ECOLOGICAL ASSESSMENT OF THE SHORELINE AROUND THE BRISBANE WATER ESTUARY



Prepared for

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by

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INTRODUCTION

The foreshore of Brisbane Water is the interface where the terrestrial and aquatic environments meet and includes the estuarine beaches, saltmarshes and wetlands, council reserves and privately owned land. It is where the community's interaction with the estuary begins and their perceptions about the "health" of the estuary are developed. The Brisbane Water estuary has had significant modifications to its natural foreshores since European colonisation and the extent of this modification has not previously been quantified.

Prior to large scale development of the Brisbane Water estuary, the foreshores and shallow intertidal areas were dominated by saltmarsh and mangrove habitat (Harty and Cheng, 2003). Saltmarshes are dominated by salt-tolerant species of plants that are generally found high up on the shoreline of estuarine intertidal mudflats usually behind fringing mangrove forests. Saltmarshes are important in the nutrient cycling process in estuaries and as feeding and nursery habitats for many birds, fish and invertebrates. They are threatened in many parts of the world because in the past they were considered wastelands rather than valued wetlands. This was particularly true in urbanised parts of Australia (Stricker, 1995). Around fifty percent of these habitats have been destroyed in NSW through the direct results of development and the indirect effects of anthropogenic disturbance. Mangroves are salt-tolerant plants that are generally found growing along the shoreline and creeks within estuaries. *Avicennia marina* (grey mangrove) and *Aegiceras corniculatum* (river mangrove) are the two most common species found in NSW and both species are found in Brisbane Water.

METHODS

Since the interface of the estuary is critically important to aquatic ecological processes, an assessment of the shoreline was deemed necessary. Making an assessment of the entire length of the foreshore was inevitably time consuming given that the estuary has been extensively modified. To overcome this, a rapid assessment method was developed. The aim of this study was to quantify the extent of disturbance around the estuary using predetermined "ecological values". A rapid assessment method was developed using a "Disturbance Index" to assist in establishing ecological values of the estuary (Table 1). The index was scaled from 1 - 5, with the greatest disturbance recorded as a "1", whilst the least amount of disturbance was recorded as a "5" (see Figs. 1-5).

INDEX	DESCRIPTION
1	Highly disturbed/modified foreshore. Includes seawalls with limited
	ecological niches e.g. vertical concrete or stone. Includes buildings in
	close proximity to the seawall, often with jetties and stormwater inlets.
	Catchment substantially developed.
2	Disturbed/modified foreshore. Seawall with limited ecological niches.
	Includes foreshore with scattered mangroves. Saltmarsh limited to
	narrow discontinuous strip. Catchment substantially developed.
3	Modified foreshore. Seawall absent. Includes irregular saltmarsh strip
	or natural rock platform associated with a variable width forest,
	contiguous to waters edge. Catchment partly/variably developed.
4	Unmodified foreshore. Rock platform, seagrass, mangrove, saltmarsh,
	forest on waters edge. Catchment partially or wholly developed.
5	Unmodified foreshore. Rock platform, seagrass, mangrove, saltmarsh,
	forest on waters edge. Catchment with no development.

 Table 1. Disturbance Index used to assess each section of foreshore around the Brisbane Water estuary.



Figure 1. Highly disturbed and modified shoreline edge with seawalls and substantially developed catchment.



Figure 2. Disturbed/modified shoreline edge with seawall, limited saltmarsh and scattered mangroves.



Figure 3. Saltmarsh and mangrove habitat with close development impacting on the ecological value of the foreshore.



Figure 4. Unmodified foreshore with mangroves on waters edge, catchment partially developed.



Figure 5. Unmodified shoreline and catchment.

