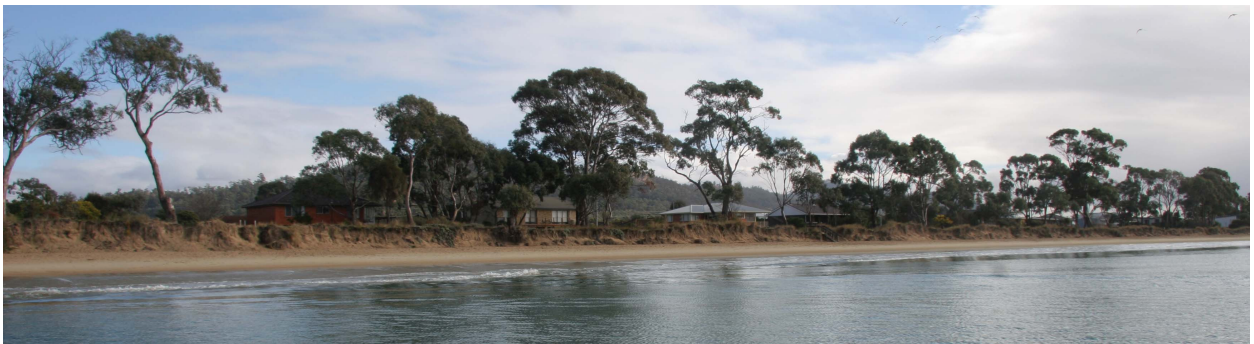


# ROCHES AND CREMORNE BEACHES – HABITAT MAPPING, BATHYMETRY AND SEDIMENT ANALYSIS

## CLARENCE CITY COUNCIL DUNE NOURISHMENT



OCTOBER 2010





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## **EXECUTIVE SUMMARY**

Aquenal Pty Ltd was engaged by the Clarence City Council to undertake a subtidal survey at Roches and Cremorne Beaches, as a component of the Council's planned dune nourishment program. The survey consisted of bathymetry, habitat mapping and sediment analysis.

Bathymetry, habitat mapping and sediment sampling were undertaken at Roches and Cremorne Beaches between the 29<sup>th</sup> of July and the 9<sup>th</sup> of September 2010. Bathymetry of both Roches and Cremorne showed depths within the bays did not exceed 6m AHD.

Habitat mapping in the target areas showed most habitats to be consistently sandy with occasional very sparse seagrass beds. One dense seagrass bed was located at the southern end of Roches Beach. The seagrass beds at Roches Beach were located in very shallow waters (under 1.5m), thus unlikely to be directly impacted by any sand removal, which is expected to take place in deeper water (c.a. 3-6m). Similarly a small area of low profile reef (Bambra Reef) at the northern end of Roches Beach unlikely to be impacted. Buffer zones around these areas of sensitive habitat are recommended. The extent of these buffer zones is yet to be determined. Potential areas of sand removal extended from 3m depth to 600m offshore.

Typically the majority of sediments analysed were retained in the 0.125mm sieve, with the percentage of coarse and fine particles increasing with increasing water depth. Sediments from Roches Beach typically had a greater percentage of particles retained on the 0.063mm sieve compared to Cremorne Beach sediments.

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# 1 PROJECT BRIEF

Aquenal was commissioned by the Clarence City Council to undertake habitat mapping and bathymetric studies off Roches and Cremorne Beaches and to analyse for sand depth and particle size characteristics from 2m AHD to 6m AHD.

*Habitat mapping* – a qualitative assessment of the subtidal waters adjacent to Roches and Cremorne Beaches to identify specific areas of habitat, such as rocky outcrops or seagrass, and any dominant biological communities associated with the various substrate types within the depth range mentioned above. The habitat mapping also included a bathymetric profile to assist with identification of suitable areas where sand may be removed for the purposes of dune nourishment.

*Sediment particle size distribution* – at eight selected locations within each of Roches and Cremorne Beaches, sediment cores (50 cm depth) were extracted from four depths (2, 3, 4 and 6m AHD), divided into three (3) stratified core samples and analysed for particle size distribution.

At each location and each site, a waypoint was marked using a differential GPS accurate to ~2m.

This report has been prepared for submission to the Clarence City Council and documents the analyses and mapping studies undertaken above. The report will be provided in both electronic (pdf) and hardcopy format.



## 2 FIELD SURVEY

### 2.1 SURVEY METHODS

#### 2.1.1 *Bathymetry*

Bathymetry readings were collected at both Roches and Cremorne Beaches using a Garmin 178C GPS/sounder, coupled with an Omnistar differential unit, with readings taken at 50 m intervals across the survey area. Depth readings were adjusted to AHD (Australian Height Datum) and provided as depth contours on a map of the coastline produced using MapInfo Professional® software.

#### 2.1.2 *Habitat Mapping*

Broad scale habitat mapping was undertaken at both Roches and Cremorne Beaches, with the intent of identifying any habitats likely to be impacted by sand removal operations. The extent of shallow seagrass beds and low profile reefs were mapped using a drop camera coupled with Garmin GPS and Omnistar differential unit. Due to poor visibility during all sampling days these methods were restricted to shallow water (less than 2m). Habitats in deeper waters were recorded by divers undertaking sediment sampling.

