

**SEAGRASS MONITORING PROGRAMME FOR  
THE PENRHYN ESTUARY HABITAT  
ENHANCEMENT PLAN: SELECTION OF  
REFERENCE SEAGRASS MEADOWS**

**PREPARED FOR**

**SYDNEY PORTS CORPORATION**

**By**

**D. E. Roberts and M. P. Lincoln Smith**

**March 2007**

**BIO-ANALYSIS PTY LTD**

*Marine, Estuarine & Freshwater Ecology*

7 Berrys Head Road, Narara NSW, 2250

Tel: 0243296030; Mobile: 0414477066; Fax: 0243292940

Email: [dan@bioanalysis.com.au](mailto:dan@bioanalysis.com.au); Website: [www.bioanalysis.com.au](http://www.bioanalysis.com.au)

## TABLE OF CONTENTS

INTRODUCTION .....	3
SITE INSPECTIONS.....	3
RESULTS .....	4
CONCLUSIONS AND RECOMMENDATIONS .....	9
ACKNOWLEDGEMENTS .....	10
REFERENCES .....	10

## INTRODUCTION

Sydney Ports Corporation requires a monitoring programme for various components of the seagrass habitat associated with the Penrhyn Estuary Habitat Enhancement Plan (Maunsell, 2006). The seagrass monitoring plan was compiled by the Ecology Lab Pty Ltd (TEL), which detailed the requirements and methodology to be used for monitoring of seagrass associated with the expansion of the port (TEL, 2006). Prior to any monitoring of seagrass taking place, it was decided that suitable reference seagrass meadows were to be identified as part of the ongoing monitoring (see TEL, 2006).

## SITE INSPECTIONS

As outlined in TEL (2006), a number of reference locations were to be selected so that relative comparisons in seagrass variables could be measured and compared to changes that may occur within the seagrass habitats associated with the expansion of the port. The selection of suitable locations and sites within Botany Bay and external reference estuaries was done during February 2007, prior to the first “before” works sampling. Site selection involved both staff from BIO-ANALYSIS Pty Ltd and The Ecology Lab Pty Ltd. Three estuaries were examined for suitable seagrass habitat; Port Hacking, Sydney Harbour and Pittwater. Potential reference locations were also examined within Botany Bay.

## RESULTS

### Botany Bay

Two sites each were examined at Towra Beach and Yarra Beach (east) and were found to have suitable patches of *Zostera capricorni* (Table 1). Towra Beach faces north to north east and has a long wind fetch from that quadrant. Therefore it would tend to be exposed to strong winds during summer. Yarra Beach faces south to south west, which is a similar aspect to Foreshore Beach. The seagrasses at the reference locations have similar morphology and the nektonic communities would also be expected to be similar to those found along Foreshore Beach. The presence of the exotic alga *Caulerpa taxifolia* at these sites would require the preparation of a simple management plan to prevent transferring it to other locations within the bay.

### Port Hacking

Gunnamatta Bay (east) is a good location assuming seagrasses do not diminish over time. This area has been susceptible to seagrass loss due to severe storms in the past and on this basis alone would not be considered as a suitable reference site. Other sites have relatively low suitability due to aspect, presence of moorings, different seagrass morphology or potential sampling hazards (Table 1).

### Sydney Harbour

Several of the locations examined within Sydney Harbour were heavily utilised by recreational boaters and/or had significant numbers of moorings. Rose Bay has suitable conditions with extensive seagrasses similar to what once occurred at Foreshore Beach (Table 1). Castle Rock may also be suitable but to a lesser extent.

### Pittwater

Currawong Beach was given the highest ranking due to its seagrass distribution and aspect. Barrenjoey and Careel Bay were ranked equally, but for different reasons (Table 1).

**Table 1. Summary of seagrass site inspections.**

ESTUARY	LOCATION	SITE AVAILABILITY	DESCRIPTION	SUITABILITY	RANK
Botany Bay	Foreshore Beach	3 sites with small patches of <i>Zostera</i>	Major reduction in <i>Zostera</i> since Parallel Runway built. South to SW aspect with large fetch and exposure to wind waves. Remaining <i>Zostera</i> short and moderately dense.	Focus of all studies – controls need to be comparable to this location.	Mandatory
Botany Bay	Towra Beach	Numerous sites available east of beach nourishment	Offshore <i>Posidonia</i> with dense short <i>Zostera</i> nearshore & sand patches. <i>Caulerpa</i> likely to be present. North aspect, long fetch to wind waves & occasional swells. Site within Towra Point Aquatic Reserve, requiring permit for sampling.	Suitable for <i>Zostera</i> morphology & nekton (seining), but may need to manage seining to prevent transfer of <i>Caulerpa</i> .	2
Botany Bay	Yarra Bay (west)	None	Dark patches on sand found to be algae & reef	Unsuitable	No good
Botany Bay	Yarra Bay (east)	3	Sandy beach, <i>Zostera</i> , <i>Halophila</i> & <i>Caulerpa</i> 10-20 m offshore. South aspect similar to Foreshore Bch.	Suitable for morphology, management problems for seining to ensure no spread of <i>Caulerpa</i> . Similar aspect to Foreshore Beach strong feature.	1
Botany Bay	Silver Beach	At least 3 sites, between groynes at western end of beach.	Offshore very dense bed of <i>Posidonia</i> with short, dense <i>Zostera</i> nearshore with some <i>Caulerpa taxifolia</i> & <i>T. filiformis</i> . North aspect, long fetch to wind.	Suitable for morphology, management problems for seining to ensure no spread of <i>Caulerpa</i> . Large <i>Posidonia</i> bed & groynes makes it less favourable	3
Port Hacking	Burraneer Bay	2 sites only	Aspect to south, with moderate fetch & wind exposure. Areas of sandy beach with <i>Zostera</i> & further offshore with <i>Posidonia</i> . Lots of boat moorings. Previously used by NSW Fisheries for <i>Zostera</i> nekton & some morphology work.	Suitability limited by presence of boats and moorings and probably somewhat more sheltered than Foreshore Beach	3