The foreshore assessment was done by surveying each section of shoreline using air photographs and ground-truthing. Each section of shoreline was accessed using a shallow-draft boat. Within each section, a brief description of the shoreline was made and the Disturbance Index applied. The type of information collected along each section of shoreline varied and where applicable, the following attributes were recorded:

- Area of foreshore vegetation (weeds, mangrove, saltmarsh and fringing forest).
- Adjacent catchment type (undisturbed, urban, industrial).
- Foreshore type and modifications eg. Seawalls and Jetties.
- Disturbance to foreshore eg. mowing of saltmarsh, mangrove removal or trimming, infilling.
- Distance of any development to the water.
- Location of oyster leases.
- Hull and propeller damage to adjacent seagrass beds.
- Stormwater and drainage lines.

RESULTS AND DISCUSSION

The foreshore of Brisbane Water extends for approximately 89 km. The shoreline ranged from an unmodified tidal interface with a catchment that has little or negligible development, to an extensively modified foreshore and catchment. A total of 145 different sections were identified using the air photographs and ground truthing. The location of each section of foreshore was recorded directly onto the air photographs in the field (see Figs. 6 - 17). Notes and comments associated with each of these sections and their associated Disturbance Index were recorded (Appendix 1).

Of the 89 km of Brisbane Water foreshore, 23 km or 26% was given a Disturbance Index of 1, whilst 24 km or 27% was given a Disturbance Index of 2 (Table 2). These highly disturbed sections of the foreshore were invariably where houses had been built close to the edge with seawalls constructed to prevent erosion. Under these conditions, the residents generally kept the foreshore clear of native vegetation and maintained exotic lawns. Only 8 km or 9% of the foreshores around the estuary were found to be in an unmodified condition and these received a disturbance index of 5.

Disturbance Index	Number	Percentage	Kilometres
1	42	26	23
2	35	27	24
3	35	19	17
4	17	19	17
5	16	9	8
TOTAL	145	100	89

 Table 2. The number of sections, percentage and distance of foreshore (km)

 represented by each of the five disturbance indices in Brisbane Water.



Figure 6. The Broadwater.



Figure 7. Point Clair.



Figure 8. Koolewong, Woy Woy Bay, Phegans Bay, Woy Woy.



Figure 9. Correa Bay.



Figure 10. East Gosford.



Figure 11. Green Point.



Figure 12. Saratoga, Cockle Channel, Kincumber Broadwater.



Figure 13. Kincumber Broadwater.



Figure 14. Cockle Channel, Cockle Bay.



Figure 15. Blackwall, St Huberts Island, Rileys Island, Cockle Channel, The Rip.

Figure 16. Rileys Bay, Hardys Bay, Pretty Beach.

Figure 17. Ettalong, Wagstaffe.

The major issue identified in this assessment was the significant amount of seawalls within the estuary (approximately 18 km). Artificial structures, such as seawalls, are common features of urbanised areas, in some areas, replacing natural habitats (Chapman and Bulleri, 2003). They are generally built to prevent erosion however in many estuaries they have been constructed with the aim of enhancing the amenity value of residential property. Seawalls have the potential to supplement natural habitat in terms of species composition and abundance of some marine organisms, however Chapman (2003) showed that on mid- and high-shore levels, there were frequent differences between assemblages on natural shores and seawalls. Although not quantified, the seawalls in Brisbane Water did not appear to provide extensive habitat for intertidal or subtidal organisms. The common practice of building seawalls and infilling the area behind has resulted in a significant change to the natural shoreline of the estuary. This land was once dominated by saltmarsh, mangroves and Casuarina forest. The land is now sufficiently elevated to prevent tidal inundation and as such the previous productivity and habitat within the estuary has been lost.

Natural foreshores also have the ability to assimilate seagrass wrack that is washed in to the shore. Modified foreshores are not generally suited to wrack assimilation and instead tend to trap wrack in the water against the foreshore creating both access and amenity issues (Chapman and Roberts, 2003; Roberts and Chapman, 2003). Furthermore, once the wrack has accumulated against the foreshore, the underlying seagrass and benthic ecology begins to deteriorate. This leads to a build up in organic sediments and the production of strong odours.