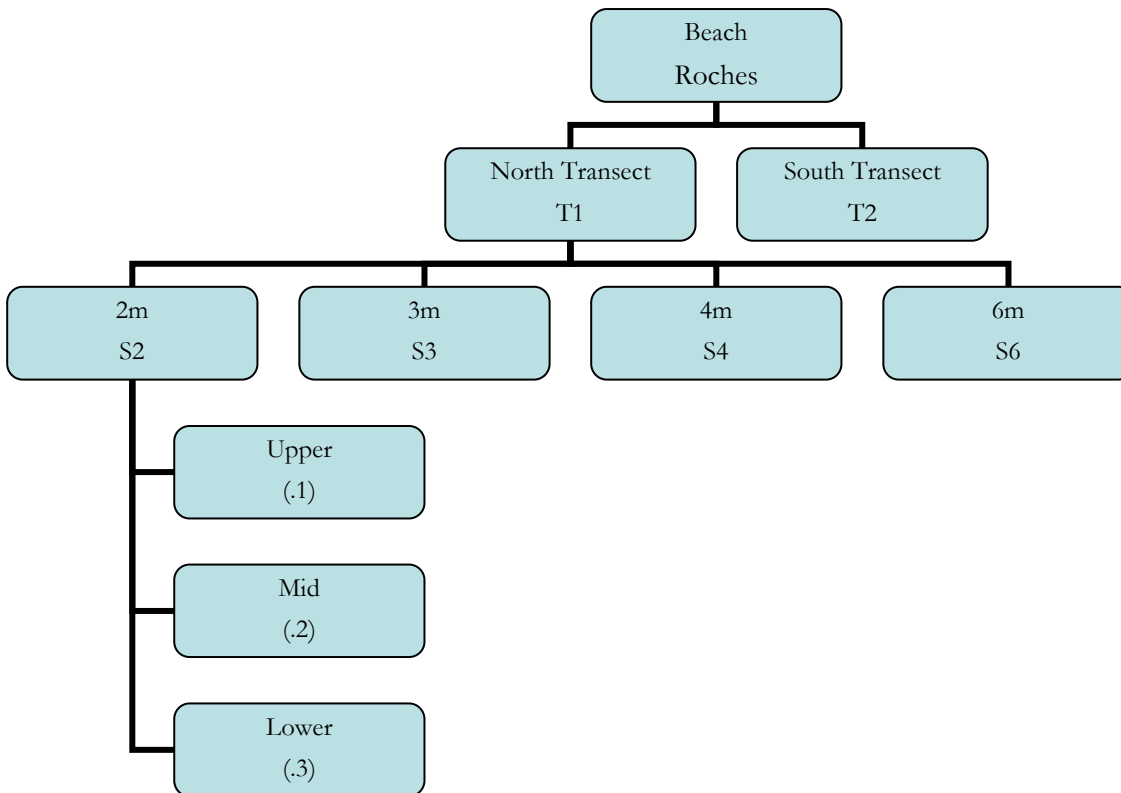
#### 2.1.3 *Particle Size Distribution*

A major aim of this survey was to determine the particle size distribution of subtidal sediments at Roches and Cremorne Beaches. The sampling design (Figure 1) was created to determine particle size distributions over a range of water and sediment depths. At each beach, two transects were established perpendicular to the shore (Figure 2 and Figure 3). Transect T1 was located at the northern end of each beach while transect T2 was located at the southern end of each beach. Along each transect samples were collected at four depths: 2m, 3m, 4m, and 6m (corrected to AHD). Sediment samples were collected using a 48mm (internal diameter) core which was inserted at least 50cm into the sediment using a cap and sledge hammer. Each core was removed from the sediment and sealed with rubber bungs and returned to the boat. Sediments were then extruded from the cores and split into three sediment depths (Figure 4), and stored in labelled plastic jars. Duplicate sediment samples were retained for archiving.

Additional particle size samples were collected from the base of the sand dunes adjacent to each of the four transects.

To obtain particle size distributions, a container of known volume (77ml) was initially filled with the sample material. This material was then washed through a stack of sieves by shaking them under a moderate water spray. The sieve aperture sizes were 4mm, 2mm, 1mm, 500µm, 250µm, 125µm and 63µm. The contents of each sieve were drained and transferred to a 100ml ( $\pm$  0.5ml) measuring

cylinder containing 20ml of water, starting with the coarsest fraction and progressively working through to the finest. The cumulative volume in the measuring cylinder was recorded after the contents of each sieve were transferred. The percentage by volume of each fraction was then calculated for the original sample. The combined percentage of measured fractions was subtracted from 100 to give the percentage of the  $<63\mu\text{m}$  fraction.



**Figure 1 Example of Sediment Particle Size Survey Design for Roches Beach. Sampling regime was repeated for each beach, transect and depth.**