ESTUARY	LOCATION	SITE AVAILABILITY	DESCRIPTION	SUITABILITY	RANK
Port Hacking	Little Turriel Bay	1 – 2 sites	South aspect, in relatively sheltered bay off main channel. Patches of dense <i>Zostera</i> in middle and east of bay – different morphology to Foreshore Beach. Large area of very dense <i>Posidonia</i> . Some short, dense <i>Zostera</i> on western shore, with sandy beach suitable for seining at low tide. Previously used by NSW Fisheries.	Suitability limited by generally very dense, long <i>Zostera</i> in much of the bay (too healthy for this study) and limited availability of sites for sampling here.	4
Port Hacking	Maianbar main channel	2 sites	Along main channel of Port Hacking, west the entrance to Cabbage Tree Basin. East-west aspect. Patches of moderately dense & long <i>Zostera</i> on edge of sand bar. Strong currents & heavy boating traffic.	Beds good here, with ample sand patches in between. Problem is strong tidal currents & boating – limited time for diving & seining & boat strike a risk to divers.	3
Port Hacking	Deeban Spit	2 sites	Along eastern edge of Deeban Spit, with aspect from NE to SE. Sandy beach with patchy <i>Zostera</i> and <i>Halophila</i> occur about 30 m offshore. Relatively deep, with strong currents and moderate boating traffic. Previously used by NSW Fisheries.	Beds here difficult to access and sample for nekton. Strong currents & boating problematic as above.	5
Port Hacking	Gunnamatta Bay – eastern entrance	1 – 2 sites	North of Fisheries Centre – sandy beaches with rocky areas in between. Aspect west to south west with moderate fetch. Limited patches of <i>Zostera</i> but very accessible for morphology & seining.	Assuming seagrasses remain or increase would be good for sampling. <u>Note</u> : we also looked briefly along the middle, eastern section of the bay – problematic due to many moorings & narrow strip of <i>Zostera</i> on drop-off.	2
Sydney Harbour	Little Manly Beach	1	Along sandy beach west of pool enclosure. Beach with patches of <i>Zostera</i> , <i>Halophila</i> and some	Access good and suitable seagrasses & aspect. Limited	3

ESTUARY	LOCATION	SITE AVAILABILITY	DESCRIPTION	SUITABILITY	RANK
			<i>Posidonia</i> ; <i>Zostera</i> moderately dense and long. South aspect, long wind fetch. Moorings offshore of beach and beach cleaned mechanically regularly. Within North Harbour Reserve and requires special permit for sampling.	area available for sampling, heavy usage by boats and mechanical beach cleaning. Low to moderate suitability.	
Sydney Harbour	Store Beach	2	Sandy beach with <i>Zostera</i> and <i>Halophila</i> 10 – 20 m offshore, with some <i>Posidonia</i> further offshore. Substratum with mounds and small pits problematic for netting. No moorings but numerous boats anchor within North Harbour Reserve and requires special permit for sampling. Within North Harbour Reserve – permit required.	Suitability limited by seagrass distribution, seabed form and potential heavy boat traffic.	4
Sydney Harbour	Quarantine Beach	1	Relatively dense bed of <i>Posidonia</i> with narrow fringe of moderately long <i>Zostera</i> about 15 – 20 m offshore from sandy beach. Relatively deep. Shore is designated no anchoring zone and beach is within North Harbour Reserve – permit required.	Suitability limited by depth and narrowness of <i>Zostera</i> bed, increasing likelihood of seining in <i>Posidonia</i> . Limited use for morphology study due to limited amount of <i>Zostera</i> present.	5
Sydney Harbour	Castle Rock (Castle Crag)	2 (just)	Rocky shore with small beaches and patches of short, relatively dense <i>Zostera</i> 10 – 20 m offshore. Aspect to south with moderate fetch. No moorings but lots of boats anchor there.	Seagrass morphology good, location limited by available sampling sites and heavy boat usage. Moderate suitability.	2
Sydney Harbour	Rose Bay – Hermitage Beach	None	Dark patches on sand found to be algae & reef. Previously shown on NSW Fisheries map to have seagrass.	Unsuitable	No good
Sydney Harbour	Rose Bay Beach	At least 3	Sandy beach with <i>Zostera</i> patches & larger beds (short to moderate length, relatively dense) 10 – 20 m offshore. S to SW aspect, long fetches.	Seagrass good here – well suited for study.	1

