

COMMUNITY SPACES & SERVICES

ATTACHMENT A

**INVESTIGATION INTO A BOAT LAUNCHING
FACILITY AT NORTH ARM COVE**

ORDINARY MEETING

28 JUNE 2017



REPORT

Great Lakes Region Boating Development Studies

PH-09 North Arm Cove Boating Development Plan

Client: Roads & Maritime Services
on behalf of MidCoast Council

Reference: M&APA1268R004F1.0

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Appendices

Appendix A: Maps and Draft Concept Design Plans

Appendix B: Stakeholder Engagement Plan

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Appendix D: Seagrass Mapping & Assessment Report

Appendix E: Final Concept Design Plan

Appendix F: Cost Estimate

1 Introduction

1.1 Background

Royal HaskoningDHV (RHDHV) has been engaged by Roads and Maritime Services (RMS) on behalf of MidCoast Council (Council) to investigate options for a boat ramp and pontoon at North Arm Cove. The area has a unique history and following World War I, plans were developed to establish Port Stephens City at the area now known as North Arm Cove. The plans included provisions for:

- wharves;
- jetties;
- two railway stations; and,
- 2,000 residential lots.

Subsequently, streets were laid out and development commenced, particularly along the foreshore. However, in 1963, Great Lakes Council (Council) closed most of the roads planned in the subdivision, setting aside a small area for residential expansion and zoning the remaining areas non-urban. At the time, planned boating infrastructure including wharves, jetties and pontoons were not constructed.

Over the years, the local community has campaigned for a boat ramp and jetty, or wharf, with numerous submissions submitted to Council. The need for improved public boating infrastructure has been driven by the following concerns:

- lack of boat launching facilities, which are important for tourism and recreational activities;
- limited access to moored vessels from the shoreline;
- limited opportunities to berth a large vessel near the foreshore to load passengers and goods;
- condition, exposure and safety of the existing informal launching facilities surrounding North Arm Cove;
- lack of emergency evacuation routes from North Arm Cove;
- absence of public transport routes; and,
- the view of some sectors of the local community that a ferry service could meet the communities' requirements for public transport.

Map 1 (refer **Appendix A**) provides a summary of the key features within the study area for the investigation.

1.2 Objectives

The objectives of the investigation are to:

- identify suitable locations for future development of maritime infrastructure including:
 - a boat ramp;
 - a jetty to cater for larger vessels; and,
 - additional jetties and pontoons for public use;
- develop maritime boating infrastructure concepts for the suitable locations in accordance with the most relevant maritime guidelines and standards; and,
- conduct community consultation and stakeholder engagement activities to record and incorporate feedback for the proposed plans.

1.3 Scope of Work

The scope of work for the investigation includes the following main tasks:

- review of background information;
- initial consultation with Council, community and government agency stakeholders;
- appraisal of existing environmental conditions;
- consideration of opportunities and constraints for boating infrastructure;
- identification of concept options for boating infrastructure improvements;
- identification and costing of further studies, design and construction associated with concept options;
- face-to-face consultation with community stakeholders; and,
- finalisation of boating infrastructure concepts.

1.4 Acknowledgements

We acknowledge the assistance provided by Council and RMS in facilitating access to background information and reviewing the deliverables for the investigation.

Furthermore, a number of stakeholders were consulted as part of the investigation to establish current issues and demands and future needs for boating infrastructure, and to provide feedback on the development of concept options. These stakeholders are identified within the Stakeholder Engagement Plan (refer **Appendix B**) and their valuable contributions to the preparation of the Masterplan are outlined within **Section 3** and **Section 5.5** of this report.

2 Review of Background Information

A wide range of background information was reviewed to establish an understanding of the existing environment and opportunities and constraints associated with boating infrastructure. The information that was compiled as part of the investigation is listed below.

Council GIS data layers:

- cadastral boundaries
- Council Land, Council-controlled Crown Land and Crown Land
- Land zoning
- SEPP14 wetland boundaries
- marine vegetation mapping
- heritage areas
- land contours
- stormwater drainage
- aerial photography

RMS GIS data layers:

- navigation aids
- navigation restriction areas
- depth contours
- aquaculture lease boundaries

Mapping Data:

- Port Stephens Acid Sulfate Soils Map (Dept. of Land and Water Conservation, 1997)
- Aus Chart 209 (Australian Hydrographic Service, 2001)
- Marine Vegetation Port Stephens Map 1 (DPI, 2004)
- Boating Map 7A for Port Stephens, Karuah River and Broughton Island Area (RMS, 2014)
- Port Stephens – Great Lakes Marine Park Zoning Map (DPI, 2015)
- Port Stephens Mooring Areas Map (RMS, 2016)

Background Reports:

- Coastal Geomorphology and Quaternary Geology of the Port Stephens-Myall Lakes Area (Thom et al, 1992)
- Port Stephens Flood Study – Stage 2 Design Water Levels and Wave Climate (MHL, 1997)
- Port Stephens Tidal Data Collection – September 1993 (MHL, 1998a)
- Port Stephens Flood Study – Stage 3 Foreshore Flooding (MHL, 1998b)
- Port Stephens/Myall Lakes Estuary Process Study – Geomorphology, Sediments and Groundwater (WRL, 1998)
- Port Stephens/Myall Lakes Estuary Processes Study (MHL, 1999)
- Great Lakes Council Heritage Study (GLC, 2007)
- Lower Pindimar, Pindimar, Upper Pindimar and Bundabah Foreshore Erosion Study (BMT WBM, 2011)

Design Standards and Guidelines:

- AS3962-2001 Guidelines for Design of Marinas
- Coastal Engineering Manual (USACE, 2008)
- NSW Boat Ramp Facility Guidelines (RMS, 2015)

Environmental and Recreation Data:

- OEH NSW Tidal Planes Analysis: 1990-2010 Harmonic Analysis (MHL, 2012)
- Australian Bureau of Statistics – 2011 Census Quickstats (ABS, 2016)
- AHIMS Extensive Search – Site list report (OEH, 2016)
- RMS Mooring Licence and Vessel Registration data (RMS, 2016)
- Bureau of Meteorology wind data from Williamtown RAAF Station No. 061078 (2016)

Council/State planning documents:

- Port Stephens and Myall Lakes Estuary Management Plan (Umwelt, 2000)
- A Foreshore Management Plan for Port Stephens (Umwelt, 2009)
- Great Lakes Development Control Plan (DCP)
- Great Lakes Local Environmental Plan (LEP) 2014
- NSW Oyster Industry Sustainable Aquaculture Strategy (DPI, 2014)
- Generic Plan of Management Community Land (GLC, 2015)

Full reference listings for key documents are provided at **Section 7**.

3 Stakeholder Engagement Plan

A Stakeholder Engagement Plan (SEP) (refer **Appendix B**) was prepared for the project to:

- facilitate the identification of key community and agency stakeholders; and,
- document methods for consultation with these stakeholders.

The SEP comprised several stages of consultation including:

- telephone interviews with key representatives;
- an initial face-to-face meeting with stakeholder representatives;
- a drop-in information session; and,
- a community meeting.

The earlier two consultation tasks were used to develop an understanding of boating infrastructure issues and needs, and the development of concept options and plans.

Initial face-to-face meetings were held separately with government agency representatives and community stakeholder representatives on 8th March 2016. Meeting notes recorded from discussions at these meetings are provided in **Appendix C**. An inspection by boat of a number of potential boating infrastructure sites was also undertaken with key stakeholders and local community members.

A summary of the key issues and opportunities/constraints raised by stakeholders during initial consultation is provided below:

- The preferred design vessel length for a boat ramp facility was indicated as 6.5 m.
- Some of the local community believe there is demand for a boat ramp at North Arm Cove that is derived from outside the area.
- A number of sites were inspected by boat with the following observations:
 - Beauty Point is considered to be the 'jewel in the crown' for developers and is highly valuable land;
 - Brackens Bay is exposed to a south-westerly wind fetch and there was little seagrass observed. The land around the foreshore of the Bay is owned by Walker Corporation;
 - Medina Bay is protected from south-west winds. A potential issue was raised in regard to the adequacy of sight lines along Cove Boulevard when approaching the access point to the potential boat ramp site;
 - An area designated as public reserve at the northern limit of the study area was discussed. However, concerns were raised associated with proximity to oyster leases, Marine Park Sanctuary Zones, seagrass beds and shallow water depths;
 - A site at Carrington was discussed. However, it was remote and would require an access road and service road to be provided;
 - A boat ramp was previously located at Casuarina Reserve. However, shallow mudflats at the site rendered it inoperable.
- On the north side of Port Stephens, the only adequate swing moorings are at Karuah and North Arm Cove. The moorings are relatively inexpensive in comparison to Sydney. There are currently 45 moorings within North Arm Cove and RMS plans to increase that number to 70.
- Dinghy skids are proposed at Casuarina Reserve and Water Street subject to Crown Lands approval. The need for these facilities is driven by an increase in moorings in North Arm Cove.

- The local community has a view that oyster leases have disrupted flows and contributed to deposition of muddy sediments along the North Arm Cove foreshore. The oyster leases were reported to be difficult (if not impossible) to get removed once they are established, even if they are disused.
- It was noted that the flushing time for North Arm Cove is reported as being as much as 12 days due to the water depths and isolation from significant wind-induced and tidal currents.
- A public jetty was suggested to be designed to cater for ferries as well as the wider community. Ferry services have been contacted and are interested in making North Arm Cove a stop along their route. The jetty was also seen to be an important facility for emergency evacuation of residents in the event of a bush fire (however this is not an evacuation option promoted or planned by the Rural Fire Service (RFS) or Council emergency management staff, as discussed below). Possible locations for a jetty were discussed including:
 - Medina Bay site that is accessible via an easement from Point Circuit. The site has good deep water access and is well positioned at the entrance to North Arm Cove. However, concerns were raised with the slope of the easement access and length of the jetty in relation to the aging population at North Arm Cove; and,
 - Casuarina Reserve where a dinghy skid is proposed to be constructed, which is currently subject to Crown Land approval. The Casuarina Park Masterplan included a jetty alongside a proposed dinghy skid. The jetty would need to be 70m long to access deep water and positioned through a gap in the oyster leases. It was noted that bedrock was 2 feet (0.6 metres) under the sand at this location. It was suggested that the jetty could incorporate a dinghy skid alongside it and could possibly be a low level jetty. However, the structure could not be too low as prolific oyster growth in the area would foul the jetty.

As noted above, it was thought by some community stakeholders that a public jetty structure would enhance emergency evacuation by providing a waterborne evacuation option. It is understood that recent works have been completed to enable the North Arm Cove Community Hall to be designated as a 'Neighbourhood Safer Place' for bush fire evacuation in the Community Protection Plan recently prepared by RFS in consultation with residents. The North Arm Cove Neighbourhood Safer Place is one of 5 such locations within the Great Lakes LGA and is designed as a place of last resort in bush fire emergencies.

Based on discussions with RFS and the Local Emergency Management Officer (LEMO) at Council, the objective of all bush fire response plans is for residents to leave early from threatened areas and heed the warnings provided by the RFS and other emergency services. As such, the designation of a wharf/jetty as a waterborne evacuation option is not part of these plans as it encourages people to rely on this infrastructure as a means for last minute evacuation. Furthermore, waterborne evacuation is inherently problematic due to a number of factors including:

- people need to make their way to the wharf/jetty via local roads, which is likely to be difficult and hazardous in the event of bush fires;
- loading people quickly into boats from a wharf/jetty is difficult, particularly for those that are elderly, have medical conditions/support apparatus or are wheelchair bound;
- visibility is likely to be poor due to smoke and fire fighting activities (e.g. airborne fire fighting involving water drops); and,
- cannot rely on emergency response at the right time from vessels sourced from the surrounding region (e.g. Water Police, Marine Rescue, ferries, cruise vessels etc.).

The later stakeholder feedback received from the drop-in session and community meeting is presented in **Section 5.5**.

4 Existing Environment

4.1 Planning Context

Land ownership and heritage areas, land use zoning, and aquatic vegetation areas and marine park zoning are provided on **Map 2.1**, **Map 2.2** and **Map 2.3**, respectively.

The waterway adjoining the foreshore from Balberook Cove, Carrington to Baromee Point, and sections of the North Arm Cove community is zoned W2 Recreational Waterways under the *Great Lakes Local Environmental Plan (LEP) 2014* (LEP 2014) (refer **Map 2.2**). The remainder of the waterway area is within the Port Stephens LGA.

The objectives of W2 zoning include:

- protect the ecological, scenic and recreation values of recreational waterways;
- allow for water-based recreation and related uses;
- provide for sustainable fishing industries and recreational fishing;
- enable development that does not detract from the visual qualities of the natural foreshore; and,
- enable development that supports the viability of adjoining land-based development.

Activities permitted with consent in a W2 zone include:

- boat launching ramps;
- boat sheds;
- jetties;
- marinas;
- mooring pens;
- moorings;
- water recreation structures; and,
- wharf or boating facilities.

Apart from the area at the head of the embayment, North Arm Cove is zoned General Use under the *Port Stephens – Great Lakes Marine Park Zoning Plan (2015)* (refer **Map 2.3**). Under the *Marine Estate Management (Management Rules) Regulation 1999*, the objectives of the General Use Zone include provision of opportunities for ecologically sustainable recreational and commercial activities. Hence, boating facilities are permissible in these areas subject to approvals.

Around Baromee Point there are four (4) foreshore areas zoned RE1 Public Recreation. These areas are all Council owned land and include:

- Foreshore Reserve in Heros Bay;
- Foreshore Reserve in Wide Bay;
- Lot 521 in Medina Bay; and,
- Lot 513 to the north of Medina Bay.

The objectives of RE1 zoning include:

- enable land to be used for public open space or recreational purposes;
- provide a range of recreational settings and activities and compatible land uses;
- protect and enhance the natural environment for recreational purposes;
- provide for a range of educational, environmental, community and cultural uses for the benefit of the community; and,
- enable access to activities and businesses located within adjacent waterways.

Activities permitted with consent in an RE1 zone include:

- boat launching ramps;
- car parks;
- community facilities;
- jetties;
- marinas;
- recreation areas, and,
- wharf or boating facilities.

The private residences within the North Arm Cove community are zoned RU5 Village under LEP 2014.

The objectives of RU5 zoning include:

- provide for a range of land uses, services and facilities that are associated with a rural village;
- provide for a range of land uses, services and facilities that are associated with a coastal village; and,
- enable non-residential development that does not prejudice the established land use pattern within the village.

Activities permitted with consent in an RU5 zone include:

- recreation areas;
- recreation facilities (outdoor); and,
- roads.

Vacant lots within North Arm Cove are generally zoned RU2 Rural Landscape under LEP 2014. The objectives of RU2 zoning include:

- encourage sustainable primary industry production by maintaining and enhancing the natural resource base;
- maintain the rural landscape character of the land;
- provide for a range of compatible land uses, including extensive agriculture;
- provide for rural tourism in association with the primary industry capability of the land which is based on the rural attributes of the land; and,
- secure a future for agriculture in the area by minimising the fragmentation of rural land and loss of potential agricultural productivity.

Activities permitted with consent in an RU2 zone include:

- boat launching ramps;
- boat sheds;
- charter and tourism boating facilities;
- marinas;
- mooring pens;
- moorings;
- recreation areas;
- recreation facilities (outdoor); and,
- wharf or boating facilities.

State Environmental Planning Policy (SEPP Infrastructure) 2007 permits the development of wharf or boating facilities, including public ferry wharves, by or on behalf of a public authority without consent on any land. Note: as for impacts on species/ communities of ecological significance, statutory and regulatory approvals would be required for works to proceed.

Under the *Great Lakes LEP* a range of boating infrastructure and facilities are permissible with consent in the W2 and RE1 zones. Similar facilities are also permissible with consent in RU2 zones.

4.2 Demand for Facilities

Documents provided by local community members indicate that access to the waterway has been a recurring item of concern for around 50 years.

The North Arm Cove Residents Association (NACRA) was formed in 1967 (note: the Residents Association has also been known as the Progress Association and the Village Association). At the second meeting of the Residents Association, they wrote to Council asking “that gravel be provided for the right of way between lots 506 and 507 (108 and 110 Cove Boulevard) in order to facilitate the launching of vessels”. Gravel was subsequently supplied by Council in response to this request.

In 1973, the NACRA’s President consulted Councils’ engineer and requested that Council “provide a launching ramp, parking spaces, picnic area, toilets and bins between lots 345-346”. The motion was passed and the area known as Casuarina Reserve was formed. However, in the 1990’s Council approved a subdivision and sold three blocks of land on each side of the Reserve, reducing its area (Kohlhoff, 2016). The current lot boundaries indicate that there are now 4 blocks of subdivided land on either side of the present reserve area.

In 1993, the NACRA prepared a submission to Council, State Government and the Maritime Services Board campaigning for a boat ramp and jetty (NACPA Inc., 1993). At a public meeting in 1994, there was strong support for a boat ramp “outside the village area”. At the time, the majority of residents believed a jetty was not necessary (Kohlhoff, 2016). However, NACRA have advised that support for a jetty has grown significantly since then. Amongst the arguments for constructing a jetty is the need to provide an emergency evacuation point, in the event that the single access road into North Arm Cove is unusable or cut off by a fire. However (as discussed in **Section 3**), this has been resolved by the establishment of the local Community Hall as a Neighbourhood Safer Place and waterborne evacuation is not an option promoted or planned by the Rural Fire Service (RFS) or Council emergency management staff.

Subsequent submissions to Government Authorities canvassing boat ramp and jetty proposals were prepared in 2002, 2003 and 2006, amongst others. The list of possible sites given consideration over the years has included:

- Heros Bay;
- Wide Bay;
- Medina Bay (Lot 521);
- Water Street Reserve;
- Casuarina Reserve;
- A site to the north of the community including southern end of Lot 1458 or between Lot 1439 and 1457;
- Parry Street on the eastern side of Carrington;
- Beauty Point or northern end of Brackens Bay; and,
- Promontory Way on the south of Brackens Bay.

The 2011 census indicated the population of North Arm Cove was 422 people and the median age was 60. As such, accessibility is a relevant consideration in the design of boating facilities.

There were 308 dwellings in North Arm Cove, of which 123 were private unoccupied dwellings (approximately 40% unoccupied). The average household size was 2.2 people (ABS, 2016). During the peak holiday season and given the high proportion of unoccupied dwellings, it is possible that the population would double. It is also noted that there are 407 residential allotments in North Arm Cove, of which approximately 300 dwellings existed in 2003 (Dirou, 2003). There is potential for development of residential dwellings in North Arm Cove. However, development over the period of 2003 to 2011 was relatively low with approximately 8 allotments developed in that time.

It is difficult to ascertain demand for a facility and boat ownership within the local community. RMS boat registration details by postcode have been reviewed. However the postcode for North Arm Cove (2324) covers a large region that includes Raymond Terrace, Seaham, Karuah, Tea Gardens and Hawks Nest. As such, the information cannot be used to ascertain boat ownership in North Arm Cove alone. However, it is understood that North Arm Cove residents have a relatively high rate of boat ownership.

A previous survey was undertaken by local North Arm Cove community members in 2002 and counted the following number of vessels:

- Boats Onshore – 302 including all dinghies and sailing vessels up to approximately 7m but excluding jet skis, canoes and surf skis. It is assumed that this includes vessels on the foreshore and vessels observed to be stored on trailers.
- Closed Garage/Boat Shed – it was assumed that at least 45 of the 178 garage/boat sheds counted could contain boats in secure storage.
- Moored Vessels – 34 (note RMS has indicated that there are currently 45 moorings in North Arm Cove and they are looking to increase the number to 70 moorings).
- Unoccupied dwellings – 50.

The survey was undertaken during the 2002 Christmas holiday period and it was noted that approximately 100 of the 407 residential allotments have water frontage suitable for all tide access and some of these landholders have private launching facilities (Dirou, 2003). The survey concluded that “perhaps 300 of 407 village landholders might be potential boat ramp users plus others from nearby Carrington and rural living areas”.



It is understood that North Arm Cove residents currently launch their boats from waterfront properties on private boat ramps or by informally accessing the foreshore through vacant blocks of land or through reserve areas with 4WD vehicles.

4.3 Estuarine Processes

4.3.1 Wind Climate

The wind climate within Port Stephens is best represented by the BoM weather station at Williamtown RAAF Base (Station No. 061078). A review of monthly wind roses available on the BoM website (accessed 21 March 2016, refer **Figure 1** and **Figure 2**) indicates that winds are seasonal and follow a typical coastal trend of stronger westerly and north-westerly winds in winter and easterly to south-easterly winds in summer. North-westerly winds are also predominant in autumn and spring.

Rose of Wind direction versus Wind speed in km/h (10 Sep 1942 to 30 Sep 2010)

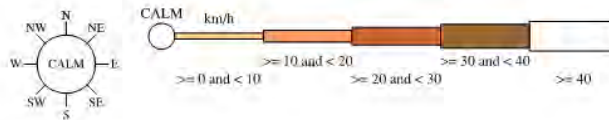
Custom times selected, refer to attached note for details

WILLIAMTOWN RAAF

Site No: 061078 • Opened Jan 1942 • Still Open • Latitude: -32.7932° • Longitude: 151.8359° • Elevation 9m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



3 pm Jul
1949 Total Observations

Calm 10%

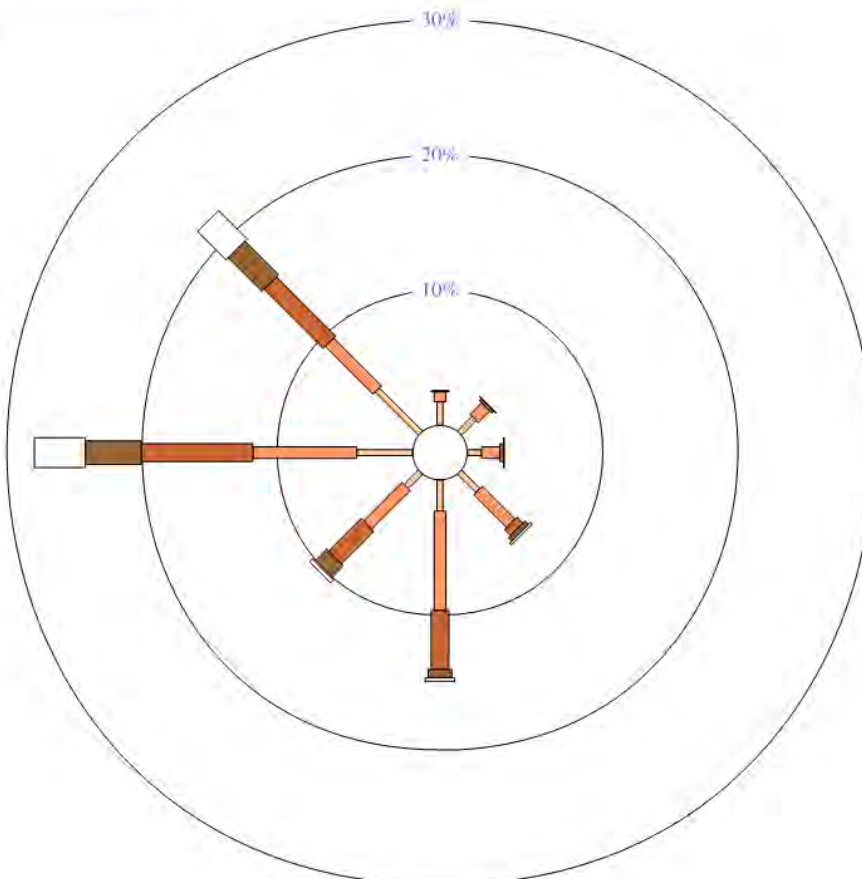


Figure 1: Williamtown RAAF Base Winter Wind Rose (BoM, 2016)

Rose of Wind direction versus Wind speed in km/h (10 Sep 1942 to 30 Sep 2010)

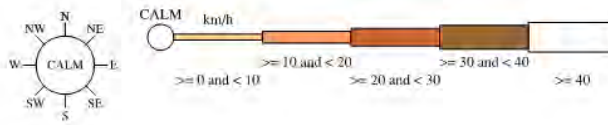
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An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



3 pm Jan
1890 Total Observations

Calm 1%

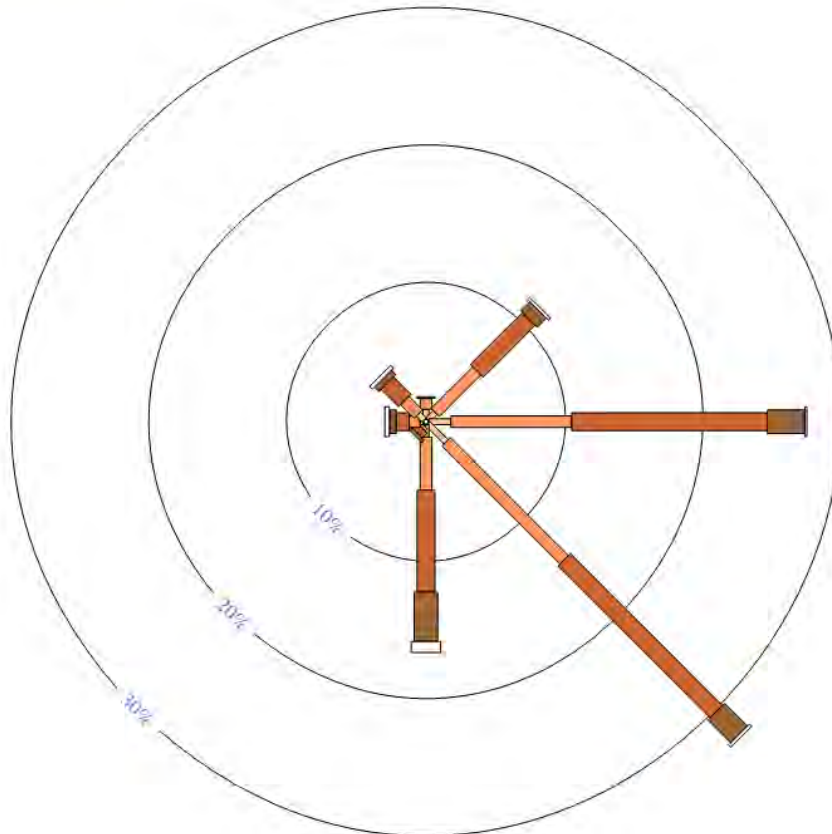


Figure 2: Williamtown RAAF Base Summer Wind Rose (BoM, 2016)

An analysis of wind data obtained from 38 years of recording at this station is reported within the *Port Stephens/Myall Lakes Estuary Processes Study* (MHL, 1999) and was initially reported within MHL (1997). The one-hour average wind speed data derived from this analysis is presented below in **Table 1**.

Table 1: Williamstown RAAF - One-Hour Average Wind Speed (m/s) (MHL, 1999)

Average Recurrence Interval (ARI)	N	NE	E	SE	S	SW	W	NW
100 years	13.3	12.4	15.2	15.2	19.5	22.9	33.3	32.4
50 years	12.4	11.9	14.8	14.8	19.0	21.0	32.4	30.5
20 years	11.0	11.4	14.3	14.3	18.6	19.0	30.5	28.6

4.3.2 Water Depths

Water depths within the study area are best represented by the information available on the Admiralty Chart for Port Stephens (Aus 209).

The chart indicates that bed levels approximately 450m south of Baromee Point, at the southern end of North Arm Cove, are 20 to 30 metres below Port Stephens Hydrographic Datum (PSHD)¹, which approximates the depth of water at Lowest Astronomical Tide (LAT). However, the deep water appears to be a localised trough extending upstream and west of “The Narrows” between North Point and Soldiers Point. The bed levels rapidly decrease to 10 to 15 metres below PSHD on both sides of this trough. The bed levels in upper Port Stephens and the western side of the North Arm Cove community are generally 2 to 5 metres below PSHD.