Mangroves, saltmarsh and intertidal rock platforms were, prior to European settlement, present along the entire Brisbane water foreshore. The removal of mangrove and saltmarsh habitat from the foreshore lowers the ecological value of the estuary by reducing habitat available for birds and other animals. Further, the mangroves and saltmarsh help to protect the shoreline from wave erosion whilst trapping sediments and recycling nutrients. The presence and/or size of mangrove and saltmarsh habitat were therefore given a high ranking in the assessment process. Other types of natural shoreline included unmodified rock platforms which extend over a significant length (approximately 12 km) of Brisbane Water. There were excellent examples of this interface with non-tidal land in Woy Woy Bay. A good example of an intertidal rock platform was identified at Wagstaffe Point opposite Umina. Rock platforms are as ecologically important as seagrass, saltmarsh and mangrove habitats, and provide habitat for a range of intertidal organisms including molluscs, crustaceans and fishes.

Other hard structures that dominated the estuary included jetties and pier pylons. There are many hundreds of jetties in Brisbane Water, which cause ongoing disturbance to the shallow areas adjacent to the shoreline. The effect of jetties is to cause shading to seagrass habitat and this has been identified as an issue for seagrass managers (Butler and Jernakoff, 1999). On the positive side, jetties extend into the estuary and can prevent propeller driven craft from entering shallow water and damaging seagrass beds.

Introduced weeds to the freshwater/saline interface by birds, humans, wind and water is also a major issue for the foreshores of the estuary. Some of these weeds notably Morning Glory, Asparagus and Lantana have blanketed the understorey of the non saline forest interface. Spiny Rush (*Juncus acutus*) is a major weed of saltmarshes and is invading many areas within the estuary. In some of the disturbed saltmarshes in Brisbane Water, *Juncus acutus* was found to be the dominant plant and was replacing the native species *Juncus kraussii* (Roberts and Sainty, 2007). The proliferation of *Juncus acutus* into saltmarshes is believed to be exacerbated by the spread of seed attached to vehicles and animals (Sainty and Jacobs, 2003). In the Woy Woy Channel there were areas overrun by this invasive species. Minor exotic weeds in saline areas included *Aster subulatus*, *Spergularia marina* and *Polypogon monspeliensis*.

A number of other foreshore issues were identified as important in this study. Examples included the disturbance to foreshores associated with maintenance of parks and roads and the construction of buildings close to the edge of the water. Untreated and unmanaged stormwater entering the estuary was also considered to reduce the ecological value of many foreshore areas. Two islands within the estuary, Pelican Island and Rileys Island, remain largely unaffected by development, however St Huberts Island is completely urbanised and has numerous canals. Whilst there has been some disturbance on Pelican Island and Rileys Island, they still provide important habitats for waterbirds and other native estuarine species. The saltmarsh and mangrove habitat on these islands was in good condition, although weeds were found to be invading some areas. The notable weed species on Pelican Island was *Juncus acutus*.

Mosquitoes are common and occur naturally in an estuary (Russel, 1993). The most productive areas for mosquitoes appear to be in saltmarsh that is infrequently flooded. Depressions in these areas are temporarily filled with rain or saltwater, depending on elevation, but are sufficiently ephemeral as to not have insect and fish predators. These depressions are generally a result of some form of anthropogenic disturbance. Depressions located along a section of foreshore at Kincumber South (Kincumber Broadwater) were found to contain tens of thousands of mosquito larvae. These depressions were a direct result of works associated with mangrove and foreshore clearing.

CONCLUSIONS AND RECOMMENDATIONS

The estuarine foreshores in Brisbane Water have been heavily modified. The major causes have been the loss of saltmarsh and mangrove habitats and the ongoing disturbance associated with the creation of hard structures such as seawalls and jetties. Approximately 23 km (26%) was given a Disturbance Index of 1, whilst 24 km (27%) received a Disturbance Index of 2. Only 8 km (9%) of the foreshore was found to be in an unmodified condition with a Disturbance Index of 5.

