02	0.05	3.33	3.77	5.85	3.13	1.40	1.40	0.05	0.05	0.03	0.02	0.01	0.01	0.04	0.05
170	0.00	0.00	0.00	0.00	0.30	0.32	1.42	1.75	1.35	1.81	4.90	3.26	2.30	1.30	0.74	0.66	0.10	0.07	0.12	0.12	0.00	0.00	0.08	0.09	3.23	3.23	6.17	2.28	1.50	1.34	0.05	0.05	0.04	0.03	0.01	0.01	0.04	0.04
180	0.00	0.00	0.00	0.00	0.28	0.23	0.99	1.40	1.61	1.49	4.78	2.76	3.10	1.54	0.74	0.53	0.09	0.06	0.12	0.11	0.00	0.00	0.04	0.03	2.97	2.49	7.77	2.70	1.30	1.14	0.04	0.05	0.03	0.05	0.01	0.01	0.04	0.02
190	0.00	0.00	0.00	0.00	0.34	0.22	0.72	1.14	1.95	1.09	4.15	2.09	4.19	2.61	0.73	0.41	0.09	0.05	0.12	0.10	0.00	0.00	0.04	0.04	2.88	2.00	6.43	2.08	1.12	1.27	0.06	0.06	0.04	0.04	0.01	0.01	0.04	0.02
200	0.00	0.00	0.00	0.00	0.37	0.23	0.52	0.88	2.31	0.91	3.78	1.66	2.88	1.48	0.78	0.43	0.09	0.05	0.11	0.09	0.00	0.00	0.06	0.06	2.80	1.69	5.02	2.15	1.13	1.34	0.07	0.07	0.05	0.05	0.01	0.01	0.03	0.01
210	0.00	0.00	0.00	0.00	0.38	0.20	0.81	0.92	2.71	1.09	3.46	1.23	4.50	2.94	0.81	0.44	0.08	0.04	0.11	0.07	0.00	0.00	0.07	0.03	2.76	1.56	4.00	1.87	1.10	1.65	0.07	0.10	0.07	0.05	0.01	0.00	0.03	0.01
220	0.00	0.00	0.00	0.00	0.34	0.17	0.90	0.66	2.66	0.79	3.03	0.80	3.78	2.60	0.79	0.44	0.07	0.03	0.10	0.06	0.00	0.00	0.06	0.03	2.12	0.83	2.87	1.36	1.55	0.90	0.09	0.12	0.06	0.03	0.01	0.00	0.06	0.02
230	0.00	0.00	0.00	0.00	0.30	0.12	0.94	0.54	2.52	0.71	2.81	0.70	3.11	2.05	0.73	0.42	0.07	0.03	0.09	0.06	0.01	0.01	0.05	0.03	2.34	0.96	2.65	1.80	0.85	0.52	0.15	0.18	0.06	0.05	0.01	0.00	0.06	0.02
240	0.00	0.00	0.00	0.00	0.27	0.10	0.66	0.40	2.29	0.73	2.78	1.02	2.15	1.44	0.73	0.42	0.06	0.03	0.09	0.05	0.01	0.01	0.07	0.06	1.79	0.65	2.52	1.50	1.29	1.46	0.14	0.11	0.07	0.03	0.01	0.00	0.04	0.01
250	0.00	0.00	0.00	0.00	0.25	0.09	0.74	0.45	2.52	0.86	2.52	1.02	2.09	1.72	0.76	0.46	0.06	0.03	0.08	0.05	0.01	0.01	0.07	0.05	1.70	0.66	1.83	0.85	3.51	2.93	0.13	0.10	0.08	0.05	0.01	0.01	0.06	0.02
260	0.00	0.00	0.00	0.00	0.23	0.09	0.92	0.52	2.15	0.86	2.29	0.92	2.50	2.17	0.68	0.42	0.05	0.03	0.08	0.05	0.00	0.01	0.06	0.02	1.55	0.60	1.99	0.63	2.16	1.84	0.11	0.14	0.03	0.03	0.00	0.01	0.06	0.02
270	0.00	0.00	0.00	0.00	0.22	0.08	0.82	0.42	1.81	0.52	2.35	1.17	4.10	3.68	0.61	0.33	0.05	0.03	0.08	0.05	0.00	0.00	0.04	0.02	2.47	1.66	1.84	0.69	1.65	1.33	0.08	0.10	0.03	0.05	0.00	0.01	0.05	0.03
280	0.00	0.00	0.00	0.00	0.20	0.07	0.43	0.32	1.65	0.39	2.02	0.86	3.75	2.47	0.58	0.25	0.05	0.03	0.08	0.05	0.00	0.00	0.09	0.07	1.26	0.58	2.92	1.57	1.14	0.98	0.05	0.08	0.05	0.05	0.00	0.01	0.04	0.02
290	0.00	0.00	0.00	0.00	0.19	0.08	0.24	0.23	2.03	0.85	2.26	1.33	3.58	2.68	0.58	0.21	0.04	0.03	0.07	0.04	0.00	0.00	0.08	0.05	1.28	0.83	3.14	2.76	0.71	0.85	0.07	0.05	0.08	0.12	0.01	0.01	0.04	0.01
300	0.00	0.00	0.00	0.00	0.18	0.10	0.40	0.35	1.91	0.88	2.24	1.43	2.23	1.88	0.54	0.18	0.03	0.03	0.06	0.04	0.01	0.01	0.08	0.11	1.12	0.63	1.63	2.19	1.34	1.10	0.06	0.07	0.08	0.08	0.01	0.01	0.04	0.02
310	0.00	0.00	0.00	0.00	0.17	0.11	0.41	0.33	1.58	0.79	1.80	1.23	2.46	2.29	0.33	0.26	0.03	0.03	0.06	0.03	0.01	0.00	0.06	0.05	1.21	0.58	2.22	2.09	0.84	0.72	0.04	0.04	0.04	0.01	0.00	0.01	0.04	0.02
320	0.00	0.00	0.00	0.00	0.15	0.10	0.56	0.43	0.76	0.47	2.21	1.90	3.00	2.19	1.07	1.21	0.02	0.02	0.05	0.03	0.01	0.01	0.08	0.10	1.70	0.88	2.71	1.75	0.81	0.41	0.07	0.05	0.05	0.05	0.00	0.00	0.03	0.02
