Trinity Point Marina and Mixed Use Development

Environmental Assessment Report – Concept Plan

Volume II
Marina Component

Issued: November 2008

Patterson Britton & Partners Pty Ltd
consulting engineers

Johnson Property Group

Issue	Description of Amendment	Prepared by (date)	Verified by (date)	Approved by (date)
1	Draft EA report	DM/BP /HN (13.12.07)		-
2	Final Draft EA Report	DM/BP/HN [17.12.07]		
3	Final EA Report	DM/BP/HN [24.06.08]	Dan Messiter (24.06.08)	Ben Patterson (24.06.08)
4	Revised Final EA Report	Dan Messiter (17.11.08)	Dan Messiter (17.11.08)	Ben Patterson (17.11.08)

Issue No. 4

Note:

This document is preliminary unless it is approved by principal of Patterson Britton & Partners.

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14 Telford Street
Newcastle East NSW 2300

PO Box 668
Newcastle NSW 2300
Australia

telephone : (02) 4928 7777
facsimile : (02) 4926 2111
email : reception@patbrit.com.au
ABN : 89 003 220 228

Patterson Britton & Partners Pty Ltd
consulting engineers

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EAR Prepared By

Name:	Benjamin George Patterson Patterson Britton & Partners
Qualifications:	BEng (Civil), MIEAust
Address:	14 Telford Street Newcastle East NSW 2300
In respect of:	Trinity Point Marina and Mixed Use Development

Development Application

Applicant name:	Johnson Property Group Pty Ltd
Applicant address:	338 Kent Street SYDNEY NSW 2000
Land to be developed:	Lot 31, DP 1117408; Part Lot 32, DP 1117408; Part Lot 33, DP 1117408 and Part Crown Land. Trinity Point Drive, Morisset

Environment Assessment Report

An environmental assessment report (EAR) is attached

I hereby certify that I have prepared the content of this Environmental Assessment and to the best of my knowledge it is in accordance with the Environmental Planning and Assessment Act and Regulations and is not false or misleading.

Signature:

Name: Benjamin George Patterson

Date: 17th November 2008

EXECUTIVE SUMMARY

ES.1 DOCUMENTATION

Johnson Property Group (*JPG*) have prepared a Marina and Mixed Use development proposal for the Trinity Point site on Bardens Bay at Morisset Park near Bluff Point, on the shores of Lake Macquarie *(locality shown on* **Figure 1***)*. A team of specialist consultants, including Patterson Britton & Partners (*Patterson Britton*) were engaged to assist in the development of the design of the proposal and preparation of Environmental Assessment documentation. This document is **Volume II** of the Environmental Assessment Report (*EAR*), which consists of the following three sets of documentation.

Volume I – Prepared by ADW Johnson Pty Ltd, addresses the overall concept including assessment of the shore based components other than those immediately associated with the operations of the proposed marina;

Volume II – Prepared by Patterson Britton and Partners Pty Ltd, addresses the Marina and associated shore based components, as well as coastal processes aspects; and

Volume III – Comprises all Appendices that **Volumes I** and **II** refer to.

ES.2 THE PROPOSAL

ES.2.1 General

The Marina Village development would consist of the breakwater, marina berths, amenities, marina management office and associated boat maintenance facilities *(travel lift, hardstand and workshop*), and other associated commercial infrastructure such as a café, restaurant and function facilities. Immediately adjacent to the Marina Village would be a cluster of multi storey buildings *(both apartment and hotel style)* for short to medium term tourist accommodation. These areas would be connected through a boardwalk structure with under-croft car parking beneath. A series of boardwalks, decks and jetties would connect the marina and adjacent building development to the foreshore area.

The remainder of the development would consist of apartment style accommodation, in two to five storey buildings, associated car parking *(under ground parking*), access roadways, footpaths, boardwalks, and landscaping. Further details of the shore-based facilities and accommodation areas are available in **Volume I** of the EAR documentation.

Figure 2 presents the architectural concepts of the proposed marina, village centre and associated tourist and residential accommodation buildings. **Figure 3** shows the corresponding car park layout. The marina berths, maintenance area, workshops and marina management facilities form the area of the development being assessed in this volume ***(Volume II)*** of the EAR documentation. This specific area has been indicated on **Figure 2.** Reference to features of the overall development outside of this area are also included in **Volume II**, but are assessed in more detail in **Volume I**.

ES.2.2 Marina Component of the Development

The marina would incorporate a breakwater around the southern and eastern boundaries. It is proposed to initially construct enough arms of the marina, consisting of floating pontoons, to satisfy immediate demand at the release of the development. Allowance has been made for additional floating pontoon arms *(up to a total of 4)* to be added at a future date. Breakwater construction would also be staged accordingly, to provide adequate protection to the marina berths as they are constructed.

As discussed above, in addition to the marina area, there would be an associated village centre incorporating a café, restaurant, function centres, chandlery, general store and commercial offices. These auxiliary commercial facilities are outlined and assessed in **Volume I** of the EAR documentation.

The proposed marina village development and adjacent buildings would comprise the following main elements:

- a staged 308 berth floating marina for craft in the length range of 8 - 20 m, including services to berths such as water, power and lighting;
- a breakwater jetty structure;
- a floating helipad pontoon;
- fuel, sewage pump-out and oily bilge pump-out facilities;
- security measures for marina berths, fuel and pump-out facilities, and helipad;
- repair and maintenance facilities;
- building structures *(commercial and tourist accommodation)*;
- timber decks/boardwalks;
- water and waste management;
- public access, amenities and parking;
- landscaping;
- lighting; and
- stormwater management facilities.

The proposal does not involve any dredging or reclamation of the waterway.