On the eastern side of the North Arm Cove community, bed levels near the centre of the channel at the entrance to North Arm Cove are 8 to 10 metres below PSHD and water depths decrease towards; the head of the Cove to the north, and the entrance to Bundabah Creek. The chart indicates relatively deep water and steep nearshore bed gradients near the headlands and wide intertidal flats with relatively flat bed gradients within the embayments on the eastern and western side of the North Arm Cove community.

4.3.3 Shoreline Morphology

It was observed that the headlands around North Arm Cove are generally steep and rocky. The embayments on the western side of the North Arm Cove community such as Heros Bay and Brackens Bay generally comprise wide intertidal sand flats at low tide (refer **Figure 3**). The eastern side of the North Arm Cove community in the vicinity of Water Street Reserve and Casuarina Reserve generally comprises wide mud flats at low tide (refer **Figure 4**) and it was reported by local residents that the depth to bedrock is relatively shallow (refer **Figure 5**).

¹ It should be noted that Port Stephens Hydrographic Datum (PSHD) is approximately 0.96 metres below Australian Height Datum (AHD) at Mallabula Point.



Figure 3: Intertidal sand flats at Heros Bay



Figure 4: Intertidal mudflats viewed from Casuarina Reserve



Figure 5: Foreshore south from Casuarina Reserve showing rock outcrops

Erosion and undercutting of trees is reported to be a concern within North Arm Cove (Umwelt, 2009). However, it appears that the erosion is only occurring where the foreshore has been reclaimed and the vertical seawalls protecting the reclamation are not built to an acceptable coastal engineering standard.

4.3.4 Water Levels

Water levels within Port Stephens vary primarily in response to astronomical tides, although storm surge (barometric and wind set-up) and freshwater flooding may also influence water levels from time to time. Sea level rise would have a long-term effect on water levels.

The study area is subject to semi-diurnal tides (i.e. two high tides and two low tides per day) that propagate through the port entrance to Soldiers Point. An analysis of data collected from the tide gauge at Mallabula Point (to the west of Soldiers Point) between 1990 and 2010 was carried out by Manly Hydraulics Laboratory (MHL, 2012) to determine the tidal planes. The latest available (2009-2010) tidal planes are summarised in **Table 2**. It should be noted that Port Stephens Hydrographic Datum (PSHD) is approximately 0.96 metres below Australian Height Datum (AHD) at Mallabula Point.

Table 2: Mallabula Point Gauge Tidal Planes (MHL, 2012)

Tidal Plane	Water Level (m PSHD)	Water Level (m AHD)
High High Water Solstice Springs (HHWSS)	2.09	1.13
Mean High Water Springs (MHWS)	1.69	0.73
Mean High Water (MHW)	1.55	0.59
Mean High Water Neaps (MHWN)	1.41	0.45
Mean Sea Level (MSL)	0.97	0.01
Mean Low Water Neaps (MLWN)	0.53	-0.43
Mean Low Water (MLW)	0.39	-0.57
Mean Low Water Springs (MLWS)	0.25	-0.71
Indian Springs Low Water (ISLW)	-0.04	-1.00

MHL (1998b) completed a flood study for the Port Stephens foreshore. The report summarised the following parameters:

- Design Peak Water Levels (DPWL), which included storm tide, flood runoff and wind;
- ocean wave and wind wave height and period discussed in **Section 0**; and,
- representative foreshore condition.

These parameters were used to determine wave runup and to establish Design Foreshore Flood Levels (DFFL). The DPWL and DFFL for two sites at Baromee Point (located east of Wide Bay) and Casuarina Reserve (located on the eastern side of the North Arm Cove community) are summarised in **Table 3**.

Table 3: Design Peak Water Levels and Design Foreshore Flood Levels (MHL, 1998b)

Site	Design Peak Water Level (m AHD)				Design Foreshore Flood Level (m AHD)		
	20 year ARI	50 year ARI	100 year ARI	Extreme Water Level	20 year ARI	100 year ARI	Extreme Water Level
Baromee Point	1.68	1.73	1.78	1.82	2.2	2.3	2.4
Casuarina Reserve	1.68	1.73	1.78	1.82	2.2	2.3	2.4

It is noted that predicted sea level rise may increase the above design water levels. Council has adopted sea level rise benchmarks of 0.5m by 2060 and 0.9m by 2100.

4.3.5 Wave Action

MHL (1997) developed a wave transformation numerical model to estimate swell wave heights within the Port Stephens waterway. This indicates that all parts of North Arm Cove has negligible ocean wave climate as Soldiers Point was referred to as the limit of swell penetration (MHL, 1999).

Wind waves that are generated from winds blowing over the surface of the waterway are generally small in height (relative to swell waves) and have a relatively short period (usually between 2 and 4 seconds). The wave height experienced at a particular site depends on fetch length (waterway distance over which the wind blows), water depth, and the wind conditions (speed, direction and duration). The magnitude of locally generated wind waves has been estimated at a number of locations within Port Stephens by MHL (1997). The wind waves were modelled using the results from the analysis of the Williamstown RAAF wind data (refer **Table 1**). The resultant maximum wind wave conditions (significant wave height (H_s) and peak wave period (T_p)) estimated for two sites at Baromee Point and Casuarina Reserve are summarised in **Table 4**.

Table 4: Design Wind Wave Conditions (MHL, 1997)

Site	Maximum Average Fetch (m)	Maximum Average Fetch Direction	20 year ARI		50 year ARI		100 year ARI	
			H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)
Baromee Point	6,700	W	1.6	4.0	1.7	4.0	1.8	4.1
Casuarina Reserve	200	E	0.1	1.0	0.1	1.0	0.1	1.0

The site would also be subject to boat wake from passing vessels. It has been reported that large cruisers travelling at low speeds may generate boat wake with a wave height of up to 0.5m with short wave periods of 2 to 3 seconds (MHL, 1999).

4.3.6 Currents

A tidal data collection exercise was undertaken by MHL in Port Stephens over 29th - 30th September 1993. The exercise utilised an in-situ current meter and an Acoustic Doppler Current Profiler (ADCP) to determine tidal velocity at the entrance to North Arm Cove (MHL, 1998a). Data from the study is presented in **Table 5**.

Table 5: Tidal velocities at North Arm Cove entrance (BMT WBM, 2011)

Tidal Cycle	Maximum Velocity (m/s)	Time	Time of Peak Tide	Depth (m) of Measurement	Tidal Prism ($m^3 \times 10^6$)	Tidal Range (m)
Ebb Tide	0.15	11:24	9:47 (High)	6.2	5.52	1.17
	0.24	9:52	9:47 (High)	1.4		
Flood Tide	0.23	16:31	14:48 (Low)	6.2	4.94	1.17
	0.23	17:59	14:48 (Low)	2.5		

It is understood the current profiling was undertaken near the centre of the entrance channel to North Arm Cove. The recorded tidal velocities of 0.24 m/s would be sufficient to mobilise sediment finer than medium grained sand. It is expected that tidal velocities would be less near the shoreline, further upstream and within the wider body of North Arm Cove. This prediction is supported by shoreline observations where the shoreline near the entrance to North Arm Cove is primarily rocky, indicating higher currents, and intertidal sand and mudflats are situated further upstream and within North Arm Cove, indicating lower

currents. A sediment sample obtained from within North Arm Cove (refer **Section 4.3.7**) indicates a low energy (current and wave) depositional environment within the Cove (WRL, 1998).

The eastern side of the North Arm Cove community lies within the Cove itself, where currents are expected to be relatively minor. It is perceived by local residents that the existing oyster lease structures (refer **Map 2.4**) have interrupted flow and contributed to deposition of muddy sediments along the shoreline (BMT WBM, 2011). Freshwater flows from Bundabah Creek and Bulga Creek flow into North Arm Cove. However, given the limited catchment area, freshwater flows are expected to be minor.

The sandy shoreline at Wide Bay, west of Baromee Point, was reported by residents to periodically accrete and erode. It is unclear whether the erosion is linked to:

- local currents resulting from freshwater flows;
- regional currents resulting from freshwater flows discharged from Karuah River and other upstream water bodies; or,
- from wind wave action during storm events.

Wind-induced currents can be generated by the action of surface shear (unidirectional currents) or wave action (oscillatory currents). Measurements (Limnology and Oceanography, 1951) have shown that unidirectional surface currents can be induced by surface shear of winds up to 7 m/s before the surface response becomes oscillatory and wind waves are generated. These unidirectional surface currents can reach 1 to 2% of the wind speed, giving a maximum potential velocity of around 0.15 m/s (0.3 knots).

4.3.7 Sediments and Sediment Transport

The project site is located within the upper port area of Port Stephens, which is defined as the area west of Soldiers Point. The area is generally considered to be a depositional environment for muddy sediments derived from fluvial sources including the Karuah River. The rate of deposition is reported to be very low (MHL, 1999).

The depositional environments within the upper port have been previously mapped within a study undertaken by Thom et al (1992). An extract from this mapping has been reproduced as **Figure 6** and indicates:

- the majority of the shoreline sediment around North Arm Cove is sandy mud (50-95% mud);
- part of the eastern shoreline of the North Arm Cove community comprises muddy sand (5-50% mud); while,
- sediments in deeper sections of the waterway within North Arm Cove and the main body of Port Stephens comprise mud (>95% mud).

A sediment sample obtained from within North Arm Cove contained very little sand (97% fines and 8% shell), indicating a low energy depositional environment within the cove (WRL, 1998).

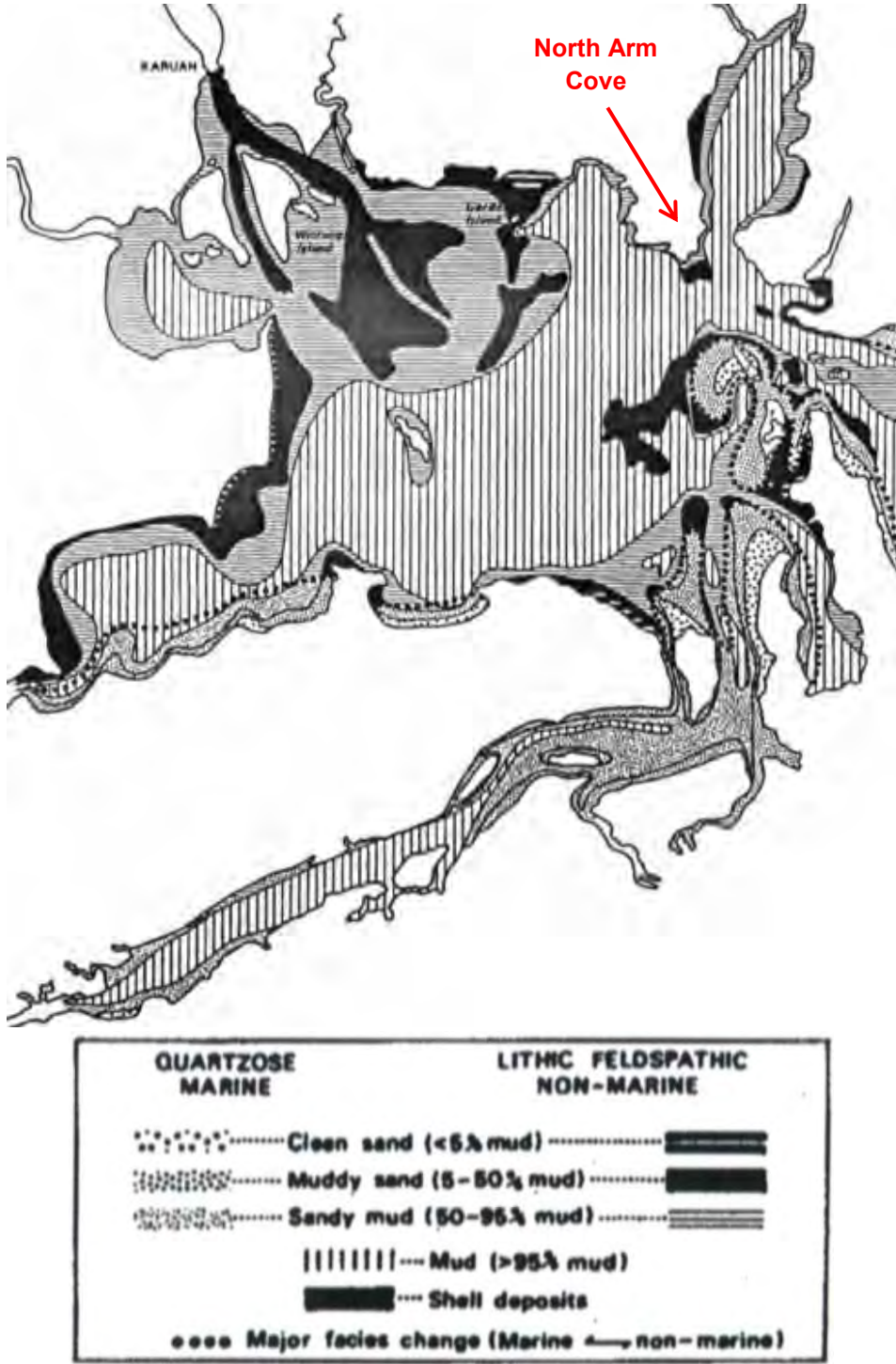


Figure 6: Depositional Environments within the Upper Port Area (Thom et al, 1992)

4.3.8 Water and Sediment Quality

Previous studies have concluded that water quality within the Port Stephens estuary is generally good and satisfies ANZECC and EPA guidelines for the protection of aquatic ecosystems, secondary and primary contact recreation, and consumption of seafood (Umwelt, 2009). It has also been noted that the water clarity (turbidity) in the Upper Port Stephens Basin is influenced by the Karuah River and other creek flows. The waterbody in this area is relatively shallow and so bottom sediments are often resuspended by wind waves, and is flushed less regularly (average flushing time 10-12 days reported by MHL, 1999) than the Lower Port areas (Umwelt, 2009). Accordingly, the water is naturally more turbid. Potential adverse influences on water quality in the vicinity of North Arm Cove include:

- stormwater runoff discharged from outlets;
- runoff from on-site waste water treatment systems (villages on the northern shoreline of Port Stephens are currently not sewered);
- drainage from oxidised acid sulfate soils;
- elevated natural turbidity caused by Karuah River flooding; and,
- rural runoff from industries in the Karuah River catchment (e.g. dairy and poultry farming).

Surface sediment samples were collected for the *Port Stephens/Myall Lakes Estuary Processes Study* (MHL, 1999) and tested for range of contaminants, including fluoride, metals and organochlorine compounds. Contaminant levels were found to be within normal background ranges, which was not unexpected for an estuary with a low level of catchment development and little intensive industry.

The presence of acid sulfate soils in the Port Stephens Estuary is identified within the acid sulfate soil risk maps produced by the NSW Department of Natural Resources. This mapping identifies bottom sediments as having a high probability of occurrence of acid sulfate soils. Furthermore, embayments including Brackens Bay, Heros Bay, Wide Bay and the foreshore within North Arm Cove near Water Street Reserve and Casuarina Reserve are identified as having a high probability of acid sulfate soils at or near the ground surface.

4.4 Navigation

Navigation through the entrance of North Arm Cove is facilitated by lit port and starboard navigation markers (refer **Map 2.4**). In addition, a cardinal marker is located near Wideview Point. Navigation markers are also located at the entrance to Bundabah Creek. There are no other formal navigation aids in the vicinity of North Arm Cove. Heros Bay is marked as a 4 knot zone on the RMS Boating Map. No other boating restrictions apply to North Arm Cove and the surrounds.

A number of oyster leases are situated inside of North Arm Cove (refer **Map 2.4**). Informal navigation aids are provided in the form of white piles near Casuarina Reserve and Water Street Reserve. These markers delineate access between the oyster leases. Oyster leases are also marked in Brackens Bay and Balbrook Cove. It is unclear if these leases are active or disused.

A large portion of the populated foreshore at North Arm Cove, from Brackens Bay to north of Medina Bay, has water frontage suited to all tide access. Navigation conditions in the vicinity of these properties are good. Within the Cove, oyster leases and shallow nearshore water depths impede navigation near the shoreline.

4.5 Shoreline Structures

The northern shoreline of Port Stephens is noted to be relatively steep and rocky (Umwelt, 2000). A number of private jetties and boat ramps have been constructed around North Arm Cove. In addition, a number of seawalls have been constructed within North Arm Cove, installed to protect land reclamations.

Cobbles and boulders on the southern and western shoreline of the North Arm Cove community have been moved to create groynes to:

- retain littoral drift sediments for foreshore protection,
- retain littoral drift sediments to provide sandy beaches fronting properties for amenity, or,
- facilitate boat launching.

The *Port Stephens and Myall Lakes Estuary Management Plan* (Umwelt, 2000) includes an action item to assess the impacts of illegal foreshore structures in North Arm Cove. It is unclear which structures were deemed to be illegal.

The *Port Stephens and Myall Lakes Estuary Management Plan* (Umwelt, 2000) states that there are 97 hectares of derelict oyster leases that exist in North Arm Cove, and a similar area of active oyster leases. These structures are separated from the shoreline and generally sited in relatively shallow water (refer **Map 2.4**).

4.6 Services

It is assumed that essential services including power and water supply are all readily available at North Arm Cove due to existing development. North Arm Cove and a number of other small villages on the northern shoreline of Port Stephens are currently not sewered.

4.7 Ecology

Mapping of aquatic vegetation (refer **Map 2.3**) indicates *Zostera* seagrass beds along the entirety of the site. The highly valued *Posidonia* seagrass beds are interspersed with the *Zostera* seagrass to the west of Baromee Point, whilst *Halophila* seagrass is present in deeper water within North Arm Cove to the north of Water Street Reserve. Fringing saltmarsh and mangrove vegetation is also recorded to the north of the community at the head of North Arm Cove (Bundabah Creek entrance) and also at the head of Balbrook Cove. Isolated pockets of mangroves are also recorded around Brackens Bay and Wide Bay.

SEPP 14 Coastal Wetlands are present near the head of North Arm Cove (Bundabah Creek entrance), outside of the study area. No other SEPP 14 Coastal Wetlands are present near the study area.

The shoreline of Port Stephens is disturbed and a number of shorebird roosting locations have been removed. Infrastructure associated with derelict oyster leases within Port Stephens is understood to provide important high tide roosts for shorebirds. As such, it has been recommended that old oyster leases and emergent posts should be retained until alternative roosting options are available (Umwelt, 2009). Further, any saltmarsh communities within North Arm Cove should be retained.

The Port Stephens – Great Lakes Marine Park has established zoning within the study area. The waterway area in the vicinity of the North Arm Cove community is designated as a General Use Zone. The northern portion of North Arm Cove is designated as a Sanctuary Zone, which extends into Bundabah Creek.

4.8 Heritage

North Arm Cove has a unique history of European settlement. The area was first settled in 1826 when the Australian Agricultural Company was established at Carrington to produce fine wool for British woollen mills. A boat harbour, church, a school and residential dwelling were created around this time. Sheep grazing was not successful and sheep flocks were withdrawn in 1856.

A NSW Royal Commission established in 1899 considered the area between Balberook Cove and North Arm Cove as the sixteenth of forty potential sites for the Nation's capital with plans to develop Port Stephens as a deep water international port. The plans never eventuated.

In 1918, Walter Burley Griffin had a plan for Port Stephens City approved by Shroud Council, which included provisions for wharves, jetties and two railway stations. His company went into liquidation and ownership of the subdivision was passed to Henry Halloran. Halloran removed public foreshore land and increased the number of lots to 2000. Development proceeded, particularly along the foreshore and the community of North Arm Cove was developed. In 1963, Great Lakes Council closed most of the roads planned in the subdivision, setting aside a small area for residential expansion (RU5 Village), and zoning the remaining land non-urban (RU2 Rural Landscape) (refer **Map 2.2**).

Council mapping indicates European heritage items and heritage conservation areas in the vicinity of Carrington and Balberook Cove (refer **Map 2.1**). This heritage item is a former boat harbour and lime kiln, directly west of Beauty Point. It is unclear what remains are present onsite. Two heritage conservation areas are noted, one of which covers the former boat harbour and lime kiln heritage item. The second conservation area is near the head of Balberook Cove, on the western side of the creek. It is unclear why the area is a conservation area.

An Aboriginal Heritage Information Management System (AHIMS) search was completed for North Arm Cove and surrounds. This determined that there are no known Aboriginal artefacts or sites at risk in the proposed development sites.

4.9 Foreshore Access and Traffic

Access to North Arm Cove is available from the Pacific Highway via Carrington Road and then North Arm Road. This is the only road route available for access to the community.

The majority of the foreshore is under private ownership (Umwelt, 2000). Waterfront residences have absolute water frontage rights, making public access to the shoreline scarce. Public foreshore access for pedestrians and vehicles is limited to the Public Reserves at Heros Bay, Wide Bay, Medina Bay and Casuarina Reserve. Foreshore access is also available from the end of Water Street.

Some of the residential lots are currently undeveloped. An action item in the document *A Foreshore Management Plan for Port Stephens* (Umwelt, 2009) states there is potential for government acquisition of private land that has important ecological, recreational and aesthetic value, and that requires long term conservation for the benefit of Port Stephens as a whole.

5 Identification and Appraisal of Concept Options

5.1 General

The community's preference is for the construction of a public boat ramp and a public jetty to cater for larger vessels with the potential to cater for ferries. The boat ramp and jetty do not necessarily need to be part of the same precinct.

Development of any boating infrastructure would depend on a number of factors including the availability of Council funds. As such, the options outlined herein are selected to provide economical and cost effective solutions that are of a size and scale that meet community expectations and demands.

In regard to community expectation, two critical design parameters have been defined, which are:

- design vessel length for a boat launching facility is 6.5m, which was discussed at the initial stakeholder engagement meeting; and,
- design vessel draft for a jetty would be 2m, which would cater for most cruisers and many of the yachts up to 40 feet (around 12m) in length that are moored within North Arm Cove.

In addition, based on discussions with ferry operators it is understood that a water depth of 2m at low tide is acceptable for ferry berthing at a public wharf facility.

5.2 Opportunities and Constraints

Whilst it is understood that the community generally supports the proposal to develop boating facilities, previous concepts have been met with opposition. Local newspaper articles note "impenetrable obstacles" have prevented previous boating infrastructure proposals from proceeding. Some of these objections have included the proximity of any such proposed development to residential dwellings.

The main constraints relating to the siting of boating infrastructure at North Arm Cove include:

- land tenure and the availability of suitable foreshore land as it is noted that the majority of the foreshore is under private ownership and residents have absolute water frontage rights.
- land needs to be of a suitable size to cater for car parking facilities in close proximity to the boating infrastructure;
- rugged terrain (rocky soils and dense vegetation cover) and steep topography in foreshore areas where suitable water depths are close to the shoreline;
- nearshore water depths as it is considered likely that dredging or the construction of access groynes/causeways would be cost prohibitive, and have adverse environmental impacts and consequently not be approved by government agencies;
- exposure to coastal processes, particularly wind waves, which have the potential to damage infrastructure or create hazardous conditions for usage;
- proximity to residents as previous reports by the local Residents Association (2006) noted that the site selected should not interfere with the lifestyle of local residents which has been a factor in preventing previous proposals from proceeding; and,
- location of oyster leases, most of which are classified as "priority oyster aquaculture areas" in the *NSW Oyster Industry Sustainable Aquaculture Strategy* (DPI, 2014).

Other constraints to be considered as part of the proposed works include:

- impacts on ecology, in particular proximity of seagrass beds;
- presence of heritage items and Aboriginal artefacts;
- sediment transport and coastal processes, which may be impacted by the infrastructure; and,
- availability of services, including electricity and water.

However, there remain opportunities which could be explored. The document *A Foreshore Management Plan for Port Stephens* (Umwelt, 2009) includes a recommendation to explore the potential for government acquisition of private land that has important ecological, recreational and aesthetic values and that require long term conservation for the benefit of Port Stephens as a whole. Whilst this is a possibility for undeveloped lots, it is unlikely that a developed block of land could be feasibly purchased for construction of boating infrastructure, particularly when the proximity of local residents is considered. Furthermore, it is unlikely that a typically sized, single residential lot would be sufficient to construct a boating infrastructure facility.

5.3 Boat Ramp

5.3.1 Appraisal of Possible Sites

A total of nine (9) sites (refer **Map 1**) were considered for the siting of a local boat ramp. The possible sites represent a compilation of those observed during site inspections, stakeholder recommendations, and sites suggested in previous reports by the NACRA, and comprise:

1. Heros Bay (refer **Figure 3**);
2. Wide Bay (refer **Figure 7**);
3. Medina Bay (Lot 521) (refer **Figure 8**);
4. Water Street Reserve (refer **Figure 9**);
5. Casuarina Reserve (refer **Figure 4**);
6. Sites to the north of the North Arm Cove community including southern end of Lot 1458 or between Lot 1439 and Lot 1457;
7. Eastern side of Carrington (refer **Figure 10**);
8. Beauty Point (Lot 8, refer **Figure 11**) or head of Brackens Bay (Lot 969, refer **Figure 12**); and,
9. Lot 829 along Promontory Way, on the south side of Brackens Bay (refer **Figure 13**).



Figure 7: Wide Bay informal boat ramp



Figure 8: Medina Bay foreshore



Figure 9: Intertidal mudflats viewed from Water Street Reserve



Figure 10: Shoreline on eastern side of Carrington



Figure 11: Shoreline at Beauty Point



Figure 12: Shoreline at head of Brackens Bay



Figure 13: Shoreline and adjacent residence on the south side of Brackens Bay

It is proposed that the facility would comprise a single lane ramp suitable for all-tide access. Ideally, parking would be provided for 20 to 30 car and trailer combinations in accordance with the NSW Boat Ramp Facility Guidelines (RMS, 2015). A summary of each location with regard to the main constraints is provided in **Table 6**.

Table 6: Summary of proposed sites and main constraints

Location	Land Tenure	Nearshore Water Depth and Foreshore Slope	Exposure to Coastal Processes	Proximity to Residents	Proximity to 'Priority Oyster Aquaculture Areas'
Heros Bay	Council owned	Unsuitable	Exposed to southwest wind waves	Both Sides	No
Wide Bay	Council owned	Suitable	Exposed to south and southwest wind waves. Sand regularly comes and goes from the site.	Both Sides	No
Medina Bay (Lot 521)	Council owned land	Suitable	Protected	Both Sides	No
Water Street	Public roadway	Unsuitable	Protected	Both Sides	Yes
Casuarina Reserve	Council owned land	Unsuitable	Protected	Both Sides	Yes
North of Community (Lot 1439 to 1458)	Private ownership	Unsuitable	Protected	No	Yes
Carrington	Council owned land	Suitable	Very exposed to south wind waves	No	No
Beauty Point	Private ownership	Suitable	Very exposed to south and southwest wind waves	No	No
South side of Brackens Bay (Lot 829)	Private ownership	Suitable	Mostly protected, however, would be exposed to southwest wind waves	One Side	No

Additional details for each site are provided below:

1. **Heros Bay** – A Plan of Management was developed and adopted by Council in 2014. This included a jetty/boardwalk facility and assessed the bay to be unsuitable for a boat ramp. The nearshore area is relatively flat and sandy. The foreshore has good vehicle access and pleasant shady and grassed surrounds.
2. **Wide Bay** – Currently used as an informal boat ramp. However, launching is understood to only be possible at high tide and retrieval is not possible at low tide (except for small vessels such as tinnies). There is insufficient space to develop a car and trailer parking area on or near the site without land reclamation.
3. **Medina Bay (Lot 521)** – Previously deemed suitable for an all tide boat ramp and jetty (NACPA, 1993). The site has access to deep water and is protected from the large southerly wind wave fetch across Port Stephens. However, the water frontage is limited to approximately 19 metres. Access to the site from Cove Boulevard is relatively steep. Oyster leases are not located near the site and seagrass beds in the vicinity of the site are in small and localised patches. It would be suitable for development of a boat ramp facility and the site was the preferred location in the NACPA submission to Council in 1993. However, the proposal was reported to have received strong opposition from nearby residents.
4. **Water Street Reserve** – A small dinghy launching ramp is proposed at this site and funding has been approved through the RMS Better Boating Program. The mudflats near the foreshore are up to 50m wide.
5. **Casuarina Reserve** – A small dinghy launching ramp is proposed at this site and funding has been approved through the RMS Better Boating Program. The Casuarina Park Masterplan included a jetty alongside a proposed dinghy skid. The mudflats near the foreshore are up to 60m wide.