ESTUARY	LOCATION	SITE AVAILABILITY	DESCRIPTION	SUITABILITY	RANK
Pittwater	Barrenjoey Beach	At least 3	Narrow sandy beach with fringe of <i>Zostera</i> 10 – 20 m offshore and very large bed of <i>Posidonia</i> further offshore. Also some <i>Halophila</i> & <i>C. taxifolia</i> . A few moorings, but not an issue. Aspect west to WNW. <i>Zostera</i> becomes shorter further to the north.	Moderate to high suitability. may need to manage seining to prevent transfer of <i>Caulerpa</i>	3
Pittwater	Greater Mackerel Beach	1 - 3	Relatively exposed with N to NE aspect. Ocean swells may penetrate to this beach. No moorings but recreational boats anchor there. Seagrasses relatively deep with <i>Zostera</i> at least 20 m from shore; <i>Posidonia</i> patches further offshore. Potential sites to the west of the ferry wharf.	Low suitability	4
Pittwater	Currawong Beach	3	Section of beach to the north of the ferry wharf is sheltered from NE by headland and has a relatively long fetch to S - SE. <i>Zostera</i> with some <i>Halophila</i> 10 – 20 m from sandy beach with patches of <i>Posidonia</i> further offshore.	High suitability for morphology and nekton. Did not observe any <i>Caulerpa</i> , but may be present hence may need to manage seining to prevent transfer of <i>Caulerpa</i>	1
Pittwater	Careel Bay NE shore (Snapper Lane)	At least 3	Narrow sandy beach with fringe of relatively dense but short <i>Zostera</i> 10 – 20 m offshore; did not observe any <i>Posidonia</i> here. Aspect SW – W with moderate fetch. Numerous boat moorings, but > 50 m from shore and lots of recreational boats (mostly skiffs & runabouts observed).	Moderate to high suitability due to seagrass position, but may be limited by presence of moorings. Did not observe <i>Caulerpa</i> , but may need to manage seining to prevent its transfer.	2



## CONCLUSIONS AND RECOMMENDATIONS

Loss of *Zostera capricorni* at Foreshore Beach restricts site availability and there may be no seagrass present by the time construction begins. Apart from mapping of seagrasses, baseline sampling of seagrass morphology could be done in the remaining seagrass patches (see Roberts et al., 2007). Nekton could be sampled in bare and vegetated areas to compile a baseline on existing utilisation of the area. This approach is consistent with providing a baseline for measuring restoration of the area under the Port Botany Expansion Seagrass Monitoring Plan (Maunsell, 2006; TEL, 2006)

The site inspection verified that suitable internal and external reference locations could be found within Botany Bay, Sydney Harbour and Pittwater. The current situation however, is problematic because of the (ongoing) decline of seagrasses at Foreshore Beach. We recommend that the morphology and nekton sampling be postponed until spring 2007. If the cover of seagrasses remains the same or increases, then the monitoring programmes should be implemented, with the first survey in spring and another just before commencement of construction.

If the seagrasses along Foreshore Beach further decline, then there would be little merit in attempting to monitor morphological attributes of seagrass or ecological function at Foreshore Beach or at reference sites. Sampling at Foreshore Beach on two occasions prior to commencement of construction would provide valuable data for comparison with post seagrass colonisation of the area once the restoration works are completed in Penrhyn Estuary.

Assuming there is no further loss of seagrasses along Foreshore Beach, we recommend the use of the following sampling locations:

- Botany Bay
  - 3 sites along Foreshore Beach (Monitoring location for assessing changes due to the Port expansion)
  - 3 sites at Towra Beach (internal reference location)
  - 3 sites at Yarra Beach (east) (internal reference location)
- Sydney Harbour – 3 sites at Rose Bay Beach (external reference location)
- Pittwater – 3 sites at Currawong (external reference location)

## **ACKNOWLEDGEMENTS**

We thank Marika Calfas (SPC) for managerial support of this project. Shane Murray provided assistance in the field.

## **REFERENCES**

Maunsell (2006). Vegetation Management Plan. Port Botany Expansion. Maunsell Australia Pty Ltd.

Roberts, D. E., Murray, S. R., Sainty, G. R. (2007). Seagrass mapping for the Penrhyn Estuary habitat enhancement plan. Report prepared for Sydney Ports Corporation. BIO-ANALYSIS Pty Ltd: Marine, Estuarine & Freshwater Ecology, Narara.

TEL (2006). Seagrass monitoring plan: Penrhyn Estuary Habitat Enhancement. Report to Maunsell Australia Pty Ltd. The Ecology Lab Pty Ltd, Brookvale.

---

*Seagrass Monitoring Programme for Penrhyn Estuary Habitat Enhancement Plan:  
Reference Site Selection  
BIO-ANALYSIS Pty Ltd: Marine, Estuarine & Freshwater Ecology  
The Ecology Lab Pty Ltd, Marine & Freshwater Studies*