ES.3 ENVIRONMENTAL EFFECTS

ES.3.1 General

A range of background information was reviewed and extensive stakeholder consultation was undertaken to identify key issues. These key issues are listed below and it is relevant to note that they generally reflect local issues:

- design of the marina;
- helicopter noise;
- local recreational opportunities in relation to the foreshore reserve and public berthing facilities;
- traffic impact and parking issues related to the marina;
- access to bay - related to navigation;
- water quality;
- stormwater runoff (incorporating water sensitive urban design) and waste management; and
- marine ecology.

While more emphasis is placed on the above key issues, a range of other issues are addressed in the EAR. A summary of the environmental assessment and proposed measures to mitigate any potential adverse impacts are summarised below for the key issues.

ES.3.2 Design of the Marina

The proposed marina size has been justified by a detailed demand study prepared by Patterson Britton *(refer* **Appendix Z***).* In addition, a number of design studies were completed by Patterson Britton including a coastal processes study *(***Appendix Y***),* hydrodynamic modelling study *(***Appendix AB***),* and a breakwater design study *(***Appendix X***).*

Geotechnical investigations have also been carried out by Douglas Partners (**Appendix F**), and preliminary marina design has been undertaken for this EAR by Patterson Britton *(refer* **Figure 4** *to* **Figure 14***).*

Berth Demand Study

A range of berth demand predictions was undertaken for the berth demand study *(refer* **Appendix Z***)*. The study indicated that at present there exists a latent demand for approximately 171 to 376 berths. At the time that the Trinity Point Marina project becomes operational *(2011)*, the demand was estimated at around 166 to 398 berths. These predictions do not allow for a substantial latent demand that may be realised from Sydney.

The demand study conservatively concluded that a marina facility with a range 200 to 250 berths, with potential to expand to around 300 berths by 2016 (*note 2016 demand was estimated at between 221 and 537 berths*).

Financial and Economic Assessment

From an economic perspective, the completion of the Trinity Point Marina up to and including Stage 4 *(308 berths)* would provide a net benefit to the NSW economy.

Location of the Marina

There is really no practical alternative to the location chosen for the marina within the Trinity Point Mixed Use development precinct. The entire foreshore edge of the proposed development area was assessed for site suitability based on the following basic criteria:

- existence of sensitive vegetation (*seagrass, saltmarsh, mangroves, etc*);
- bathymetry of nearshore water area and need for dredging;
- topography of adjacent land; and
- exposure to wind and wave impacts.

The proposed floating marina has been located at the northern end of the development site, which is logical from an access, operational and environmental management perspective. There are no practical alternative locations if marina berths are to be provided as the remainder of the site foreshore has significant constraints in a number of the above criteria. The proposed location has limited impact on the sensitive aquatic vegetation, does not require any dredging or reclamation, suits the topography of the adjoining land, and has a reasonable exposure level to wind and waves.

Trinity Point is a unique site on Lake Macquarie as it is one of very few edges of the lake that are zoned for the purpose of tourism and one of few that also has the capacity for a

Marina that can be constructed without significant environmental impacts such as loss of sea grass and disturbance through dredging operations.

Type of Maintenance and Repair Facility and Form of Construction

A hardstand area and boat lift facility, rather than a number of slipways, enables vastly improved environmental controls to be installed and represents best practice. It is a clear preferred alternative.

Layout of the Marina Berths

The proposed layout of the marina berths has been influenced by a range of factors or constraints, as listed above e.g. existence of seagrass, existing available water depths, alignment with most severe wave exposure, visual impact and boat size distribution in accordance with projected demand.

Having established the available waterway area for the marina berths, provision of the berths in the manner shown *(refer* **Figure 4***)* represents an arrangement which best addresses all influencing factors and constraints, some of which have competing requirements.

Floating Versus Fixed Marina Berths

Two principal alternatives exist for the structure of marina berths; floating structure *(as proposed)* and fixed structure, i.e. walkways and fingers that are at a fixed level supported by piers.

A floating system has been adopted for a combination of reasons:

- it provides safer and more convenient access to and from craft, accordingly there are amenity and occupational health and safety benefits;
- it enables better tying up of craft *(the craft and the deck of the marina remain at the same relative level at all lake levels)*;
- the floating system has much less visual impact compared to a fixed system particularly at lower lake levels; and
- it provides additional aquatic habitat *(floating pontoon surfaces)*.

ES.3.3 Helicopter Noise

Heli-Consultants *(refer* **Appendix AA***)* advised Arup Acoustics *(refer* **Appendix P***)* of likely helicopter flight paths and the type of helicopters likely to use the proposed Trinity Point helipad. From these, the Bell407 helicopter was selected as a typical scenario. Helicopter movements were estimated at a maximum of four movements per day, or 28 per week. Note that the proposed helipad hours of operation for Trinity Point are 7 am to 6 pm on weekdays and 10 am to 4 pm on weekends and public holidays *(except for emergencies).* Measured noise levels from the Bell407 were used to predict values in **Table E-1**.

Table E-1 - Helicopter Noise Predictions (Flyover, Bell407 Helicopter)