6. **Southern end of Lot 1458 or between Lot 1439 and Lot 1457** – Located out of the main village area of North Arm Cove and was suggested in a number of submissions to Council in the early 2000's. Lot 1458 is currently owned by Walker Corporation and Lots 1439 to 1457 are also privately owned. Previous proposals for development of the site included a groyne/causeway up to 50m long with a T-head and boat ramp at the end of the structure. This proposal would be costly to implement and is likely to have adverse environmental impacts, including disruption of hydrodynamic and sediment transport processes and visual amenity impacts.
7. **Eastern Side of Carrington** – Sited in bushland and would require clearing of vegetation, construction of roads to access the site, and installation of utilities. A section of Council owned land is located on the point, which would be relatively exposed to wind waves. The majority of the Council owned land is a heritage conservation area, which encompasses a heritage item recorded as a boat harbour and lime kiln. Aboriginal artefacts registered in the AHIMS database are located to the north of the site. Given the Aboriginal and European heritage items near the site, it is possible that other items could be discovered, if works were to be undertaken. Mapping of aquatic vegetation (refer **Map 2.3**) indicates *Zostera* seagrass beds and the highly valued *Posidonia* seagrass beds near the site, which may be impacted by a boat ramp.
8. **Beauty Point or head of Brackens Bay** – Currently owned by Walker Corporation and zoned RU2 Rural Landscape. Beauty Point is considered to be the 'jewel in the crown' for developers and is highly valuable land that may be costly to acquire for public infrastructure. The Beauty Point area is currently used as an informal boat ramp and provides access to relatively deep water. The site is in bushland and 4WD vehicle access is provided through informal unsealed tracks off Promontory Way and through Lot 969. Development of the site would require clearing of vegetation, construction of roads to access the site, and installation of utilities.
9. **Lot 829 along Promontory Way, on the south side of Brackens Bay** – Currently owned by Walker Corporation and zoned RU2 Rural Landscape. It is accessible from Promontory Way, which is a sealed road managed by Council. The block of land is relatively steep for access to the foreshore. However, it does have access to deep water. The site would be protected from southerly wind waves and would be mostly protected from southwest wind waves. Mapping of aquatic vegetation (refer **Map 2.3**) indicates *Zostera* seagrass beds and the highly valued *Posidonia* seagrass beds near the site, which may be impacted by a boat ramp. The site would be suitable for development with adjacent blocks on the opposite side of Promontory Way utilised for car and trailer parking.

The majority of the sites are not deemed to be suitable for a boat launching facility due to shallow water depths and/or exposure to adverse wave conditions associated with long south and southwest wind fetches across the Port Stephens waterway. The two sites deemed to be potentially suitable for future development are Medina Bay (Lot 521) and the southern side of Brackens Bay (Lot 829). These sites:

- have access to deep water;
- are relatively protected from wind waves; and,
- are accessible from existing sealed public roads.

It is assumed that utilities, including electricity and water, would be readily available at both sites due to nearby existing residential development. Based on the available heritage information, neither site would have significant adverse effects on known European or Aboriginal heritage sites or areas. Furthermore, it is expected that a boat ramp facility would have minimal impact on terrestrial and marine ecology at Medina Bay. Small and localised patches seagrass are present off the shoreline and it appears that the land access area is already significantly disturbed by the passage of a stormwater channel.

It is noted that future progression of the concepts proposed at either of these two sites would be subject to establishment of a consensus view on a preferred site amongst stakeholders and the community, commercial terms and conditions associated with any land acquisition and the availability of Council funds.

Concept sketches for potential boat ramp facilities at Brackens Bay and Medina Bay are provided on **Map 3.1** and **Map 3.2**, respectively (refer **Appendix A**). The design features and potential constraints of both options are summarised below.

5.3.2 Brackens Bay (Lot 829)

Potential constraints at Brackens Bay include:

- Land tenure of Lot 829. Initial correspondence with Walker Corporation on this matter has indicated that they would be open to negotiate the use or sale of land holdings affected by boating infrastructure development proposals;
- Grade of the block, which is relatively steep and would require retaining walls or similar to level part of the site;
- Site topography and available area limits the ability to construct level parking areas without significant earthworks, therefore all parking needs to be located along the Promontory Way road reserve which fronts several privately owned lots;
- Seagrass beds, which mapping indicates are present and include highly valued *Posidonia* seagrass. However, local residents have reported that there is little or no seagrass in Brackens Bay and the extent of existing seabed vegetation needs to be confirmed with an updated marine ecology survey; and,
- Proximity of residents on the southern side of the block.

Design features shown on **Map 3.1** include:

- Access from Promontory Way at the northern end of the site, which is 8m wide to allow two-way traffic and comfortable passing of trailers. The access road traverses across the slope to the southern end of the site, which has sufficient space for a manoeuvring area. The lower portion of the access road would require rock armour protection or similar to protect the road and the foreshore reclamation required to achieve desired levels.
- Manoeuvring area with a slope of 1V:20H (vertical:horizontal) from the crest of the boat ramp. A retaining wall up to 4 metres high would need to be constructed around the manoeuvring area and part of the access road.
- Boat ramp located at the southern end of the site. The slope of the boat ramp is proposed to be sloped at 1V:7H² and would be supported on a rubble mound foundation elevated above the existing seabed level³. The boat ramp would be a single-lane, 4.5m wide concrete ramp extending over around 25 metres from a crest level at 1.64m AHD (0.5m above HHWSS) to a toe level at -1.96m AHD (1m below the design low water level taken as 0m PSHD or -0.96m AHD) (refer **Section 4.3.4** for water levels).

² This has been set at the upper limit of the recommended boat ramp slope range of 1V:9H to 1V:7H in the NSW Boat Ramp Facility Guidelines (RMS, 2015) in order to reduce the ramp length and height of the ramp toe above existing seabed levels.

³ Seabed levels shown on plan have been derived from limited boat depth soundings taken during RHDHV site inspections and need to be confirmed with collection of bathymetric survey data.

- A total of 30 car and trailer parking spaces are proposed on the opposite side of Promontory Way to the ramp. The parking spaces are angled so that their footprint lies within Council's road reserve, and to avoid acquisition of additional private property. However, road access to these properties would still be affected, should development of these currently vacant lots be proposed in the future. As such, provision of these parking areas for public use would require Council to negotiate terms with affected landowners. The parking areas would need to be constructed in a manner that future private property access can be readily provided if required as part of future development applications.
- A derigging bay would be located at the top of the access road adjacent to Promontory Way to minimise congestion around the ramp and manoeuvring area.
- A footpath would be located along the side of the access road to link the Promontory Way parking area to the boat ramp.
- Power supply to service light poles at the top of the access road and at the boat ramp.
- A sandy beach area is available at the head of Brackens Bay and near Promontory Way, which would be suitable for small craft to pick up and drop off passengers.

5.3.3 Medina Bay (Lot 521)

Potential constraints at Medina Bay include:

- Grade of the lot, which is relatively steep and would require retaining walls or similar to level part of the site;
- Proximity of residents on both sides of the lot; and,
- Site topography and available area limits the ability to construct level parking areas without significant earthworks, therefore all parking needs to be located along the Cove Boulevard road reserve which fronts several privately owned lots.

Design features shown on **Map 3.2** include:

- Access road from Cove Boulevard to the boat ramp and manoeuvring area, which is 8m wide to allow two-way traffic and comfortable passing of trailers. The existing 600mm diameter stormwater pipeline under Cove Boulevard (currently discharging through a headwall at the top of the lot) would need to be extended to a new headwall and outlet near the boat ramp. Drainage from the access road would also feed into the stormwater culvert.
- Manoeuvring area with a slope of 1V:20H from the crest of the boat ramp. A retaining wall up to 4 metres high would be constructed around the manoeuvring area and part of the access road.
- Boat ramp located along the water frontage of the lot with a proposed slope of 1V:8H to approximately match the existing foreshore gradient. The boat ramp would nominally be founded on grade, subject to geotechnical investigations. The boat ramp would be a single-lane, 4.5m wide concrete ramp extending over around 27 metres from a crest level at 1.64m AHD (0.5m above HHWSS) to a toe level at -1.7m AHD (1.25m below the 80% exceedance design low water level at -0.45m AHD). An 80% exceedance low water level was adopted to minimise the length of

the ramp and encroachment into the water frontage of adjacent properties. This should be reviewed following collection of bathymetric survey data⁴. The impact of the development on water access to the private property to the east of the boat ramp (i.e. Lot 525) relates to the definition of 'Division of Waterway' by RMS. Although the property does not currently have a wharf facility, the impact on the ability of the property owner to construct a wharf in the future and/or to safely access their beach water frontage would need to be considered as part of the boat ramp proposal.

- A total of 25 car and trailer parking spaces are proposed on the opposite side of Cove Boulevard and have been positioned to avoid access impacts to existing developed residential lots. The parking spaces are angled so that their footprint lies within Council's road reserve, and to avoid acquisition of private property. However, road access to these properties (i.e. Lot 687 and Lot 657) would still be affected, should development of these currently vacant lots be proposed in the future. As such, provision of these parking areas for public use would require Council to negotiate terms with affected landowners. The parking areas would need to be constructed in a manner that future private property access can be readily provided if required as part of future development applications. Furthermore, the extension of parking spaces across the road reserve set aside for possible future extension of road access to the west (opposite Point Circuit) would also affect future development of a number of vacant lots to the west of Cove Boulevard.
- A bay of 5 car only spaces provided around the central area of Point Circuit.
- Pedestrian access to the boat ramp from this parking area could be provided via a stepped and ramped access way constructed from the point where Lot 581 links with Point Circuit. The access way would be lit with low-level bollard lighting.
- A footpath would be provided along the side of the access road to link the Cove Boulevard parking area to the boat ramp.
- Power supply to service light poles at the top of the access road and at the boat ramp.
- An alternate car and trailer parking arrangement is proposed at the entry to Point Circuit. This is likely to require acquisition of land from the currently vacant private lots in this area (i.e. Lot 524 and Lot 535). Pedestrian access to the boat ramp from these parking areas could be provided via a stepped and ramped accessway constructed from the point where Lot 581 links with Point Circuit (as noted above).

5.4 Jetty

A total of ten (10) sites (refer **Map 1**) were considered for the siting of a public jetty suitable for deep water access, including:

1. Heros Bay;
2. Wide Bay;
3. Medina Bay (Lot 521);
4. Water Street Reserve;
5. Casuarina Reserve;

⁴ Seabed levels shown on plan have been derived from limited boat depth soundings taken during RHDHV site inspections and need to be confirmed with collection of bathymetric survey data.

6. A site to the north of the North Arm Cove community including southern end of Lot 1458 or between Lot 1439 and Lot 1457;
7. Eastern side of Carrington;
8. Beauty Point (Lot 8) or head of Brackens Bay (Lot 969);
9. Lot 829 along Promontory Way, on the south side of Brackens Bay; and,
10. Easement between No. 53 and No. 55 Point Circuit.

It is proposed that the structure would comprise a length of fixed jetty providing access from the foreshore to a gangway and floating pontoon. The facility would be sited at a location where the minimum water depth at low tide is approximately 2 metres (to provide sufficient water for ferry access and tide dependent access for deep keeled yachts). Ideally, parking would be provided for 20 to 30 cars.

The majority of the above sites were also considered for siting of a public boat ramp. With the exception of Brackens Bay and Medina Bay, the sites were not deemed suitable for a boat launching facility due to shallow water depths and/or exposure to adverse wave conditions. Similarly, these sites are not deemed suitable for a jetty and pontoon.

Brackens Bay (Lot 829) and Medina Bay (Lot 521) are considered to be relatively sheltered sites for berthing. However, both sites are space constrained and would not be able to accommodate a boat launching facility and a public jetty. Furthermore, Brackens Bay is located on the outskirts of the North Arm Cove village area further away from the main tourist hubs of Tea Gardens and Port Stephens, which increases the distance for ferry operations to service the community.

The easement between No. 53 and No. 55 Point Circuit (refer **Figure 14**) is located in close proximity to Medina Bay. The easement is approximately 80m long and 6m wide. It is relatively steep with an average grade of around 1V:6H from 1m AHD at the base of the easement to 15m AHD at the location where the easement links with Point Circuit. The site has access to deep water at a relatively short distance from the shoreline and it would be relatively protected from wind waves. A concept sketch for development of the site to service a public jetty facility is shown on **Map 3.2**.



Figure 14: View of easement from shoreline (left) and entry from Point Circuit (right)

Constraints relating to the proposed development include:

- Steep grade and narrow width of the easement, which does not permit vehicle access to the jetty landing point. This has been raised as an amenity issue, particularly given the aging population at North Arm Cove that the jetty would be servicing; and,

- Proximity of residents on both sides of the proposed accessway.

Design features shown on **Map 3.2** include:

- stepped and ramped pedestrian access from Point Circuit;
- low-level bollard lighting along the pedestrian access way;
- Power supply to service light poles at the top of the access road and at the boat ramp;
- 25 car parking spaces and landscaping proposed in the central turning circle at Point Circuit;
- timber jetty with a deck level at 1.7m AHD (0.3m freeboard above HHWSS water level at 1.13m AHD and half of 0.5m wave height from boat wake)⁵ and approximately 25m long;
- gangway approximately 20m long with a maximum slope at low tide of approximately 1V:8H;
- pontoon approximately 10m long and 3m wide, which would be restrained by piles;
- leaning piles provided off the face of the pontoon to assist with ferry berthing; and,
- water depth at low tide of approximately 2 metres⁶ at the pontoon berthing area.

⁵ An allowance for sea level rise should also be considered in detailed design of the jetty deck level amongst other considerations relating to level of access (i.e. acceptable overtopping frequency for jetty deck).

⁶ Seabed levels shown on plan have been extrapolated from limited boat depth soundings taken during RHDHV site inspections in Medina Bay and need to be confirmed with collection of bathymetric survey data.

5.5 Summary of Consultation Feedback

The draft report and concept design plans were placed on public exhibition from 4 October 2016 to 23 October 2016. During this period a project email address and phone number was also made available for community stakeholders to provide responses. A drop-in centre was also held at the North Arm Cove Community Hall on 18 October 2016. A total of 51 email submissions were received from local residents within the exhibition period and 38 people were registered as attending the drop-in centre. An additional 7 email submissions were received after the exhibition period and were included in the summary of consultation feedback.

The following summarises feedback received from the community on the draft proposals for public boat ramp and jetty infrastructure.

5.5.1 Boat Ramp

The provision of a public boat ramp at North Arm Cove was supported by most residents (79% of email respondents were supportive, 14% were not supportive, and 7% were neutral or did not specify a preference). It was also generally acknowledged that Brackens Bay was a less favourable site in comparison to Medina Bay for several reasons including:

- private ownership of the land parcel;
- exposure to adverse weather conditions from SSE through to NW, with southerly wind waves reported to wrap around the point into the site;
- presence of Posidonia seagrass;
- steep hill on approach to the ramp from the NE along Promontory Way encourages cars to travel over the existing speed limit of 50km/hr; and,
- higher cost of construction.

Although the majority of residents supported a boat ramp at Medina Bay (55% of email respondents were supportive, 16% were not supportive, and 29% were neutral or did not specify a preference), there were a number of issues raised in regard to the draft concept proposal. Many of these issues were related to road safety due to the positioning of the boat ramp accessway at the low point between two crests in Cove Boulevard and the location of proposed trailer parking bays within the road reserve. Suggestions to improve vehicular access and parking arrangements included:

- installation of warning signage and traffic calming devices (e.g. speed humps);
- reduction of speed limit along affected section of Cove Boulevard to 40km/hr;
- creating one-way flow of traffic through the facility with an exit road through the narrow leg (3m wide) of Lot 521 into Point Circuit;
- installation of trailer parking bays alongside the proposed boat ramp accessway;
- locating trailer parking off-road in nearby private property acquired for this purpose, possibilities include Lot 524 or Lot 535 (alternative shown on draft concept plan), Lot 657 (43 Point Circuit, zoned RU2 non-urban and reported to be currently for sale with a \$57,000 asking price), Lot 687 (117 Cove Boulevard, zoned RU2 non-urban and owned by Walker Corporation);
- changing angle of proposed trailer parking so that reversing across opposite lane of traffic is not required (Point Circuit could be used as a turning circle in both cases);
- reduction of trailer parking to 12-15 spaces to better suit local usage and staging of parking subject to demand; and,
- removal of the trailer spaces extending across the unsealed Point Circuit road reserve (currently used by property owners to access undeveloped blocks of land).

Other suggestions to improve the Medina Bay boat ramp proposal included the provision of boat holding structures at the boat ramp, such as an on-ramp pontoon. It was noted that this could be installed as a staged facility to reduce the initial cost of the project. Some residents suggested that a pontoon installed alongside the boat ramp could also act as a loading/unloading point and perform a similar function to a public jetty (discussed further below in **Section 5.5.2**).

A number of residents, including several within Point Circuit, did not support development of the site. Objections raised by these residents included:

- roads leading into North Arm Cove are not designed for extra traffic that a boat ramp would generate and are too narrow for vehicles with boat trailers;
- close proximity of the boat ramp to residential dwellings and associated impacts from noise generated from increased road traffic and boat engines;
- road safety issues along Cove Boulevard (as outlined above);
- parking proposed would reduce value of vacant lots and existing houses;
- facility would attract non-residents who have little regard to protection of local environment, leading to issues with exceeding road speed limits, rubbish disposal and anti-social behaviour;
- toilets would be required, otherwise people would use the surrounding bush;
- boat ramp would attract jetski users into the sheltered area of the Cove, which does not currently have any navigation restrictions;
- impacts on water frontage of Lot 525 relating to 'Division of Waterway' (as discussed in **Section 5.3.3**);
- use of Lot 521 as a wildlife corridor and associated impacts of land clearing and increased traffic;
- visual impacts of proposed lighting on surrounding residents, and noise impacts associated with lighting encouraging early morning and late night use;
- aesthetic impacts on surrounding residents of clearing vegetation within Lot 521;
- loss of the publicly accessible sandy beach area at Medina Bay, which is a safe and sheltered area enjoyed by adults and children for swimming, picnicking, passive recreation activities (e.g. kayaking) and dinghy launching to access moored vessels off the shore;
- impacts of increased boat traffic on turtles and dolphins reported to visit the rocky shoreline around Point Circuit;
- potential adverse impacts on the value of properties in close proximity to the proposed boat ramp development; and,
- shallow water depths within Medina Bay, which would limit boat launching and retrieval.

A number of the above points would need to be addressed in future design investigations and/or would be included within any environmental assessment completed to support a boat ramp development proposal at Medina Bay.

5.5.2 Public Jetty

The need for a public jetty was supported by most residents but was considered to be a lower priority than a boat ramp. However, opinions on the proposed location of the jetty and its primary function varied.

The benefits and potential uses of a public jetty noted by residents included:

- provide a loading/unloading point for elderly/less able people who are not able to clamber onto boats from the water or small tenders;
- provide family and wheelchair access to boats;

- provide a loading/unloading point for supplies and equipment;
- provide ferry service access for North Arm Cove residents to able to travel to Nelson Bay or Tea Gardens;
- improvement of community safety by providing a pickup point for medical emergencies and waterborne escape route from bushfires (although this is not endorsed by RFS as noted previously); and,
- provide an attractive point for fishing, dolphin watching and enjoying sunsets.

A number of residents questioned the financial viability of a ferry service being provided at North Arm Cove given the absence of facilities for visitors including shops, restaurants and park areas. These residents considered that the primary function of the jetty should be for loading/unloading of supplies, equipment and personnel and would be of particular benefit for those who are elderly or disabled. In this regard, the proposed jetty location at Medina Bay was not considered to be suitable for less able people due to the steps, slope and length of the proposed accessway from Point Circuit. Views were expressed that if the depth requirements for ferry berthing did not apply then other sites may be more appropriate as the length of jetty to access a reduced water depth for recreational boats would decrease and foreshore access from level land areas could be achieved.

Alternative jetty sites included the installation of a pontoon alongside a proposed boat ramp at Medina Bay. This pontoon could terminate offshore with a t-head to facilitate vessel berthing.

Casuarina Reserve was also suggested by several residents to be a more favourable site for a public jetty servicing recreational boats. Advantages of the site were noted to include:

- level foreshore access for less able people;
- existing informal parking area; and,
- land buffer to adjacent residents.

A jetty at Casuarina Reserve may need to extend offshore through aquaculture leases to achieve the required water depth. However, it was reported that the area of leases near Casuarina Reserve was disused and that there are mechanisms for removal of parts of oyster leases for public benefit.

6 North Arm Cove Boating Development Plan

6.1 General

Following the public exhibition period and drop-in session a meeting was held with representatives from RHDHV, Council (technical staff and a Councillor), RMS (management and operational staff), Crown Lands, and Department of Primary Industries (Port Stephens-Great Lakes Marine Park representative). This meeting provided a forum to run through the draft concept design plans and the consultation feedback. As a result of discussions and suggestions put forward at the meeting to address stakeholder issues a number of amendments were implemented to finalise the preferred concept design plan.

The final concept design plan is provided in **Appendix E** and the final amendments are outlined below. The final concept design plan and final amendments should be read in conjunction with **Section 5**. A rough order of magnitude cost estimate was also prepared to reflect the final concept and is provided in **Appendix F**.

6.2 Final Concept Design

The boat ramp proposal at Brackens Bay received substantially less support during community consultation than the alternative option proposed at Medina Bay. The environmental issues relating to the presence of Posidonia seagrass and exposure to adverse weather conditions from the south were noted to be the main factors contributing to a strong preference for siting a boat ramp at Medina Bay. At the time of the drop-in centre, the initial results of a field investigation into the extent, density and species of seagrass beds at both Brackens Bay and Medina Bay were available. This investigation was undertaken by Ocean Environmental and the final report documenting findings is provided in **Appendix D**.

The field survey undertaken in Brackens Bay confirmed the extent of Posidonia and Zostera seagrass beds previously mapped by DPI (2004). The seagrass beds were reported to be in good condition and quite dense throughout most of the surveyed area. It was also reported that the highly valued Posidonia seagrass beds extended further inshore and covered a greater area than indicated in previous mapping. A boat ramp development in Brackens Bay would have a considerable localised impact on seagrass and is unlikely to be supported by DPI.

The field survey undertaken in Medina Bay confirmed the presence of Zostera seagrass patches as mapped by DPI (2004) and indicated that these patches were slightly more extensive. Two small patches of Zostera seagrass not previously mapped by DPI were also identified. In terms of the impacts of proposed boat ramp development on seagrass, Medina Bay was considered to be favourable when compared with Brackens Bay.

As such, Medina Bay was selected as the preferred site for boat ramp development. A number of amendments were made to the draft concept plan in response to consultation feedback received from community and government agency stakeholders.

The proposed trailer parking arrangements along the side of Cove Boulevard were the subject of considerable discussion during consultation due to road safety issues associated with their position within a dip between two crests in the road. The initial trailer parking areas included within the proposed facility have been provided as 3.5m wide bays positioned alongside the accessway on existing available public land (DP 613896 Lot 521). This provides a length of around 60m on the northern side of the accessway and around 90m on the southern side for parallel parking of around 7 to 8 car and trailer combinations. A total of four (4) options for future staged car and trailer parking are shown on the final concept plan and are subject to further consideration of land acquisition and road safety aspects. These options include:

- Option 1 – Up to 21 car and trailer spaces within the road reserve alongside Cove Boulevard (adjacent to DP 9938 Lot 657 and DP 9938 Lot 687) and angled such that vehicles exiting the ramp accessway would need to turn around within Point Circuit to undertake rear to kerb parking manoeuvre from the adjacent road lane;
- Option 2 – Up to 20 car and trailer spaces within the vacant blocks of land (DP 9938 Lot 524 and DP 9938 Lot 535) at the entrance to Point Circuit, which would be subject to land acquisition;
- Option 3 – Approximately 10 car and trailer spaces within the vacant block of land on the southern side of the ramp accessway (DP 12 5638 Lot 1), which would be subject to land acquisition; and,
- Option 4 – Approximately 10 car and trailer spaces within the vacant block of land on the northern side of the ramp accessway (DP 9938 Lot 520), which would be subject to land acquisition.

To warn approaching vehicles along Cove Boulevard of the boat ramp facility, caution signage advising vehicles to slow down has been positioned at the crests in the road on either side of the entry to the ramp accessway.

The footpath accessway from Point Circuit to the boat ramp has been removed as the parking around the turning circle is no longer a part of the final concept. It is considered that existing informal roadside parking in the surrounding area would cater for cars initially (and any car and trailer overflow) and car only parking could be incorporated into future parking areas associated with car and trailer parking options. Pedestrian access to the boat ramp would be via the footpath running from Cove Boulevard and along the southern side of the ramp accessway.

Lighting has been removed from the boat ramp concept proposal to encourage daytime use of the facility and minimise impacts on residents.

Consultation feedback indicated that the proposed jetty location at Medina Bay was not considered to be suitable for less able people due to the steps, slope and length of the proposed accessway from Point Circuit. Although the position of the jetty provided the shortest access from the shore to deep water suitable for ferry berthing, it was considered that the primary function of the jetty should be for loading/unloading of supplies, equipment and personnel. If the jetty serviced smaller recreational vessels only (not deep keeled yachts) it would be able to extend to shallower water depths. In addition, stakeholders suggested that an on-ramp pontoon for boating holding would be beneficial at the boat ramp. It is considered that an on-ramp pontoon terminating in an L-shaped wharf face would act as a dual purpose structure to facilitate both boat holding and loading/unloading only from recreational boats. This structure has been included in the final concept plan as a future staged facility.

6.3 Cost Estimate

A rough order of magnitude (ROM) cost estimate is tabulated below for the various works proposed on the final concept design plan for Medina Bay. A detailed breakdown of the estimate is provided in **Appendix F**. The cost estimate excludes construction of possible future staged car and trailer parking areas and associated land acquisition costs.

The construction cost estimate is inclusive of a 30% contingency considered to be appropriate for the current level of design development and site investigation. Indicative cost estimates for other elements including site investigations, detailed design fees, environmental assessment and approvals, tendering, site supervision and certification, and administration are also provided.

These estimates are based on RHDHV's experience and judgement as a firm of practising professional engineers familiar with the construction industry. The quantities have been estimated from the latest

revision of the concept design plan, prepared by RHDHV. The construction cost estimates can NOT be guaranteed as we have no control over Contractor's prices, market forces and competitive bids from tenderers. The construction cost estimate may exclude items which should be considered in a cost plan. Examples of such items are project management fees, authority approval fees, contractors risk and all project contingencies (e.g. to account for construction and site conditions, weather conditions, ground conditions and unknown services).