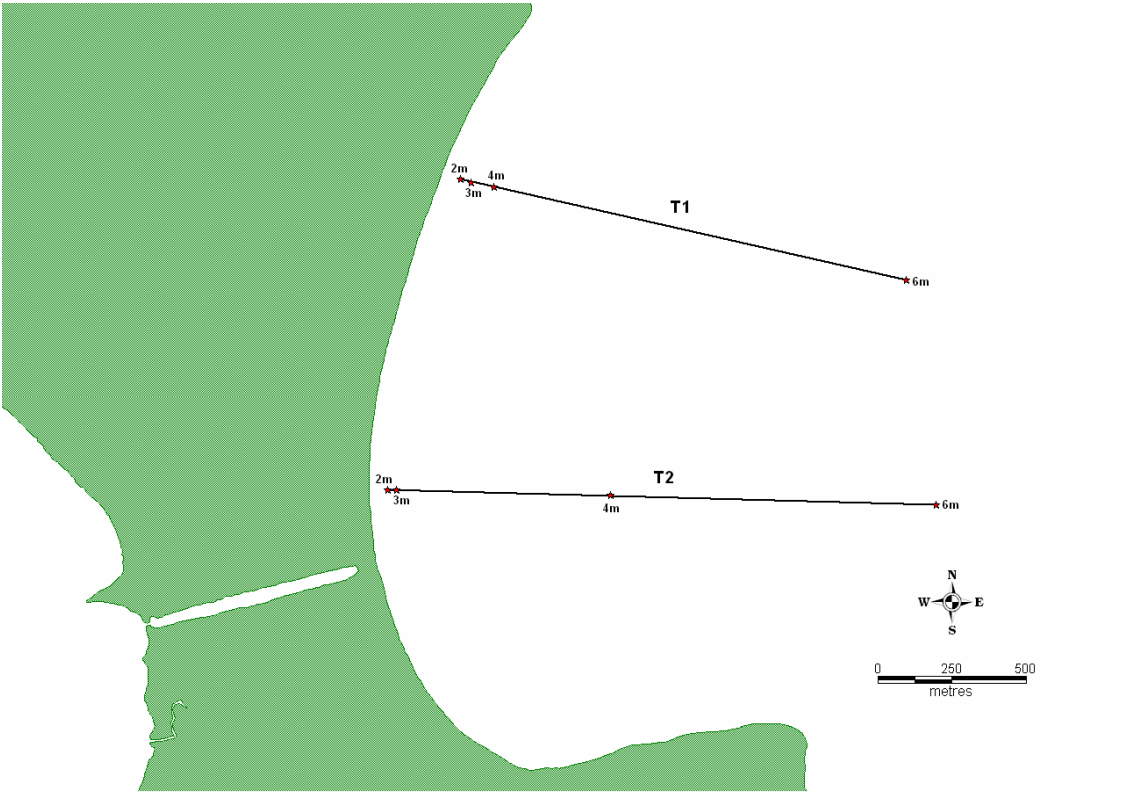


Figure 2 Sampling Locations Roches Beach

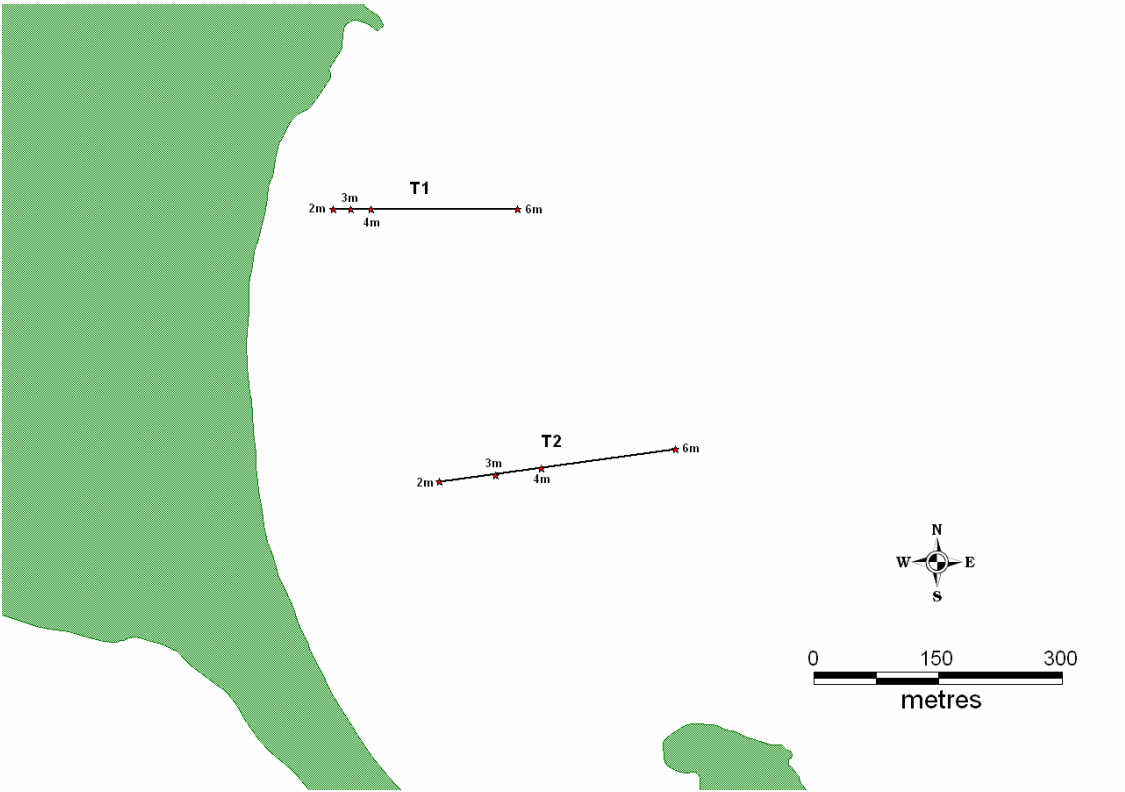
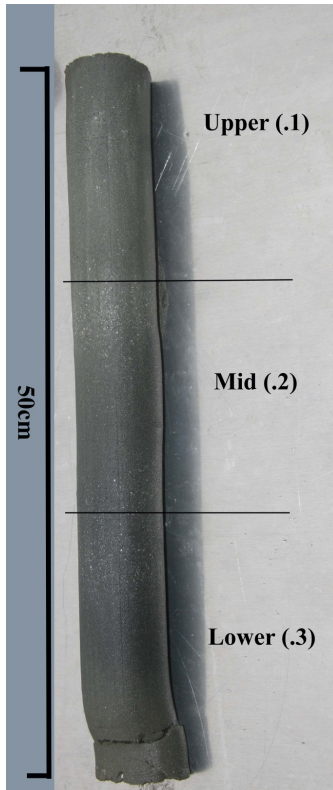


Figure 3 Sampling Locations Cremorne Beach



**Figure 4 Extruded sediment core showing sub sample depths**

## 2.2 RESULTS

### 2.2.1 Bathymetry

Bathymetry of both Roches and Cremorne showed depths within the bays not to exceed 6m AHD (Figure 5 and Figure 6). Both beaches possess shallow areas in the southern corners. Cremorne Beach also encompasses an entrance to Pipeclay Lagoon.

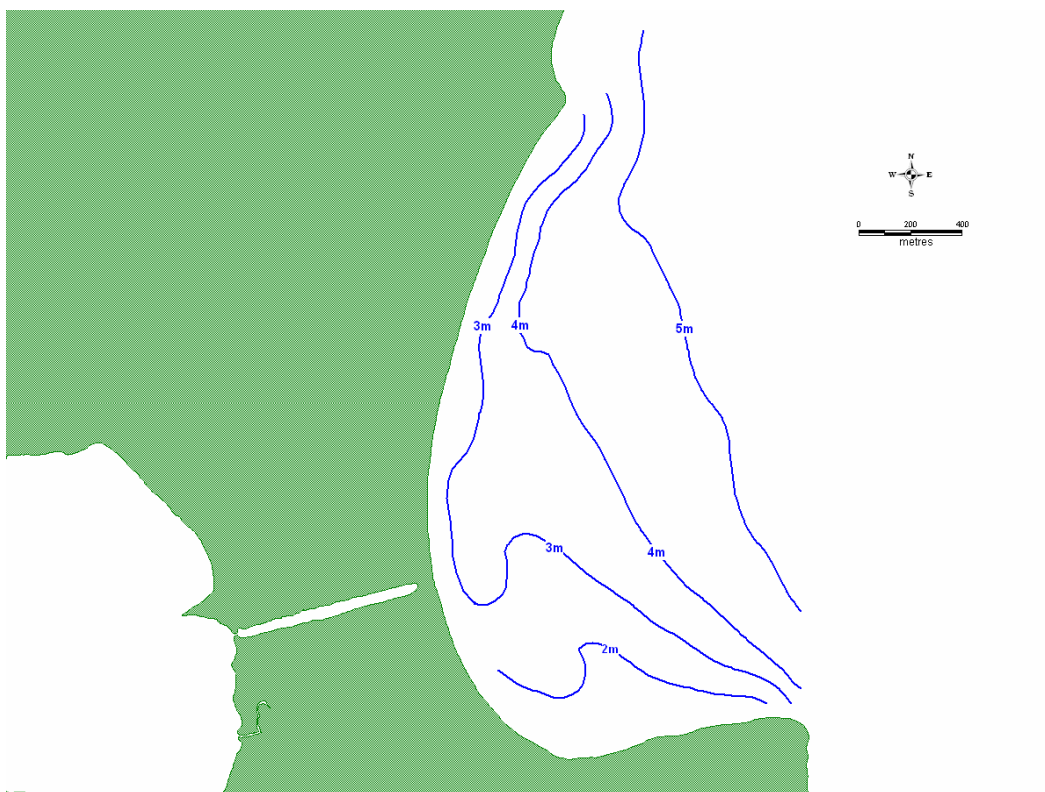


Figure 5 Bathymetric profile of Roches Beach (depths corrected to AHD)