Receivers	Predicted Noise Level $L_{Aeq,24hr}$ downwind	Noise Criteria dB(A)	Predicated Noise Level $L_{Amax\ downwind}$	Noise Criteria dB(A)
57C Lakeview Road, Morisset Park	43	**50**	71	**95**
6 Macquarie Road, Morisset Park	42	**50**	68	**95**
6 Lakeview Road, Morisset Park	45	**50**	74	**95**
28 Pillapai Road, Windermere Park	50	**50**	82	**95**
Brightwaters Christian College	47	**50**	77	**95**
34 Bulgonia Road, Brightwaters	45	**50**	73	**95**
52 Buttaba Road, Brightwaters	45	**50**	74	**95**
6 Dandaraga Road, Brightwaters	42	**50**	68	**95**
11 Omaru Place, Summerland Point	44	**50**	73	**95**
14 Scott Road, Vales Point	33	**50**	59	**95**
39 Henry Road, Morisset Park	39	**50**	64	**95**
34 Rhodes Parade, Windermere Park	42	**50**	69	**95**
57 Asquith Avenue, Windermere Park	42	**50**	70	**95**
117 Grand Parade, Bonnells Bay	39	**50**	69	**95**
21 Riesling Road, Bonnells Bay	48	**50**	79	**95**
16 Wilson Street, Bonnells Bay	45	**50**	77	**95**
5 Lakeside Close, Bonnells Bay	43	**50**	74	**95**
63 Waikiki Road, Yarrawonga Park	38	**50**	65	**95**
2 Yoorala Road, Yarrawonga Park	33	**50**	60	**95**
4 Kimbul Road, Brightwaters	40	**50**	67	**95**
30 Mirrabooka Road, Mirrabooka	36	**50**	60	**95**
205 Dandaraga Road, Mirrabooka	36	**50**	61	**95**

As shown in **Table E-1** predicted average and maximum noise levels associated with operation of the helipad would be at, or below, the noise level criteria. Noise levels for helicopters while on the landing pontoon were also predicted from the measured data from the Bell 407 and found to be below the industrial noise level criteria *(refer* **Section 5.8***)*.

Other noise impacts include those associated with plant and equipment during the construction phase *(in part due to the existing low background noise levels)*, and operation of the travel lift and traffic noise during peak periods on completion of the proposed development. Noise predictions for the operational aspects *(identified in **Section 5.8.2**)* are conservative and hence actual noise levels may be lower. A Construction Noise Management Plan and operational procedures would be developed, employing measures such as those identified in **Section 7**, to minimise noise impacts.

ES.3.4 Local Recreational Opportunities in Relation to the Foreshore Reserve and Public Berthing Facilities

The proposed development offers the following local recreational opportunities in relation to the foreshore reserve and public berthing facilities:

- the foreshore of the Trinity Point Development would be transferred to Lake Macquarie City Council as a foreshore reserve for access by the public at all times. This foreshore park would be landscaped using indigenous native vegetation and would incorporate informal access pathways, boardwalks, a number of public art features, landmarks and interpretive signage.
- the entire breakwater would have full public access with the marina, marina village centre and remainder of the Trinity Point tourist development being connected through a series of elevated decks and boardwalks.
- approximately 120m of public berthing facilities would be provided along the southern breakwater *(note - berthing along the outside of the southern arm of the breakwater would not be allowed to protect the extensive seagrass bed to the south of the marina*);
- public re-fuelling, sewage / bilge pump-out facilities;
- access to boat servicing and repair facilities at the workshop and associated travel lift / hardstand area;
- there exists the possibility of incorporating public wharfage along the outside of the eastern breakwater for accommodating large tourism vessels or public transport vessels.
- Café / restaurant / function centre, and short term tourist accommodation would be provided within the marina village. Building structures presenting opportunities for both resort and serviced apartments style lodging are proposed.

ES.3.5 Traffic Impact and Parking Issues Related to the Marina

The traffic and parking assessment undertaken by Better Transport Futures *(refer **Appendix T**)* related to the entire development, including the tourist and residential apartments. It found that subject to intersection upgrading works in the general locality, the local road system had adequate capacity to cater for the entire development. It should also be noted that all parking requirements would be accommodated within the Trinity Point site.

ES.3.6 Access to Bay - Related to Navigation

Navigation paths from within some parts of Bardens Bay would be lengthened *(and in some wind conditions more difficult under sail)* and recreational towing activities would need to be relocated to nearby areas of the main lake body due to the presence of the marina. The marina area would lead to a loss of open water for navigation. This loss is not considered significant in terms of the overall lake area. Public berthing at the site would provide a facility and access currently unavailable at the site. Some boats moored at swing moorings in the vicinity would benefit from the protection offered by the breakwater (*others would be unchanged*) and all would benefit from the provision of maritime services and workshop / repair facilities at the marina.

ES.3.7 Water Quality

In general, Lake Macquarie does not meet a lot of the criteria for the protection of aquatic ecosystmes under ANZECC *(2000)* Water Quality guidelines, in particular Dissolved Oxygen, Nutrients, Chlorophyll-a and some heavy metals. In terms of water quality monitoring at the Trinity Point site, only slight differences were found compared to the general trend in the lake.

At the site, Dissolved Oxygen levels generally conformed with ANZECC *(2000)* guidelines, and only some metals exceeded guideline values, confirming the trend that the waters in the southern portion of the lake are in better condition in terms of metal contaminants than those in the northern parts of the lake, adjacent to site occupied historically by heavy industry.

In order to mitigate any potential impacts on water quality during the construction stage, a range of well accepted erosion and sediment control measures would be adopted, such as those outlined in the "Blue Book" prepared by the Department of Housing. In addition, a turbidity barrier could be installed if necessary around the proposed lake based work area to contain the migration of any fine sediments in suspension (*i.e. due to piling operations*).

A monitoring program would be developed for the construction phase in consultation with the consent authority and the Department of Environment and Climate Change NSW (*DECC*) and the Department of Water and Energy *(DWE)*. A preliminary water quality monitoring programme has been developed, as shown in **Appendix W**.

Providing appropriate measures are put in place and properly maintained, it is considered that water quality impacts during construction would be acceptable.