330	0.00	0.00	0.00	0.00	0.14	0.09	0.48	0.36	0.91	0.48	2.11	1.95	2.86	2.07	0.56	0.74	0.02	0.02	0.04	0.02	0.00	0.00	0.08	0.05	1.31	0.76	2.19	1.31	0.90	0.68	0.13	0.09	0.08	0.07	0.00	0.00	0.03	0.02
340	0.00	0.00	0.00	0.00	0.13	0.07	0.51	0.26	0.62	0.43	2.06	1.72	2.00	1.08	0.22	0.19	0.02	0.02	0.04	0.02	0.00	0.00	0.03	0.03	1.36	0.68	1.55	0.93	0.79	0.49	0.04	0.08	0.08	0.09	0.00	0.00	0.03	0.01
350	0.00	0.00	0.00	0.00	0.12	0.07	0.45	0.24	0.95	1.27	2.10	1.73	3.01	1.39	0.37	0.28	0.02	0.02	0.03	0.02	0.00	0.00	0.05	0.05	1.05	0.53	1.07	0.85	0.80	0.78	0.05	0.06	0.07	0.03	0.00	0.00	0.03	0.02
360	0.00	0.00	0.00	0.00	0.09	0.05	0.30	0.14	1.00	1.16	2.17	1.97	4.04	2.31	0.21	0.12	0.02	0.02	0.03	0.01	0.00	0.00	0.02	0.02	1.49	0.87	1.14	1.30	1.55	0.79	0.06	0.03	0.06	0.03	0.00	0.00	0.03	0.02
370	0.00	0.00	0.00	0.00	0.07	0.06	0.18	0.05	1.75	1.52	2.14	1.97	2.62	1.66	0.24	0.20	0.02	0.02	0.02	0.01	0.00	0.00	0.05	0.06	1.20	1.09	1.40	1.71	1.07	1.18	0.08	0.04	0.03	0.03	0.00	0.00	0.03	0.02
380	0.00	0.00	0.00	0.00	0.06	0.05	0.20	0.08	1.08	0.96	1.94	1.87	1.70	1.55	0.39	0.33	0.02	0.01	0.02	0.02	0.00	0.00	0.03	0.04	0.79	0.70	1.40	1.57	1.50	1.54	0.03	0.05	0.03	0.05	0.00	0.00	0.02	0.01
390	0.00	0.00	0.00	0.00	0.05	0.04	0.32	0.21	1.31	1.17	1.73	1.59	2.36	1.57	0.60	0.70	0.01	0.01	0.02	0.02	0.00	0.00	0.01	0.03	0.64	0.45	1.48	1.65	1.10	0.94	0.05	0.07	0.06	0.10	0.00	0.00	0.01	0.01
400	0.00	0.00	0.00	0.00	0.06	0.05	0.15	0.11	0.93	0.98	1.37	1.21	1.14	1.10	0.31	0.13	0.01	0.01	0.02	0.01	0.00	0.00	0.03	0.05	0.70	0.42	2.44	2.79	1.05	0.92	0.04	0.05	0.02	0.06	0.00	0.00	0.01	0.01
410	0.00	0.00	0.00	0.00	0.05	0.04	0.17	0.14	1.25	1.17	1.23	1.14	2.14	2.00	0.32	0.19	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.02	1.15	0.70	3.68	4.47	0.65	0.58	0.04	0.03	0.02	0.05	0.00	0.00	0.01	0.01
420	0.00	0.00	0.00	0.00	0.04	0.04	0.19	0.15	1.18	1.02	1.12	1.11	1.37	1.56	0.41	0.30	0.01	0.01	0.01	0.01	0.00	0.00	0.03	0.04	0.62	0.42	2.86	3.51	0.94	0.70	0.05	0.04	0.03	0.08	0.00	0.00	0.01	0.01
430	0.00	0.00	0.00	0.00	0.04	0.05	0.20	0.15	0.82	0.69	1.08	1.00	1.25	1.32	0.31	0.31	0.01	0.01	0.02	0.02	0.00	0.00	0.01	0.02	0.69	0.47	1.71	2.15	0.85	0.56	0.04	0.04	0.04	0.07	0.00	0.00	0.01	0.01
440	0.00	0.00	0.00	0.00	0.06	0.07	0.16	0.12	0.35	0.21	1.94	1.83	1.04	1.09	0.48	0.33	0.01	0.02	0.02	0.01	0.00	0.00	0.04	0.03	0.74	0.46	2.16	2.41	0.54	0.32	0.04	0.04	0.03	0.05	0.00	0.00	0.02	0.02
450	0.00	0.00	0.00	0.00	0.04	0.05	0.29	0.23	0.23	0.38	1.42	1.26	0.83	0.86	0.35	0.17	0.01	0.01	0.02	0.01	0.00	0.00	0.02	0.03	0.68	0.40	2.25	2.25	0.33	0.19	0.04	0.04	0.03	0.05	0.00	0.00	0.01	0.01
460	0.00	0.00	0.00	0.00	0.03	0.04	0.24	0.19	0.17	0.32	1.05	0.87	0.62	0.62	0.11	0.13	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.04	0.49	0.19	1.78	1.81	0.38	0.17	0.07	0.06	0.02	0.04	0.00	0.00	0.01	0.01
470	0.00	0.00	0.00	0.00	0.02	0.02	0.24	0.18	0.11	0.26	1.32	1.27	0.41	0.39	0.08	0.10	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.04	0.48	0.19	1.20	0.92	0.56	0.29	0.10	0.08	0.01	0.03	0.00	0.00	0.00	0.01
480	0.00	0.00	0.00	0.00	0.01	0.01	0.13	0.10	0.05	0.20	1.38	1.42	0.20	0.15	0.05	0.07	0.02	0.01	0.01	0.01	0.00	0.00	0.02	0.03	0.33	0.17	1.08	1.01	0.48	0.21	0.10	0.07	0.01	0.02	0.00	0.00	0.00	0.01
490	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.15	-0.01	0.14	1.04	1.03	-0.01	0.00	0.02	0.04	0.01	0.02	0.01	0.01	0.00	0.00	0.03	0.02	0.25	0.08	1.13	1.39	0.39	0.20	0.08	0.06	0.01	0.01	0.00	0.00	0.00	0.00

