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&APA1268R004D05
Revision:	05/Draft
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Enhancing Society Together

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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 5.6** 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 5.6**.

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.

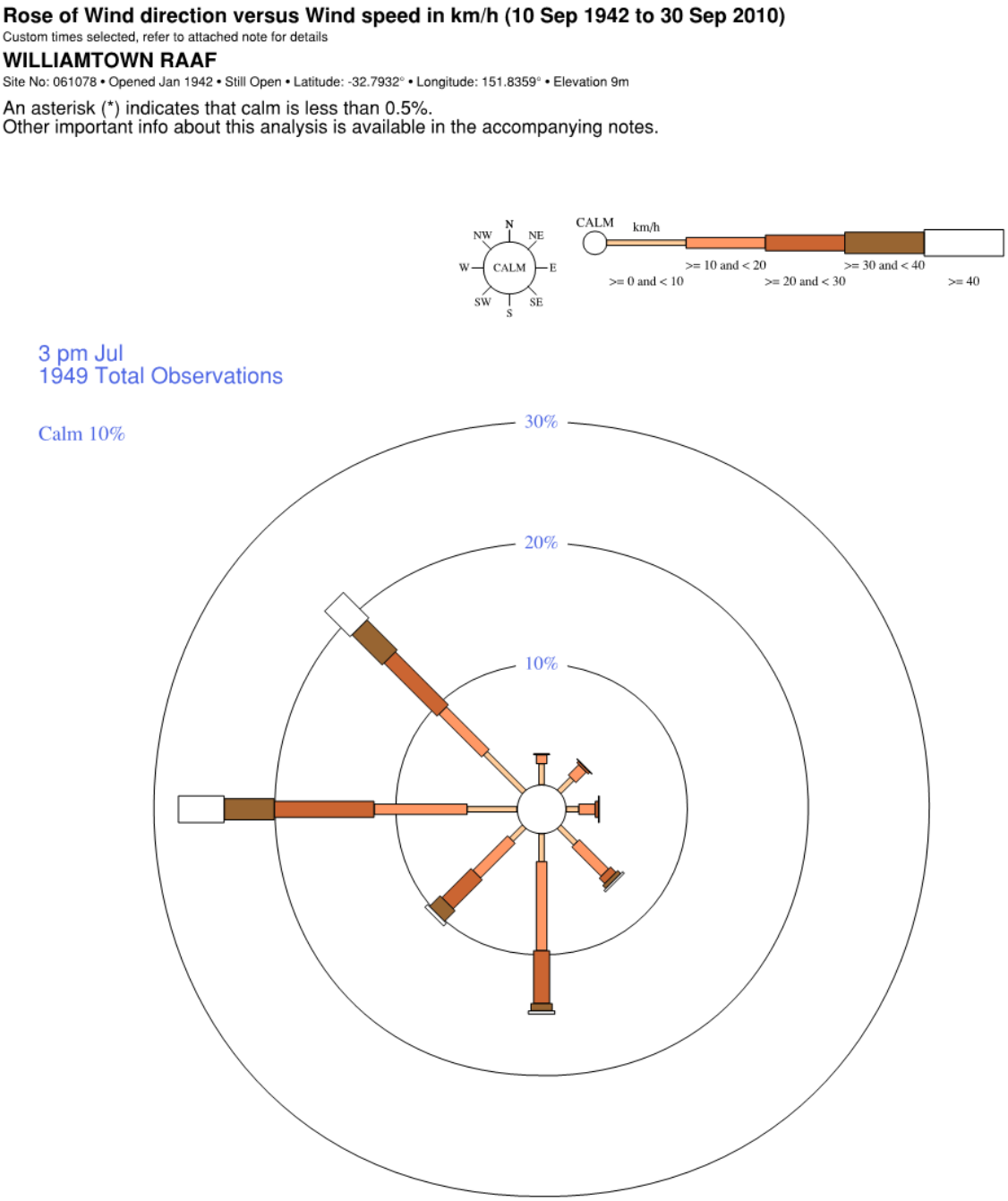

Figure 1: *Williamtown RAAF Base Winter Wind Rose (BoM, 2016)*