The proposed development is considered to have a number of positive benefits in regard to water quality in the operational phase, as opposed to ad-hoc development of swing moorings within Lake Macquarie. These positive benefits are the result of the following:

- provision of a concrete hardstand for the repair and maintenance of vessels, incorporating a first flush and wash down water collection and treatment system;
- provision of a sewage pump-out facility;
- provision of oily bilge pump-out facilities;
- provision of industry best practice arrangements for the dispensing of fuel;
- provision of industry best-practice "*water sensitive*" water quality controls on stormwater from the site;
- incorporation of regulations governing use of the marina berths that would require flushing heads *(toilets)* on craft to not be used while the craft are at the berth;
- incorporation of regulations governing use of the marina berths that would require automatic bilge pumps in craft to be fitted with an isolation switch which must be left in the "off" position while the craft are at the berths; and
- provision of a floating boom on site to contain any surface pollutants in the event of any accidental leakage of bilge water. Oil absorbent material would also be maintained to absorb any petroleum contained in the boom.

In addition to the above, solid waste and recycling bins would be provided throughout the development. The bins would be emptied by commercial contractors.

It is noted that the operation of the proposed development would be a 'scheduled activity' within the meaning of Schedule 1 of the Protection of the Environment Operations (*POEO*) Act 1997. As such, an Environment Protection Licence must be issued under the Act for the carrying out of the activity. The licence would be issued by DECC, being the 'appropriate regulatory authority'.

The licence would set out a range of conditions which must be complied with, including conditions related to pollution of waters. If any condition of a licence, including those related to pollution of waters, is contravened by any person, each holder of the licence is guilty of an offence and significant financial penalties apply.

ES.3.8 Stormwater Runoff (*incorporating Water Sensitive Urban Design*) and Waste Management

As noted above, during construction, best practice erosion and sediment controls would be incorporated into the design, including measures to limit the disturbance of existing lake bed sediments. Providing appropriate measures are put in place and properly maintained, it is considered that water quality impacts during construction would be acceptable.

As outlined below, a suite of best practice "water sensitive" stormwater and water cycle management measures are proposed for the site, which would mitigate any impacts, and minimise the environmental footprint of the proposed development in terms of downstream water quality and potable water demand management.

Proposed stormwater control measures for the development are outlined as follows:

Preventative Measures –

- minimise areas of impervious surfaces;
- incorporate drought tolerant native plant species into the landscape;
- establish a fertiliser management plan;
- provision of industry best practice arrangements for the dispensing of fuel;
- provide adequate rubbish bins and waste disposal services to encourage responsible disposal of waste and rubbish;
- provide a grease trap on sewer draining from kitchens regularly cleaned out by a commercial waste contractor;
- provide oily waste storage tank for recycling by a commercial waste contractor;
- establish measures to reduce pet droppings in the development area; and
- establish a public education system, which informs residents and guests of the stormwater management issues and encourages environmentally responsible behaviour.

Source Controls -

- rooftop gardens could be used to achieve a reduction in runoff volume and treatment of runoff by infiltration into the soil media;
- rainwater harvesting - would capture roof and boardwalk runoff for reuse within the establishment for non-potable purposes;
- permeable pavements; and
- bio-filtration swales.

The workshop/hardstand area is a potential source of pollutants toxic to marine life. Hence, strict stormwater controls would be required, these are outlined as follows:

Preventative Measures –

- mist shrouds would be used in the wash down bay;
- abrasive blasting and painting would be undertaken within tarp or workshop enclosures;
- where practical, vacuum sanders would be used to remove paint from hulls and collect paint dust;
- sacrificial anodes would be removed or covered before water blasting;
- the majority of solid contaminants (*e.g. paint shavings, marine growths, etc*) which can accumulate on the hardstand would be regularly swept up in the dry and stored in solid waste bins for collection by a commercial waste contractor;
- tributyltin would not be used onsite; and
- the hardstand area would be set above the 5 year ARI Lake Macquarie still water flood level to prevent frequent inundation.

Containment and Treatment Controls – A first flush tank would be provided to capture the initial 15mm of runoff from the hardstand\workshop area (*as well as any water used for vessel wash down*). Captured stormwater would be treated using a proprietary treatment package and reused for vessel repair/wash down purposes. Excess water would be discharged to the sewer under a trade waste agreement.

Water quality monitoring would be undertaken to provide a more detailed assessment of the existing water quality conditions and observe water quality parameters during both construction and operational stages of the proposed development. Water quality observations would be used to assess the impact of the development on water quality and would provide a framework for ongoing assessment of the effectiveness of the water quality management plan proposed for the site, allowing for remedial action to be taken if required.

ES.3.9 Marine Ecology

There is currently no affected riparian or emergent vegetation on the proposed marina site. The nearest emergent vegetation is the strip of mangrove trees and saltmarsh to the north-west of the marina. The proposed development would not impact on these saltmarsh or mangrove stands.

The impacts on submerged habitats of the construction of the proposed marina development can be mitigated by the following:

- management of potential material spills during construction (*through best practice construction management practices*);
- the design calls for the minimisation of disturbance of marine sediments during construction, and the results of contamination assessment for sediments undertaken by Douglas Partners as part of this study indicate that existing bottom sediments have low levels of contamination. In addition, disturbance of sediments during placement of piles would cause localised turbidity which would settle rapidly and would not cause significant impact. Appropriate mitigation measures such as turbidity curtains could be employed, as required.
- the placement of locator piles and the placement of floating pontoons would provide a very large increase in wetted surface area for colonisation by encrusting organisms.

Note also that pontoon surface areas are considered very good fish habitat (*NSW Fisheries 1999 and Fisheries Habitat Protection Plan No 3 Hawkesbury Nepean River System*) (*NSW Fisheries 1998*). These are seen as a net benefit, however advice from The Ecology Lab indicates that this should not be counted as a positive outcome of the development. The addition of netting hung in the water column below the breakwater structure would create habitat for seahorses.