Year 2 Sand Thickness (feet)

Beach Width = 250'

Distance Offshore	DM565		DM560		DM580		DM590		SD595		SD600		SD610		SD620		SD625	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
0	0.00	0.00	0.00	0.00	0.27	0.07	0.08	0.05	0.09	0.16	5.27	7.67	2.75	9.20	0.03	0.01	0.00	0.00
10	0.00	0.00	0.00	0.00	0.17	0.24	1.60	1.00	0.46	1.41	1.75	4.45	2.98	8.34	0.62	0.60	0.04	0.06
20	0.00	0.00	0.00	0.00	0.18	0.37	1.48	1.00	0.92	1.90	4.14	6.80	2.90	6.68	0.98	1.26	0.03	0.09
30	0.00	0.00	0.00	0.00	0.15	0.43	1.33	0.97	0.83	2.13	3.22	5.49	2.50	5.57	1.26	1.71	0.09	0.16
40	0.00	0.00	0.00	0.00	0.17	0.42	1.34	1.05	1.03	2.41	3.94	6.24	2.05	5.08	0.85	1.20	0.07	0.12
50	0.00	0.00	0.00	0.00	0.21	0.41	1.10	0.99	1.07	2.22	4.03	6.40	1.95	4.77	0.49	1.03	0.05	0.09
60	0.00	0.00	0.00	0.00	0.23	0.37	0.65	0.79	1.25	2.35	3.61	5.99	1.69	4.01	0.38	0.94	0.05	0.08
70	0.00	0.00	0.00	0.00	0.26	0.37	0.56	0.82	1.37	2.29	2.97	5.41	1.93	3.74	0.39	0.92	0.05	0.07
80	0.00	0.00	0.00	0.00	0.30	0.40	0.69	0.95	1.34	2.11	2.79	5.22	2.84	4.24	0.53	0.99	0.04	0.07
90	0.00	0.00	0.00	0.00	0.27	0.37	1.03	1.30	1.05	1.79	4.13	6.42	4.37	5.09	0.64	1.11	0.03	0.07
100	0.00	0.00	0.00	0.00	0.16	0.31	1.59	1.80	0.95	1.91	4.99	6.92	4.67	4.80	0.71	1.18	0.03	0.06
110	0.00	0.00	0.00	0.00	0.08	0.26	1.99	2.23	0.63	1.88	4.26	5.95	4.51	3.95	0.72	1.25	0.05	0.09
120	0.00	0.00	0.00	0.00	0.16	0.36	1.37	1.93	1.14	2.86	4.13	5.80	6.88	5.48	0.74	1.35	0.04	0.09
130	0.00	0.00	0.00	0.00	0.18	0.37	1.05	1.81	1.34	3.48	4.14	5.66	3.18	2.52	0.95	1.43	0.04	0.07
140	0.00	0.00	0.00	0.00	0.29	0.45	1.01	1.82	1.19	3.43	4.55	5.54	5.21	4.91	1.01	1.34	0.06	0.08
150	0.00	0.00	0.00	0.00	0.38	0.50	1.09	1.83	0.87	3.05	5.20	5.18	4.27	3.50	1.00	1.20	0.10	0.10
160	0.00	0.00	0.00	0.00	0.36	0.45	1.57	2.15	0.99	2.51	5.79	4.76	3.32	1.66	1.02	1.05	0.12	0.10
170	0.00	0.00	0.00	0.00	0.34	0.37	1.84	2.27	1.69	2.27	5.78	3.85	2.71	1.53	1.03	0.92	0.12	0.09
180	0.00	0.00	0.00	0.00	0.32	0.26	1.28	1.82	2.02	1.86	5.64	3.26	3.66	1.82	1.03	0.75	0.12	0.07
190	0.00	0.00	0.00	0.00	0.38	0.25	0.94	1.48	2.44	1.36	4.90	2.47	4.95	3.08	1.02	0.57	0.11	0.07
200	0.00	0.00	0.00	0.00	0.43	0.26	0.68	1.14	2.90	1.14	4.46	1.95	3.40	1.75	1.10	0.61	0.11	0.06
210	0.00	0.00	0.00	0.00	0.43	0.23	1.05	1.19	3.39	1.37	4.08	1.45	5.31	3.47	1.13	0.62	0.10	0.05
220	0.00	0.00	0.00	0.00	0.39	0.19	1.17	0.86	3.33	0.99	3.57	0.94	4.46	3.07	1.10	0.61	0.09	0.04
230	0.00	0.00	0.00	0.00	0.34	0.14	1.22	0.70	3.15	0.88	3.31	0.82	3.68	2.42	1.02	0.59	0.09	0.04
240	0.00	0.00	0.00	0.00	0.31	0.12	0.86	0.52	2.86	0.91	3.28	1.20	2.54	1.70	1.03	0.59	0.08	0.04
250	0.00	0.00	0.00	0.00	0.28	0.10	0.97	0.58	3.16	1.08	2.97	1.20	2.47	2.04	1.06	0.64	0.07	0.04
260	0.00	0.00	0.00	0.00	0.26	0.10	1.20	0.67	2.69	1.08	2.70	1.08	2.96	2.56	0.96	0.60	0.06	0.04
270	0.00	0.00	0.00	0.00	0.25	0.09	1.07	0.55	2.26	0.66	2.77	1.38	4.84	4.35	0.86	0.46	0.06	0.04
280	0.00	0.00	0.00	0.00	0.23	0.08	0.56	0.42	2.07	0.49	2.38	1.01	4.43	2.92	0.82	0.35	0.06	0.04
290	0.00	0.00	0.00	0.00	0.21	0.09	0.31	0.30	2.55	1.06	2.67	1.57	4.22	3.16	0.81	0.30	0.05	0.04
300	0.00	0.00	0.00	0.00	0.21	0.11	0.52	0.46	2.39	1.10	2.65	1.68	2.64	2.22	0.76	0.25	0.04	0.03
310	0.00	0.00	0.00	0.00	0.20	0.13	0.53	0.43	1.98	0.99	2.12	1.45	2.91	2.70	0.46	0.37	0.03	0.03
320	0.00	0.00	0.00	0.00	0.17	0.12	0.72	0.56	0.95	0.59	2.61	2.25	3.54	2.59	1.50	1.70	0.03	0.03
330	0.00	0.00	0.00	0.00	0.16	0.11	0.62	0.47	1.13	0.60	2.49	2.30	3.38	2.44	0.78	1.04	0.02	0.03
340	0.00	0.00	0.00	0.00	0.15	0.08	0.66	0.33	0.78	0.54	2.44	2.03	2.36	1.28	0.32	0.27	0.02	0.02
350	0.00	0.00	0.00	0.00	0.13	0.08	0.58	0.31	1.19	1.59	2.48	2.05	3.56	1.64	0.52	0.39	0.02	0.02
360	0.00	0.00	0.00	0.00	0.10	0.06	0.38	0.18	1.25	1.46	2.56	2.33	4.78	2.73	0.30	0.17	0.02	0.02
370	0.00	0.00	0.00	0.00	0.08	0.06	0.23	0.06	2.19	1.90	2.53	2.33	3.09	1.97	0.34	0.29	0.02	0.02
380	0.00	0.00	0.00	0.00	0.07	0.06	0.25	0.10	1.35	1.20	2.29	2.21	2.01	1.83	0.54	0.46	0.02	0.02
390	0.00	0.00	0.00	0.00	0.06	0.04	0.42	0.28	1.64	1.46	2.04	1.88	2.79	1.85	0.85	0.99	0.02	0.01
400	0.00	0.00	0.00	0.00	0.07	0.06	0.19	0.14	1.17	1.23	1.61	1.43	1.35	1.30	0.43	0.18	0.02	0.01
410	0.00	0.00	0.00	0.00	0.06	0.05	0.22	0.18	1.57	1.46	1.45	1.34	2.53	2.36	0.45	0.26	0.02	0.01
420	0.00	0.00	0.00	0.00	0.05	0.04	0.25	0.20	1.47	1.27	1.32	1.31	1.62	1.84	0.57	0.42	0.02	0.01
430	0.00	0.00	0.00	0.00	0.05	0.05	0.27	0.20	1.03	0.86	1.27	1.18	1.48	1.56	0.44	0.43	0.01	0.01
440	0.00	0.00	0.00	0.00	0.07	0.08	0.21	0.16	0.43	0.27	2.30	2.16	1.23	1.29	0.67	0.47	0.02	0.02
450	0.00	0.00	0.00	0.00	0.04	0.06	0.37	0.30	0.28	0.48	1.68	1.49	0.98	1.01	0.49	0.23	0.01	0.02
460	0.00	0.00	0.00	0.00	0.03	0.04	0.31	0.24	0.21	0.40	1.24	1.02	0.73	0.73	0.15	0.18	0.02	0.01
470	0.00	0.00	0.00	0.00	0.02	0.03	0.31	0.23	0.13	0.33	1.56	1.50	0.48	0.46	0.11	0.14	0.02	0.01
480	0.00	0.00	0.00	0.00	0.01	0.01	0.17	0.12	0.06	0.25	1.63	1.68	0.23	0.18	0.07	0.10	0.02	0.02
490	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.19	-0.02	0.18	1.23	1.21	-0.02	0.00	0.03	0.06	0.02	0.02