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

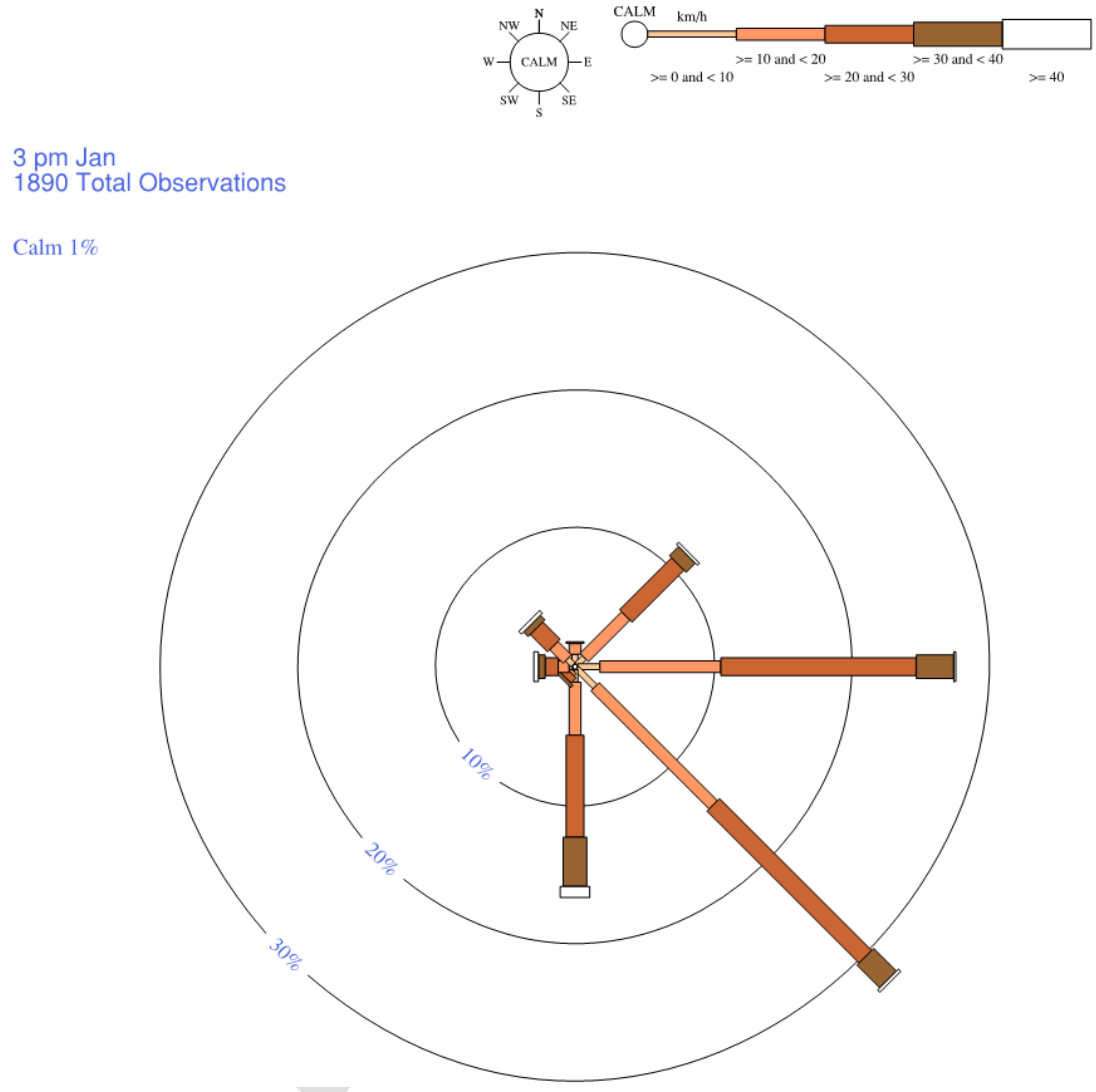

Figure 2: *Williamtown RAAF Base Summer Wind Rose (BoM, 2016)*

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: *Williamtown 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 Williamtown 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		1.17
	0.24	9:52	9:47 (High)	1.4	5.52	
Flood Tide	0.23	16:31	14:48 (Low)	6.2		1.17
	0.23	17:59	14:48 (Low)	2.5	4.94	

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).