The impacts on submerged habitats of the operation of the proposed development are as follows:

- very minimal seagrass beds, mangroves or saltmarsh would be directly or indirectly impacted by the operation of the proposed development;
- creation of the travel-lift platform would not significantly impact on marine vegetation;
- placement of locator piles for the floating marina would be into un-vegetated soft benthic habitat and while placement of each pile would result in the loss of a small area of soft benthic habitat, this impact is not considered significant in the aggregate. Note also that, as argued above, the loss of soft benthic habitat would be offset by the creation of a larger net area of hard substratum habitat which would be colonised by a variety of algae and encrusting biota;
- there are limited potential shading impacts from the structures and the moored vessels as the marina configuration has been designed to place the majority of structures plus moored vessels over bare soft sediment substratum;
- there are no significant potential seabed disturbance impacts arising from vessels using the facilities over and above the present potential for seabed disturbance. The proposal does not include any dredging for the marina or navigational channels;
- with respect to vessels wishing to transit to the south of the marina, these vessels would be made aware of the shallows and seagrass beds to the south and east via appropriate signage and navigation marks. The clear definition of the navigation areas and the provision of signage and navigation marks, would result in the protection of the adjacent shallow water habitats;
- vessels speed restrictions would be imposed and navigation encouraged through the centre of the bay, such that any additional boat wake impacts created by the development would be mitigated, hence limiting erosion and scour issues.
- the proposed development would not alter the utilisation of the aquatic habitats by aquatic birds*;*
- the potential for light interference from the walkway lighting on aquatic birds over-flying the facilities or roosting/feeding on the intertidal shoals and in the mangrove stands to the west and north of the facility would be minimised by use of downward directed lighting; and
- the proposed downward directed lighting on the floating marina could alter the use of the Bay by both mobile aquatic fauna and birds by attracting small aquatic organisms which in turn could attract fishing birds. In addition, insects may be attracted to the light beams and become prey for insectivorous birds.

Of the six aquatic species listed under the NSW Threatened Species Conservation Act, NSW Fisheries Management Act and Commonwealth Environment Protection and Biodiversity Act which have been known to occur within Lake Macquarie, none were found, or are likely to occur in the type of habitat present at Trinity Point.

It is concluded that the proposed development could be undertaken in such a manner that the construction and use of the facilities would meet the fish and aquatic habitat protection provisions of the Fisheries Management Act as detailed in the NSW Guidelines (*NSW Fisheries 1999*) and as specified in the Habitat Protection Plans gazetted under the Act.

It is also concluded that the proposed development does not require a permit under the *Fisheries Management Act (1994)* and, as no listed threatened species are adversely impacted by the project, a Species Impact Statement is not required.

ES.4 JUSTIFICATION FOR THE PROPOSAL

Analysis has shown that there is strong demand in Lake Macquarie and the surrounding region for modern marina style berthing and associated facilities. The Trinity Point Marina proposal aims to satisfy this demand whilst providing a best practice facility that through design and mitigation measures ensures preservation and enhancement of the surrounding environment. The proposal is shown to be of net benefit to the NSW economy and the local and regional community and is consistent with the principles of Ecologically Sustainable Development *(ESD)*.

In addition, should the proposed development not proceed, a number of other community and environmental benefits would not be achieved, such as:

- landscaping that includes a large proportion of indigenous and native plant species and is in keeping with the visual character of the area;
- re-establishment of foreshore vegetation and erosion stabilisation;
- public access to lake foreshore which otherwise would be unattainable;
- public berthing and possible transport links;
- the consolidation of vessel berthing/maintenance arrangements to mitigate the detrimental impacts of the proliferation of swing moorings;
- additional employment and training opportunities in the maritime industry; and
- a land/water interface for the local community to enjoy the foreshore.

1 INTRODUCTION

1.1 BACKGROUND

Johnson Property Group (*JPG*) have prepared a Marina and Mixed Use development proposal for the Trinity Point site on Bardens Bay at Morisset Park near Bluff Point, on the shores of Lake Macquarie. Refer to **Figure 1** for locality plan. The site is within the Lake Macquarie City Council (*LMCC*) Local Government Area (*LGA*) and is situated within the Trinity Point master plan site (*also referred to as the Kendall Grange Masterplan*). The proposed Trinity Point Marina and Mixed Use development proposal broadly consists of the following components:

- residential and mixed use accommodation;
- a marina with floating pontoon style wet berths;
- a combined marina/mixed use village;
- foreshore jetties;
- a marine workshop;
- car parking; and
- a helipad.

JPG commissioned a team of specialist consultants, including Patterson Britton & Partners *(Patterson Britton)*, to assist in the development of the design of the proposal and preparation of Environmental Assessment documentation. The consultant team have undertaken extensive investigation, design studies, and consultation with authorities and the community. The design for the Trinity Point Marina and Mixed Use Development described in the Environmental Assessment Report *(EAR)* reflects the outcome of this process. This document is **Volume II** of the Environmental Assessment Report (*EAR*), which consists of the following three sets of documentation.

Volume I – Prepared by ADW Johnson Pty Ltd, addresses the overall concept including assessment of the shore based components other than those immediately associated with the operations of the proposed marina;

Volume II – Prepared by Patterson Britton and Partners Pty Ltd addresses the Marina and associated shore based components, as well as coastal processes aspects; and

Volume III - Comprises all Appendices that **Volumes I** and **II** refer to.

The EAR has been prepared in accordance with the requirements of the Director-General (*DG*) of the Department of Planning to accompany a “Concept Plan Application” pursuant to the provisions of *Part 3A of the Environmental Planning and Assessment (EP & A) Act*, 1979.

1.2 OUTLINE OF THE TRINITY POINT MARINA DEVELOPMENT

The proposed marina and village centre would include a 308 berth marina consisting of four arms of floating pontoons, marina administration offices, a breakwater, a travel lift with associated hardstand area for boat repairs and maintenance, and a workshop. Construction of the marina would be staged, commencing with the southern portion of the breakwater and Arm A. If initial demand for berths (*on release of the development*) was higher, more than one arm of the marina would be constructed in Stage 1. Timing for the construction of subsequent stages would be based on the permanent occupancy rate, with an 80% take up rate being the threshold for construction of the next arm of the marina.