Distance Offshore	SD630		SD650		SD660		SD670		SD675		SD680		SD690		SD695		SD700		SD710	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
0	0.06	0.05	0.00	0.00	0.00	0.00	0.08	0.03	3.06	2.68	0.01	0.01	0.43	0.43	0.00	0.00	0.01	0.00	0.00	0.00
10	0.21	0.20	0.01	0.01	0.08	0.14	5.15	5.87	7.37	6.84	5.61	4.34	0.42	0.35	0.18	0.19	0.01	0.01	0.05	0.06
20	0.19	0.24	0.01	0.01	0.07	0.19	3.39	5.53	4.62	4.97	4.53	3.72	0.24	0.20	0.15	0.14	0.01	0.01	0.05	0.09
30	0.18	0.26	0.01	0.01	0.07	0.18	5.57	8.30	4.01	5.34	3.56	3.49	0.11	0.11	0.11	0.11	0.00	0.01	0.04	0.09
40	0.21	0.30	0.00	0.00	0.07	0.15	3.85	6.57	5.74	8.17	2.71	3.00	0.07	0.09	0.09	0.09	0.00	0.00	0.05	0.10
50	0.19	0.25	0.00	0.00	0.07	0.13	3.11	5.54	5.63	9.21	2.56	2.85	0.09	0.12	0.05	0.07	0.00	0.00	0.02	0.07
60	0.15	0.21	0.00	0.00	0.06	0.09	2.73	4.95	3.67	7.91	2.66	2.93	0.09	0.14	0.07	0.11	0.00	0.00	0.02	0.06
70	0.17	0.21	0.01	0.01	0.06	0.07	2.52	4.12	3.79	7.75	2.25	2.71	0.09	0.17	0.09	0.14	0.00	0.00	0.01	0.04
80	0.16	0.19	0.01	0.01	0.11	0.11	3.86	5.15	4.11	7.91	1.67	2.40	0.14	0.22	0.09	0.13	0.00	0.00	0.01	0.03
90	0.13	0.16	0.01	0.01	0.22	0.19	4.22	5.26	4.40	8.31	1.80	2.68	0.08	0.15	0.07	0.09	0.00	0.00	0.01	0.04
100	0.12	0.16	0.01	0.01	0.20	0.12	4.51	5.37	4.20	8.15	1.09	2.13	0.16	0.22	0.07	0.05	0.00	0.01	0.03	0.06
110	0.13	0.18	0.01	0.01	0.18	0.12	3.85	4.87	1.82	5.42	0.77	1.86	0.22	0.22	0.09	0.04	0.01	0.01	0.05	0.10
120	0.15	0.19	0.01	0.01	0.18	0.08	4.42	5.63	1.77	4.61	1.36	2.49	0.19	0.13	0.13	0.04	0.01	0.01	0.05	0.11
130	0.16	0.19	0.01	0.00	0.14	0.06	5.03	6.37	2.12	3.81	1.83	3.02	0.16	0.08	0.12	0.05	0.01	0.01	0.05	0.10
140	0.18	0.21	0.01	0.00	0.10	0.07	4.32	5.65	3.55	3.88	1.63	2.74	0.11	0.05	0.08	0.03	0.01	0.01	0.06	0.10
150	0.19	0.22	0.01	0.00	0.09	0.07	4.43	5.48	5.75	4.27	1.56	2.46	0.10	0.08	0.04	0.03	0.01	0.01	0.06	0.08
160	0.19	0.21	0.01	0.01	0.02	0.08	4.29	4.86	6.99	3.74	1.81	1.81	0.09	0.09	0.04	0.03	0.01	0.01	0.06	0.07
170	0.17	0.18	0.01	0.01	0.13	0.14	4.16	4.16	7.37	2.72	1.94	1.74	0.08	0.09	0.05	0.04	0.01	0.01	0.05	0.04
180	0.17	0.16	0.00	0.00	0.06	0.04	3.83	3.21	9.28	3.22	1.69	1.47	0.08	0.08	0.04	0.06	0.01	0.01	0.05	0.02
190	0.17	0.14	0.01	0.01	0.06	0.06	3.71	2.58	7.68	2.48	1.45	1.64	0.10	0.10	0.05	0.05	0.01	0.01	0.06	0.03
200	0.16	0.13	0.01	0.01	0.09	0.10	3.61	2.17	5.99	2.57	1.46	1.74	0.13	0.12	0.07	0.06	0.01	0.01	0.04	0.02
210	0.15	0.10	0.01	0.01	0.10	0.05	3.55	2.01	4.78	2.23	1.42	2.14	0.12	0.18	0.10	0.07	0.01	0.01	0.03	0.01
220	0.14	0.09	0.01	0.01	0.09	0.05	2.73	1.07	3.42	1.62	2.01	1.17	0.16	0.20	0.07	0.04	0.01	0.00	0.07	0.03
230	0.13	0.08	0.01	0.01	0.07	0.04	3.02	1.24	3.16	2.15	1.10	0.67	0.26	0.31	0.08	0.07	0.01	0.00	0.08	0.03
240	0.13	0.08	0.01	0.01	0.11	0.10	2.31	0.84	3.01	1.80	1.67	1.89	0.25	0.18	0.09	0.03	0.01	0.01	0.05	0.01
250	0.12	0.07	0.01	0.01	0.12	0.08	2.19	0.85	2.18	1.02	4.55	3.80	0.23	0.18	0.11	0.07	0.01	0.01	0.08	0.02
260	0.11	0.07	0.01	0.01	0.09	0.03	1.99	0.77	2.37	0.76	2.81	2.39	0.19	0.25	0.04	0.04	0.01	0.01	0.07	0.03
270	0.11	0.07	0.01	0.01	0.06	0.04	3.18	2.14	2.20	0.83	2.14	1.72	0.13	0.17	0.04	0.06	0.00	0.01	0.06	0.04
280	0.11	0.07	0.01	0.01	0.15	0.12	1.63	0.75	3.49	1.87	1.48	1.27	0.10	0.14	0.07	0.06	0.01	0.01	0.05	0.02
290	0.09	0.06	0.00	0.00	0.13	0.09	1.65	1.07	3.75	3.30	0.93	1.10	0.11	0.08	0.11	0.16	0.01	0.01	0.05	0.01
300	0.09	0.06	0.01	0.01	0.13	0.18	1.45	0.81	1.95	2.61	1.74	1.43	0.11	0.13	0.11	0.10	0.01	0.01	0.05	0.02
310	0.08	0.05	0.01	0.01	0.10	0.08	1.55	0.75	2.65	2.50	1.08	0.93	0.08	0.06	0.05	0.01	0.00	0.01	0.05	0.02
320	0.07	0.04	0.01	0.01	0.13	0.15	2.20	1.14	3.24	2.10	1.05	0.53	0.12	0.08	0.07	0.07	0.00	0.00	0.04	0.02
330	0.06	0.03	0.01	0.01	0.13	0.08	1.69	0.98	2.61	1.57	1.16	0.88	0.23	0.16	0.11	0.10	0.00	0.00	0.04	0.02
340	0.05	0.03	0.01	0.01	0.05	0.05	1.76	0.87	1.25	1.11	1.02	0.64	0.08	0.15	0.11	0.12	0.01	0.01	0.03	0.02
350	0.04	0.03	0.00	0.01	0.08	0.08	1.35	0.68	1.28	1.01	1.03	1.01	0.09	0.10	0.10	0.05	0.00	0.00	0.04	0.03
360	0.04	0.02	0.00	0.00	0.03	0.04	1.92	1.12	1.37	1.55	2.01	1.02	0.10	0.05	0.08	0.04	0.00	0.00	0.03	0.02
370	0.03	0.02	0.00	0.00	0.08	0.09	1.54	1.40	1.67	2.04	1.39	1.53	0.15	0.07	0.04	0.03	0.00	0.00	0.03	0.02
380	0.03	0.02	0.00	0.01	0.04	0.06	1.02	0.90	1.67	1.87	1.95	2.00	0.05	0.08	0.04	0.06	0.00	0.00	0.02	0.02
390	0.02	0.02	0.00	0.01	0.02	0.04	0.83	0.58	1.77	1.98	1.43	1.21	0.09	0.13	0.08	0.13	0.00	0.00	0.02	0.01
400	0.02	0.02	0.00	0.00	0.04	0.07	0.90	0.54	2.92	3.33	1.36	1.19	0.08	0.10	0.03	0.08	0.00	0.00	0.01	0.01
410	0.02	0.02	0.00	0.00	0.02	0.04	1.49	0.90	4.39	5.34	0.84	0.75	0.07	0.06	0.02	0.07	0.00	0.00	0.01	0.01
420	0.02	0.01	0.00	0.00	0.05	0.07	0.80	0.54	3.41	4.19	1.22	0.90	0.08	0.07	0.04	0.10	0.00	0.00	0.01	0.01
430	0.03	0.02	0.00	0.00	0.02	0.03	0.88	0.60	2.04	2.57	1.10	0.73	0.07	0.07	0.05	0.10	0.00	0.00	0.01	0.01
440	0.02	0.02	0.00	0.00	0.06	0.05	0.96	0.59	2.58	2.87	0.70	0.42	0.07	0.08	0.04	0.06	0.00	0.00	0.02	0.02
450	0.03	0.02	0.00	0.00	0.03	0.04	0.88	0.51	2.69	2.69	0.43	0.25	0.07	0.07	0.04	0.06	0.00	0.00	0.01	0.01
460	0.01	0.01	0.01	0.00	0.03	0.06	0.63	0.24	2.13	2.16	0.49	0.22	0.11	0.11	0.03	0.05	0.00	0.00	0.01	0.01
470	0.01	0.02	0.01	0.00	0.04	0.07	0.62	0.24	1.43	1.10	0.72	0.37	0.18	0.13	0.02	0.04	0.00	0.00	0.01	0.01
480	0.02	0.02	0.00	0.00	0.03	0.04	0.43	0.21	1.29	1.20	0.62	0.27	0.17	0.12	0.01	0.02	0.00	0.00	0.01	0.01
490	0.01	0.01	0.00	0.00	0.05	0.03	0.32	0.11	1.34	1.65	0.51	0.26	0.13	0.10	0.02	0.02	0.00	0.00	0.00	0.00