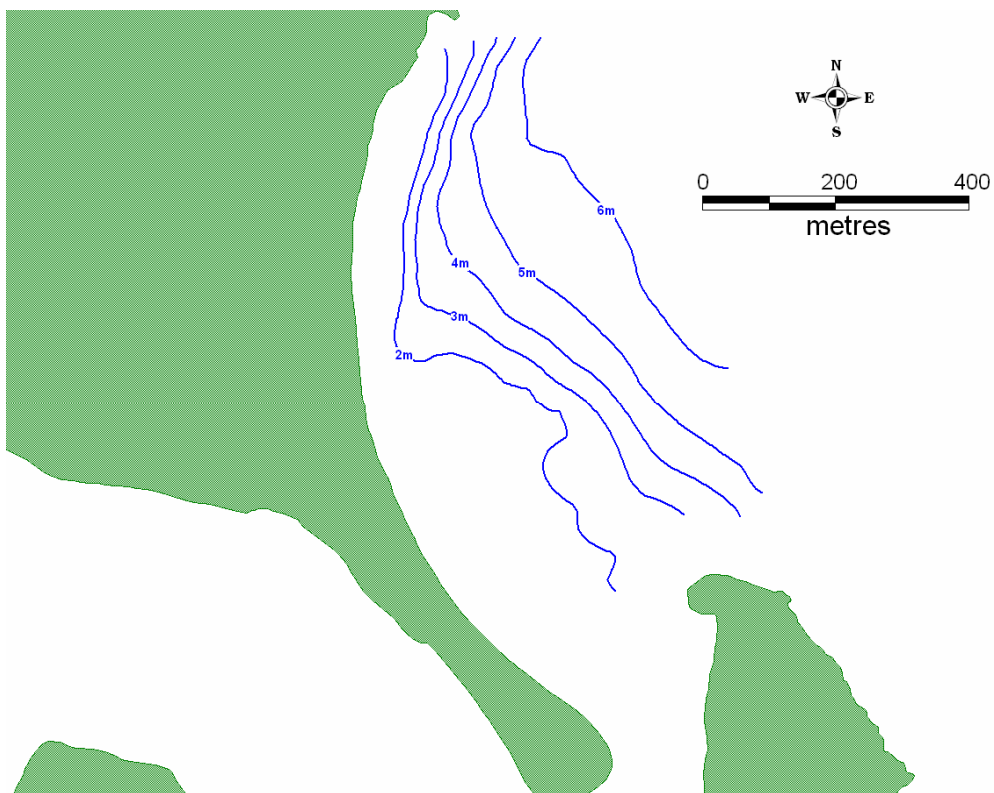
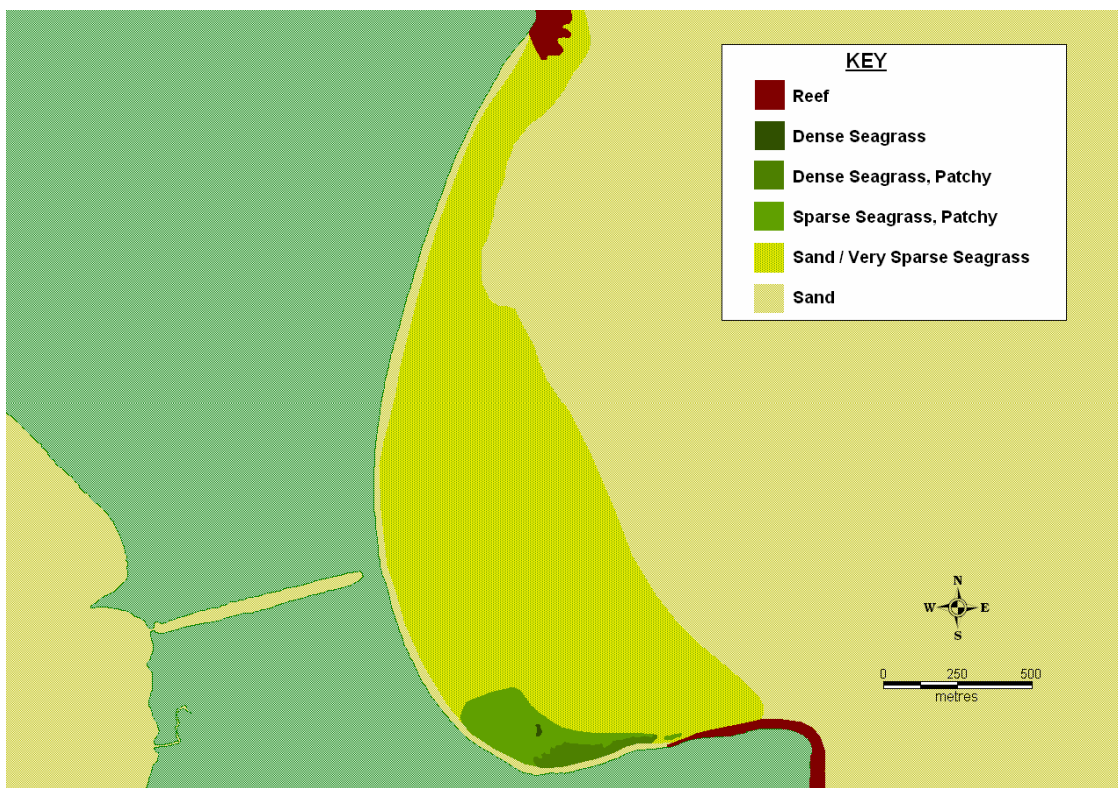


Figure 6 Bathymetric Profile of Cremorne Beach (depths corrected to AHD)