In addition, there would be an associated village centre incorporating a café, restaurant, function centres, chandlery, general store and commercial offices which is addressed in **Volume I**.

1.3 CONSENT AUTHORITY

The proposed development is defined as a major project under **State Environmental Planning Policy (*SEPP*) Major Projects, 2005**. On this basis the Minister of Planning is the Consent Authority under Part 3A of the EP&A Act.

Land Owners Consent for the Marina is also required from LANDS, which has been granted. Documentation of this consent has been included for submission with the EAR documents.

1.4 ENVIRONMENTAL ASSESSMENT REQUIREMENTS

An application for approval of a concept plan is to:

- outline the scope of the project and any development options;
- set out any proposal for the staged implementation of the project; and
- contain any other matter required by the Director-General of the Department of Planning.

Notwithstanding the current Concept Plan Application, the marina component of the proposed development has been developed in greater detail than required at this application level. The structure of **Volume II** of the EAR is based on the framework outlined in the *EIS Guideline for Marinas and Related Facilities* prepared by the then Department of Urban Affairs and Planning in October 1996. However, at this stage only a Concept Plan Application for the entire development, including the marina, is being lodged.

1.5 DIRECTOR GENERALS REQUIREMENTS

The Department of Planning *(DoP)* released Director General's Requirements on 7 April 2008, a copy of which is included in **Appendix M**.

The requirements stated that the concept plan application must include:

- an executive summary;
- an outline of the scope of the project including:-
    I. any development options;
    II. justification of the project taking into consideration any environmental impacts of the project, the suitability of the site and whether the project is in the public interest; and
    III. outline of the staged implementation of the project;
- a thorough site analysis including the affected part of the waterway *(Lake Macquarie)* and description of existing environment and constraints mapping;
- consideration of relevant statutory and non-statutory provisions, in particular relevant provisions arising from environmental planning instruments, State Environmental Planning Policies in particular SEPP 65 – Design Quality of Residential Flat Development, Regional Strategies *(including draft Regional Strategies)* and Development Control Plans. Including *Lake Macquarie Estuary Management Plan; Lake Macquarie Mooring Management Plan; Lake Macquarie Foreshore Stabilisation and Rehabilitation Guidelines;*

and Lake Macquarie Lifestyle 2020 Strategy. Identify non-compliances and provide justification for any departures;
- Consideration of impacts, if any, on matters of national environmental significance under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*;
- Consideration of the consistency of the project with the objectives of the *Environmental Planning and Assessment Act 1979*;
- An assessment of the potential impacts of the project and a draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures to be implemented to minimise any potential impacts of the project;
- Plans and documents outlining the proposal and associated investigations;
- A signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false or misleading;
- A Quantity Surveyor's Certificate of Cost to verify the capital investment value of the project; and
- An assessment of specified key issues and a table outlining how and where in the EA document key issues and requirements have been addressed.

Key issues identified in the Director General's requirements are as follows:

- strategic planning and rezoning;
- owner's consent;
- design and visual impact;
- public access;
- water cycle management;
- waste management;
- groundwater protection;
- infrastructure provision;
- noise impact;
- traffic and access;
- Aboriginal and cultural heritage;
- flora and fauna;
- natural hazards;
- marina development and potential impacts;
- establishment of helipad and helicopter noise impacts;
- energy efficiency; and
- consultation.

A table referencing the relative specific issues outlined in the Director General's requirements, and the relevant sections of this report, is available in **Appendix M**.

1.6 CONSULTATION

1.6.1 Community Consultation and Communications Plan

JPG has employed a full time Public Relations Manager to coordinate and liaise with local communities and authorities throughout the area.

The JPG Public Relations Policy is outlined below:

> *"To encourage and facilitate community access to the development process throughout design, concept, submission, approval until the final stages of implementation of our projects in a timely and transparent manner."*

The following consultation activities were undertaken as part of the Communications Plan for the Trinity Point project (*refer **Section 1.6.2** for further details*):

- introduction to project via personal visits to residents' homes – door knocking;
- informal questionnaires;
- liaison with the local government authority and attendance at Council meetings – Lake Macquarie City Council;
- community consultation and project information days;
- regular media briefings regarding all stages of the development process;
- meetings with State Government Authorities; and
- phone calls to interested parties on the community database.

1.6.2 Activities to Date

Door Knocking
Over a period of several days, the Public Relations Division at JPG visited every home along the shoreline directly adjacent to the Trinity Point Marina site. Throughout this process, JPG was able to gauge community sentiment from the early stages of the project. This has enabled the Project Management team to formulate a plan for the Trinity Point Marina project that considers the various needs of the community.

Community Questionnaire
A community questionnaire was circulated throughout November, 2007. This was an informal survey to further gauge community sentiment and to provide an opportunity for individuals to comment on the proposal. Of those that responded, 68% were residents of Morisset Park and Bardens Bay.

Lake Macquarie City Council *(LMCC)*
JPG has liaised with Council officers and attended relevant Council meetings.

State Agencies
In November / December 2006, JPG engaged a number of state government agencies to advise them of the proposal which was aimed to assist them in preparing the environmental assessment requirements, which would ultimately form part of the DG's Requirements.

As a result of receiving final DGR's in April 2008, JPG conducted a further round of consultation with relevant state agencies during May/June 2008.

Community Information Day and Community Feedback
A Community Information Day was held in November 2007. This provided an opportunity for community input on the proposal directly to developer.

Representatives from each of the independent specialist consultant companies were present and available to answer residents' questions in their various areas of expertise.

Community Groups Consulted

- Southlakes Business Chamber & Community Alliance;
- Central Coast Community Environment Network;
- Morisset Park & District Action Group; and
- Local Aboriginal Groups.