Year 2 Sand Thickness (feet)

Beach Width = 300'

Distance Offshore	DM565		DM560		DM580		DM590		SD595		SD600		SD610		SD620		SD625		SD630		SD650		SD660		SD670		SD675		SD680		SD690		SD695		SD700		SD710	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
0	0.00	0.00	0.00	0.00	0.30	0.08	0.10	0.07	0.12	0.20	6.21	9.04	3.25	10.86	0.04	0.01	0.00	0.00	0.08	0.07	0.00	0.00	0.01	0.01	0.10	0.04	3.56	3.11	0.02	0.01	0.68	0.68	0.00	0.00	0.01	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.19	0.26	1.96	1.22	0.58	1.78	2.07	5.24	3.52	9.85	0.80	0.78	0.04	0.07	0.28	0.27	0.01	0.01	0.11	0.21	6.29	7.17	8.56	7.94	6.86	5.31	0.68	0.56	0.23	0.25	0.01	0.01	0.06	0.08
20	0.00	0.00	0.00	0.00	0.20	0.41	1.82	1.23	1.16	2.39	4.88	8.02	3.42	7.89	1.27	1.63	0.04	0.11	0.25	0.32	0.01	0.01	0.10	0.28	4.14	6.75	5.36	5.77	5.54	4.56	0.38	0.32	0.20	0.19	0.01	0.01	0.06	0.11
30	0.00	0.00	0.00	0.00	0.16	0.48	1.62	1.18	1.05	2.68	3.79	6.47	2.95	6.58	1.63	2.20	0.10	0.19	0.24	0.35	0.01	0.01	0.11	0.26	6.80	10.13	4.65	6.20	4.35	4.27	0.17	0.17	0.15	0.14	0.00	0.01	0.05	0.11
40	0.00	0.00	0.00	0.00	0.19	0.47	1.65	1.29	1.30	3.04	4.64	7.36	2.42	5.99	1.10	1.55	0.08	0.14	0.28	0.39	0.01	0.01	0.10	0.23	4.70	8.02	6.66	9.48	3.31	3.67	0.11	0.14	0.11	0.11	0.00	0.00	0.06	0.12
50	0.00	0.00	0.00	0.00	0.24	0.45	1.35	1.21	1.35	2.80	4.76	7.54	2.31	5.64	0.64	1.33	0.06	0.11	0.25	0.33	0.00	0.01	0.10	0.19	3.80	6.77	6.54	10.68	3.14	3.49	0.15	0.19	0.07	0.09	0.00	0.00	0.03	0.09
60	0.00	0.00	0.00	0.00	0.26	0.41	0.79	0.96	1.58	2.96	4.26	7.06	2.00	4.74	0.49	1.21	0.06	0.09	0.20	0.28	0.00	0.01	0.08	0.13	3.33	6.04	4.26	9.18	3.25	3.58	0.15	0.23	0.08	0.14	0.00	0.00	0.03	0.07
70	0.00	0.00	0.00	0.00	0.29	0.41	0.68	1.00	1.72	2.88	3.50	6.37	2.28	4.42	0.51	1.19	0.06	0.09	0.22	0.28	0.01	0.01	0.08	0.10	3.08	5.03	4.40	8.99	2.75	3.31	0.15	0.27	0.12	0.18	0.00	0.00	0.01	0.05
80	0.00	0.00	0.00	0.00	0.34	0.44	0.84	1.16	1.69	2.65	3.28	6.16	3.35	5.01	0.68	1.28	0.05	0.09	0.21	0.25	0.01	0.01	0.16	0.16	4.71	6.29	4.77	9.18	2.04	2.94	0.23	0.36	0.11	0.17	0.00	0.00	0.01	0.04
90	0.00	0.00	0.00	0.00	0.29	0.42	1.26	1.60	1.32	2.26	4.87	7.57	5.15	6.00	0.83	1.43	0.04	0.08	0.17	0.22	0.01	0.01	0.32	0.28	5.15	6.42	5.11	9.64	2.20	3.28	0.12	0.24	0.09	0.12	0.00	0.00	0.02	0.05
100	0.00	0.00	0.00	0.00	0.17	0.34	1.94	2.20	1.20	2.41	5.89	8.16	5.51	5.66	0.92	1.53	0.04	0.07	0.16	0.21	0.01	0.01	0.29	0.18	5.50	6.56	4.88	9.46	1.33	2.61	0.26	0.35	0.08	0.07	0.01	0.01	0.03	0.08
110	0.00	0.00	0.00	0.00	0.09	0.29	2.44	2.73	0.80	2.36	5.03	7.02	5.33	4.66	0.93	1.61	0.06	0.10	0.18	0.23	0.02	0.01	0.27	0.17	4.70	5.95	2.11	6.29	0.94	2.28	0.34	0.35	0.12	0.05	0.01	0.01	0.07	0.13
120	0.00	0.00	0.00	0.00	0.18	0.40	1.68	2.36	1.44	3.61	4.86	6.84	8.12	6.47	0.96	1.74	0.05	0.10	0.19	0.24	0.01	0.01	0.27	0.12	5.39	6.87	2.05	5.35	1.67	3.05	0.31	0.21	0.17	0.05	0.01	0.01	0.06	0.13
130	0.00	0.00	0.00	0.00	0.20	0.42	1.29	2.22	1.69	4.38	4.89	6.68	3.75	2.98	1.22	1.84	0.05	0.09	0.21	0.26	0.01	0.01	0.21	0.09	6.14	7.78	2.46	4.42	2.24	3.70	0.25	0.13	0.15	0.06	0.01	0.01	0.06	0.13
140	0.00	0.00	0.00	0.00	0.32	0.50	1.24	2.24	1.50	4.32	5.36	6.53	6.15	5.80	1.31	1.73	0.07	0.09	0.23	0.28	0.02	0.01	0.15	0.10	5.27	6.90	4.12	4.50	1.99	3.36	0.17	0.08	0.10	0.04	0.01	0.01	0.07	0.12
150	0.00	0.00	0.00	0.00	0.42	0.56	1.34	2.24	1.09	3.84	6.13	6.11	5.05	4.13	1.30	1.55	0.12	0.12	0.24	0.29	0.01	0.00	0.14	0.11	5.41	6.69	6.67	4.95	1.91	3.01	0.16	0.12	0.05	0.03	0.01	0.01	0.07	0.10