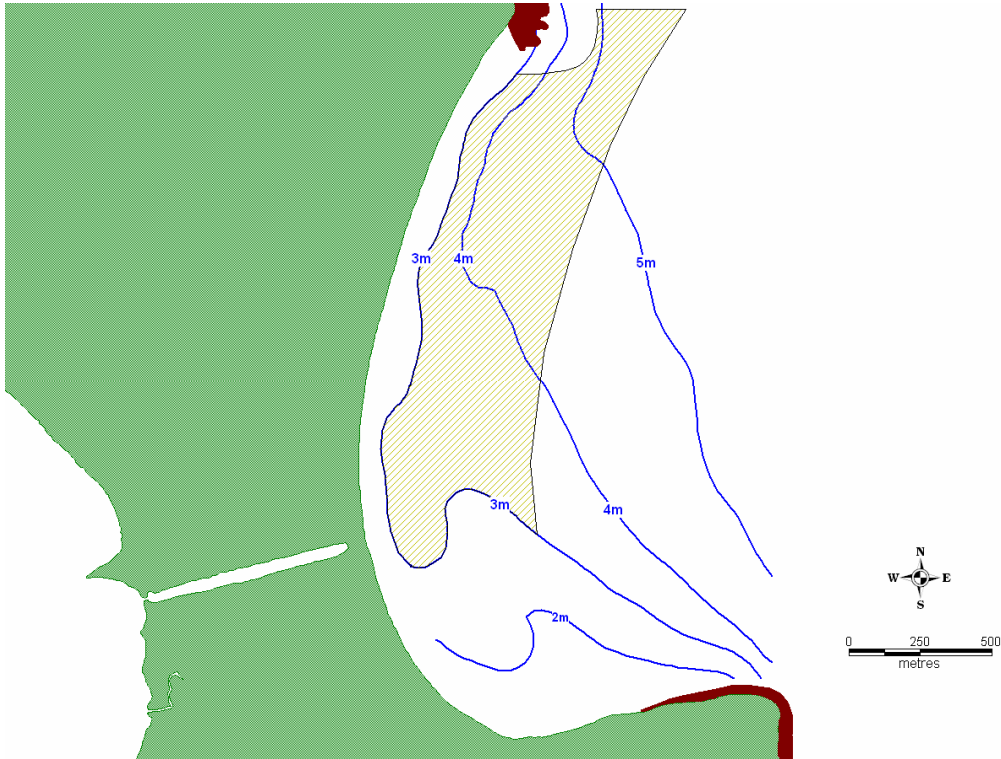


### 2.2.2 *Habitat Mapping*

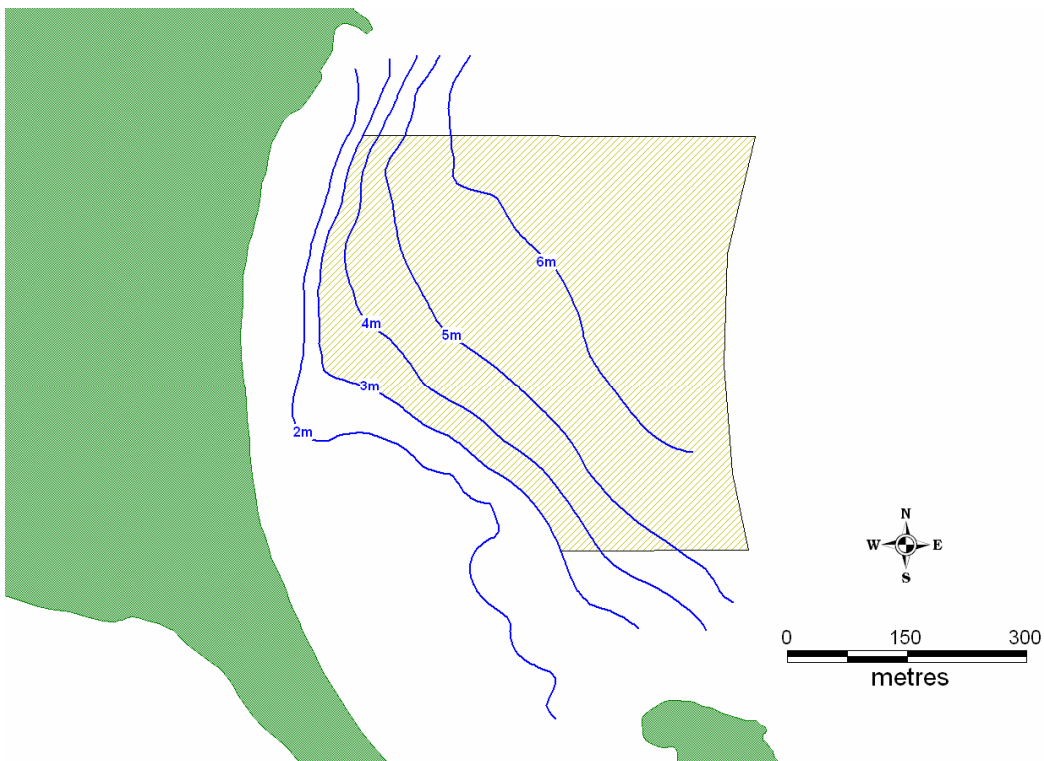
Habitat mapping in the target areas showed most habitats to be consistently sandy with occasional very sparse seagrass beds. One dense seagrass bed was located at the southern end of Roches Beach. The seagrass beds at Roches Beach were located in very shallow waters (under 1.5m), thus unlikely to be directly impacted by sand removal, which is expected to take place in deeper water (c.a. 3-6m). A small area of low profile reef (Bambra Reef) at the northern end of Roches Beach is unlikely to be impacted. Buffer zones around these areas of sensitive habitat are recommended to further reduce any likelihood of impact. No sensitive or significant habitats were located at Cremorne Beach. The seabed at Cremorne consisted mostly of bare sand with occasional very sparse seagrass. Based on the assessment of habitat types and bathymetric profiles, potential zones available for sand removal have been designated for Roches Beach (Figure 8), and Cremorne Beach (Figure 9). These zones extended from 3m depth to 600m offshore, leaving a buffer zone around sensitive habitats.