Community Groups Approached for Consultation *(declined)*

- Bonnells Bay Precinct Committee;
- Lake Macquarie Tourism; and
- Hunter Economic Development Corporation.

Regular Media Briefings and Multimedia Accessibility
Over the last two years, JPG have regularly updated the local and regional media on issues pertaining to the planning process and progress of the Trinity Point Marina development.

In addition, JPG set up a webpage *(www.trinitypointmarina.com.au)* including a Community Feedback Portal directly routed to an internal database at the JPG head office.

1.7 ACKNOWLEDGEMENTS

JPG appointed a specialist consultant team to prepare the EAR documentation, comprising:

- ARUP - Air, Noise, Vibration, and Building Services Consultant
- Asquith & deWitt - Consultant Planner
- Better Transport Futures - Traffic Engineering
- Birzulis Engineering - Building Structural Engineering
- Douglas Partners - Consultant Geotechnical Engineers
- Ernst and Young - Financial and Economic Consultants
- Harper Somers O'Sullivan - Land Based Ecologist and Bushfire Consultant
- Harris Crime Prevention Services - Crime Assessment
- HBO/EMTB - Consultant Architects
- Heli-Consultants Pty Ltd - Helicopter Landing Site Consultant
- Insite Heritage - Heritage Consultant
- Key Insight - Social/Economic Consultant
- Patterson Britton and Partners - Maritime Structural, Coastal, Civil/Environmental Engineers
- Phillip Chun & Associates - Building and Regulation Consultant
- Richard Lamb & Associates - Visual Impact
- Terras Landscaping - Landscape Architect
- The Ecology Lab - Consultant Marine Ecologist
- Thompson Kane - Hydraulic Engineer
- WT Partnership - Quantity Surveyor

2 DESCRIPTION OF THE PROPOSAL

2.1 OBJECTIVES OF THE PROPOSAL

The proposed Trinity Point Marina Development has the following objectives:

- to provide boat repair and maintenance facilities to meet community demand, incorporating environmental controls which are world best practice and which meet the requirements of the *Protection of the Environment Operations Act 1997* (*POEO Act*);
- to provide an opportunity to limit the proliferation of swing moorings *(and hence protect sensitive seagrass areas)* where increased development pressures are expected, by providing a floating berth marina which occupies a smaller total waterway area (*for the equivalent berthing capacity*);
- to address the demand for floating marina berths by providing as many berths as practicable, consistent with environmental and other site constraints *(total 308 berths staged in accordance with future demands)*;
- to provide public access to the mixed use site and surrounding public foreshore;
- to provide sewage pump-out facilities and oily bilge pump-out facilities for disposal of wastes from craft;
- to provide a workplace that meets occupational health and safety requirements;
- to provide services amenities to the boating community such as fuel supply *(incorporating best practice environmental controls)*, chandlery, and administration offices;
- to provide foreshore facilities for the local community to enjoy the foreshore;
- to provide adequate onsite parking;
- to provide an architectural style for the building structures, and for the materials and finishes, that is harmonious with the surrounding natural and built environment;
- to enable access by persons with disabilities; and
- to provide a landscape scheme that includes a large proportion of indigenous plant species and is in keeping with the visual character of the area.

2.2 ENTIRE DEVELOPMENT OVERVIEW

The Marina Village development would consist of the breakwater, marina berths, amenities marina management office and associated boat maintenance facilities *(travel lift, hardstand and workshop*), and other associated commercial infrastructure such as a café, restaurant and function facilities. Immediately adjacent to the Marina Village would be a cluster of multi storey buildings *(both apartment and hotel style)* for short to medium term tourist accommodation. These areas would be connected through a boardwalk structure with under-croft car parking beneath. A series of boardwalks, decks and jetties would connect the marina and adjacent building development to the foreshore area.

The remainder of the development would consist of apartment style accommodation, in two to five storey buildings, associated car parking *(under ground parking*), access roadways, footpaths, boardwalks, jetties and landscaping. Further details of the shore-based facilities and accommodation areas are available in **Volume I** of the EAR documentation.

Figure 2 presents the architectural concepts of the proposed marina, village centre and associated tourist and residential accommodation buildings. **Figure 3** shows the corresponding car park layout. The marina berths, maintenance area, workshops and marina management facilities form the area of the development being assessed in this volume ***(Volume II)*** of the EAR documentation. This specific area has been indicated on **Figure 2.** Reference to features of the overall development outside of this area are also included in **Volume II**, but are assessed in more detail in **Volume I**.

2.3 DESCRIPTION OF PROPOSED MARINA COMPONENT OF THE DEVELOPMENT

2.3.1 General

The proposed marina village development and adjacent buildings would comprise the following main elements:

- a staged 308 berth floating marina for craft in the length range of 8 - 20 m, including services to berths such as water, power and lighting;
- a breakwater jetty structure;
- approximately 120m of floating public berthing wharf;
- a floating helipad pontoon;
- fuel, sewage pump-out and oily bilge pump-out facilities;
- security measures for marina berths, fuel and pump-out facilities, and helipad;
- repair and maintenance facilities;
- building structures *(commercial and tourist accommodation);*
- timber decks/boardwalks;
- water and waste management;
- public access, amenities and parking;
- landscaping;
- lighting; and
- stormwater management facilities.

Each of the above elements is discussed in more detail in the following sections. A plan view of the proposed marina is presented is presented in **Figure 4** with the proposed staging indicated in **Figure 5**.

2.3.2 Access

Access to the floating marina would be via an elevated boardwalk connecting the marina village centre with the floating berths. A hinged aluminium gangway approximately 10 m long would provide access from the fixed boardwalk level to the floating walkway. **Figure 6** shows a conceptual gangway detail. A sliding gate would be installed at the head of the access gangway for security.