Table 7: ROM Cost Estimate for Medina Bay Boat Ramp Facility

Item No.	Description	Cost (excl. GST)
1	General and Preliminary Work	\$95,000
2	Site Preparation	\$11,250
3	Earthworks and Retaining Walls	\$154,530
4	Access Road and Manoeuvring Area	\$87,550
5	Boat Ramp	\$122,200
6	Car and Trailer Parking Areas	\$183,255
7	Stormwater Services and Drainage	\$109,150
8	Pedestrian Access	\$12,000
9	Site Disestablishment and Restoration	\$25,000
	Total	\$794,935
	30% Contingency	\$238,481
	Construction Costs Subtotal	\$1,033,416
	Topographic Survey	\$5,000
	Hydrographic Survey	\$5,000
	Marine Ecology Survey and report	\$10,000
	Geotechnical Investigation	\$30,000
	Detailed Design Fees	\$100,000
	Environmental Assessment and Approvals	\$30,000
	Preparing, advertising and assessing tenders	\$25,000
	Site supervision and certification of the Works	\$40,000
	Administration	\$15,000
	Other Costs Subtotal	\$260,000

The construction of a future staged on-ramp pontoon and wharf face has been excluded from the breakdown in **Table 7** and is estimated to cost in the order of \$286,000 (excl. contingency and other costs).

6.4 Concluding Remarks

It should be noted that although the above cost estimate is likely to be conservative due to the preliminary level of design and application of a 30% contingency, it is considered that the costs of a boat ramp development at Medina Bay would be high relative to typical installations in more suitable sites elsewhere in NSW. This is due to the challenging nature of the site which has steep terrain and requires establishment of vehicular access. Based on an appraisal of new boat ramp facilities built in the last 10 to 15 years, the costs of construction are typically in the order of \$300,000 to \$500,000 with smaller rural ramps costing less than \$100,000.

In addition, contributing to the high costs associated with a boat ramp facility, there are also a number of unfavourable design aspects and environmental issues associated with the Medina Bay proposal that are related to problematic site constraints. These include:

- large amounts of vegetation clearing and earthworks required to provide site access;
- deep excavation and retaining walls required to establish vehicular access and ramp manoeuvring area;
- close proximity of surrounding existing residential dwellings;
- potential impacts of ramp footprint on water access to adjacent private property (subject to confirmation with hydrographic survey and navigation assessment to determine 'Division of Waterway');
- limited car and trailer parking space is available on existing available public land without undertaking substantial earthworks to manage steep topography; and,
- possible future staged car and trailer parking options require acquisition of private land and these areas are located some distance away from the boat ramp, which is not ideal for the high median age of the North Arm Cove community.

Due to the high cost, unfavourable design aspects and environmental issues associated with available development options it may be difficult to justify public expenditure on the proposal from a 'value for money' perspective unless some resolution of these aspects/issues is achieved or alternative funding mechanisms are considered. Alternatively, opportunities may exist to upgrade/expand facilities in neighbouring areas that are currently utilised by boaters in the North Arm Cove area. These include existing boat ramps at Karuah and Tea Gardens.

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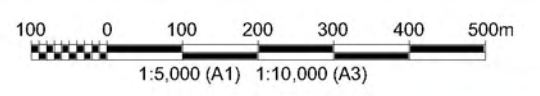
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Appendix A: Maps and Draft Concept Design Plans

NOTES

1. AERIAL PHOTOGRAPH DATED NOVEMBER 2012.



NOTES


1. AERIAL PHOTOGRAPH DATED NOVEMBER 2012.


LEGEND

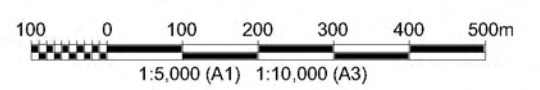
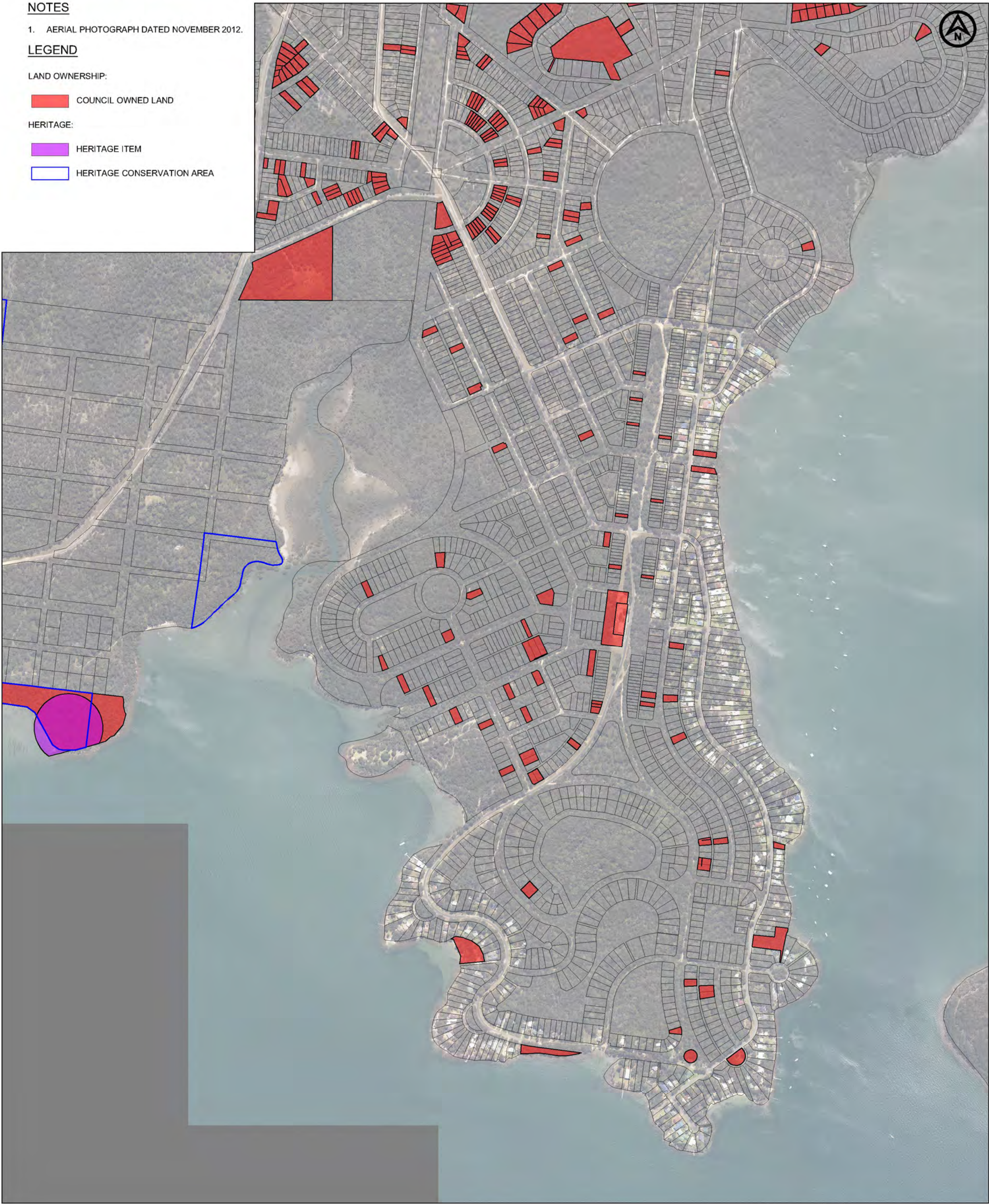
LAND OWNERSHIP:

 COUNCIL OWNED LAND

HERITAGE:

 HERITAGE ITEM

 HERITAGE CONSERVATION AREA



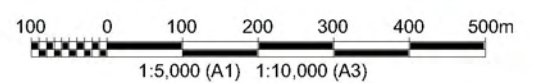
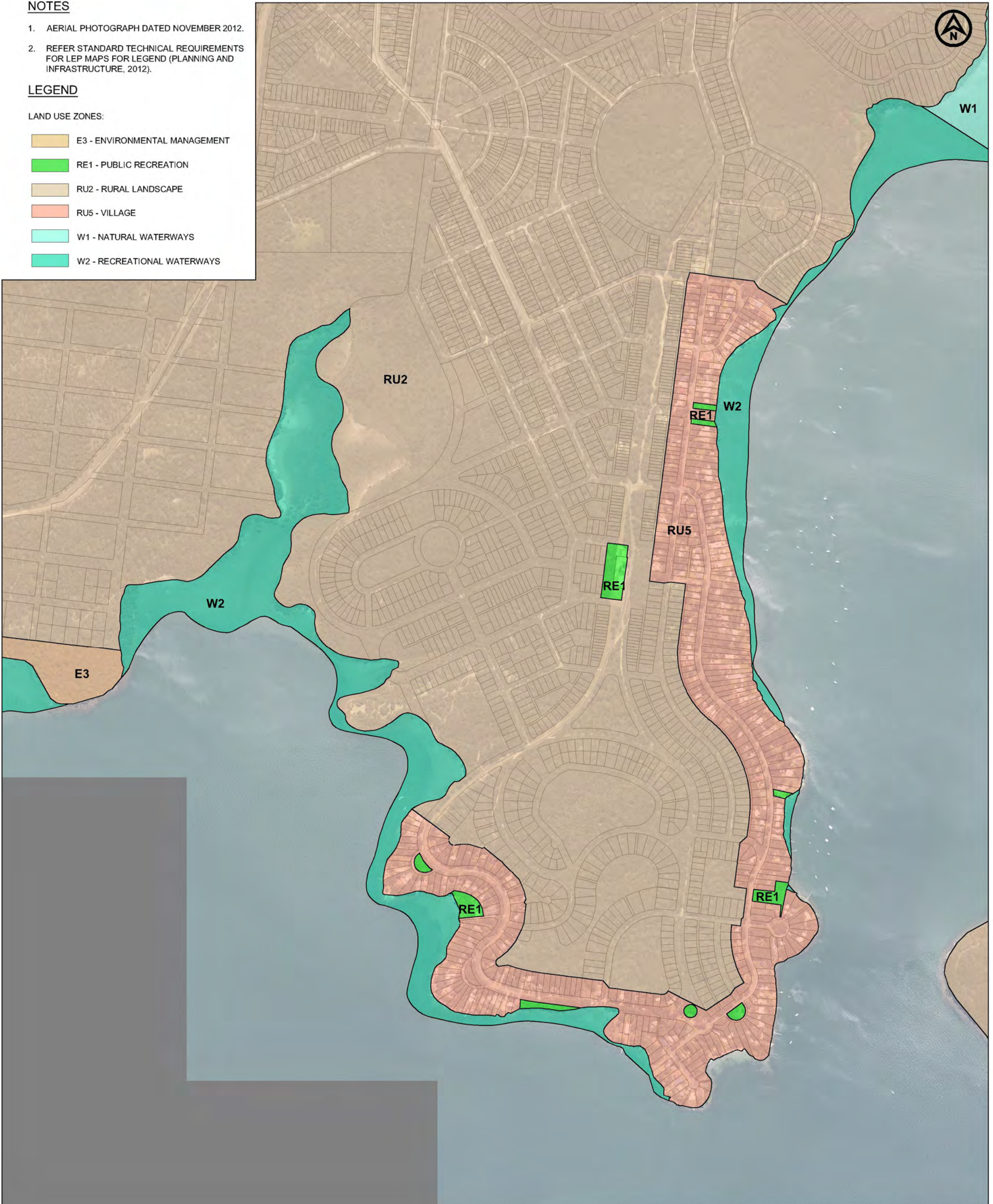
NOTES

1. AERIAL PHOTOGRAPH DATED NOVEMBER 2012.
2. REFER STANDARD TECHNICAL REQUIREMENTS FOR LEP MAPS FOR LEGEND (PLANNING AND INFRASTRUCTURE, 2012).

LEGEND

LAND USE ZONES:

- E3 - ENVIRONMENTAL MANAGEMENT
- RE1 - PUBLIC RECREATION
- RU2 - RURAL LANDSCAPE
- RU5 - VILLAGE
- W1 - NATURAL WATERWAYS
- W2 - RECREATIONAL WATERWAYS



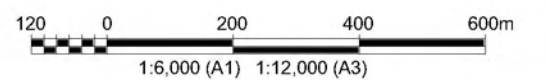
NOTES

1. AERIAL PHOTOGRAPH DATED NOVEMBER 2012.

LEGEND

MARINE VEGETATION (DPI, 2004):

	POSIDONIA		SALTMARSH
	ZOSTERA		MANGROVE
	MANGROVE / SALTMARSH		HALOPHILA



NOTES

1. AERIAL PHOTOGRAPH DATED NOVEMBER 2012.
2. BATHYMETRIC SURVEY OBTAINED FROM RMS AND HAS BEEN COMPILED FROM A NUMBER OF SOURCES OF VARYING SURVEY DATES. CONTOURS VARY AND ARE TO CHART DATUM.

LEGEND








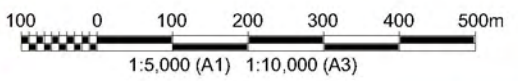
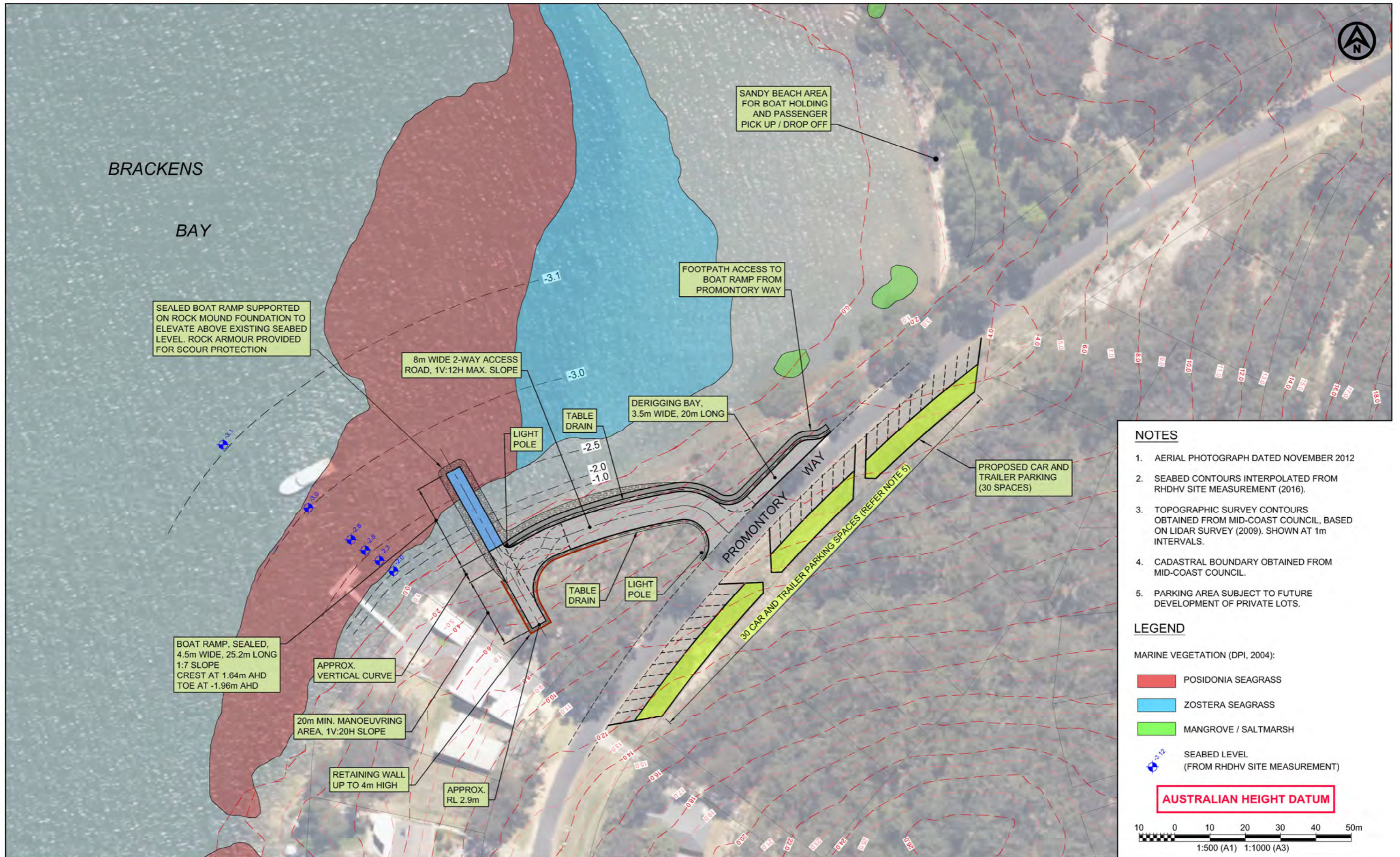
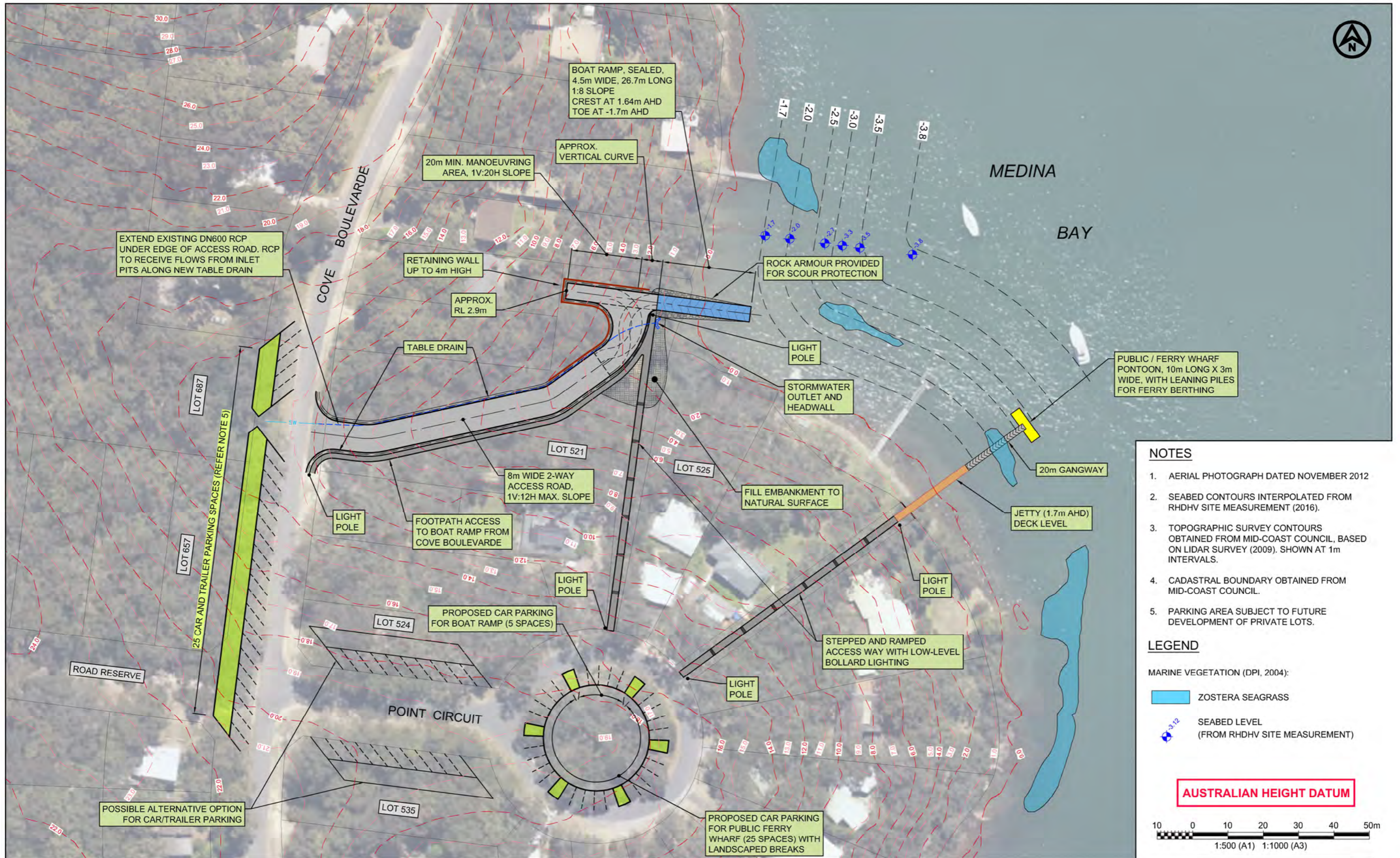
-  OYSTER LEASES (DPI, JAN 2016)
- RESTRICTED ACTIVITIES AND CAUTIONS (RMS):**
-  4 KNOTS SPEED LIMIT AREA
- NAVIGATION AIDS (RMS):**
-  SOUTH CARDINAL BUOY - AQUA BUOY
-  SPECIAL MARK - PILLAR BUOY
-  LIT PORT BUOY - NTM
-  LIT STARBOARD BUOY - NTM
-  SPECIAL MARKER BUOY - CAN BUOY NTM



CHART DATUM







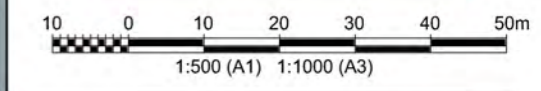
NOTES

1. AERIAL PHOTOGRAPH DATED NOVEMBER 2012
2. SEABED CONTOURS INTERPOLATED FROM RHDHV SITE MEASUREMENT (2016).
3. TOPOGRAPHIC SURVEY CONTOURS OBTAINED FROM MID-COAST COUNCIL, BASED ON LIDAR SURVEY (2009). SHOWN AT 1m INTERVALS.
4. CADASTRAL BOUNDARY OBTAINED FROM MID-COAST COUNCIL.
5. PARKING AREA SUBJECT TO FUTURE DEVELOPMENT OF PRIVATE LOTS.

LEGEND

- MARINE VEGETATION (DPI, 2004):
- ZOSTERA SEAGRASS
 - SEABED LEVEL (FROM RHDHV SITE MEASUREMENT)

AUSTRALIAN HEIGHT DATUM



Appendix B: Stakeholder Engagement Plan

To : Indeewa Chandrawansa and Lun Yeung
 From : Rick Plain and Gary Blumberg
 Date : 26 February 2016
 Copy : Matt Potter and Heather Nelson
 Our reference : PA1268_M0.1_160209_Great Lakes Stakeholder
 Engagement Plan_v2_HKA FINAL 160226

**Subject : GREAT LAKES BOATING STUDIES
 STAKEHOLDER ENGAGEMENT PLAN (SEP)**

General

Consultation with the community and stakeholders is proposed in accordance with the Study Components outlined in Great Lakes Region Boating Development Studies Proposal for Consultancy Services (the "Proposal"). This would include:

- Stakeholder Engagement Plan (SEP)
- consultation with community stakeholders
- consultation with agencies
- drop-in information sessions
- community meetings
- Summary of Consultation Feedback
- comments on organizational structure and responsibilities

The Revised Program (v1) amended 10 February 2016 applied to this SEP.

Stakeholder Engagement Plan (SEP)

The SEP is outlined in this memorandum to be issued in draft and finalised in consultation with RMS and Great Lakes Council. RMS has confirmed that it is acceptable for Haskoning to liaise directly with Council in relation to stakeholder engagement generally, with RMS copied into all correspondence.

Consultation with Community Stakeholders

Stakeholder consultations are proposed during Weeks 3 to 5 of the program. This would initially comprise telephone interviews with representatives from relevant community groups, which would include:

PH-01 – Tea Gardens/Hawks Nest Foreshore Redevelopment Plan		
Group	Name	Contact details
Marine Drive Foreshore Reference Group	Chair Clr Len Roberts.	(02) 4997 1011
Tea Gardens/Hawks Nest Progress Association	Trevor Jennings	0431 250 563
Tea Gardens Chamber of Commerce	Graham Halley (Chair)	0400 018 197

Myall River Action Group	Gordon Grainger	(02) 4997 0205
Art Walk	Leigh Allen	(02) 4997 9313
Myall River Historical Society	Trevor Cook	(02) 4997 0820
Tea Gardens School	TBA	TBA
Myall Lakes Aquatic Club	Terry Coates	(02) 4982 5425
Myall Koala and Environmental Support Group	Ian Morphett	(02) 4997 1550
Tea Gardens Slipway	Paul Bendy	0400 123 639
Ferry operators	Ray Horsfield (Wallamba)	0408 494 262
	Tamboi Queen	(02) 4981 1959
	Port Stephens/Tea Gardens Ferry Services	0412 682 117
Tea Gardens Real Estate	Rick Wraight	(02) 4997 1300
Worimi Local Aboriginal Land Council	Andrew Smith	(02) 4033 8812
Karuah Indigenous Incorporation	Dave Feeney	(02) 4997 5952
Pindimar/Bundabah Community Association	Peter Economos	(02) 4997 2081
Commercial Fisherman's Co-operative (Newcastle)	Robert Gaulta	(02) 4965 4229
Sheargold Group	Ryan Duff	0400 435 820

PH-07 - Nerong Boating Redevelopment Plan		
Group	Name	Contact Details
Nerong Progress Association/Community Centre	David Hirtes	0417 449 070
Community Volunteers	Joan Rolls	0422 298 360

PH-08 - Tahlee Wharf/Jetty Options Investigation		
Group	Name	Contact Details
Tahlee Ministries	Rev. John Anderson	0412 311 474
Frank Future	Imagine Cruises	(02) 4984 9000
Ray Horsfield	Nelson Bay Cruises	0408 494 262

PH-09 – North Arm Cove Development Plan		
Group	Name	Contact Details
North Arm Cove Progress Association	Doug Kolhoff	(02) 4997 3341
North Arm Cove Residents Association	The Secretary	(02) 4997 3341
Resident (ex RMS)	Peter Chappelow	(02) 4997 3149

General points of discussion would include:

- community preferences for boating facilities and associated amenities;
- limitations or issues with existing facilities;
- potential facilities for inclusion in plans;
- suggested locations to explore as part of the plans;
- previous studies, grants, applications and the like including location of previous work and reasons for not progressing with the work; and
- any other issues or items to consider.

If requested by the community stakeholders or if considered beneficial to our understanding of particular matters raised by the stakeholders in our telephone discussion, Haskoning would request a meeting onsite. Any onsite meetings would be conducted in Weeks 4 or 5 during the main Site Visit task. We would propose to meet with the selected community stakeholders prior to the agency consultation to take place at Tea Gardens.

Consultation with Agencies

Agency consultation would be conducted at Council Offices in Tea Gardens during Week 4 or 5. This venue would be booked through Council upon finalisation of the SEP and after confirming the availability of key officers for attendance.

Agencies invited to the consultation would include:

Group	Name	Contact Details
Port Stephens Estuary Committee	Charlene Wellard (Port Stephens Council)	(02) 4980 0251
RMS Boating Safety Officer	Brett Boehm Tony Woodford Both best contacts to organise water site visit. Any initial correspondence with Tony to copy in Brett who is the Senior BSO.	0428 626 603 0428 264 316
Marine Parks Authority NSW	Luke Erskine	(02) 4916 3976
NSW Department of Primary Industries (Fisheries)	Scott Carter	(02) 4916 3931
National Parks and Wildlife Services	Stephen Smith Brett Cann	(02) 6591 0300
NSW Department of Primary Industries (Lands)	Terrence Hemmingway	(02) 6591 3573
Office of Environment and Heritage (OEH)	Neil Kelleher	(02) 4320 4206 0413 278 772

Council and RMS officers would be notified of the agency consultation and would be welcome to attend the meeting. It is envisaged that the following key Council staff would be involved in the project:

- Andrew Morris – Manager of Parks and Recreation
- Roger Busby – Manager Strategic Planning (local planning issues, future growth, available sites, zoning) (02 6591 7254)
- Gerard Tuckerman – Manager Natural Systems (water quality and dredging) (02 65917274)

Contact details for other senior staff with an interest in the Boating Development Studies have been provided to Haskoning. These personnel, listed below, would be contacted as required to address any particular matters that may emerge during the studies:

Name	Position	Contact Details
Sharon Bultitude	Tourism - GLC Marketing and Partnership coordinator	(02) 6591 7405
Mat Bell	Senior Ecologist -biodiversity issues	(02) 65917243
Wayne Burgess	Manager Planning	(02) 65917292
John Dougherty	Manager, Property and Assets - asset manager for Forster Marina	(02) 65917251
Lisa Schiff	Director, Planning*	
Ron Hartley	Director, Engineering*	(02) 65917227
Tracey Farrant	Community Engagement Officer	(02) 65917325
Jamie Condie	Works Engineer - Southern Depots- maintenance and local issues operational issues	(02) 65917152
Councillors	c/- Ann Gambrill (PA)	(02) 6591 7222 Anne.gambrill@greatlakes.nsw.gov.au

The agency consultations would focus on opportunities and constraints for each site. Typical matters for discussion would include:

- project overview;
- presentation of findings from initial consultation with stakeholders (telephone and site discussions);
- discussion of project options based on desktop review, Inception Meeting site visits undertaken in Week 1 and community stakeholder consultation;
- legislative requirements identified by the Agencies;
- identification of additional studies required to gain approval; and
- identification of opportunities for future development.