It is recommended that Council develop a comprehensive foreshore management plan for the estuary which balances social and economic needs whilst ensuring that natural shoreline habitats and their ecological function are not impacted.

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APPENDIX 1

C	DI	Disbane Water Foreshore Disturbance muck (DI).
Section	DI	Comment
1	2	The Broadwater. Rail edge east. Loose seawall. Scattered saltmarsh. Numerous
	2	weeds.
2	3	The Broadwater. Rail edge. Loose seawall. Scattered saltmarsh species.
	2	Shallow seagrass interface.
3	3	Pt Clare. Mangroves in patches to 7m tall. Scattered rock oysters. Extensive
		Posidonia australis meadows.
4	1	Pt Clare, Noonan Pt. Mostly seawall. Saltmarsh.
5	2	Mix of seawall and mangroves. Some seagrass wrack.
6	2	Tascott. Shallow seagrass sandy substratum. Seagrass wrack.
7	1	Seawall and jetties. Picnic area.
8	1	Houses and jetties. Shallow edge. Poor.
9	2	Couche Park. Includes park with some native trees.
10	1	Murphys Bay. Seawall. Poor.
11	2	Mangrove & seawall. Headland of saltmarsh.
12	1	Rail bridge to Woy Woy Bay. Seawall.
13	2	Mangroves & narrow edge of saltmarsh next to rail.
14	1	Woy Woy. Seawall & scattered mangroves.
15	3	Woy Woy. Includes variable 30m strip saltmarsh. Mosquitoes.
16	1	Seawall and major saltmarsh weed <i>Juncus acutus</i> .
17	3	Rocky shore with mangroves and forest.
18	1	Seawall jetties. Disturbance high.
19	1	Jetties, seawall, poor habitat.
20	2	Woy Woy. Houses set back 50m. Patchy saltmarsh.
21	1	Blackwall Point. Seawall and houses. Poor.
22	3	Upstream (west) Rip Bridge, Mangroves.
23	1	Booker Bay. Jellies & seawall. Poor.
24	4	Platform foreshore. Narrow fringe of mangroves and casuarinas. Public wharf.
25	4	Variable rock. Narrow fringe of Mangroves. Catchment mostly undeveloped.
26	1	Merritts Wharf, Seawall, Houses, Highly modified.
27	5	Adjacent to Yaringa Parade. Wide mangrove with saltmarsh behind.
	_	Undeveloped catchment.
28	1	Cockle Channel. Extensive seawalls.
29	5	Island, Wide mangrove & saltmarsh, Catchment good
30	4	Substantial seagrass Mangrove/saltmarsh interface. Some catchment
50		development
31	1	Seawalls
32	2	Humphreys Wharf
33	3	Mangroves Casuarina plus weedy Buffalo Grass
34	3	Cronned mangroves & saltmarsh Mosquitoes in depressions
35	<u> </u>	Cronned Mangroves with good saltmarsh. Mosquitoes
36		Kincumber Broadwater, Seagrass, excellent saltmarsh & forest
27	3	Kincumber Broadwater, South Neutrical Village, Modified
20	5 5	Kincumber Droadwater, North of Neutical Village, Manageres and
58	3	undeveloped established
1	1	ן חותב אבוטףכת כמוכווווכות.

Brisbane Water Foreshore Disturbance Index (DI).