160	0.00	0.00	0.00	0.00	0.40	0.50	1.93	2.63	1.25	3.17	6.83	5.61	3.92	1.96	1.32	1.35	0.15	0.12	0.25	0.28	0.01	0.01	0.03	0.11	5.24	5.93	8.11	4.34	2.22	2.22	0.14	0.14	0.05	0.04	0.01	0.01	0.07	0.08
170	0.00	0.00	0.00	0.00	0.38	0.41	2.25	2.78	2.13	2.86	6.82	4.54	3.20	1.81	1.33	1.19	0.15	0.10	0.22	0.23	0.01	0.01	0.18	0.21	5.08	5.08	8.56	3.15	2.38	2.13	0.13	0.15	0.06	0.05	0.01	0.01	0.07	0.06
180	0.00	0.00	0.00	0.00	0.35	0.29	1.57	2.23	2.55	2.35	6.65	3.84	4.32	2.15	1.33	0.97	0.14	0.09	0.23	0.21	0.00	0.00	0.09	0.06	4.67	3.92	10.77	3.74	2.06	1.80	0.12	0.13	0.06	0.08	0.02	0.01	0.06	0.03
190	0.00	0.00	0.00	0.00	0.43	0.28	1.15	1.82	3.07	1.72	5.77	2.91	5.85	3.64	1.32	0.74	0.13	0.08	0.23	0.19	0.01	0.01	0.09	0.09	4.52	3.15	8.91	2.88	1.78	2.01	0.16	0.17	0.07	0.07	0.01	0.01	0.07	0.03
200	0.00	0.00	0.00	0.00	0.47	0.29	0.83	1.40	3.65	1.44	5.26	2.30	4.01	2.07	1.41	0.79	0.13	0.08	0.21	0.17	0.01	0.01	0.13	0.14	4.40	2.65	6.96	2.99	1.79	2.13	0.21	0.19	0.09	0.08	0.01	0.01	0.05	0.02
210	0.00	0.00	0.00	0.00	0.48	0.26	1.29	1.46	4.27	1.72	4.81	1.71	6.27	4.10	1.46	0.81	0.12	0.06	0.20	0.14	0.01	0.01	0.15	0.08	4.33	2.46	5.54	2.59	1.74	2.61	0.20	0.28	0.12	0.09	0.01	0.01	0.04	0.02
220	0.00	0.00	0.00	0.00	0.43	0.22	1.43	1.05	4.19	1.25	4.21	1.11	5.27	3.63	1.42	0.79	0.11	0.05	0.18	0.12	0.01	0.01	0.13	0.08	3.33	1.30	3.97	1.88	2.46	1.43	0.26	0.33	0.10	0.06	0.01	0.01	0.09	0.03
230	0.00	0.00	0.00	0.00	0.38	0.15	1.50	0.86	3.97	1.11	3.91	0.97	4.34	2.85	1.32	0.76	0.10	0.04	0.18	0.10	0.01	0.01	0.11	0.06	3.68	1.51	3.67	2.50	1.35	0.82	0.41	0.49	0.10	0.09	0.01	0.00	0.10	0.03
240	0.00	0.00	0.00	0.00	0.34	0.13	1.06	0.64	3.61	1.15	3.86	1.42	3.00	2.01	1.32	0.76	0.09	0.04	0.17	0.10	0.01	0.02	0.17	0.15	2.82	1.02	3.49	2.08	2.04	2.32	0.39	0.29	0.12	0.04	0.01	0.01	0.06	0.02
250	0.00	0.00	0.00	0.00	0.31	0.11	1.18	0.71	3.98	1.36	3.51	1.42	2.91	2.40	1.37	0.83	0.09	0.05	0.16	0.09	0.01	0.02	0.17	0.11	2.67	1.04	2.53	1.18	5.56	4.65	0.37	0.28	0.15	0.09	0.01	0.01	0.10	0.03
260	0.00	0.00	0.00	0.00	0.29	0.12	1.47	0.82	3.39	1.35	3.18	1.28	3.49	3.02	1.24	0.77	0.08	0.05	0.14	0.09	0.01	0.02	0.14	0.04	2.43	0.94	2.75	0.88	3.43	2.93	0.31	0.40	0.05	0.06	0.01	0.01	0.09	0.04
270	0.00	0.00	0.00	0.00	0.27	0.10	1.31	0.67	2.85	0.83	3.27	1.62	5.72	5.13	1.11	0.60	0.07	0.04	0.15	0.09	0.01	0.01	0.08	0.05	3.89	2.61	2.55	0.96	2.62	2.11	0.21	0.27	0.05	0.08	0.01	0.01	0.08	0.04
280	0.00	0.00	0.00	0.00	0.25	0.09	0.68	0.51	2.61	0.61	2.81	1.19	5.23	3.45	1.06	0.46	0.07	0.04	0.14	0.09	0.01	0.01	0.22	0.17	1.98	0.91	4.05	2.18	1.81	1.55	0.15	0.22	0.09	0.08	0.01	0.01	0.06	0.03
290	0.00	0.00	0.00	0.00	0.23	0.10	0.38	0.37	3.21	1.34	3.14	1.86	4.99	3.73	1.04	0.38	0.06	0.04	0.12	0.08	0.01	0.00	0.19	0.13	2.02	1.31	4.36	3.83	1.13	1.35	0.18	0.13	0.14	0.20	0.01	0.01	0.06	0.02
300	0.00	0.00	0.00	0.00	0.23	0.12	0.64	0.56	3.02	1.39	3.12	1.98	3.11	2.62	0.98	0.32	0.05	0.04	0.11	0.07	0.01	0.02	0.19	0.26	1.77	0.99	2.26	3.03	2.13	1.75	0.18	0.20	0.14	0.13	0.01	0.01	0.07	0.03
310	0.00	0.00	0.00	0.00	0.22	0.14	0.65	0.53	2.49	1.25	2.50	1.71	3.43	3.19	0.60	0.47	0.04	0.04	0.10	0.06	0.02	0.01	0.15	0.12	1.90	0.91	3.08	2.90	1.33	1.14	0.12	0.10	0.07	0.02	0.00	0.01	0.06	0.03
320	0.00	0.00	0.00	0.00	0.19	0.13	0.89	0.68	1.20	0.75	3.07	2.65	4.18	3.06	1.93	2.20	0.03	0.04	0.09	0.06	0.02	0.02	0.19	0.22	2.68	1.39	3.76	2.43	1.28	0.65	0.19	0.13	0.09	0.09	0.00	0.00	0.05	0.03