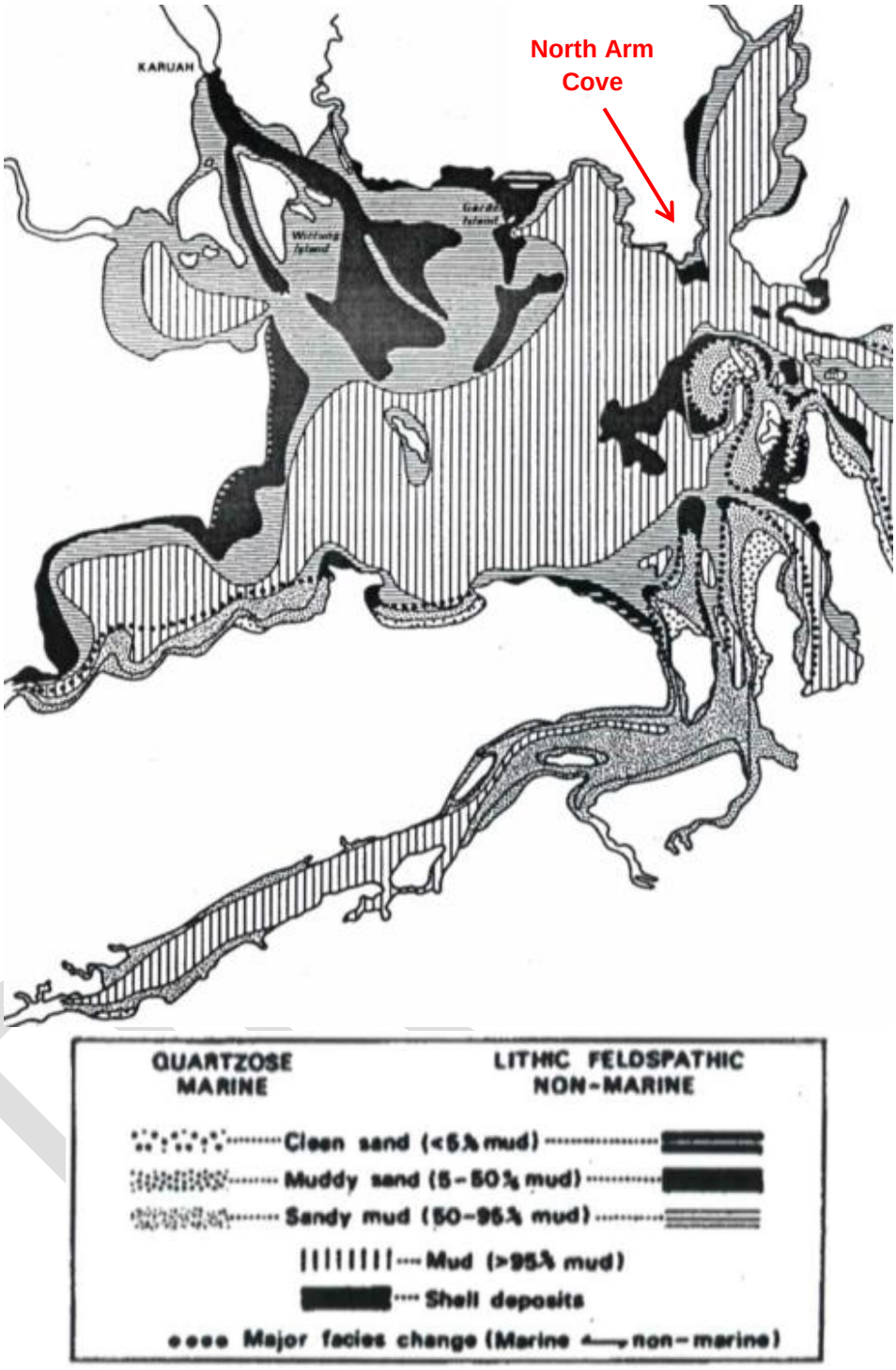

Figure 6: *Depositional Environments within the Upper Port Area (Thom et al, 1992)*

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 Balberook 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 Balberook 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 with 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 Lot1457** – 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:7H[2] and would be supported on a rubble mound foundation elevated above the existing seabed level[3]. 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 data[4]. 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 metres[6] 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 Rough Order of Magnitude Costing

Rough order of magnitude (ROM) cost estimates are presented in **Table 7**, **Table 8** and **Table 9** for the two boat ramp options and public wharf proposal, respectively. A detailed breakdown of each estimate is provided in **Appendix D**.

These comprise a construction cost estimate 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, 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 concept design plans, 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 design fees, site investigation fees, 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: *Brackens Bay Boat Ramp Facility ROM Cost Estimate*

Item No.	Description	Cost (excl. GST)
1	General and Preliminary Work	$95,000
2	Site Preparation	$7,500
3	Earthworks and Retaining Walls	$555,500
4	Rock Protection along Access Road	$23,625
5	Access Road, Manoeuvring and Derigging Area	$85,080
6	Boat Ramp	$111,975
7	Car and Trailer Parking Areas (30 spaces)	$67,170
8	Installation of Services	$19,800