Section	DI	Comment	
39	2	Kincumber Broadwater. Boar ramp with houses behind.	
40	3	Yattalunga. After (north) boat ramp. Some mangrove trimming.	
41	3	Saratoga. Wide mangroves with Casuarina forest behind.	
42	3	Houses & narrow strip of mangroves. New seawalls. Mangrove removal.	
43	2	Saratoga. All mangroves removed. Mown behind.	
44	4	Broad mangroves.	
45	2	Includes River Mangrove.	
46	5	Mangrove & saltmarsh. Undeveloped catchment. Excellent.	
47	5	Low island opposite section 46. Mix of mangrove & saltmarsh.	
48	1	House & lawn. Mangroves removed.	
49	3	Mangrove/Casuarina interface.	
50	1	Mown lawns with mangroves removed.	
51	1	Eulalia Wharf. Poor ecological value.	
52	1	Mown saltmarsh. Poor.	
53	3	Mix of mangroves & saltmarsh. Juncus acutus infestation.	
54	3	Mangrove & narrow saltmarsh.	
55	2	Council land - mown. Warning sign by Council to not remove or cut the	
		vegetation.	
56	5	Cockle Channel. Narrow island. River & Grey Mangroves plus saltmarsh.	
57	5	Cockle Channel. Wide forest. Mangroves & saltmarsh.	
58	2	Narrow fringe saltmarsh. Mown behind.	
59	5	Includes wide Casuarina Forest & good saltmarsh.	
60	2	Pine Ave Rec Park. Fringing saltmarsh, mown.	
61	1	Hard edge & houses. Mown.	
62	3	Spit of land with good saltmarsh.	
63	2	Lintern Channel. Sandy edge to mown strip. Lintern St Wharf.	
64	1	Lintern Channel. Next to Henderson St. Hard edge.	
65	4	Lintern Channel. Oyster lease against mangroves.	
66	1	Lintern Channel. Seawall to Veterans St Wharf.	
67	2	Houses behind thin strip of mangroves.	
68	5	Saratoga. Mangroves & wide saltmarsh.	
69	4	Pt Frederic. Good Seagrass & saltmarsh.	
70	1	Seawall. Deep 200m sediments.	
71	2	Caroline Bay. Mangrove ribbon, rock wall behind.	
72	3	Caroline BayMangroves/Seagrass/Saltmarsh.	
73	3	Casuarina Forest with dense weeds behind.	
74	1	Peeks Point. Seawall & big houses.	
75	1	Loose rocks. Minimal habitat.	
76	3	Punt Bridge. River & Grey Mangrove. Erina Main Rd separates arm.	
77	4	East Gosford. Mangrove & saltmarsh. Includes Gosford Council Depot in	
		catchment.	
78	1	Fringe of Casuarinas & mangroves. Filled behind.	
79	3	Ironbark Point. Rocky habitat. Mown behind.	
80	1	Ironbark Point. Loose rock edge. Mown behind.	
81	3	Spit of land with saltmarsh.	
82	1	Variably infilled. No saltmarsh.	