330	0.00	0.00	0.00	0.00	0.18	0.12	0.76	0.58	1.43	0.76	2.94	2.71	3.99	2.88	1.01	1.35	0.03	0.03	0.08	0.05	0.01	0.01	0.18	0.11	2.06	1.20	3.03	1.82	1.42	1.07	0.36	0.26	0.14	0.12	0.00	0.00	0.05	0.03
340	0.00	0.00	0.00	0.00	0.16	0.09	0.81	0.41	0.98	0.68	2.87	2.39	2.78	1.51	0.41	0.35	0.03	0.03	0.07	0.04	0.01	0.01	0.07	0.08	2.15	1.07	1.45	1.29	1.25	0.78	0.12	0.23	0.14	0.16	0.01	0.01	0.04	0.02
350	0.00	0.00	0.00	0.00	0.15	0.08	0.72	0.39	1.50	2.01	2.92	2.41	4.20	1.94	0.66	0.50	0.02	0.02	0.06	0.04	0.00	0.01	0.12	0.12	1.65	0.83	1.49	1.17	1.26	1.24	0.14	0.16	0.13	0.06	0.00	0.00	0.05	0.03
360	0.00	0.00	0.00	0.00	0.11	0.07	0.47	0.22	1.57	1.83	3.02	2.74	5.64	3.22	0.38	0.22	0.02	0.03	0.05	0.03	0.00	0.01	0.04	0.05	2.34	1.37	1.59	1.80	2.46	1.25	0.16	0.09	0.10	0.05	0.00	0.00	0.04	0.02
370	0.00	0.00	0.00	0.00	0.09	0.07	0.29	0.07	2.76	2.40	2.98	2.75	3.65	2.32	0.44	0.37	0.03	0.02	0.04	0.03	0.00	0.01	0.12	0.14	1.89	1.71	1.94	2.36	1.70	1.88	0.24	0.11	0.05	0.04	0.00	0.00	0.04	0.03
380	0.00	0.00	0.00	0.00	0.08	0.06	0.31	0.13	1.71	1.51	2.70	2.60	2.37	2.16	0.70	0.60	0.02	0.02	0.04	0.03	0.01	0.01	0.07	0.08	1.24	1.10	1.94	2.17	2.39	2.44	0.09	0.13	0.05	0.08	0.00	0.00	0.03	0.02
390	0.00	0.00	0.00	0.00	0.06	0.05	0.52	0.34	2.06	1.85	2.40	2.21	3.29	2.19	1.09	1.27	0.02	0.02	0.03	0.03	0.01	0.01	0.03	0.06	1.01	0.71	2.06	2.29	1.75	1.49	0.14	0.21	0.10	0.17	0.00	0.00	0.02	0.02
400	0.00	0.00	0.00	0.00	0.07	0.07	0.24	0.17	1.47	1.55	1.90	1.69	1.59	1.54	0.55	0.23	0.02	0.02	0.03	0.02	0.01	0.01	0.06	0.10	1.10	0.65	3.38	3.87	1.67	1.46	0.12	0.15	0.04	0.10	0.00	0.00	0.02	0.01
410	0.00	0.00	0.00	0.00	0.06	0.05	0.27	0.22	1.98	1.85	1.71	1.58	2.99	2.78	0.58	0.34	0.02	0.02	0.03	0.02	0.00	0.00	0.03	0.05	1.81	1.10	5.09	6.20	1.03	0.92	0.11	0.09	0.03	0.09	0.00	0.00	0.02	0.01
420	0.00	0.00	0.00	0.00	0.05	0.05	0.31	0.24	1.85	1.60	1.56	1.55	1.91	2.17	0.74	0.54	0.02	0.02	0.03	0.02	0.00	0.00	0.07	0.10	0.98	0.66	3.96	4.86	1.50	1.11	0.13	0.10	0.05	0.13	0.00	0.00	0.02	0.01
430	0.00	0.00	0.00	0.00	0.05	0.06	0.33	0.24	1.29	1.08	1.50	1.39	1.75	1.85	0.57	0.56	0.02	0.02	0.04	0.03	0.00	0.00	0.03	0.05	1.08	0.74	2.37	2.98	1.35	0.89	0.11	0.11	0.07	0.13	0.00	0.00	0.01	0.01
440	0.00	0.00	0.00	0.00	0.08	0.08	0.26	0.19	0.55	0.34	2.71	2.55	1.45	1.52	0.86	0.60	0.02	0.02	0.03	0.03	0.00	0.01	0.08	0.08	1.17	0.72	3.00	3.34	0.86	0.52	0.11	0.12	0.06	0.08	0.00	0.00	0.03	0.03
450	0.00	0.00	0.00	0.00	0.05	0.06	0.46	0.37	0.36	0.60	1.98	1.76	1.16	1.19	0.63	0.30	0.02	0.02	0.03	0.03	0.01	0.01	0.05	0.06	1.08	0.62	3.12	3.12	0.52	0.31	0.11	0.12	0.05	0.08	0.00	0.00	0.02	0.02
460	0.00	0.00	0.00	0.00	0.04	0.05	0.38	0.30	0.26	0.51	1.46	1.20	0.87	0.87	0.19	0.23	0.02	0.02	0.02	0.02	0.01	0.01	0.05	0.09	0.77	0.29	2.47	2.51	0.61	0.27	0.18	0.17	0.04	0.06	0.00	0.00	0.01	0.01
470	0.00	0.00	0.00	0.00	0.02	0.03	0.38	0.28	0.17	0.41	1.84	1.76	0.57	0.54	0.14	0.18	0.02	0.02	0.02	0.02	0.01	0.01	0.05	0.10	0.75	0.29	1.66	1.28	0.88	0.46	0.28	0.22	0.02	0.05	0.00	0.00	0.01	0.01
480	0.00	0.00	0.00	0.00	0.01	0.01	0.21	0.15	0.07	0.32	1.92	1.97	0.28	0.22	0.09	0.12	0.02	0.02	0.02	0.02	0.00	0.00	0.04	0.06	0.52	0.26	1.49	1.40	0.76	0.33	0.27	0.18	0.02	0.03	0.00	0.00	0.01	0.01
490	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.23	-0.02	0.22	1.45	1.43	-0.02	0.00	0.04	0.07	0.02	0.02	0.02	0.02	0.00	0.00	0.07	0.04	0.39	0.13	1.56	1.92	0.62	0.32	0.21	0.17	0.02	0.02	0.00	0.00	0.01	0.01