Drop-in Information Sessions

Three hour drop-in sessions would be convened at Tea Gardens, Nerong and North Arm Cove on consecutive weekday afternoons in Week 22. Further, a one hour drop-in session would be convened

at Tahlee, either immediately prior to or following the North Arm Cove drop in session. The drop-in sessions would be at least one week after delivery of the Final Draft Reports and Boating Development Plans to RMS. No later than the start of Week 22, Haskoning would provide a one page summary to Council for distribution and comment by the community (ref Attachment D, section 1.2 (h) of the RFP).

In consultation with Council we would make arrangements with the respective progress associations or other relevant community groups to use a suitable space in close proximity to the sites for the drop-in sessions. The community stakeholder contacts would be notified of the drop-in sessions and requested to notify their respective community groups of the time and date of the drop-in sessions. It would be requested that Council advertise the drop-in sessions through print or online media.

We would liaise with Council and provide suitable concise written content for the information bulletin that Council issues to advertise for the community sessions. We expect that this would be posted to Council's web site, to the Tea Gardens Online community web noticeboard at the 'Whats On' page, and also inserted to the Myall Coast News (new free community newspaper) and Port Stephens Examiner/ Myall Coast Nota. All bulletins would invite feedback via the email address and mobile number (set up toll free through 1800 REVERSE for both text or voice) of the responsible team member from Haskoning. In consultation with Council, Haskoning would assist to facilitate the dissemination of this material to the various forums and noticeboards as required.

Final draft plans would be presented at the drop-in sessions to provide an opportunity for the wider community to discuss the plans and any specific concerns regarding the plans. Final draft plans could be left on exhibition at the community hall, library or other suitable location for public exhibition. Members of the community would be invited to write to or call staff from Haskoning to discuss specific concerns regarding the plans. The concerns would be raised with RMS and Council, discussed as required at the upcoming community meetings and considered in the Summary of Consultation Feedback.

Community Meetings

Community meetings would be planned for Week 25. These would provisionally commence at 5.30 pm on consecutive weekday evenings at Tea Gardens, Nerong and North Arm Cove. A meeting would be convened at Tahlee, either prior to or following the North Arm Cove community meeting.

Meeting arrangements would be as per the Drop-in Information Sessions.

The meeting would present the Final Draft Plans together with reasoning for the preferred option, and constraints, which make alternate options unviable. The meetings would focus specifically on boating infrastructure. Community members would be encouraged to ask questions relating to the plans during the meetings. Queries or concerns raised at the community meetings would be discussed with RMS and Council and considered for inclusion in the Summary of Consultation Feedback.

Summary of Consultation Feedback

Following the drop-in sessions and community meetings, Haskoning would summarise the community consultation comments with the proposed changes to the Plans as a draft Summary of Consultation Feedback for Council and RMS review. Our draft Feedback Summaries would be submitted in Week 26 and finalised in Week 28. Final version of the Summaries would be incorporated into the Final Plans as Appendices.

Organisational Structure and Responsibilities

The team at Haskoning would be responsible for preparing all material regarding the Draft Plans. Haskoning staff would chair all meetings and would record minutes from the meetings and consultation. Haskoning would be responsible for collation, organisation and interpretation of community and stakeholder feedback and the information would assist in developing the Plans for inclusion in the Final Deliverable.

While the cost of organising the community engagement sessions and agency consultation would be the responsibility of Haskoning, it is noted that Council would facilitate and pay for the venue and advertising in print and online media. Haskoning would ensure that Council was given one month's advance notice to coordinate the community consultation sessions and agency consultation. It is possible that a single venue might be most convenient for multiple sites, however this would be agreed beforehand with RMS and Council.

Should you have any queries regarding the above, please contact the undersigned.

Yours faithfully
Royal HaskoningDHV

Rick Plain
Engineer
Maritime and Waterways

Gary Blumberg
Principal Engineer
Maritime and Waterways

Appendix C: Stakeholder Meeting Minutes

Minutes

Present	: Gary Blumberg (GB) – Royal HaskoningDHV (Principal Engineer) Matt Potter (MP) – Royal HaskoningDHV (Senior Engineer) Drew Morris (DM) – Great Lakes Council (Manager of Parks and Recreation) Len Roberts (LR) – Councillor / Marine Drive Foreshore Reference Group (Chair) Charlene Wellard (CW) – Port Stephens Estuary Committee / Port Stephens Council Luke Erskine (LE) – NSW Department of Primary Industries (Marine Parks) Dave Cooper (DC) – NSW Department of Primary Industries (Lands) Stuart Johnson (SJ) – NSW Department of Primary Industries (Lands) Brett Boehm (BB) – RMS Senior Boating Safety Officer Neil Kelleher (NK) – NSW Office of Environment and Heritage (OEH) Joshua Ward (JW) – NSW Office of Environment and Heritage (OEH)
Absent	: Tony Woodford – RMS Boating Safety Officer Scott Carter – NSW Department of Primary Industries (Fisheries)
Date	: 7 th March 2016
Copy	:
Our reference	: PA1268_MM0 1_160307_Agency Meeting_v3
Subject	: Great Lakes Boating Studies – Government Agency Meeting

Item	Content	Actions
1.0	Introduction	
1.1	GB introduced project and purpose of meeting	
2.0	Tea Gardens / Hawks Nest Foreshore Redevelopment Plan	
2.1	MP outlined terms of reference for investigations at Tea Gardens / Hawks Nest <ol style="list-style-type: none"> 1) Investigate feasibility of harbour/marina sites 2) Identify options for additional small craft access points 3) Identify options for additional tie up locations 4) Identify options for wharves, jetties and pontoons 	

Item	Content	Actions
3.0	Recent and Current Projects	
3.1	DM noted recent spending under Boating Now Program for resurfacing of public wharf and ferry wharf decking areas.	
3.2	<p>LR outlined 3 other projects that are related to foreshore redevelopment at Tea Gardens. His understanding is that only 2 of these projects are supported by the community.</p> <ol style="list-style-type: none"> 1) New public jetty at Ogden Street 2) Shelter at current ferry wharf for waiting passengers and extension to existing pontoon 3) Dinghy storage at Anzac Park <p>People are not supportive of formalised vertical dinghy storage at Anzac Park. Prefer money is spent on resolving erosion with bank protection instead. Although there is some support for low-profile storage that wouldn't impact on visual aesthetic in the area.</p>	
3.3	<p>LR outlined existing arrangements and proposals for ferry wharves. Ferries have been moved from Ogden Street to a single dedicated ferry wharf (no public vessel access permitted) near the Tea Gardens Hotel. Ferries currently share the single berth at the existing ferry wharf. However, there are 2 proposals for separate (privately operated) wharf facilities that have been submitted to Crown Lands. One wharf would service Wallamba/Tamboi Queen (Ferrylink) and the other would service the Tea Gardens Ferry Services.</p> <p>Separate ferry wharves are not preferred as it is better to have a centralised facility. This could be achieved if a single dedicated ferry wharf was built with room for multiple ferries to berth simultaneously. An option would be to duplicate the existing public jetty (which has a very long pontoon attached to it) for use as a ferry wharf. The location would potentially be somewhere between Maxwell St and Ogden St.</p> <p>However, poor working relationships exist between ferry operators and this is not good for tourism.</p>	
3.4	<p>DM clarified remaining funding left from Boating Now Program for sheltering and extension to pontoon at current designated ferry wharf. \$176K total budget from Boating Now Program and only \$35K has been spent on wharf deck resurfacing.</p> <p>Other infrastructure improvements could be partly funded under future Boating Now funding programs, current funding is limited to current Redevelopment Masterplan investigations by Royal HaskoningDHV.</p>	

Item	Content	Actions
4.0	Harbour / Marina Options	
4.1	<p>Discussion of possible marina options included:</p> <ol style="list-style-type: none"> 1) Limekilns Road site (Paul Bendy proposal) DC advised that foreshore land in this area is ‘accreted land’ and is Crown Land. Freehold land would need to be acquired to provide access to a marina facility. DC thought no Aboriginal land claims were located here (Note – on checking departmental systems, ALC 6686 exists over the seabed to the high tide mark of Port Stephens [including bed of Myall River extending upstream to the Singing Bridge linking Tea Gardens/Hawks Nest]). GB advised that water depths in the area were still shallow and dredging would be required to achieve sufficient marina depths. 2) Immediately downstream of Singing Bridge DC advised that this land is privately owned (Dennis Antipas) and the boundary extends over water (possibly due to historic shoreline erosion). GB advised that water depths were shallow here and would require dredging. An important consideration/question is how sustainable dredging would be (i.e. how often would dredging need to be carried out to maintain sufficient marina depths). LR said the ballast wall along the SW margin of this site was placed around the 1820’s. DC said may need to acquire the freehold land to get access to this site. 3) Marina proposal at Durness (near Shearwater development) 4) Marina proposal further downstream of the Singing Bridge in a bay near the boat ramp 	
4.2	<p>LR believed best sites for marina development were:</p> <ol style="list-style-type: none"> 1) Fame Cove (privately owned, outside of study area) 2) Bundabah (outside of study area) 	
4.3	<p>BB noted that there was a significant waiting list for permanent moorings, some waiting for years. This may support demand for a marina. There is also only 1 ‘courtesy’ mooring available to visitors, which is located on the Hawks Nest side of the river upstream of the bridge which is insufficient.</p>	
4.4	<p>LE advised that in accordance with the <i>Marine Estate Management Act 2014</i>, it would be difficult for DPI to give concurrence for marina developments in areas outside of the ‘special use zone’ defined in current marine park zoning. The Tea Gardens SPZ extends from just upstream of the Singing Bridge (corridor to cover former punt operation) and runs along the Tea Gardens foreshore as a 40m width offshore from the mean high water mark. It extends up through ‘The</p>	

Item	Content	Actions
	<p>Gut' to Coupland Avenue. Marina proposals elsewhere would need to have a significant business case / benefit to community to enable assessment in accordance with the principles of ecologically sustainable use and requirements of Marine Estate Management and Fisheries Management Acts. From discussions heard at this meeting, which is the first time that these proposals have been discussed with marine parks, LE cannot see a major business case driving a marina proposal. However in general terms, consolidation of swing moorings into a marina as a 'trade off' is something that DPI would consider.</p>	
4.5	<p>DC advised that marina at Forster is managed by Council, who employ a marina manager to allocate moorings, collect fees etc.</p>	
4.6	<p>CW advised that she has passed under the Singing Bridge in a 27ft yacht which was just able to clear the bridge with a fixed mast at low tide. This yacht would be considered small, other yachts would be greater than 32ft on average.</p>	
4.7	<p>LR conveyed his understanding, which was generally agreed upon by the agency group, that if it was not feasible to develop a marina at Tea Gardens / Hawks Nest, the community would accept this with little consternation.</p>	
5.0	Tea Gardens Foreshore	
5.1	<p>General consensus that a consideration of upgrade and reorganisation of moorings along the Tea Gardens Foreshore is far more feasible than a marina.</p>	
5.2	<p>LR believed that a boardwalk running along the waterfront with moorings would be attractive to the community.</p>	
5.3	<p>CW advised that kayaking groups come over from Nelson Bay (she is one of them) and hop off on the beach near the water police (Anzac Park area). This is a popular activity.</p>	
5.4	<p>DC noted that the 2003 DCP split the foreshore into different areas and LR confirmed that the Marine Drive Foreshore Reference Group still support the content of this DCP.</p>	
5.5	<p>NK suggested that existing moorings could be orientated perpendicular to the foreshore (along 'The Gut' for example) to increase mooring capacity. BB advised that re-orientation of moorings may be possible in the town centre but not further upstream in 'The Gut' where fore/aft moorings exist along the shoreline. The channel is very narrow through The Gut and couldn't safely accommodate perpendicular to shore moorings due to strong currents and lack of manoeuvrability. BB noted that the moorings near the Boatshed are 4-</p>	

Item	Content	Actions
	point piled moorings that extend up to the Community Slipway.	
5.6	BB believes that the best area for additional moorings is around the Ogden Street foreshore, between the boat ramp and the Public Wharf. RMS could also provide a second public mooring in the area.	
5.7	NK noted that the community may not want to look at vessels moored along the entire foreshore.	
5.8	DC advised that licences issued for The Gut moorings are around 50% Crown Lands and 50% RMS.	
5.9	BB noted that no new swing moorings are being issued. They take up more space and damage seagrass beds.	
5.10	<p>General discussion of the reconstruction of the historic swimming enclosure that existed immediately downstream of Ogden Street. NK suggested that this could look like the enclosure at Woy Woy, which has a timber boardwalk around the edge. However, to meet criteria for Boating Now grant the facility would need to have a boating purpose. This could be achieved by a 3-sided floating pontoon around the perimeter of the historic swimming enclosure footprint. Boats could be moored against the pontoon which would provide foreshore access.</p> <p>DM raised issues with maintenance and facilities (toilets, lifeguards) associated with swimming enclosures. The establishment of the swimming enclosure with netting/facilities etc. could be implemented at a later date. The 3-sided pontoon structure would serve as boating infrastructure and an interesting link to the historic swimming pool in the meantime.</p> <p>DC advised that Crown Lands would need to issue a licence for the facility and Council would prepare an REF and construct the works. This could possibly be done under SEPP (Infrastructure).</p>	
5.11	<p>GB mentioned a suggestion made by Andrew Staniland (GLC) to provide kayak/stand up paddleboard (SUP) launching facility at the Council reserve at the end of Coupland Avenue. LR understood that there were already 2 main kayak/SUP launching areas at Hawks Nest (where there is an existing commercial operator) and Anzac Park. Another launching area was not considered necessary and this was generally agreed with by the meeting.</p>	
5.12	<p>LE raised the point that the Community Slipway was not operating to current environmental standards and was on the watchlist of Marine Parks. The slipway is too close to the water and catch drains do not exist to capture waste (paint flakes, wash water etc.). LE asked if upgrades to the facility were possible under the current masterplan</p>	

Item	Content	Actions
	<p>process. The meeting thought this would be a good idea and given that the slipway was a 'not for profit' organisation RMS may be able to fund this. The slipway would need to be shifted further landward or relocated to an alternate site to achieve the required environmental standards for slipway operation.</p>	
6.0	North Arm Cove	
6.1	<p>MP outlined terms of reference for investigations at North Arm Cove:</p> <ol style="list-style-type: none"> 1) Identify and prioritise locations for a boat ramp and jetty to cater for larger vessels 2) Identify locations for additional jetties and pontoons for public use 	
6.2	<p>It is understood that the need for a boat ramp at NAC has been established, it is just the location that is the issue. GB outlined the location of several alternative sites for a boat ramp. LR noted that Heros Bay should be crossed off the list due to conflicts with other uses and Council would not support a boat ramp proposal there. Brackens Bay was noted to be a possible site, however there is freehold land along the foreshore.</p>	
6.3	<p>LE would be pleased to look at any potential boat ramp/jetty sites and offer advice on constraints from Marine Parks perspective. Marine parks and Fisheries staff would utilise the assessment guidelines within Section 5.1.6 and 5.1.7 of <i>Policy and Guidelines for Fish Habitat Conservation and Management Update 2013</i> in addition to the assessment criteria contained within the Act, regulations and supporting policy and guidelines.</p>	
6.4	<p>It was noted that there are 2 dinghy ramp proposals at NAC, which are to be built at Water Street and Casuarina Reserve. The licence for these works is currently sitting with Crown Lands.</p>	
7.0	Tahlee	
7.1	<p>MP outlined terms of reference for investigations at Tahlee:</p> <ol style="list-style-type: none"> 1) Determine feasibility and location of future wharf/jetty 	
7.2	<p>A jetty is understood to be proposed off the end of the heritage stone harbour structure. Tahlee have been talking to boat charter companies such as 'Imagine Cruises' (Frank Future) to gauge interest in cruise visits to Tahlee, particularly during periods where adverse weather conditions prevent offshore access for dolphin watching etc. Please note: Commercial dolphin watching is not permitted west of Soldiers Point.</p>	

Item	Content	Actions
8.0	Nerong	
8.1	MP outlined terms of reference for investigations at Nerong: <ol style="list-style-type: none"> 1) Identify upgrades to existing wharf, boat ramp and pontoon 2) Identify locations for additional small craft launch/retrieval points 3) Identify locations for additional boat storage 	
8.2	BB advised that the main issue with the existing boat ramp is that the manoeuvring/parking area is too tight. BB has watched several people with varying boat sizes launch successfully at the ramp.	
8.3	LR suggested the head of the Bay may be a better place to launch boats. BB though that if money was available then this would be a good option.	
8.4	BB advised that in recent times RMS has been encouraging wake boarders from other congested areas such as Williams River to use the Nerong launching facility.	

Minutes

Present	:	Gary Blumberg (GB) – Royal HaskoningDHV (Principal Engineer) Matt Potter (MP) – Royal HaskoningDHV (Senior Engineer) Drew Morris (DM) – Great Lakes Council (Manager of Parks and Recreation) Doug Kohlhoff (DK) – North Arm Cove Residents Association (President) Ken Yearsley (KY) – North Arm Cove Residents Association (Vice President) Tony Hann (TH) – North Arm Cove Residents Association (Committee Member) Gary Sylvaney (GS) – North Arm Cove Residents Association (Committee Member) Peter Chappelow (PC) – North Arm Cove resident (ex RMS)
Absent	:	
Date	:	8 th March 2016
Copy	:	
Our reference	:	PA1268_MM0 1_160308_NAC Stakeholder Meeting_v1
Subject	:	North Arm Cove – Stakeholder Representative Meeting

Item	Content	Actions
1.0	Introduction	
1.1	GB introduced project and purpose of meeting. MP outlined scope of studies in other areas and the terms of reference for the North Arm Cove (NAC) investigation.	
2.0	Boat Ramp	
2.1	Discussions were had regarding size of design vessel for boat launching. Generally agreed that a 6-7m length vessel would be the maximum sized trailerable vessel that would use a boat ramp, and that 6.5m would represent a reasonable design vessel size for any new boat ramp at NAC. It was noted that a survey of boats in NAC was undertaken around 8 years ago by Brian de Roux.	
2.2	Beauty Point was discussed as a potential boat ramp site. This was	

Item	Content	Actions
	considered to be the 'jewel in the crown' for developers and is highly valued land.	
2.3	Brackens Bay was discussed as a potential boat ramp site. Walker Corporation (Contact: Duncan Handy) own land at the site and have a number of other land holdings in the NAC area. Brackens Bay is exposed to a south-westerly wind fetch. There is little or no seagrass in Brackens Bay, possibly related to its relative exposure.	
	GB outlined a potential proposal to site a boat ramp on the southern side of the Bay with carparking located along vacant blocks on the landward side of Promontory Way. This was considered to be worth investigating further by those at the Meeting.	
2.4	Medina Bay was discussed as a potential boat ramp site, where around 20m of waterfront is accessible via an L-shaped block. An advantage of Medina Bay is its protection from south-west winds. However, a potential issue was raised with regard to the adequacy of sight lines along Cove Boulevard when approaching the access point to a boat ramp facility.	
2.5	An area designated as public reserve at the northern limit of the study area was discussed as a potential boat ramp site. However, there were several issues with the site including: <ul style="list-style-type: none"> • close proximity to oyster leases • close proximity to Marine Park Sanctuary Zone at the head of the NAC embayment • water depths are too shallow • seagrass is known to grow in the area 	
2.6	A potential boat ramp site at Carrington (visited by boat with PC) was discussed. This site is in a remote area that would require an access road (off Carrington Road) and services to be provided. However, it is not burdened by a steep foreshore. This site may be able to service a wider area as it is located out of the NAC village and near Carrington/Tahlee.	
2.7	GS noted that from his house during summer he sees around 3 cars per day looking for boat ramps along the foreshore. GS believes there is also demand for a boat ramp at NAC from outside the area.	
3.0	Moorings	
3.1	There are a total of around 45 moorings currently in NAC. RMS has advised that they are looking to increase to a total of 70 moorings and more are being added each week.	
3.2	On the north side of Port Stephens, the only good moorings are at	

Item	Content	Actions
	<p>Karuah and NAC. There is no more room for additional moorings at Tea Gardens/Hawks Nest. The moorings at NAC are around half the price of Sydney moorings so they are attractive to people from outside the area.</p>	
3.3	<p>In NAC people are currently able to select where they would like their moorings to be located.</p>	
4.0	Jetty	
4.1	<p>A potential jetty site at Medina Bay was discussed. This site was considered to be a good pick up/drop off location as it is situated at the entrance to NAC embayment with good deep water access. It could be accessed via a 20ft wide easement from Point Circuit. The slope of the access down the easement was raised as an issue with the aging population at NAC.</p>	
4.2	<p>Casuarina Park was discussed as a potential jetty site. A 70m long jetty was thought to be required to access deep water and oyster leases were noted to be close by. Bedrock is only 2 feet under the sand.</p>	
	<p>DK advised that the Casuarina Park Masterplan included a jetty alongside the proposed dinghy skid. The dinghy skids proposed at Casuarina Park and Water Street are currently subject to Crown Lands approval. The need for these facilities is being driven by increase in NAC moorings.</p>	
	<p>There used to be a boat ramp at Casuarina Park but this didn't work due to shallow muds on the foreshore.</p>	
	<p>A jetty could be positioned through the gap in the oyster leases. The oyster leases are difficult (if not impossible) to get removed once they are established, even if they are disused.</p>	
4.3	<p>The jetty could be designed to cater for ferries as well. Ferry services have been contacted and have shown an interest in making NAC a stop along their route.</p>	
4.4	<p>A jetty was also noted as being an important facility for emergency evacuation of residents in the event of bushfires.</p>	
4.5	<p>GB thought that a jetty at Casuarina Park could incorporate a dinghy skid alongside it. This could be achieved with 2 parallel rails extending from the end of the proposed skid into deep water. The current proposed location of the dinghy skid would need to be moved to accommodate the alignment of a jetty through the gap in the oyster leases.</p>	

Item	Content	Actions
4.6	GB asked what the deck level of the jetty could be. It could be at a relatively low level but not too low as oyster growth would foul the walkway. Oyster growth is prolific in NAC and the particular species of 'feral' oysters prevalent in the area are quite sharp.	
4.7	A view was shared that the existing oyster lease structures have interrupted flow and contributed to deposition of muddy sediments along the NAC foreshore.	
4.8	It was noted that the flushing period for NAC is as much as 12 days. (This would be due to the relatively deep water in the Cove and isolation from significant wind-induced and tidal currents)	
5.0	Community Consultation	
5.1	<p>DK advised that the community can be notified through several methods:</p> <ol style="list-style-type: none"> 1. Mailout to owner addresses (some live outside the area), the Residents Association can assist with letter box drops 2. Residents Association website 3. Cove News (Maureen Kelly) 4. Community blackboards 	

Appendix D: Seagrass Mapping & Assessment Report



Great Lakes Region Boating Development Study

North Arm Cove Seagrass Mapping & Assessment



Prepared on behalf of Royal HaskoningDHV

3 November 2016 - Final Report

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SUMMARY

Royal HaskoningDHV are completing the Great Lakes Region Boating Development Study for Roads and Maritime Services (RMS). Based on a high level review of site constraints, two potential sites for new boat ramp developments have been identified at North Arm Cove, Port Stephens; Brackens Bay and Medina Bay. Ocean Environmental was engaged by Royal HaskoningDHV to undertake seagrass surveys for the two sites to confirm current mapping and help inform final site selection for the development.

This report provides the results of the seagrass field surveys undertaken at Brackens Bay and Medina Bay in October 2016, an assessment of the potential impacts relating to the proposed boating infrastructure developments on seagrass from construction and operation, and a range of mitigation / management measures to be adopted during construction and operation to help protect seagrass.



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APPENDIX 1 – NSW DPI ESTUARINE VEGETATION MAPPING (PORT STEPHENS MAP 2)



1. INTRODUCTION

1.1 Project Background & Proposed Development

Royal HaskoningDHV are completing the Great Lakes Region Boating Development Study for Roads and Maritime Services (RMS). Based on a high level review of site constraints, two potential sites for new boat ramp developments have been identified at North Arm Cove, Port Stephens; Brackens Bay and Medina Bay. The general location of these sites is shown in Figure 1.1. Concept design plans for boating infrastructure at both sites are provided in Figure 1.2 (Brackens Bay) and Figure 1.3 (Medina Bay).



Figure 1.1 General location of the two potential development sites at Brackens Bay and Medina Bay (Source: Royal Haskoning DHV 2016).

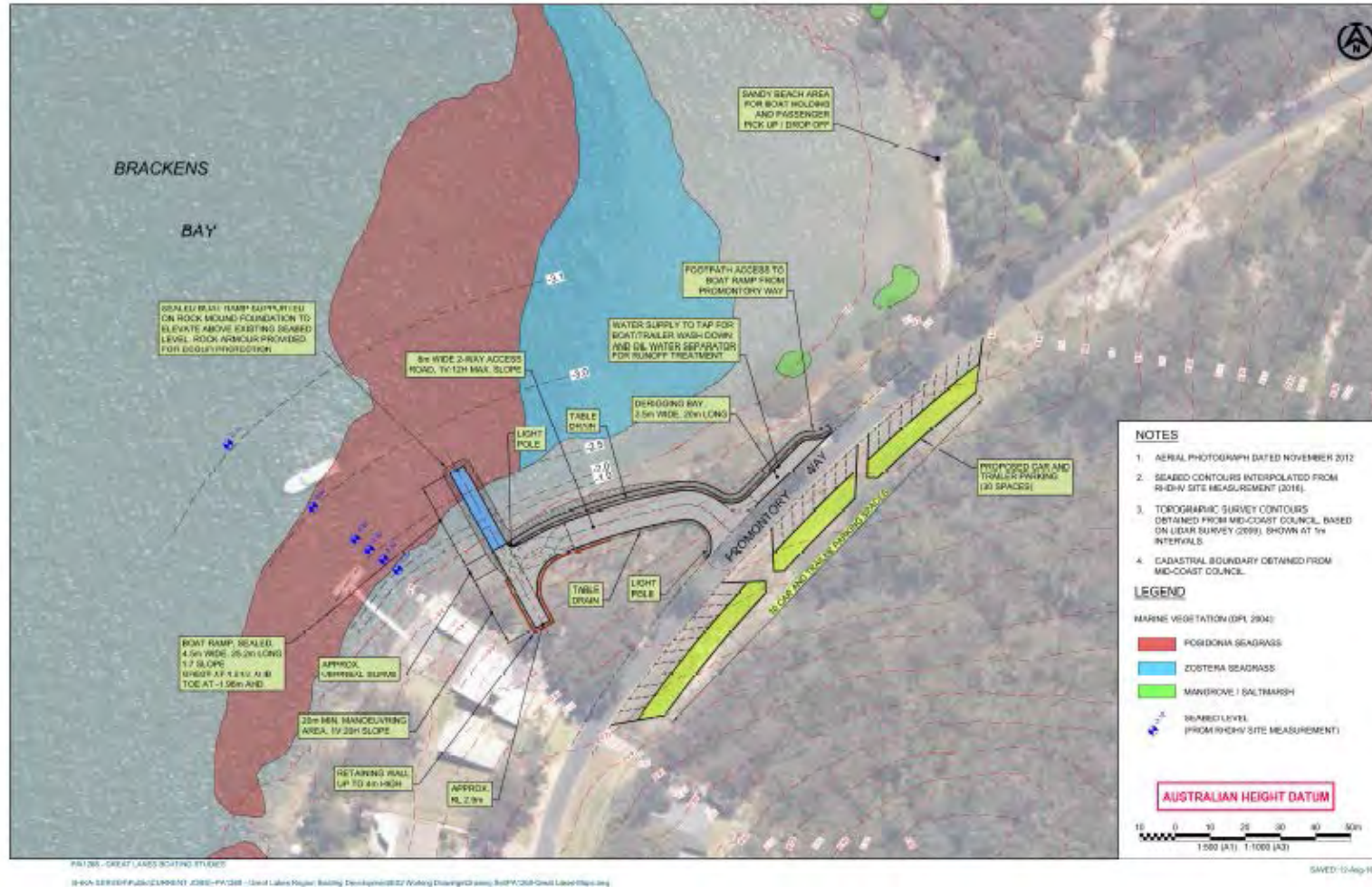


Figure 1.2 Proposed concept design plans for Brackens Bay (Source: Royal Haskoning DHV 2016).