**Figure 7 Habitat Map Roches Beach**



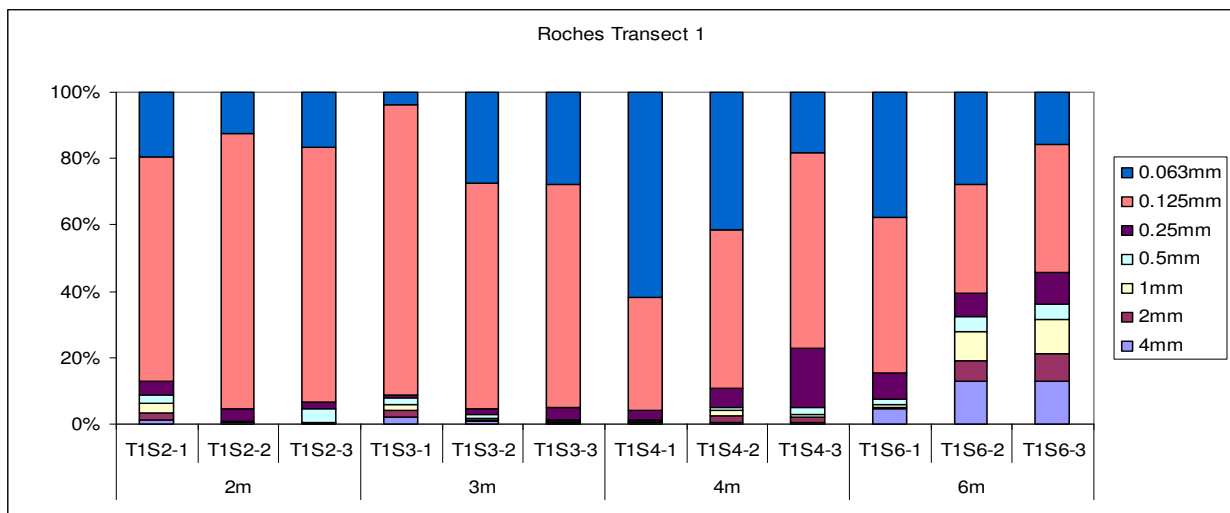
**Figure 8 Roches Beach - Potential zone of sand removal (3m depth AHD to 600m offshore). Total area 0.8485 km<sup>2</sup>.**



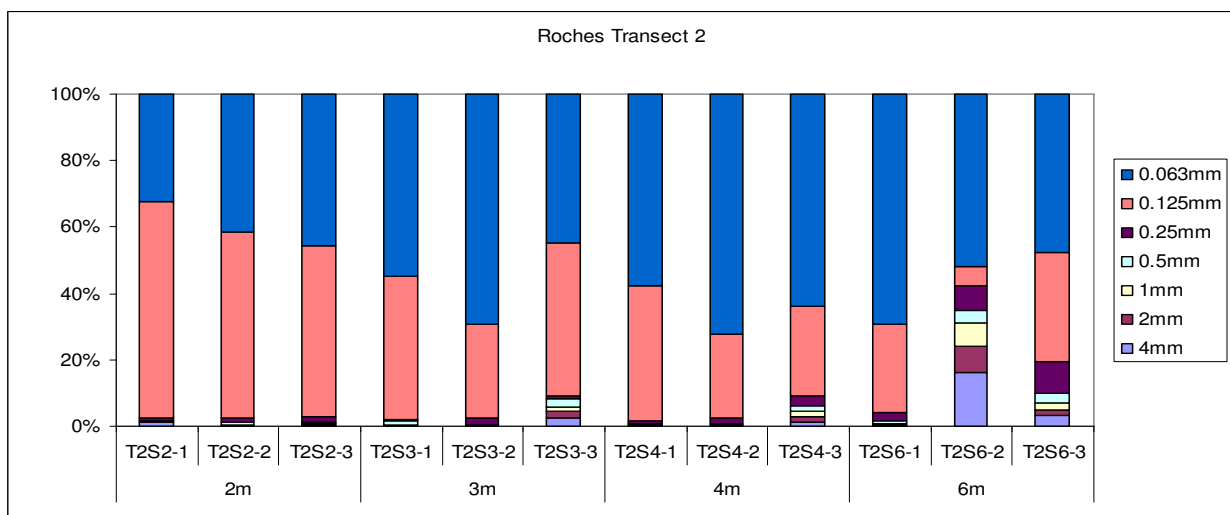
**Figure 9 Cremorne Beach - Potential zone of sand removal (3m depth AHD to 600m offshore). Total area 0.2234 km<sup>2</sup>.**

### 2.2.3 Particle Size Distribution

Roches Transect 1 (north) is dominated by sediments retained in the 0.125mm sieve with increasing volumes of coarse particles with increasing depth. Roches Transect 2 (south) shows a similar pattern in terms of coarse particles; however these samples possess more fine (0.063mm) particles, which might reflect the more sheltered nature the southern end of the bay. Both Cremorne transects are highly dominated by particles in the 0.125mm size, with greater overall percentages of fine and coarse material in the deeper samples. Additional samples collected at the base of the sand dunes for each transect showed these sediments to generally consist of a coarser distribution of particles. For most dune samples the majority of particles were retained in the 0.25mm sieve, compared with the 0.125mm sieve for subtidal sediments.