Section	DI	Comment	
83	4	Green Point. Broad rock platform. Species rich. Houses in catchment.	
84	3	Broad rock platform. Sandy substratum. Some forest with houses behind.	
85	1	Fully developed with houses. Area mown.	
86	2	Mown. Some fringing saltmarsh.	
87	4	Good mix. Sandy substratum. Mangrove strip 20m wide.	
88	5	Saltmarsh mangrove interface. Benthos diverse. Egans Ck.	
89	1	Houses on edge. Yattalunga Wharf.	
90	3	Dense Seagrass. Broad shallow interface.	
91	3	Steep bank. Weedy, but well forested.	
92	3	Rocky steep bank. Well forested. Houses behind.	
93	1	Seawall & jetties. New Brighton Wharf. Highly disturbed.	
94	2	Sandstone platform. Good seagrass.	
95	1	Seawall. Mown behind.	
96	2	Woy Woy Bay. Contiguous to rail line. Natural rocks.	
97	4	Woy Woy Bay. Good Seagrass/saltmarsh interface.	
98	3	Woy Woy Bay. As for 97 but narrower.	
99	1	Woy Woy Inlet. Jetties, seawalls and houses.	
100	2	Woy Woy Inlet. Berts Drain. Grey & River Mangrove.	
101	1	Woy Woy Inlet. Boat ramp. Patchy Mangroves.	
102	1	Woy Woy InletJetties & seawall	
103	4	Currawong point, Correa Bay. Mouth of Woy Woy Creek. Mangroves;	
		productive fish zone.	
104	3	Woy Woy Inlet. Semi-natural edge, very steep behind, scattered mangroves	
		plus forest.	
105	2	Woy Woy Bay. Steep interface. Mangroves cleared. Good platform.	
106	3	Horsefield Bay. Mangrove Ck entry. Steep interface. Some mangroves cleared.	
107	1	Pheagans Bay. Steep edge. Jetties and houses.	
108	2	Pheagans Bay. Blue boat shed. No seawall. Drain line. Mown.	
109	5	Brisbane Water National Pk. Steep. Wide rock platform. Good forest behind.	
110	4	Woy Woy Bay. Good seagrass/beach ecotone. Weeds downgrade section from a	
		5 index.	
111	3	Woy Woy Bay. Good seagrass/sand flat ecotone.	
112	1	Woy Woy Bay. Seawall & jetties. Good seagrass on sand.	
113	5	Brisbane Water National Park. Woy Woy Bay. Seagrass, mangrove & steep	
		rocky edge. Good catchment.	
114	2	Disturbed interface. Steep to first jetty.	
115	1	Seawall, jetties and houses.	
116	3	Good platform, but road on rock edge. Good catchment.	
117	2	Some seawalls. Good catchment with forest behind.	
118	3	Bookers Bay downstream Booker Bay Bridge. Flood bench. May be eroded	
		during storms.	
119	1	Seawall. Patchy seagrass. Large sand flat. No edge vegetation.	
120	3	Ettalong. Includes Ettalong Wharf. Patchy seagrass. Sandy edge. Narrow	
		section of edge vegetation.	
121	3	Ettalong beach. Steep sand beach and patches of seagrass. Includes stormwater	
		line. Some areas mown.	
122	2	Ettalong beach. Loose rock seawall. Fringe of vegetation before road.	

Section	DI	Comment
123	3	Ettalong. Wide beach. Small dune. With Spinifex before it meets Broken Bay.
124	5	Opposite Ettalong Beach. At Broken Bay interface. Sandstone rock shelf.
		Excellent seagrass.
125	2	Rubble seawall. Houses behind.
126	1	Pretty Beach. Seawalls, houses, lawns and jetties.
127	2	Pretty Beach. Short section with mangroves. Hardys Bay Wharf. Very
		modified.
128	4	Hardys Bay. Excellent oyster rock platform. Houses behind. 30 m of cleared
		mangroves.
129	3	Hardys Bay. Loose seawall. Fringing saltmarsh. Houses behind.
130	1	Hardys Bay. Seawall. Houses behind. Good seagrass
131	2	Hardys Bay. Killcare Rd wharf. Some mangroves. Dense development.
132	4	Hardys Bay. Mangroves with large catchment, largely undeveloped.
133	1	Hardys Bay. Seawall and houses. Good seagrass.
134	4	Killcare Wharf. Mangroves and Casuarinas and minor Rd. Oyster lease.
135	3	Some seawalls. Houses and road near edge. Good rock shelf.
136	2	Loose seawall. Oyster lease. Houses and road near water.
137	5	Rileys Bay. Mangroves and large catchment with one house. Oysters.
138	3	Rileys Bay. Mangroves and rock shelf. Large oyster lease. Weedy foreshore. A
		few houses.
139	4	Mangroves, rock shelf and a few houses. Steep.
140	1	St Huberts Island. Apart from a few small patches of saltmarsh totally
		developed and dredged.
141	3	St Huberts Island. Council Reserve. Mangroves. Good seagrass adjacent.
142	2	St Huberts Island. Mangroves have been "hedged". Includes launch ramp.
143	5	Rileys Island. Undeveloped.
144	2	St Huberts Island. Patchy mangroves. Some patchy saltmarsh. Houses behind.
145	2	St Huberts Island. Mangroves and seagrass. Catchment fully developed.