Figure 1.3 Proposed concept design plans for Medina Bay (Source: Royal Haskoning DHV 2016)



1.2 Seagrass at the Proposed Development Sites

Estuarine habitat mapping for Port Stephens, undertaken by the NSW Department of Primary Industries (NSW DPI) (**Appendix 1**), indicates that the seagrass species *Posidonia* and *Zostera* occur within Brackens Bay, with very extensive beds present in this location. The NSW DPI mapping also indicates that *Zostera* seagrass beds occur within Medina Bay, in smaller patches. The extent of seagrass currently mapped by NSW DPI in both potential development areas is overlain on the concept design drawing in Figure 1.2 and Figure 1.3.

The presence of seagrass at the two potential boating infrastructure development sites needs to be considered when making decisions regarding the final selected site as the presence of seagrass will have the following implications for the project:

- If present, there may be potential impacts on seagrass during construction and operation of the boating facility. More extensive areas of seagrass within the selected development footprint will result in greater potential impacts on seagrass.
- A permit under s205 of the *NSW Fisheries Management Act (FM Act) 1994* to harm marine vegetation (i.e. a Part 7 Permit to Harm Marine Vegetation) will be required for the works if they have the potential to harm marine vegetation, including seagrass, either directly or indirectly. This will need to be submitted, approved and obtained prior to commencement of any construction works
- A Seagrass Management Plan and/or Monitoring Plan for the selected site may be required to be submitted to DPI Fisheries prior to construction works taking place.
- Any harm to seagrass resulting from construction or operation of the facility may need to be compensated for in a manner consistent with Policy 3.3.3.2 of the *DPI Fisheries Policy and Guidelines for Fish Habitat Conservation and Management 2013*.

1.3 Scope of Works

Ocean Environmental was engaged to undertake seagrass surveys and assessments for the two potential development sites. In summary the following tasks were undertaken:

- Background searches for aquatic vegetation mapped within both of the potential development areas (i.e. a review of the NSW DPI estuarine vegetation mapping).
- Field surveys to confirm the seagrass mapping undertaken by NSW DPI and map the current extent of seagrass within and adjacent to the proposed development footprints in Brackens Bay and Medina Bay (i.e. within a 50 m buffer area), including collection of underwater photographs and notes on seagrass density and condition.
- A general assessment of the potential impacts of the project (associated with construction and operation of the boating facility) on seagrass.
- Identification of management and/or mitigation measures to reduce the potential impacts of construction and operation of the boating facility on seagrass.
- Discussion of permitting, rehabilitation and compensation measures which may be required by DPI Fisheries.



2. STUDY METHODS

2.1 Review of Existing Data

A desktop review included a general review of seagrasses in NSW and an examination of existing NSW DPI estuarine vegetation mapping for the two sites.

2.1.1 Seagrasses in NSW

All aquatic vegetation (including mangroves, saltmarsh, seagrass and macroalgae) is protected under the NSW FM Act 1994. The NSW DPI administers legislation which protects aquatic vegetation on public water land and foreshores. Harming or removal of aquatic vegetation is generally only permissible by permit (i.e. a Part 7 Permit to Harm Marine Vegetation). An overview of seagrasses in NSW and potential threats to seagrasses is provided.

2.1.2 NSW DPI Estuarine Vegetation Mapping

Mapping of estuarine vegetation undertaken by NSW DPI was reviewed, specifically for Port Stephens (Map 2) (NSW DPI Map 30b):

http://www.dpi.nsw.gov.au/content/research/areas/aquatic-ecosystems/estuarine-habitats-maps/IINSW_EstMac_map30b.pdf (map provided in **Appendix 1**).

2.2 Seagrass Field Surveys

Field surveys of the two potential boating infrastructure development sites were undertaken on 15 October 2016, with the aim of confirming the current NSW DPI mapping and more accurately mapping the extent of seagrass at each site if required.

Conditions on the day were fine and sunny with light winds. Air temperatures ranged from 14°C to 24°C and water temperature was approximately 18°C. Underwater visibility was poor/moderate at ~ 2 - 4 m depending on location and depth. The surveys were undertaken between the hours of 11 am and 2 pm, coinciding with a run out tide.

The field surveys were undertaken within a 50 m buffer zone of the proposed development footprints as shown in Figure 2.1 and Figure 2.2. The following information was obtained during the surveys:

- Current extent and general condition of seagrass.
- Underwater and above water imagery of the survey areas.

Results of the surveys are provided in Section 3.2.



Figure 2.1 Extent of the Brackens Bay field survey (black lines show the 20 m and 50 m buffer zone around the proposed development) (Source: Royal Haskoning DHV).



Figure 2.2 Extent of the Medina Bay field survey (black lines show the 20 m and 50 m buffer zone around the proposed development) (Source: Royal Haskoning DHV).



2.3 Potential Impacts and Mitigation

Potential impacts on seagrass which may occur during the construction and operation of the boating infrastructure facilities are described in Sections 4.1 and 4.2.

Proposed mitigation / management measures to protect seagrass which may be adopted during and after construction are also described in Sections 4.1 and 4.2.

2.4 Permitting, Rehabilitation and Compensation

A discussion of the NSW DPI permitting requirements (associated with marine vegetation) for the project, along with potential options for rehabilitation or compensation which may be required by NSW DPI if any harm to seagrass in the area is detected following construction is provided in Section 5.



3. RESULTS

3.1 Review of Existing Ecological Data

3.1.1 Seagrasses

Seagrasses are a unique group of marine flowering plants which are generally found in shallow subtidal and intertidal zones of protected bays and estuaries. Like any plant species, seagrasses require sunlight to photosynthesise and grow so are generally restricted to areas where sufficient penetration of sunlight through the water column is available. This may be influenced by water depth and/or turbidity (NSW DPI 2007).

Seagrasses have an extensive rhizome (root) structure and grow in soft sediments such as sands or muds. They have specialised tissue which allows them to absorb nutrients from soft sediment. For this reason they are important contributors to coastal productivity and biodiversity and play an important role in nutrient cycling through the uptake of nutrients. They can also substantially alter the oxygen concentrations in sediments by releasing oxygen through their rhizomes. Their extensive rhizome structure also results in them being particularly important in maintaining sediment stability (NSW DPI 2007).

Seagrasses serve three key functions:

1. They provide habitat (in particular shelter and nursery areas) for fish and other aquatic fauna.
2. They help to reduce erosion and improve water quality.
3. They are a source of food for fish and other aquatic fauna (NSW DPI 2007).

Seasonal variation in the extent, biomass, shoot or epiphyte characteristics of seagrasses have been reported, with senescence over the cooler winter months often occurring, with re-establishment in summer (Bulthuis and Woelkerling 1983; McKenzie 1994; Lanyon and Marsh 1995; Kendrick and Burt 1997; NSW DPI 2007; Hansen and Reidenbach 2013). While growth in seagrasses is known to vary spatially and temporally, a lack of research means it is often difficult to determine if fluctuations in seagrass beds reflects human impacts or natural variability (Jordan *et al.* 2002).

SEAGRASSES IN NSW

Australia has the largest and most diverse assemblage of seagrasses in the world, including about half of the ~70 species which are thought to occur worldwide. There are an estimated 51,000 km² of seagrass meadows in Australia. Most recent estimates (from 2005) indicate that NSW has approximately 159 km² of seagrass (from 144 surveyed estuaries). This is slightly higher than previous estimates 154 km² (from 1985), yet overall, these numbers indicate that seagrass is quite rare in the state (NSW DPI 2007).



Six species of seagrass occur in NSW including *Posidonia australis* (strapweed), *Zostera capricorni*, *Zostera muelleri*, *Heterozostera nigricaulis* (all commonly called eelgrass or ribbonweed), *Halophila ovalis* and *Halophila decipiens* (both called paddleweed). The three most widespread species are *Z. capricorni*, *H. ovalis* and *P. australis*, respectively (NSW DPI 2007). The characteristics and distribution of each species in NSW are provided in Table 3.1.

Any area of *P. australis* seagrass, or areas of *Zostera*, *Heterozostera*, *Halophila* and *Ruppia* seagrass >5 m² in area are classed as TYPE 1 Marine Vegetation - Highly Sensitive Key Fish Habitat under the NSW DPI Policy and Guidelines for Fish Habitat Conservation and Management 2013. NSW DPI will generally not approve any new developments or activities that will harm TYPE 1 marine vegetation without adequate mitigation and compensation measures in place (refer to Section 5)(NSW DPI 2013).

Table 3.1 Characteristics and distribution of NSW seagrasses (Source: NSW DPI 2007).

Common Name	Scientific Name	Distinguishing Features	Distribution in NSW
Strapweed	<i>Posidonia australis</i>	<ul style="list-style-type: none"> • Largest leaves of any seagrass in NSW in terms of leaf width and bulk. Thick, stiff, strap-like leaves 30 – 60 cm in length and 6 – 14 mm wide with rounded ends. • Leaves are bright green. • Occurs below mean low water mark. • Strong 2 cm diameter creeping rhizome. • Flowers in early spring. The buoyant green fleshy fruit are often found on beaches in late Dec. 	Occurs in about 20 NSW estuaries, southwards from Wallis Lake to Twofold Bay.
Eelgrass or Ribbonweed	<i>Zostera capricorni</i>	<ul style="list-style-type: none"> • The most common seagrass in NSW. • Found on tidal flats in most rivers and lagoons. • Leaves range from short narrow leaves to long wide leaves 1 – 50 cm long and 1 – 5 mm wide. • Leaves occur in bundles of 4 – 6 and leaf tip is rounded. • Olive green to brown. 	Entire NSW coast.



		<ul style="list-style-type: none"> • Has slender rhizome and upright reproductive stems. 	
	<i>Zostera muelleri</i>	<ul style="list-style-type: none"> • Very similar to above, but generally smaller, narrower strap-like leaves with notched tips. • Leaves are up to 50 cm long and 1 - 5 mm wide. 	Some estuaries south of Jervis Bay to the Vic border.
	<i>Heterozostera nigricaulis</i>	<ul style="list-style-type: none"> • Very similar to above, but with leaves arising from upright stems (can be confused with reproductive stems of <i>Zostera</i> spp.), up to 50 cm long and 1 - 5 mm wide. 	Some estuaries, south of Port Stephens to the Vic border.
Paddleweed	<i>Halophila ovalis</i>	<ul style="list-style-type: none"> • Paired oval leaves, ranging from short narrow leaves to long wide leaves 1 - 5 cm long and 5 - 20 mm wide. • Leaves have a blunt apex and 4 - 5 longitudinal veins. • Bright green to brown. • The delicate creeping rhizome is usually white and translucent. 	Entire NSW Coast.
	<i>Halophila decipiens</i>	<ul style="list-style-type: none"> • Very similar to <i>H. ovalis</i>, except for fine hairs visible under a microscope. • Paired oval leaves, 1 - 5 cm long and 5 - 20 mm wide. 	Entire NSW coast, but mainly in Sydney region.

(Information from West 1989).



GENERAL THREATS TO SEAGRASSES

Seagrasses are fragile and may be damaged directly and indirectly through a number of natural and anthropogenic sources. The most common direct cause of seagrass decline is the reduction of light availability (Burdick and Short 1999; Jordan *et al.* 2002; Shafer 2002). Reductions in light levels may be caused by increased nutrient levels and turbidity from a range of point and diffuse sources relating to water or land based development, catchment management practices, stormwater and sewage discharges. Elevated nutrient levels from stormwater and sewage discharges may promote epiphytic algal growth on seagrass fronds. Epiphytic growth on seagrass leaves is essentially a form of shading which can limit the ability of seagrasses to photosynthesise (Bulthuis and Woelkerling 1983; NSW DPI 2007). Higher turbidity levels reduce the amount of light reaching seagrass beds, with deeper beds most vulnerable to light reductions. As seagrass density strongly influences the community structure and abundance of fishes (Jordan *et al.* 2002) and invertebrates (Edgar *et al.* 1995), decreases in density can result in considerable loss of benthic diversity and productivity.

Direct physical disturbance of seagrass beds from coastal developments which physically disturb the seafloor may occur e.g. dredging and reclamation of shallow estuarine areas. In addition, shading of existing seagrass beds by newly installed foreshore structures including pontoons and jetties is common and depending on the extent and degree of shading can be harmful. Physical scouring and sedimentation of seagrass beds by stormwater drains is also possible (NSW DPI 2007).

Boating related activities are also documented to cause harm to seagrass beds. The scarring of seagrass beds by direct contact from boat hulls, propellers and prop wash have all been linked to detrimental effects upon seagrass (Sargent *et al.* 1995; Burfeind and Stunz 2006). Boat anchors can cause damage to the seabed and scouring of seagrass beds by swing moorings can be significant (Hastings *et al.* 1995; Montefalcone *et al.* 2008).

Other potential causes of seagrass decline include:

- Storms, floods and disease.
- Invasive species.
- Some fishing practices.
- Algal blooms.
- Global warming (NSW DPI 2007).

3.1.2 NSW DPI Estuarine Vegetation Mapping

Estuarine vegetation maps for Port Stephens were prepared by NSW DPI using aerial photography from 1997 and 2001, ground truthed via field surveys in 2004. The Port Stephens Map 2, which contains the study areas, is provided in **Appendix 1**.

Figure 3.1 provides an excerpt from this map and shows that *Posidonia* and *Zostera* seagrass are both widespread in Brackens Bay, while smaller patches of *Zostera* seagrass occur in



Medina Bay. These areas of seagrass have been delineated more clearly on the concept design plans (Figure 1.2 and Figure 1.3) and also in the field survey buffer zone figures (Figure 2.1 and Figure 2.2).

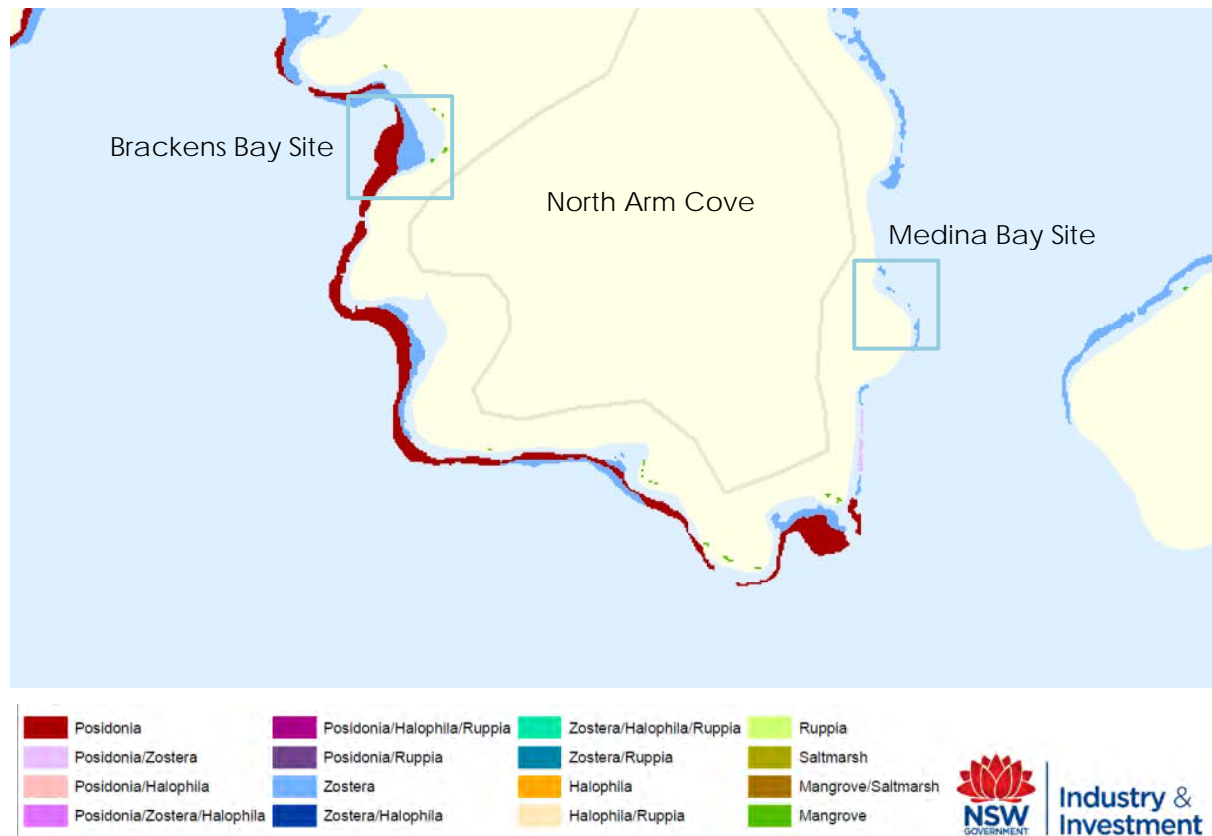


Figure 3.1 NSW DPI aquatic vegetation mapping (excerpt from Port Stephens Map 2) showing the general location of the two potential development sites.

3.2 Results of the Field Survey

3.2.1 Brackens Bay

The field survey undertaken in Brackens Bay confirmed the extensive extent of *P. australis* and *Z. capricorni* seagrass within this area, as mapped by NSW DPI. Almost the entire subtidal habitat within the 20 m buffer zone and the vast majority of the 50 m buffer zone was inhabited by *P. australis* as delineated in Figure 3.2. This seagrass was in good condition and quite dense throughout most of the survey area, especially in the shallower areas. Density decreased slightly in deeper parts of the study area and some sedimentation of seagrass was evident in these deeper areas owing to the muddier seafloor (see images in Figure 3.3).

Slight differences in the location of division between *Posidonia* and *Zostera* seagrass beds in Brackens Bay, as had previously been mapped by NSW DPI, were noted. The division between the dark dense area of seagrass and slightly darkened area, shown in Figure 3.2



(based on 2015 aerial imagery from Nearmap), is the more likely current distribution. This slight change in local distribution is not surprising considering the 12 year gap between the NSW DPI surveys and current survey. Furthermore, it is expected that some finer scale temporal changes in the local distribution of both species may occur (e.g. seasonally) which could be assessed with the use of high quality aerial imagery if available for the site.

The *Zostera* seagrass present within the 20 m and 50 m buffer zones of the proposed Brackens Bay development was of low to medium density and fronds were quite short and thin. This may indicate that recolonisation of this species after winter senescence is starting to occur, or that localised impacts on nearshore seagrass beds such as smothering by mobile sand bars occur in this area. Images of *Zostera* at the site are shown in Figure 3.3.

A number of mangrove trees were present along the shoreline as shown in Figure 3.2 but these were located outside of the 20 m and 50 m buffer zones.

The considerable extent and high density of seagrasses located within the 20 m and 50 m buffer zones of the proposed Brackens Bay site, along with the large extent of seagrass mapped by NSW DPI in the greater Brackens Bay area, indicate that development here will have a considerable localised impact on seagrass.

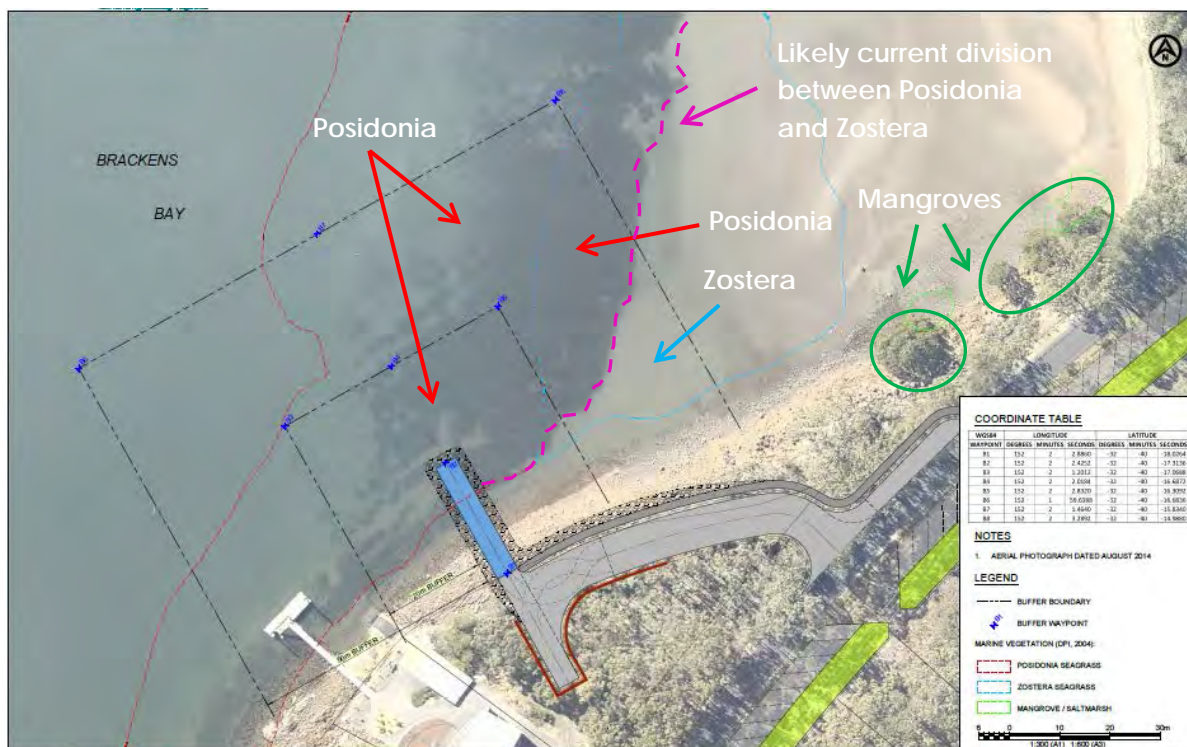
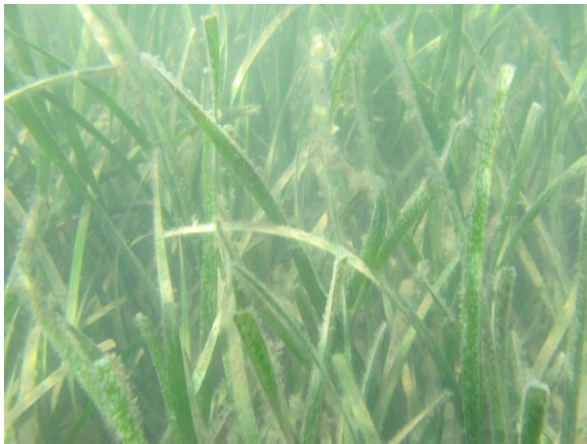
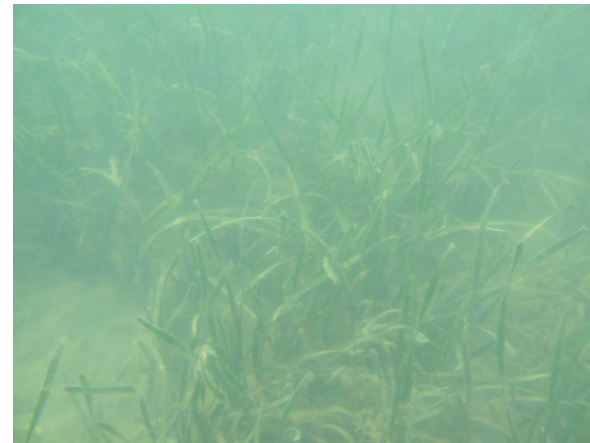
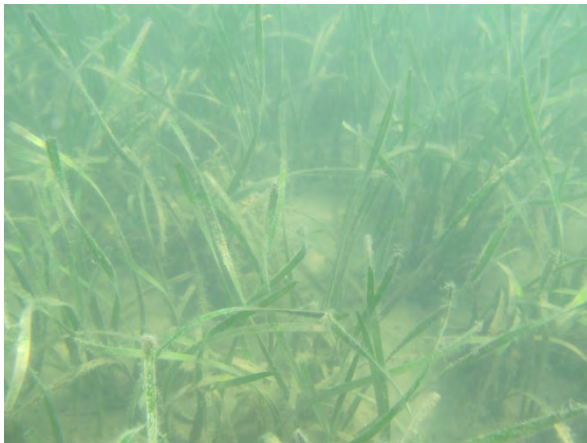


Figure 3.2 Distribution of seagrass within the 50 m buffer zone in Brackens Bay.



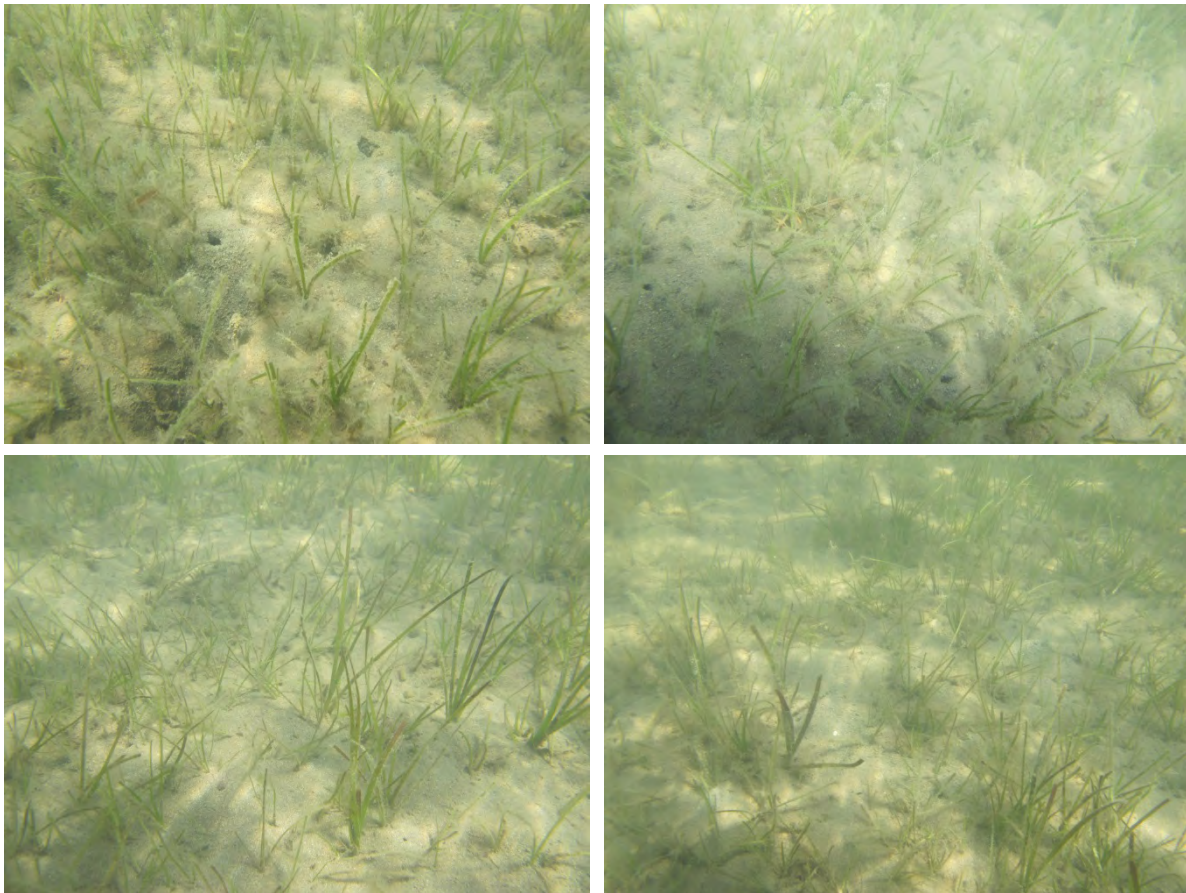
Posidonia australis in the Brackens Bay study area – condition in shallower areas.