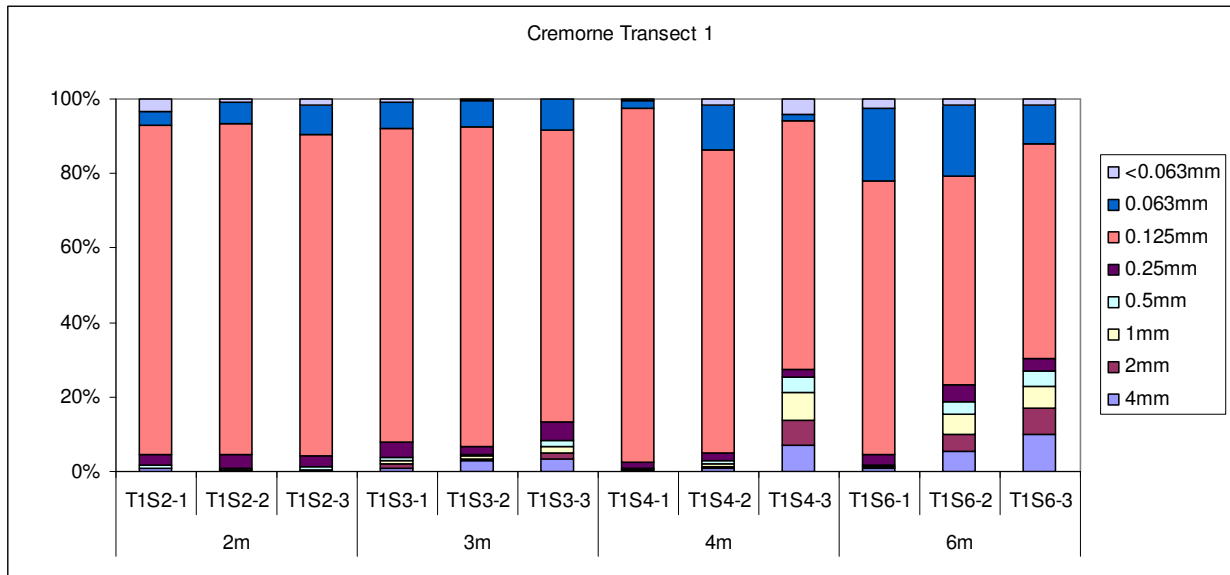


**Figure 10 Sediment particle size distribution for Roches Beach Transect 1, as percent of total volume**

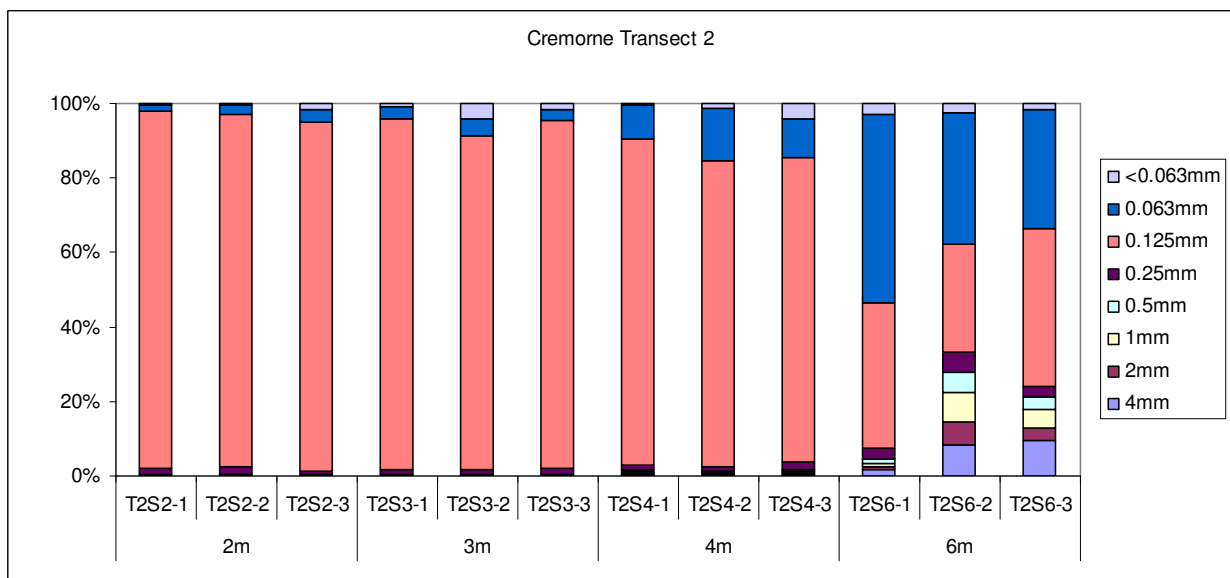


**Figure 11 Sediment particle size distribution for Roches Beach Transect 2, as percent of total volume.**

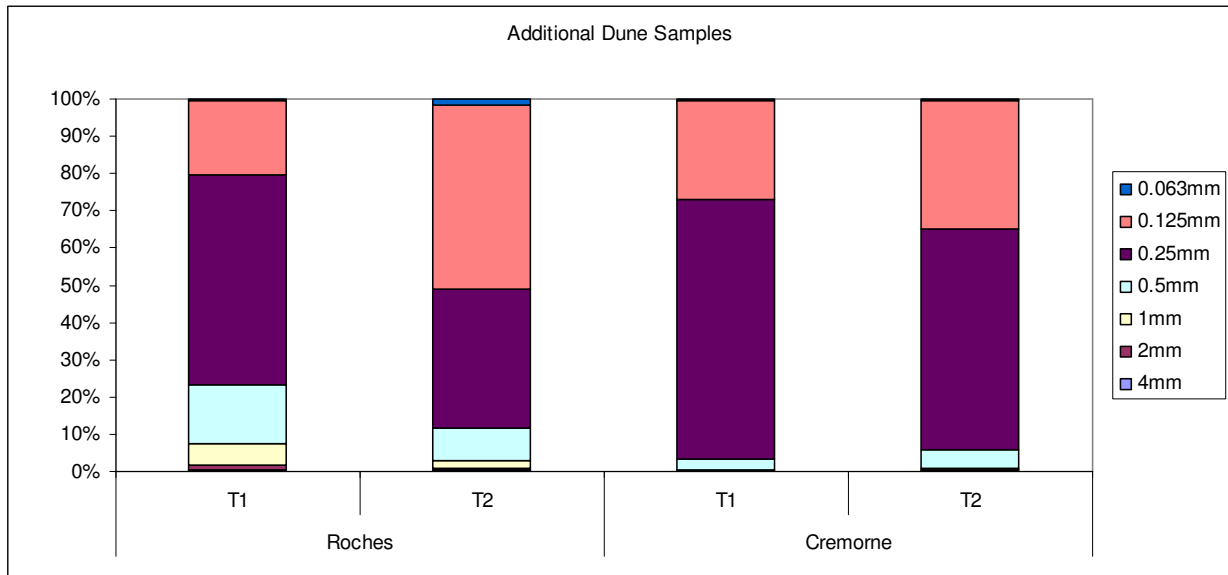




**Figure 12 Sediment particle size distribution for Cremorne Beach Transect 1, as percent of total volume.**



**Figure 13 Sediment particle size distribution for Cremorne Beach Transect 2, as percent of total volume.**



**Figure 14 Additional sediment particle size distribution for dune samples from each transect, as percent of total volume.**

#### 2.2.4 Potential Sand Volumes

Areas with the potential for sand removal for each beach are shown in Figure 8 and Figure 9. The area from 3m depth (AHD) to 600m offshore was designated as potentially suitable for the removal of sand. These parameters were determined firstly by the closure depth of the beach (3m) and the dredges potential working distance from the shore. Also considered in determining the total area was a buffer zone around Bambra Reef at the northern end of Roches Beach. The total potential area for Roches Beach was 0.8485 km<sup>2</sup>, while for Cremorne Beach the area was 0.2234km<sup>2</sup>. If the depth of sand removal extends to 0.5m the total volumes of available sand for Roches Beach and Cremorne Beach will be 424250m<sup>3</sup> and 111700m<sup>3</sup> respectively.