9	Pedestrian Access	$8,500
10	Site Disestablishment and Restoration	$20,000
	Total	$994,650
	30% Contingency	$298,395
	Construction Costs Subtotal	**$1,293,045**
	Topographic Survey	$5,000
	Hydrographic Survey	$5,000
	Marine Ecology Survey and report	$10,000
	Geotechnical Investigation	$30,000
	Design Fees	$80,000
	Environmental Assessment and Approvals	$30,000
	Private land acquisition costs	Subject to negotiations
	Preparing, advertising and assessing tenders	$25,000
	Site supervision and certification of the Works	$40,000
	Administration	$15,000
	Other Costs Subtotal (excl. private land acquisition)	**$240,000**

Table 8: *Medina Bay Boat Ramp Facility ROM Cost Estimate*

Item No.	Description	Cost (excl. GST)
1	General and Preliminary Work	$95,000
2	Site Preparation	$9,000
3	Earthworks and Retaining Walls	$114,180
4	Access Road and Manoeuvring Area	$64,950
5	Boat Ramp	$95,300
6	Car and Trailer Parking Areas (25 spaces)	$68,520
7	Car Parking Area (5 spaces)	$5,135
8	Installation of Services	$22,000
9	Stormwater Services and Drainage	$95,950
10	Pedestrian Access	$89,600
11	Site Disestablishment and Restoration	$20,000
	Total	$669,635
	30% Contingency	$200,891
	Construction Costs Subtotal	**$870,526**
	Topographic Survey	$5,000
	Hydrographic Survey	$5,000
	Marine Ecology Survey and report	$10,000
	Geotechnical Investigation	$30,000
	Design Fees	$80,000
	Environmental Assessment and Approvals	$30,000
	Private land acquisition costs (potential for parking areas)	Subject to negotiations
	Preparing, advertising and assessing tenders	$25,000
	Site supervision and certification of the Works	$40,000
	Administration	$15,000
	Other Costs Subtotal (excl. private land acquisition)	**$240,000**