Appendix B
Year 2 Impacts (Spring and Fall) to Surfgrass, Other Indicator Species, and Intertidal Reef Platform Using 0.3 m Sedimentation Criteria For Each Reach, Beach Width Option, and Sea Level Rise Scenario

LOW SEA LEVEL RISE SCENARIO

	50FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	0.0	0.0	0.0	0.0
Reach 2	0.0	0.0	0.0	0.0
Reach 3	0.2	0.0	0.7	0.4
Reach 4	0.8	0.0	1.4	0.2
Reach 5	0.0	0.0	0.0	0.0
Reach 6	0.0	0.0	0.1	0.1
Reach 7	0.0	0.0	0.0	0.0
Reach 8	0.0	0.0	2.3	0.7
Reach 9	0.0	0.0	0.5	0.3

	100FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	0.0	0.0	0.0	0.0
Reach 2	0.2	0.1	0.2	0.1
Reach 3	0.9	0.3	4.2	2.7
Reach 4	1.4	0.7	3.9	1.9
Reach 5	0.0	0.0	0.1	0.0
Reach 6	0.0	0.0	0.1	0.1
Reach 7	0.0	0.0	0.0	0.0
Reach 8	0.0	0.0	7.3	3.5
Reach 9	0.0	0.0	1.5	0.9

	150FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	0.1	0.0	0.1	0.1
Reach 2	1.0	0.8	1.2	1.1
Reach 3	1.7	1.2	8.6	7.3
Reach 4	1.6	1.2	8.3	4.5
Reach 5	0.2	0.4	2.4	1.9
Reach 6	0.0	0.0	0.1	0.1
Reach 7	0.0	0.0	0.0	0.0
Reach 8	0.0	0.0	10.2	7.5
Reach 9	0.0	0.0	2.3	1.5

	200FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	0.2	0.1	0.2	0.8
Reach 2	2.6	2.0	3.8	2.9
Reach 3	2.0	1.8	13.6	11.6
Reach 4	1.7	1.4	11.7	6.9
Reach 5	0.7	0.9	6.3	4.5
Reach 6	0.0	0.0	0.1	0.1
Reach 7	0.0	0.0	0.1	0.0
Reach 8	0.0	0.0	12.1	9.2
Reach 9	0.0	0.0	2.50	1.9

	250FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	NA	NA	NA	NA
Reach 2	NA	NA	NA	NA
Reach 3	NA	NA	NA	NA
Reach 4	NA	NA	NA	NA
Reach 5	NA	NA	NA	NA
Reach 6	NA	NA	NA	NA
Reach 7	0.0	0.0	0.2	0.3
Reach 8	0.0	0.0	13.1	10.3
Reach 9	0.0	0.0	2.9	2.7

	300FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	NA	NA	NA	NA
Reach 2	NA	NA	NA	NA
Reach 3	NA	NA	NA	NA
Reach 4	NA	NA	NA	NA
Reach 5	NA	NA	NA	NA
Reach 6	NA	NA	NA	NA
Reach 7	0.0	0.00	0.90	0.6
Reach 8	0.0	0.0	13.8	11.3
Reach 9	0.0	0.0	3.4	3.8

HIGH SEA LEVEL RISE SCENARIO

	50FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	0.0	0.0	0.0	0.0
Reach 2	0.0	0.0	0.0	0.0
Reach 3	0.4	0.1	2.3	1.3
Reach 4	1.1	0.3	2.3	0.9
Reach 5	0.0	0.0	0.0	0.0
Reach 6	0.0	0.0	0.1	0.1
Reach 7	0.0	0.0	0.0	0.0
Reach 8	0.0	0.0	5.0	1.8
Reach 9	0.0	0.0	1.09	0.6

	100FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	0.0	0.0	0.0	0.0
Reach 2	0.2	0.1	0.2	0.2
Reach 3	1.0	0.4	4.5	3.1
Reach 4	1.4	0.8	4.3	2.3
Reach 5	0.0	0.0	0.1	0.1
Reach 6	0.0	0.0	0.1	0.1
Reach 7	0.0	0.0	0.0	0.0
Reach 8	0.0	0.0	7.5	4.0
Reach 9	0.0	0.0	1.5	1.0

	150FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	0.1	0.0	0.1	0.1
Reach 2	1.0	0.8	1.2	1.1
Reach 3	1.7	1.3	9.2	7.8
Reach 4	1.7	1.2	8.7	4.8
Reach 5	0.2	0.40	2.5	2.0
Reach 6	0.0	0.0	0.1	0.1
Reach 7	0.0	0.0	0.0	0.0
Reach 8	0.0	0.0	10.5	7.8
Reach 9	0.0	0.0	2.3	1.6

	200FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	0.2	0.0	0.2	0.1
Reach 2	2.6	0.8	3.8	1.1
Reach 3	2.1	1.3	14.1	7.8
Reach 4	1.8	1.2	12.1	4.8
Reach 5	0.7	0.4	6.4	2.0
Reach 6	0.0	0.0	0.1	0.0
Reach 7	0.0	0.0	0.1	0.0
Reach 8	0.0	0.0	12.2	9.4
Reach 9	0.0	0.0	2.5	2.0

	250FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	NA	NA	NA	NA
Reach 2	NA	NA	NA	NA
Reach 3	NA	NA	NA	NA
Reach 4	NA	NA	NA	NA
Reach 5	NA	NA	NA	NA
Reach 6	NA	NA	NA	NA
Reach 7	0.00	0.00	0.2	0.3
Reach 8	0.0	0.0	13.2	10.4
Reach 9	0.0	0.0	2.9	2.9

	300FT BEACH WIDTH			
	Bedrock w/ Surfgrass Area (acres)		Bedrock w/ Other Indicators Area (acres)	
	Spring 2	Fall 2	Spring 2	Fall 2
Reach 1	NA	NA	NA	NA
Reach 2	NA	NA	NA	NA
Reach 3	NA	NA	NA	NA
Reach 4	NA	NA	NA	NA
Reach 5	NA	NA	NA	NA
Reach 6	NA	NA	NA	NA
Reach 7	0.0	0.0	0.9	0.6
Reach 8	0.0	0.0	13.8	11.5
Reach 9	0.0	0.0	3.5	4.1

Rocky Reef Platform in Acres (for Tabletops Reef in Solana Beach)

Beach Width	Season	Sea Level Rise Scenario	
		Low	High
50 ft	Spring	0.0	0.0
	Fall	0.0	0.0
100 ft	Spring	0.1	0.1
	Fall	0.1	0.1
150 ft	Spring	0.3	0.3
	Fall	0.3	0.3
200 ft	Spring	0.4	0.4
	Fall	0.4	0.4
250 ft	Spring	0.4	0.4
	Fall	0.4	0.4
300 ft	Spring	0.4	0.4
	Fall	0.4	0.4