Posidonia australis in the Brackens Bay study area – condition in deeper areas.



Division between *Posidonia* and *Zostera* seagrass in the Brackens Bay study area.



Zostera capricorni in the Brackens Bay study area.

Figure 3.3 Images of seagrass in the Brackens Bay study area.

3.2.2 Medina Bay

The Medina Bay field survey found that all the *Zostera* seagrass previously mapped by NSW DPI in this area was currently present. However, in most cases the patches of seagrass currently present at the site were slightly more extensive than the previous DPI mapping. In addition, two small patches of seagrass not mapped by NSW DPI were observed. Figure 3.4 shows the footprint of the proposed boating infrastructure in Medina Bay along with the NSW DPI mapping and revised mapping resulting from the field survey.

The *Zostera capricorni* seagrass in Medina Bay was generally of low to medium density and the condition and length of seagrass varied between patches. Sedimentation of seagrass was often high in the deeper muddier areas. Epiphytic growth on seagrass was also substantial in places. No other species of seagrass was detected in this location. However, marine macroalgae was found growing around the subtidal rocky fringes of the entire foreshore and amongst the seagrass in the northern most seagrass patch in the study area. Epiphytic growth on macroalgae was also high. Images of seagrass at Medina Bay are provided in Figure 3.5. Images of macroalgae at Medina Bay are provided in Figure 3.6.

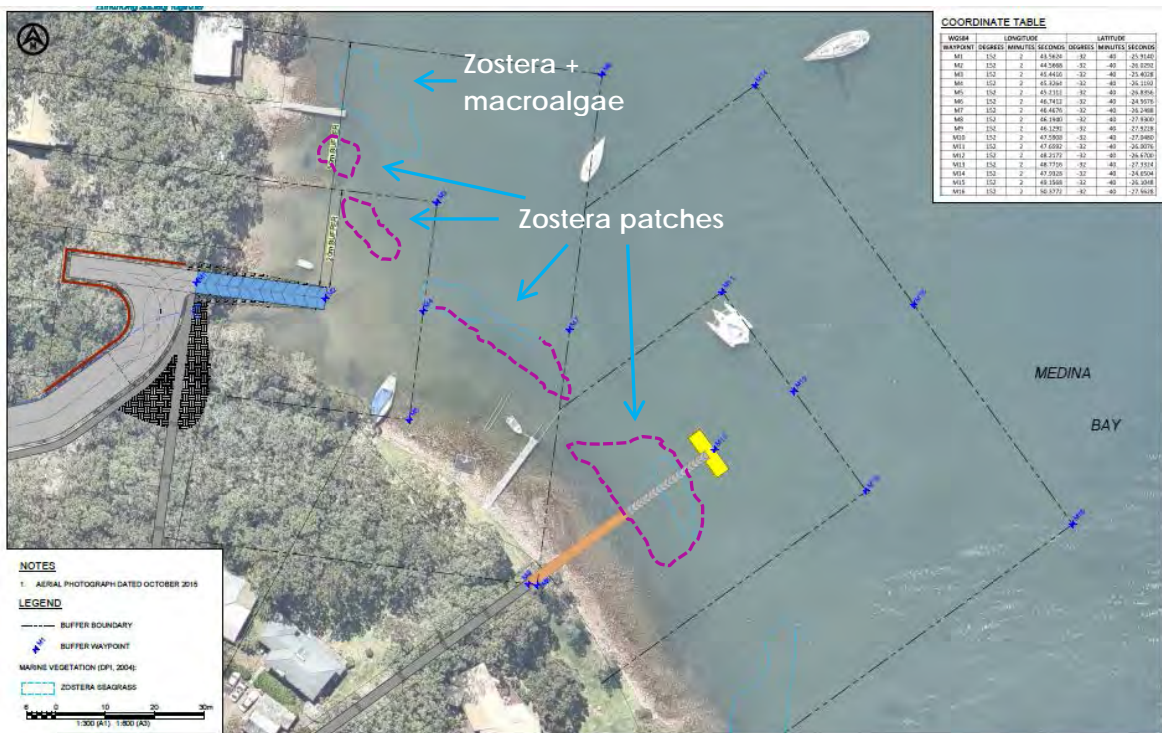
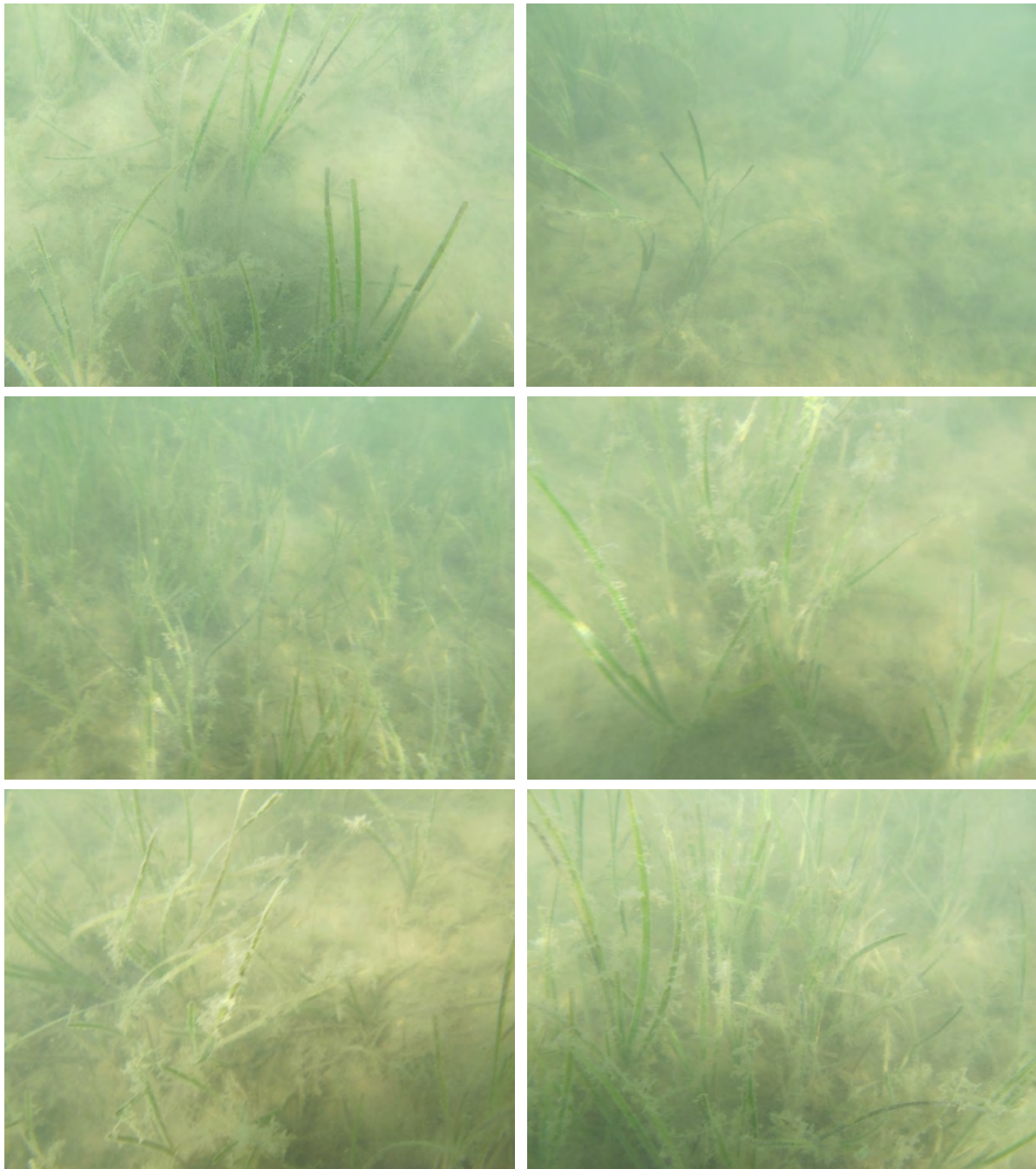
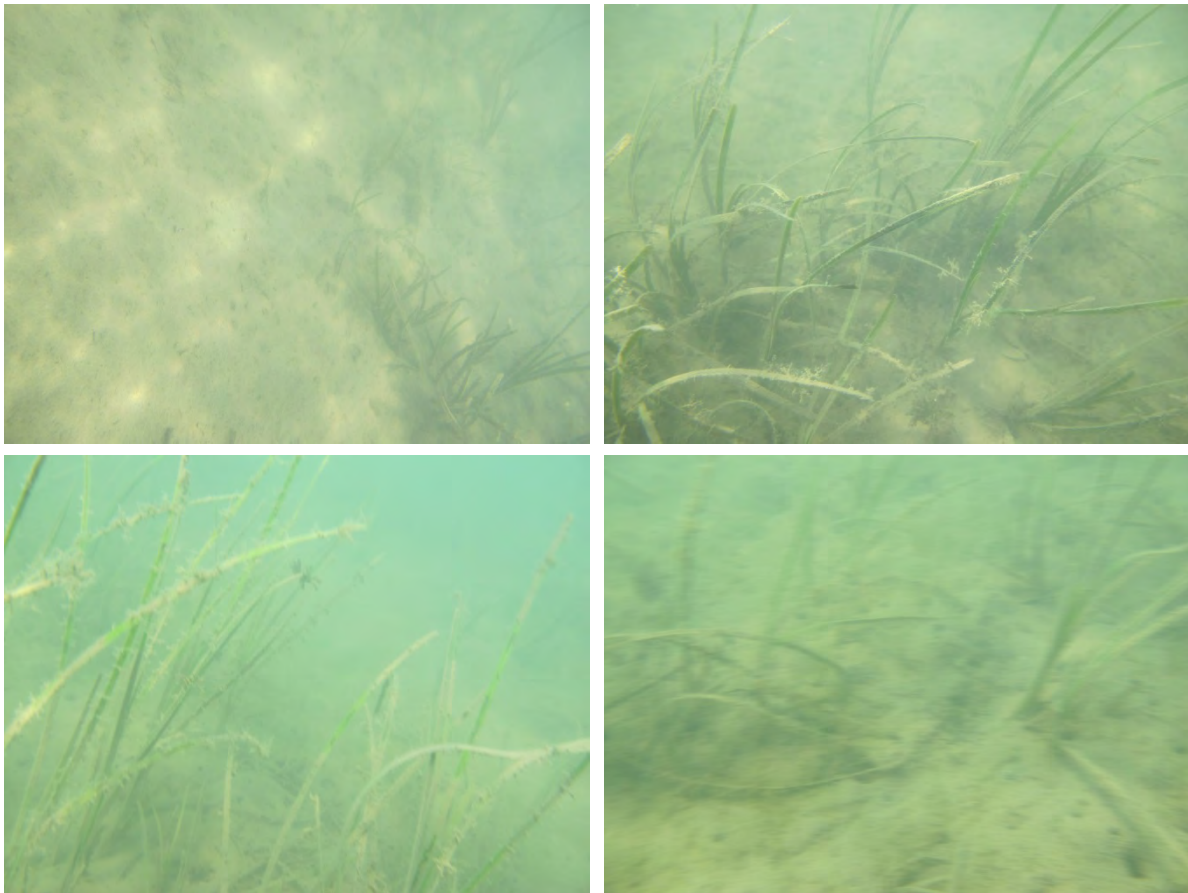


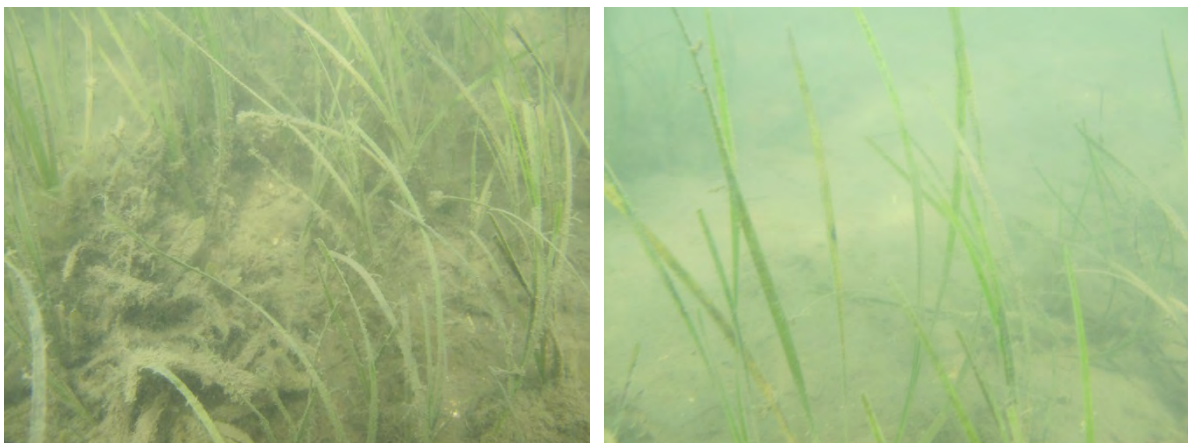
Figure 3.4 Distribution of seagrass within the 50 m buffer zone in Medina Bay (blue lines indicate NSW DPI mapping and purple lines indicate revised current distribution).

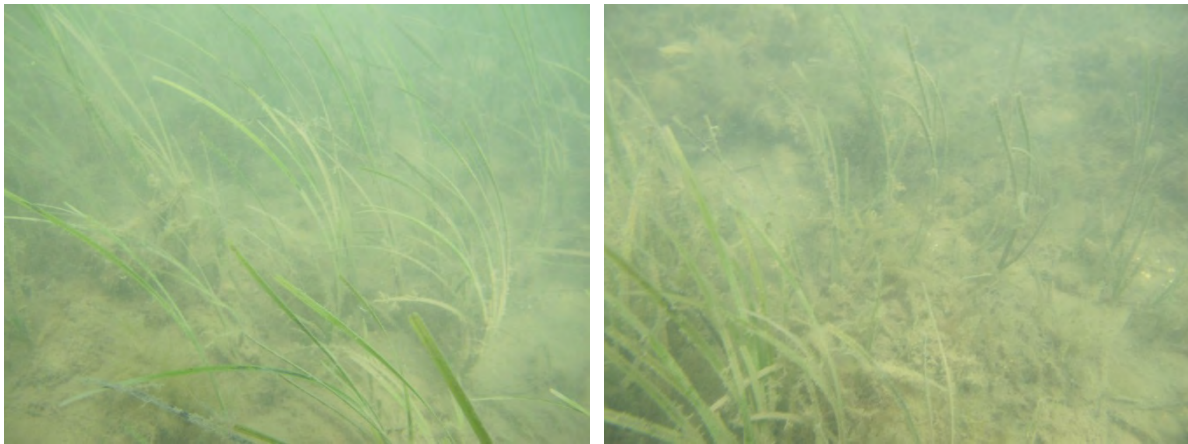


Seagrass patches located north of the proposed boat ramp.



Central seagrass patch near the existing private jetty.





Seagrass in the vicinity of the proposed public wharf at the south of the study area.

Figure 3.5 Images of seagrass in Medina Bay.



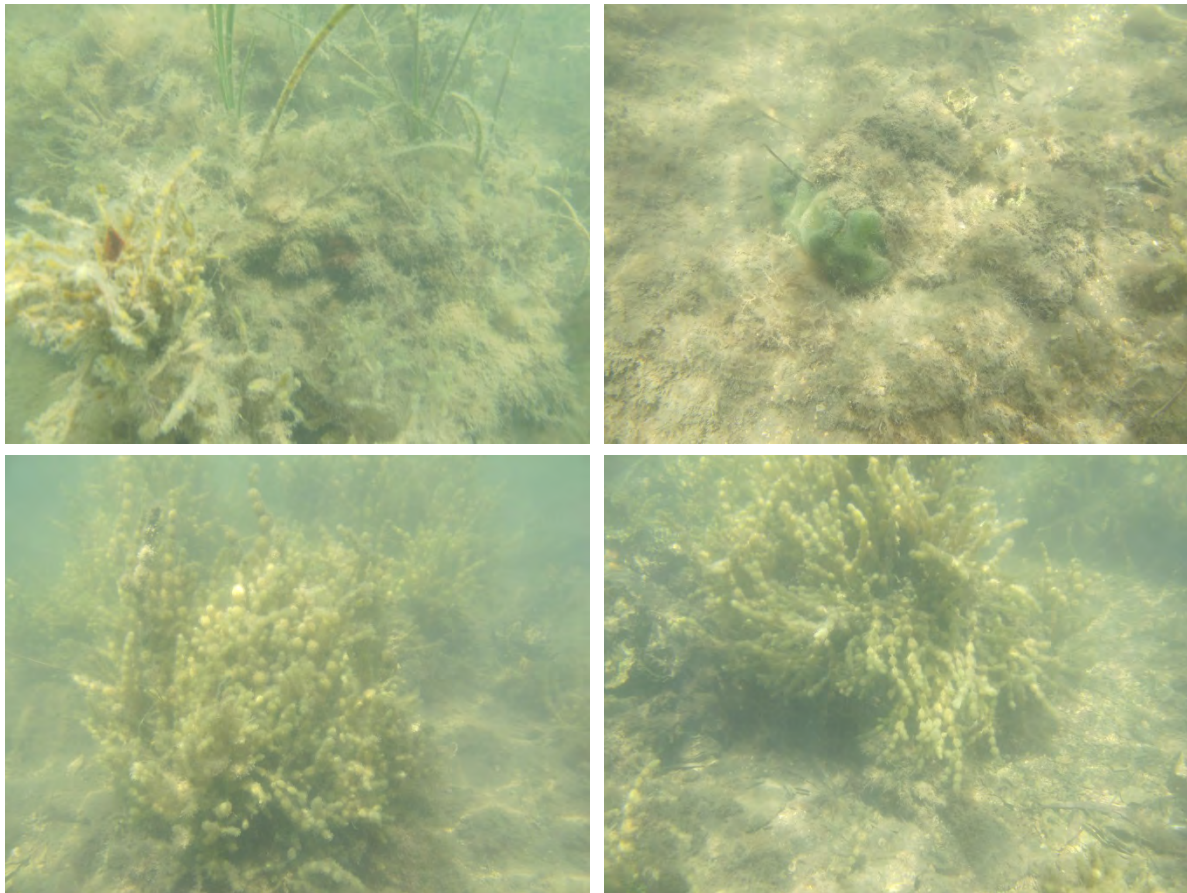


Figure 3.6 Images of macroalgae in Medina Bay.



4. POTENTIAL IMPACTS & MITIGATION

Potential construction and operational impacts on seagrass resulting from the proposed North Arm Cove boating infrastructure (N.B. this is a general assessment based on the fact that no site has yet been selected or actual project details determined), along with ways to manage / mitigate these are outlined in Sections 4.1 and 4.2 respectively.

4.1 Construction Phase

Potential construction related impacts on seagrass along with mitigation measures are provided in Table 4.1.

Table 4.1 Construction phase impacts and mitigation.

Potential Impact	Mitigation / Management
<p>Light reductions caused by increased turbidity resulting from construction activities that generate either:</p> <ol style="list-style-type: none"> 1. runoff of soils from the foreshore (e.g. stabilisation works / revetment works / creation of access ways / reclamation / installation of boat ramps); or 2. resuspension of sediment in the waterway (e.g. piling work, dredging or construction vessel activities), <p>causing harm to seagrass.</p>	<p>Any localised and short term reductions in light penetration caused by increased turbidity are not expected to cause significant harm to seagrasses given that the waterway is often affected by high levels of turbidity.</p> <p>However, the use of appropriate sediment controls for any land based construction (i.e. sediment fencing) and around any in-water works (i.e. silt curtains and/or sleeves around piling or dredging activities) will help to prevent increases in turbidity and mitigate this impact.</p> <p>Construction vessels should aim to minimise disturbance of bottom sediments by undertaking water based works during periods of high tide where possible, ensuring that vessel speeds are low in shallow areas and limiting any unnecessary anchoring.</p> <p>Contractors should be made aware of the location of seagrass beds at the site and also the ways in which they can reduce harm to these beds via a Construction Environment Management Plan (CEMP).</p>
<p>Sedimentation of seagrass beds through the resuspension of seafloor sediments caused</p>	<p>The spread of resuspended sediments and potential sedimentation of seagrass beds</p>



<p>by piling works, dredging and/or construction vessel activities (e.g. propeller wash, anchoring), or from land based runoff.</p>	<p>caused by water based works (e.g. piling or dredging) can largely be mitigated with the use of silt curtains around the immediate construction zone and/or sleeves around any piles being installed. Any seagrass within the actual development footprints (i.e. in areas piles or dredging are planned) will likely be directly impacted however.</p> <p>Sediment control fencing should be used between any land based works and the waterway to prevent runoff of soils into the waterway and onto the seagrass beds which occur near the foreshore.</p> <p>Special care should be taken to separate mapped seagrass areas from the land based and water based construction works with sediment and erosion control devices.</p> <p>Care should also be taken not to contain areas of seagrass within sediment control devices wherever possible, as if this occurs, when the sediment settles, the level of sedimentation of these beds will be more severe than if not used at all (i.e. the sediment will become trapped and settle on the beds).</p> <p>Water based works should be undertaken during periods of high tide where possible to reduce the potential for vessel propeller wash causing resuspension of bottom sediments and therefore minimise potential sedimentation impacts from propeller wash.</p>
<p>Direct harm to seagrass beds from the installation of new structures (e.g. piling for wharves / reclamation of seafloor for boat ramps), dredging which may be required for boat access and by construction vessels (e.g. through anchoring, propeller wash and wave scarring).</p>	<p>Direct harm to seagrass within the proposed construction footprint may be unavoidable so the final selected site should take into account the extent, species and health of seagrass in the area which will likely be directly harmed.</p> <p>No anchoring of construction vessels should be allowed over areas of mapped seagrass, or in the close vicinity of seagrass beds (to avoid impacts of dragging anchor lines/chains). Seagrass maps should be</p>



	<p>provided to contractors showing the location of seagrass beds and 'no anchoring' zones (i.e. within and nearby seagrass beds).</p> <p>During periods of low tide and clear waters the seagrass beds at the site should also be highly visible to contractors.</p> <p>Construction vessels should avoid travelling over seagrass beds, especially at low tide, to minimise potential sedimentation impacts from propeller wash.</p> <p>Low vessel speeds should be kept to reduce the potential impacts of wave scarring / wash on the nearshore seagrass beds.</p>
<p>Water quality impacts e.g. spills of fuels and oils from construction vessels, which have the capacity to cause harm to fragile benthic communities such as seagrasses and the mobile fauna which reside in and depend on them.</p>	<p>All equipment / construction vessels used should be well maintained and regularly serviced to ensure they are in proper working order and reduce the likelihood of fuel / oil leaks and spills.</p> <p>Pre-start equipment checks should be undertaken to ensure that there are no leaks of fuels / oils occurring.</p> <p>Oil spill response kits should be kept on construction vessels and on the land at all times during the works. All contractors should be trained to respond and use these.</p> <p>If a spill occurs works should cease until it is cleaned up and the cause is rectified.</p> <p>All waste materials should be contained and disposed of appropriately offshore.</p>



4.2 Operation Phase

Potential impacts during operation of the North Arm Cove boating infrastructure and ways to mitigate / manage these impacts are provided in Table 4.2.

Table 4.2 Operation phase impacts and mitigation.

Potential Impact	Mitigation / Management
<p>Shading of seagrass beds caused by new floating pontoons, gangways and wharves.</p>	<p>If located over seagrass beds some shading of seagrass during various times of day may occur.</p> <p>To help mitigate this impact, any new structures that are located directly over seagrasses e.g. wharves or gangways, should utilise mesh decking to allow light to penetrate through to the seagrass beds.</p>
<p>Sedimentation of seagrass beds through resuspension of seafloor sediments from boating activities (e.g. propeller wash).</p>	<p>Vessels should avoid travelling over seagrass beds, especially at low tide, to minimise potential impacts from propeller wash.</p> <p>Vessels should maintain low speeds when approaching the facilities near seagrasses (this is expected to occur as NSW Maritime bylaws have a 10 knot speed limit within 30 m of moorings so any vessel being navigated in this area should be doing so at low speed).</p> <p>The running of engines and props when waiting on the wharves should be avoided.</p> <p>Users of the facilities should be made aware of the presence of seagrass in the area and ways to avoid impacts on seagrass. Maps or signage on the boat ramps / wharves could be provided.</p>
<p>Direct harm to seagrass beds from vessel anchors, propeller wash and wave scarring.</p>	<p>No anchoring should be allowed by over any areas of mapped seagrass.</p> <p>Vessels should avoid travelling over seagrass beds, especially at low tide, to minimise potential sedimentation impacts from propeller wash.</p> <p>Vessels should maintain low speeds when</p>



	<p>approaching the facilities to avoid any impacts of wave scarring / wash on nearshore seagrasses.</p> <p>The running of engines and props when on the wharf should be avoided.</p>
<p>Water quality impacts caused by accidental spills of fuels and oils, sewage and general waste from boats using the facilities which have the capacity to cause harm to fragile benthic seagrass communities and the fauna which reside in and depend on them.</p>	<p>All vessels should be well maintained and regularly serviced to ensure they are in proper working order and reduce the likelihood of fuel / oil leaks and spills.</p> <p>No release of sewage into the waterway is allowed.</p> <p>Waste disposal facilities should be readily available at the site so users have an area to dispose of their waste and avoid illegal dumping into the waterway.</p>

4.3 General Guidelines

General Guidelines which should be adopted by the marina include the following:

4.3.1 Environmentally Friendly Seawalls (OEH 2012)

This document provides design measures which could be adopted during the design and construction of any foreshore stabilisation works to increase the value of intertidal and foreshore habitats for aquatic flora and fauna. This document is provided online at:

<http://www.environment.nsw.gov.au/resources/estuaries/pubs/090328-Seawall-Guide-2012-Reprint.pdf>

4.3.2 Fish Friendly Marinas (NSW DPI 2016)

This "10 Tips for Fish Friendly Marinas" document provides measures for marina operators to make their marinas more 'friendly' to fishes. Some of these measures may also be adopted for the proposed boating infrastructure facilities. The "10 Tips for a Fish Friendly Marina" are provided online at:

http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0004/633928/MIA-10-tips-for-a-Fish-Friendly-Marina-Booklet-260216.pdf



5. PERMITTING, REHABILITATION AND COMPENSATION

5.1 Permitting

Due to the presence of seagrass within the footprint of the proposed developments at both potential North Arm Cove sites, a Part 7 Permit under s205 of the NSW FM Act 1994 to Harm Marine Vegetation will be required for the activity, regardless of the chosen site. This will need to be applied for and approved by NSW DPI (Fisheries) prior to commencement of any construction works.