**Appendix 1 Geographical coordinates (projection WGS 84) for field survey sites.****Roches Beach**

<b>Site</b>	<b>Easting</b>	<b>Northing</b>
6m - T1	542191	5249897
4m - T1	540874	5250194
3m - T1	540707	5250232
2m - T1	540685	5250236
6m - T2	542290	5249135
4m - T2	541271	5249162
3m - T2	540472	5249184
2m - T2	540438	5249185

**Cremorne Beach**

<b>Site</b>	<b>Easting</b>	<b>Northing</b>
T1 2m	543650	5244210
T1 3m	543671	5244210
T1 4m	543696	5244210
T1 6m	543872	5244210
T2 2m	543778	5243879
T2 3m	543846	5243887
T2 4m	543902	5243895
T2 6m	544063	5243919

## Appendix 2 Particle size distribution data

Roches Beach Northern Transect (T1)		(% volume retained)	Sieve size (mm)					
		4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.063mm
2m	T1S2-1	1.3	1.9	2.9	2.7	4.0	67.7	19.4
	T1S2-2	0.0	0.0	0.3	0.6	3.8	82.8	12.5
	T1S2-3	0.0	0.4	0.0	4.1	2.3	76.8	16.4
3m	T1S3-1	2.0	2.3	1.6	2.0	1.0	87.2	3.9
	T1S3-2	1.0	0.3	0.3	1.0	2.0	67.7	27.6
	T1S3-3	0.0	0.3	0.5	0.5	3.5	67.3	27.8
4m	T1S4-1	0.4	0.0	0.4	0.7	2.6	34.0	62.0
	T1S4-2	0.4	2.1	1.7	0.8	5.8	47.7	41.5
	T1S4-3	0.6	1.6	0.8	2.0	17.8	59.0	18.2
6m	T1S6-1	4.5	0.3	1.2	1.5	7.9	46.7	38.0
	T1S6-2	13.0	6.3	8.5	4.6	6.9	33.0	27.8
	T1S6-3	12.9	8.5	10.2	4.4	9.8	38.6	15.6

Roches Beach Southern Transect (T2)		(% volume retained)	Sieve size (mm)					
		4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.063mm
2m	T2S2-1	1.3	0.0	0.3	0.0	0.8	65.3	32.4
	T2S2-2	0.0	0.0	0.4	0.8	1.2	56.2	41.4
	T2S2-3	0.0	0.6	0.4	0.4	1.6	51.5	45.5
3m	T2S3-1	0.0	0.6	0.0	1.0	0.4	43.1	54.9
	T2S3-2	0.0	0.3	0.2	0.0	1.9	28.4	69.2
	T2S3-3	2.5	1.9	1.4	2.5	0.8	46.2	44.7
4m	T2S4-1	0.2	0.0	0.3	0.3	0.8	40.5	57.8
	T2S4-2	0.2	0.4	0.0	0.4	1.6	25.0	72.4
	T2S4-3	1.4	1.4	1.8	1.8	2.8	27.1	63.7
6m	T2S6-1	0.0	0.3	0.7	0.7	2.5	26.4	69.4
	T2S6-2	16.3	7.8	7.0	3.7	7.4	5.9	51.9
	T2S6-3	3.3	1.6	2.0	3.0	9.5	32.8	47.9

Cremorne Beach Northern Transect (T1)		Sieve size (mm)							
		4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.063mm	<0.063mm
2m	T1S2-1	0.78	0.00	0.00	0.78	2.81	88.75	3.75	3.13
	T1S2-2	0.00	0.15	0.29	0.29	3.82	88.82	5.88	0.74
	T1S2-3	0.00	0.30	0.30	0.60	3.02	86.40	7.55	1.81
3m	T1S3-1	1.01	1.16	0.87	0.58	4.35	84.06	7.25	0.72
	T1S3-2	3.11	0.31	0.78	0.47	1.86	86.02	7.14	0.31
	T1S3-3	3.33	1.67	1.67	1.67	5.00	78.33	8.33	0.00
4m	T1S4-1	0.33	0.33	0.16	0.16	1.31	95.42	1.96	0.33
	T1S4-2	0.68	0.68	0.68	0.68	2.37	81.36	11.86	1.69
	T1S4-3	7.25	6.52	7.39	4.35	2.03	66.67	1.74	4.06
6m	T1S6-1	0.68	0.34	0.34	0.34	2.71	73.56	19.66	2.37
	T1S6-2	5.37	4.70	5.37	3.36	4.36	56.04	19.13	1.68
	T1S6-3	10.14	6.76	5.74	4.39	3.38	57.43	10.47	1.69

Cremorne Beach Southern Transect (T2)		Sieve size (mm)							
		4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.063mm	<0.063mm
2m	T2S2-1	0.00	0.00	0.00	0.32	1.95	95.78	1.62	0.32
	T2S2-2	0.00	0.00	0.00	0.30	2.40	94.31	2.69	0.30
	T2S2-3	0.00	0.00	0.00	0.33	0.98	93.63	3.43	1.63
3m	T2S3-1	0.00	0.00	0.00	0.31	1.25	94.39	3.12	0.93
	T2S3-2	0.00	0.00	0.00	0.32	1.26	89.73	4.42	4.27
	T2S3-3	0.00	0.00	0.00	0.32	1.59	93.33	3.17	1.59
4m	T2S4-1	0.61	0.31	0.31	0.61	0.92	87.73	9.05	0.46
	T2S4-2	0.34	0.34	0.34	0.34	1.01	82.09	14.19	1.35
	T2S4-3	0.62	0.31	0.31	0.31	2.17	81.68	10.56	4.04
6m	T2S6-1	1.57	0.94	0.94	1.26	2.83	38.99	50.63	2.83
	T2S6-2	8.37	6.31	7.78	5.29	5.29	29.37	35.24	2.35
	T2S6-3	9.49	3.50	4.96	3.21	2.92	42.34	32.12	1.46

## Additional dune samples

		% retained						
		4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.063mm
Roches	T1	0.3703704	1.4814815	5.5555556	15.740741	56.481481	20	0.3703704
	T2	0.3067485	0.6134969	2.1472393	8.5889571	37.423313	49.386503	1.5337423
Cremorne	T1	0	0	0.3115265	2.8037383	70.093458	26.479751	0.3115265
	T2	0.00	0.32	0.63	4.76	59.37	34.60	0.32