Table 9: *Medina Bay Public Wharf ROM Cost Estimate*

Item No.	Description	Cost (excl. GST)
1	General and Preliminary Work	$60,000
2	Site Preparation	$5,175
3	Earthworks and Retaining Walls	$2,000
4	Jetty, Pontoon and Gangway	$290,000
5	Car Parking Area (25 spaces)	$27,885
6	Installation of Services	$17,050
7	Pedestrian Access	$73,300
8	Site Disestablishment and Restoration	$15,000
	Total	$490,410
	30% Contingency	$147,123
	Construction Costs Subtotal	**$637,533**
	Topographic Survey	$5,000
	Hydrographic Survey	$5,000
	Marine Ecology Survey and report	$10,000
	Geotechnical Investigation	$30,000
	Design Fees	$30,000
	Environmental Assessment and Approvals	$15,000
	Preparing, advertising and assessing tenders	$15,000
	Site supervision and certification of the Works	$20,000
	Administration	$10,000
	Other Costs Subtotal	**$140,000**

It should be noted that although the above cost estimates are likely to be conservative due to the preliminary level of design and application of a 30% contingency, it is considered that the costs of potential boat ramp and jetty options at North Arm Cove would be high relative to typical installations in more suitable sites elsewhere in NSW. This is due to the challenging nature of available sites which have steep terrain, require establishment of vehicular access, and in the case of the public wharf require a long length of jetty to access suitable water depth for ferry berthing. Based on an appraisal 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 to and/or underpinning the high costs associated with a boat ramp or wharf facility, there are also a number of unfavourable design aspects and environmental issues associated with each proposal that are related to problematic site constraints. These are summarised below.

Brackens Bay boat ramp proposal:

- large amount of vegetation clearing and earthworks required to provide site access;
- high cost of earthworks associated with disposal of surplus excavated fill at a landfill facility (could be significantly reduced if able to be accepted for use as fill at a nearby site location);
- deep excavation and retaining walls required to establish vehicular access and ramp manoeuvring area;
- presence of Posidonia seagrass is mapped at the proposed ramp location (subject to confirmation with hydrographic and marine ecology survey), this species of seagrass is listed as a 'threatened

ecological community' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and is also protected under State legislation (*Fisheries Management Act 1994*);

- parking areas are located at a distance away from the boat ramp, which is not ideal for the high median age of the North Arm Cove community;
- parking areas are positioned along the potential future vehicular access points for currently vacant private lots;
- use of parking areas requires reversing of trailers across Promontory Way; and,
- requirement to negotiate acquisition of private land parcel for development to be possible.

Medina Bay boat ramp proposal:

- large amount 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');
- parking areas are located at a distance away from the boat ramp, which is not ideal for the high median age of the North Arm Cove community;
- parking areas are positioned along the potential future vehicular access points and undeveloped road reserve for currently vacant private lots;
- use of parking areas requires reversing of trailers across Cove Boulevard; and,
- alternative trailer parking area shown at entry to Point Circuit requires acquisition of private land.

Medina Bay Public Wharf proposal:

- significant vegetation clearing is required along the existing easement to provide site access;
- suitable water depths for ferry berthing may be located at a significant distance from the shoreline (subject to confirmation with hydrographic survey);
- long length of stepped and ramped accessway is required to access the wharf from Point Circuit, which is not ideal for the high median age of the North Arm Cove community; and,
- increase in local traffic within Point Circuit due to provision of parking areas.

It is noted that a marine ecologist has been engaged to undertake a diver survey over the potential boat ramp development areas within Brackens Bay and Medina Bay. This information will be available prior to finalisation of this report and will address the potential issues associated with posidonia seagrass in Brackens Bay.

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 these proposals 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.

5.6 Summary of Consultation Feedback

To be completed following consultation.

6 North Arm Cove Boating Development Plan

To be completed following consultation.

7 References

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Appendix A: Maps

Appendix B: Stakeholder Engagement Plan

Appendix C: Stakeholder Meeting Minutes

Appendix D: Cost Estimates