Taking into account the species, extent, density and quality of seagrasses in both locations it is considered more likely that Fisheries would approve development in Medina Bay than Brackens Bay.

5.2 Rehabilitation and Compensation

Section 3.3.3 of the NSW DPI Fisheries Policy and Guidelines for Fish Habitat Conservation and Management 2013 provides information regarding rehabilitation and compensation measures which may be required to mitigate damage to fish habitat (i.e. seagrass beds in the current case).

Two main types of activity can be used to mitigate damage to fish habitat:

1. Habitat Rehabilitation – i.e. repairing damage caused by past activities.
2. Environmental Compensation – i.e. creation or enhancement of fish habitat or fisheries resources in order to compensate for actual or anticipated adverse effects.

5.2.1 Habitat Rehabilitation

Features of Habitat Rehabilitation are:

- Can be either passive or active.
- Passive rehabilitation is the act of leaving a habitat to recover naturally over time. This is generally of low cost but success can vary greatly and the timeframe for rehabilitation may be in the decades, if it occurs at all.
- Active rehabilitation includes the use of remedial engineering works, construction of artificial habitats, habitat enhancement, restocking, re-snagging, removal of exotic species, fencing of stock and revegetation to rehabilitate habitat.

5.2.2 Environmental Compensation

Features of Environmental Compensation are:



- Compensation must consider the representativeness and value of different types of habitat (e.g. based on increased productivity or biodiversity of fish).
- May involve replacement of one habitat type with another (e.g. replacement of mangroves with saltmarsh).
- May include:
 - structures which represent an integral part of the development (e.g. groynes, pylons, artificial waterways),
 - works which are undertaken as compensation for disturbance of ecologically important habitats (e.g. transplanting vegetation, fishways, environmental flows, removal of barriers to fish passage, removal of polluted areas), or
 - money to pay for the value of the habitat lost.

5.2.3 Policy and Guidelines for Habitat Rehabilitation and Environmental Compensation

Section 3.3.3.2 of the Policy and Guidelines for Fish Habitat Conservation and Management 2013 outlines Policy and Guidelines for Habitat Rehabilitation and Environmental Compensation. These are summarised below.

- 1) NSW DPI enforces a 'no net loss' habitat policy as a permit condition or condition of consent. This may require proponents to conduct habitat rehabilitation and/or provide environmental compensation. A monetary bond or payment may be required to be lodged with NSW DPI to ensure the works are completed in accordance with the permit conditions.
- 2) NSW DPI calculates habitat compensation on a minimum 2:1 basis for all key fish habitat. A greater compensation ratio may be considered if opportunities for compensation are not available in the vicinity of, or of the type of, habitat that has been lost. Compensation for disturbances to SEPP 14 coastal wetlands (which may include TYPE 1 and 2 habitats) requires approval from the Department of Planning and Infrastructure and a ratio of 10:1 generally applies. This is calculated at the rate of \$51/m² for marine and freshwater vegetation which equates to \$102/m² to meet the 2:1 habitat offset requirement.
- 3) NSW DPI does not support seagrass transplanting as an impact compensation measure as the viability of transplanting methods is yet to be scientifically proven for all species. In circumstances where seagrass is likely to be negatively impacted and cannot be avoided or mitigated, environmental compensation will be required and calculated in line with the rate outlined in point 2 above.
- 4) In the case of mangroves and saltmarsh, transplanting the vegetation from the impact site to the compensation site may be required.
- 5) NSW DPI requires a management plan be developed for any compensatory area of habitat that ensures:
 - a. replanting, transplanting and monitoring methods are documented in accordance with the permit conditions;
 - b. the site is suitable for habitat creation (e.g. is of suitable substrate and depth, not exposed to excessive pollution);



- c. in the case of revegetation, species used must be endemic to the area and suitable for the site;
- d. performance indicators are set to adequately measure success of the project over time and to identify where responses are not being achieved.

Guidelines for implementing the above policies include:

- a) Opportunities to enhance and/or protect existing key fish habitat, and to avoid direct or indirect impacts on such habitats is preferred and should always be explored as a first option.
- b) NSW DPI supports strategic resource investment such that rehabilitation efforts should primarily be invested in areas where there is likelihood of rehabilitation success (key fish habitats with high recovery potential).
- c) Subject to point b above, habitat rehabilitation and compensation should take place as close as possible to the site of the impact to achieve 'no net loss' of habitat within the area affected and the catchment as a whole.
- d) Pre-development habitat compensation (i.e. prior to disturbance) is recommended over post-development compensation (i.e. after the habitat is lost).
- e) Repair of degraded habitat is recommended over habitat creation and should be conducted as close to the site of proposed 'habitat loss' as possible.
- f) Transplanting of aquatic vegetation should only be undertaken if an appropriate donor site is available or where reestablishment is likely to be successful (e.g. plants with vegetative growth and fairly shallow roots – e.g. sedges and rushes).
- g) Where affected habitat is less sensitive, secondary compensation may be more appropriate than implementing a 'like for like' habitat replacement policy.
- h) Habitat rehabilitation efforts should be directed at achieving the maximum benefits for fish habitat and fisheries. Proposals should be discussed with NSW DPI to ensure that efforts are directed at key fish habitat areas as a priority, methods used are appropriate and relevant approvals are obtained prior to the commencement of works.

5.2.4 Environmental Bonds

The lodgement of an environmental bond may be a permit requirement for developments that present a risk of causing significant impact on key fish habitats or fisheries resources and/or require substantial performance in terms of environmental protection/outcomes.

The purpose of the bond is to ensure predicted outcomes / proposed mitigation measures are implemented and achieved. Examples of the types of activities that generally require an



environmental bond include developments which may impact on protected areas, protected or threatened species and TYPE 1 and 2 key fish habitats.

Calculation of environmental bonds will be undertaken by NSW DPI Fisheries in accordance with the information outlined in Section 3.3.4.2 of the DPI Fisheries Policy and Guidelines for Fish Habitat Conservation and Management 2013.

On satisfactory completion of the works in accordance with permit conditions and where predicted outcomes / mitigation measures are achieved, the bond will be returned.

A monitoring program may be required as a condition of consent to measure the success of any compensation or rehabilitation requirements. The bond may only be redeemable on the completion of the monitoring program and providing the rehabilitation or compensation measures were successful based on specified performance criteria.



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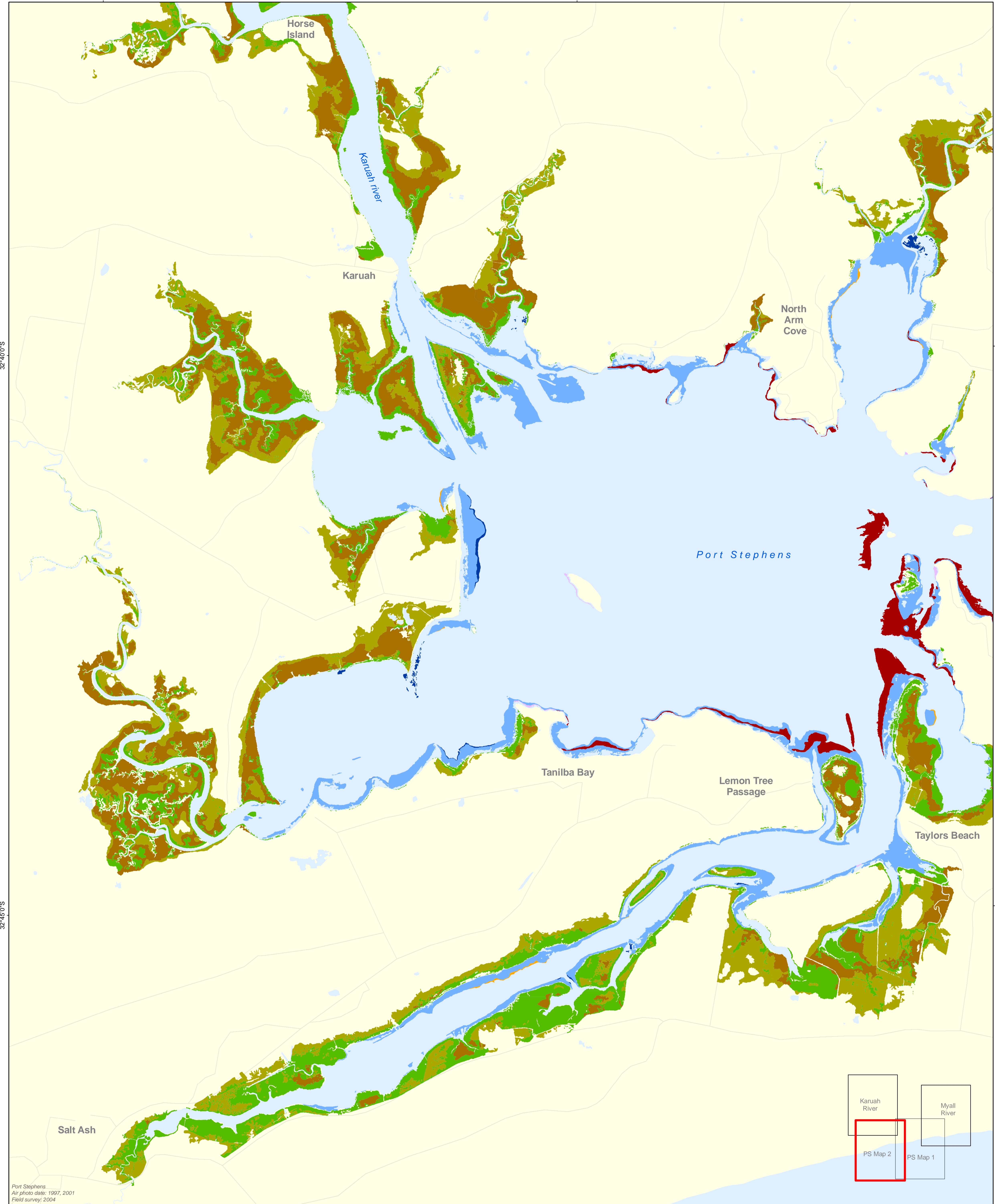


Appendix 1 – NSW DPI Estuarine Vegetation Mapping (Port Stephens Map 2)

Port Stephens (map 2)

151°55'0"E

152°0'0"E



32°40'0"S

32°40'0"S

32°45'0"S

32°45'0"S

Port Stephens
Air photo date: 1997, 2001
Field survey: 2004

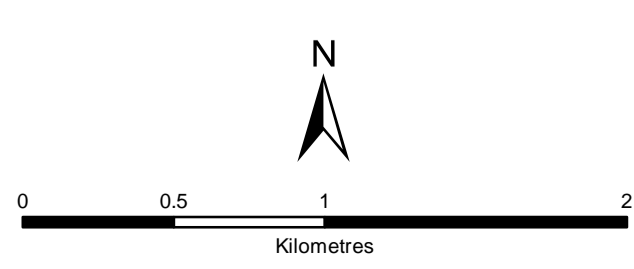
151°55'0"E

152°0'0"E

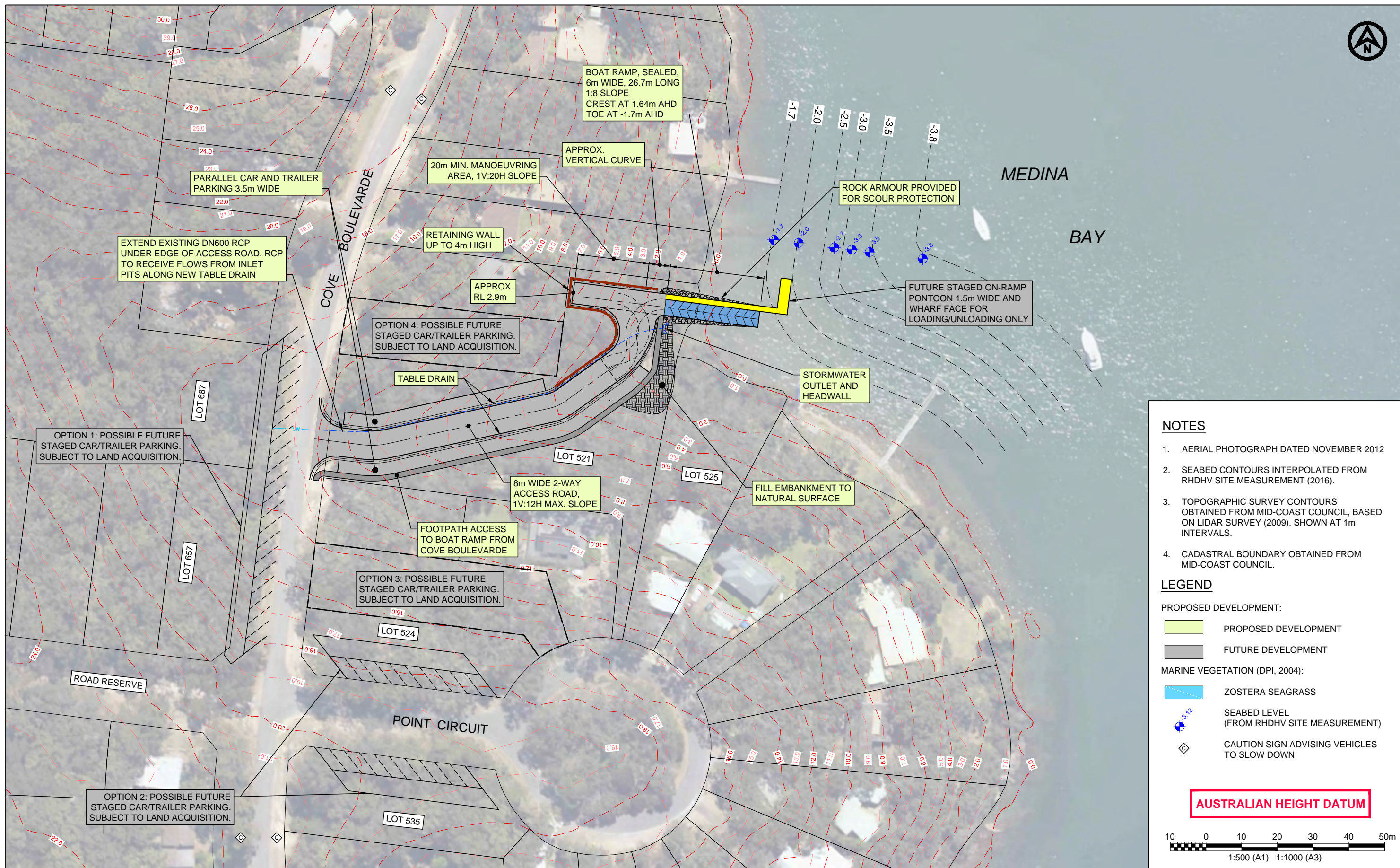
Legend

Posidonia	Posidonia/Halophila/Ruppia	Zostera/Halophila/Ruppia	Ruppia
Posidonia/Zostera	Posidonia/Ruppia	Zostera/Ruppia	Saltmarsh
Posidonia/Halophila	Zostera	Halophila	Mangrove/Saltmarsh
Posidonia/Zostera/Halophila	Zostera/Halophila	Halophila/Ruppia	Mangrove

Not all habitats may be present in this map.



Appendix E: Final Concept Design Plan



Appendix F: Cost Estimate

BASIS FOR UNIT RATES

Description	Rate	Unit	Source
Aluminium Gangway	\$ 1,500	sqm	RHDHV Costing Memo to NPWS 2014
On-ramp pontoon concrete abutment	\$ 1,000	cum	RHDHV estimate
Pontoon (including restraint piles)	\$ 2,000	sqm	RHDHV Costing Memo to NPWS 2014
Linemarking establishment cost	\$ 1,000	Lump Sum	Rawlinsons 2016 page 224, thermoplastic line marking establishment \$800-\$1000
Linemarking	\$ 5	m	Rawlinsons 2016 page 224, thermoplastic marking of bitumen paving \$1.65-\$1.95/m
Signage	\$ 600	no.	Rawlinsons 2016 page 683, road sign 900x900mm \$490-\$510/sign + 10% regional index
Geotextile fabric underlay	\$ 15	sqm	2011 Bonna Point Boat Ramp Tender \$7.7-\$10/sqm x 1.14 BPI escalation 2011-2016 + 10% regional index
Boat Ramp basecourse (layering, compaction, testing)	\$ 100	tonnes	2011 Bonna Point Boat Ramp Tender \$66-\$85/tonne (\$75/t avg.) x 1.14 BPI escalation 2011-2016 + 10% regional index
Boat Ramp (in situ concrete slab above MHW)	\$ 1,900	cum	2011 Bonna Point Boat Ramp Tender \$1104-\$1877/cum (\$1500/cum avg.) x 1.14 BPI escalation 2011-2016 + 10% regional index
Boat Ramp (precast planks below MHW)	\$ 650	sqm	2011 Bonna Point Boat Ramp Tender \$409-\$581/sqm (\$500/sqm avg.) x 1.14 BPI escalation 2011-2016 + 10% regional index
Boat Ramp mass concrete toe	\$ 1,000	cum	RHDHV estimate
Rock Protection (supply and place)	\$ 150	tonnes	2011 Bonna Point Boat Ramp Tender \$99-\$120/tonne (\$110/t avg.) x 1.14 BPI escalation 2011-2016 + 10% regional index
Clear vegetation	\$ 5	sqm	RHDHV estimate
Preparation of foreshore bank for rock protection	\$ 5	sqm	Rawlinsons 2016 page 214, trim surfaces of cuttings and embankments \$3.45/sqm + 10% regional index
Pavement Basecourse	\$ 28	sqm	Rawlinsons 2016 page 222, crushed rock/blue metal base course including grading, rolling and consolidating to receive paving, 200 mm thick \$24.70 + 10% regional index.
Hot bituminous concrete Wearing Course	\$ 31	sqm	Rawlinsons 2016 page 222, hot bituminous concrete including tack coat 40 mm thick \$28.3 + 10% regional index.
Excavation in clay (reduce levels)	\$ 35	cum	Rawlinsons 2016 page 212, excavate over site to reduce levels in clay \$29.4/cum + 10% regional index
Excavation in clay (pit)	\$ 75	cum	Rawlinsons 2016 page 213, excavate pits in clay 1/2m deep \$67/cum + 10% regional index
Haulage of excavated material	\$ 20	tonne	Rawlinsons 2016 page 704, Sydney haulage rate \$110/hr for 20t truck + 10% regional index, 3hr round trip to Tuncurry landfill
Disposal of excavated material at landfill facility	\$ 77	tonne	Tuncurry Landfill 2015-2016 prices for receipt of clean fill, only charge EPA levy
Regrade and compact surface	\$ 10	sqm	RHDHV estimate
Concrete footing	\$ 640	cum	Rawlinsons 2016 page 113, strip footing 25Mpa concrete in strip footing including 20kg/cum reinforcement \$578/cum + 10% regional index
Retaining wall (keystone with gravel backfill layer)	\$ 400	sqm	Rawlinsons 2016 page 171, keystone wall 1-3m high \$325/sqm + backfilling with blue metal 250mm thick \$28.3 + 10% regional index
Concrete Footpath (1.5m wide)	\$ 100	m	Rawlinsons 2016 page 683, paved footpath composite price \$85.5/m + 10% regional index
Excavated material as filling	\$ 10	cum	Rawlinsons 2016 page 214, excavated material as filling (on site) \$8.15/sqm + 10% regional index
Stormwater Culvert (600mm dia.)	\$ 270	m	Rawlinsons 2016 page 482, steel reinforced polyethylene pipe with rubber ring gasket joints \$245/m + 10% regional index
Stormwater Headwall and Scour Protection	\$ 5,000	no.	RHDHV estimate based on Deepwater Creek (Nick Lewis)
Pipe Joint (45°)	\$ 1,500	no.	Rawlinsons 2016 page 482, Extruded polypropylene non pressure pipe joint at 45° for 600 mm pipe \$1305 each + 10% regional index
Concrete dish drain	\$ 220	m	Rawlinsons 2016 page 224, 600x225mm kerb and gutter \$200/m + 10% regional index
Concrete sump	\$ 800	no.	Rawlinsons 2016 page 485, light duty (2670kg) galvanised steel grated concrete sump 600x600x900mm deep \$700 each + 10% regional index
Trenching (clay, 300mm wide, <1m depth, incl. backfilling)	\$ 30	m	Rawlinsons 2016, page 476, excavate trench by machine 300mm wide, 1m depth in clay \$19.5/m + 10% regional index
Trenching (clay, >300mm wide, <1m depth, incl. backfilling)	\$ 75	cum	Rawlinsons 2016 page 476, excavate trench by machine 1/2m depth and more than 300 mm wide in clay \$66/cum + 10% regional index

MEDINA BAY BOAT RAMP FACILITY

Item #	Description	Rate	Unit	Quantity	Cost	Subtotals	Reference/Comment
1	General and Preliminary Work					\$ 95,000	
1.1	Site Establishment	\$ 40,000	Lump Sum	1	\$ 50,000		
1.2	Preparation of CEMP and Safety Documentation	\$ 10,000	Lump Sum	1	\$ 10,000		
1.3	CEMP Implementation	\$ 25,000	Lump Sum	1	\$ 25,000		
1.4	Setout and Compliance Surveys	\$ 10,000	Lump Sum	1	\$ 10,000		
2	Site Preparation					\$ 11,250	
2.1	Clear Vegetation	\$ 5	sqm	2250	\$ 11,250		115x10m (access road), 120x1.2m (footpath), 25x8m (manoeuvring area), 0.5x15x30m (fill area), 60x3.5m (nth trailer parks), 90x3.5m (sth trailer parks)
3	Earthworks and Retaining Walls					\$ 154,530	
3.1	Excavate Access Road, Balance Cut and Fill (in clay)	\$ 45	cum	50	\$ 2,250		
3.2	Excavate Manoeuvring Area (in clay)	\$ 75	cum	400	\$ 30,000		50cum/m over 8m width
3.3	Excavated material as filling (near ramp)	\$ 10	cum	125	\$ 1,250		25m x 10m x 0.5m depth
3.4	Haulage of excess excavation material	\$ 20	tonne	550	\$ 11,000		275cum excess material at 2t/cum
3.5	Dispose excess excavation material at landfill facility	\$ 77	tonne	550	\$ 42,350		275cum excess material at 2t/cum
3.6	Concrete footing for retaining wall	\$ 640	cum	12	\$ 7,680		0.5m wide x 0.3m deep x 75m length
3.7	Retaining wall around manoeuvring area (keystone wall)	\$ 400	sqm	150	\$ 60,000		average 2m height over 75m length
4	Access Road and Manoeuvring Area					\$ 87,550	
4.1	Pavement Basecourse	\$ 28	sqm	1350	\$ 37,800		200mm thick crushed rock/blue metal base course, 115x10 (access road) + 25x8 (manoeuvring area)
4.2	Hot Bituminous Concrete Wearing Course	\$ 31	sqm	1350	\$ 41,850		40mm thick hot bituminous concrete, 115x10 (access road) + 25x8 (manoeuvring area)
4.3	Linemarking establishment cost	\$ 1,000	Lump Sum	1	\$ 1,000		
4.4	Linemarking	\$ 5	m	300	\$ 1,500		115m access road centreline + 60m trailer park + 90m trailer park
4.5	Signage (e.g. Entry/Exit, Standard Boat Ramp Signage)	\$ 600	no.	5	\$ 3,000		
4.6	Caution Signage on Cove Boulevard	\$ 600	no.	4	\$ 2,400		
5	Boat Ramp					\$ 122,200	
5.1	Geotextile fabric underlay	\$ 15	sqm	160	\$ 2,400		26.7m x 6m ramp area
5.2	Boat Ramp basecourse (layering, compaction, testing)	\$ 100	tonnes	110	\$ 11,000		160sqm x 0.3m thickness x 2.2t/cum
5.3	Boat Ramp (in situ concrete slab above MHW)	\$ 1,900	cum	12	\$ 22,800		6.7 x 6m wide x 0.3m thick
5.4	Boat Ramp (precast planks below MHW)	\$ 650	sqm	120	\$ 78,000		20m x 6m wide
5.5	Boat Ramp mass concrete toe	\$ 1,000	cum	5	\$ 5,000		
5.6	Rock Protection (supply and place)	\$ 150	tonnes	20	\$ 3,000		0.2cum/m (0.5m high wedge at 1V:1.5H) over 26.7 length x 2 x 2.6t/cum x 0.7 (30% voids)
6	Car and Trailer Parking Areas					\$ 183,255	
6.1	Excavate car and trailer parking areas (in clay)	\$ 35	cum	320	\$ 11,200		1m wedge across 3.5m over 60m length (nth area), 1m wedge across 4.7m over 90m length (sth area)
6.2	Haulage of excess excavation material	\$ 20	tonne	640	\$ 12,800		320cum excess material at 2t/cum
6.3	Dispose excess excavation material at landfill facility	\$ 77	tonne	640	\$ 49,280		320cum excess material at 2t/cum
6.4	Concrete footing for retaining walls	\$ 640	cum	25	\$ 16,000		0.5m wide x 0.3m deep x 150m length
6.5	Retaining walls (keystone wall)	\$ 400	sqm	150	\$ 60,000		1m high x 60m length (nth area), 1m high x 90m length (sth area)
6.6	Pavement Basecourse	\$ 28	sqm	525	\$ 14,700		200mm thick crushed rock/blue metal base course, 60x3.5m (nth area), 90x3.5m (sth area)
6.7	Hot Bituminous Concrete Wearing Course	\$ 31	sqm	525	\$ 16,275		40mm thick hot bituminous concrete, 60x3.5m (nth area), 90x3.5m (sth area)
6.8	Signage (e.g. car and trailer parking only)	\$ 600	no.	5	\$ 3,000		
7	Stormwater Services and Drainage					\$ 109,150	
7.1	Trenching for stormwater culvert extension (incl. backfilling)	\$ 75	cum	110	\$ 8,250		1cum/m over 110m length
7.2	Stormwater Culvert Extension (600mm dia. pipeline)	\$ 270	m	110	\$ 29,700		
7.3	Pipe Joint (45°)	\$ 1,500	no.	2	\$ 3,000		
7.4	Stormwater Headwall and Scour Protection	\$ 5,000	no.	1	\$ 5,000		
7.5	Concrete table drain	\$ 220	m	280	\$ 61,600		dish drain on each side of 115m access road + 50m around manoeuvring area
7.6	Concrete sump	\$ 800	no.	2	\$ 1,600		
8	Pedestrian Access					\$ 12,000	
8.1	Access road footpath	\$ 100	m	120	\$ 12,000		120m alongside access road
9	Site Disestablishment and Restoration	\$ 20,000	Lump Sum	1	\$ 20,000	\$ 25,000	

Total	\$ 794,935
30% Contingency	\$ 238,481
CONSTRUCTION COSTS SUBTOTAL	\$ 1,033,416
Topographic Survey	\$ 5,000
Hydrographic Survey	\$ 5,000
Marine Ecology Survey and report	\$ 10,000
Geotechnical Investigation	\$ 30,000
Design Fees	\$ 100,000
Environmental Assessment and Approvals	\$ 30,000
Preparing, advertising and assessing tenders	\$ 25,000
Site supervision and certification of the Works	\$ 40,000
Administration	\$ 15,000
OTHER COSTS SUBTOTAL	\$ 260,000