The breakwater would also have a similar elevated timber walkway, allowing access around the perimeter of the marina, and for access to the Helicopter Landing Platform.

The boardwalk access to the marina and breakwater has been designed such that access from the marina village at a much higher level can be afforded without having to go down to ground level and then back up to the marina level (refer **Figure 6**). Should a preference for these access ways to reach existing ground levels prior to them going out onto the marina and/or breakwater, then the design could be modified.

Access to the berths themselves would be via a floating walkway and fingers. These are further discussed in **Section 2.3.4**.

2.3.3 Marina and Breakwater

The layout of the floating marina was influenced by a range of factors:

- avoidance of direct or indirect impacts on seagrass beds;
- existing available water depths, as dredging is not proposed;
- retention of navigation access within Bardens Bay;
- exposure of the site to wind and wind generated waves, particularly waves from the south-east quadrant;
- visual impact of the proposal; and
- minimum dimensions for berths, channels and fairways set out in the Australian Standard AS3962-2001, 'Guidelines for Design of Marinas' and in Guidance Notes prepared by NSW Maritime.

A wave climate assessment was undertaken for the site (*refer* **Appendix AB**). Based on this wave climate assessment and the criteria for 'good' and 'moderate' wave climate in AS 3962-2001 it can be shown that breakwater protection would be required for craft berthing at the marina.

The marina would incorporate a breakwater around the southern and eastern boundaries. As noted in **Section 1.2**, it is proposed to initially construct enough arms of the marina, consisting of floating pontoons, to satisfy immediate demand at the release of the development. Allowance has been made for additional floating pontoon arms *(up to a total of 4)* to be added at a future date. Breakwater construction would also be staged accordingly, to provide adequate protection to the marina berths as they are constructed.

In addition to the staged provision of 308 permanent and casual private berths, a public berthing facility would be provided adjacent to the breakwater structure providing approximately 120m of floating pontoon wharf (*as shown in* **Figure 4**). The breakwater would have full public access. Berthing along the outside of the southern side of the breakwater would be not allowed as there are extensive seagrass beds in this location. Navigational markers and signage would be positioned to identify and manage a vessel exclusion zone in this area. However, along the outside of the eastern breakwater, accommodating large tourist vessels or public transport vessels is a possibility. This design feature would be included in subsequent detailed design stages.

Figure 7 and **Figure 8** outline the conceptual breakwater design and **Figure 9** specifies the marina berth footprint. **Table 2-1**, defines the proposed size-based vessel berth configuration for each of the four marina arms *(stages).* The vessel berth distribution was based on the outcomes of the specific berth demand study undertaken for the site (*refer* **Section 5.14.2** *and* **Appendix Z**).

Table 2-1 - Vessel Berth Distribution

	Marina Arm *(Stage)*					
Vessel Size	A	B	C	D	Total	%
8m	2	6	8	5	21	6.8
10m	6	8	6	8	28	9.1
12m	32	30	25	33	120	39.0
14m	28	28	24	28	108	35.0
16m	4	4	8	6	22	7.1
18m	-	-	5	1	6	2.0
20m	-	-	2	1	3	1.0
Total Berths	**72**	**76**	**78**	**82**	**308**	

The proposed sizing and configuration of the marina berths was designed such that larger boats are positioned towards the outer edge of the pontoon arms, in deeper water, and smaller vessels closer to the shore. In addition, the travel lift extends sufficiently from the shore to ensure that boats that can be removed have sufficient draft to access the travel lift. Accordingly no dredging for the marina, or of the area surrounding the travel lift, would be required.

The breakwater would consist of two rows of parallel tubular steel piles driven into the lake bed, with timber slats supported on the outer side of each row of piles in a partial depth double skirt arrangement. The seaward row of timber slats would be spaced to allow water movement. This arrangement would attenuate wave energy within the marina, as well as minimising the reflection of wave energy and subsequent impacts on surrounding foreshore areas. The partial depth of the slats allows water exchange across the breakwater alignment.

2.3.4 Types and Layout of Berths

The marina berths would comprise a floating system of walkways, with finger units at right angles to the walkways creating the berthing pens and providing access alongside the craft. The floating berths would be delineated by circular steel piles driven into the lake bed. **Figure 10** indicates the plan layout of these piles**. Figure 11** and **Figure 12** provide indicative details of the floating marina system.

The final widths of walkways and fingers would be dependent on the actual proprietary flotation system adopted for the marina, of which there are a number to select from. However, the detailed design would only differ marginally from concepts shown in the figures, if at all.

A floating berthing system was preferred to fixed jetties on the basis of greater convenience to users *(e.g. disabled persons including those requiring wheelchairs)* and minimisation of visual impacts, particularly at low lake levels. Most modern marinas are floating structures and this form of construction is also preferred by regulatory authorities, largely due to lesser visual impact.

2.3.5 Services to Berths Including Lighting

The marina berths would be supplied with water, power, and lighting, with the capacity for introduction of telephone and TV if required. These services would be available to the berths via low height *(approximately 900 mm high)* service pedestals, an example of which is shown in **Photo 1** below.

The service pedestals would be located at the junctions between fingers and the walkway and, on the longer runs of the walkway where there are no fingers, at a spacing of about 10 m *(light only).*

The various services to the pedestals would be supplied from the land-based infrastructure via pipe work and conduits which would run along the access gangway *(incorporating flexible couplings)* and be fitted under the floating walkway deck, out of view but accessible for inspection and maintenance.

Photo 1 – Service Pedestal

View of a services pedestal similar to that proposed for the Trinity Point Marina Development, situated at HolmePort Marina, Church Point. A fire hose reel is also visible near the services pedestal, with a red cover *(October 2004).*

2.3.6 Fire Fighting

Fire fighting equipment would be provided in accordance with AS 3962-2001 and to the requirements of relevant authorities. The equipment would include fire hose reels, a fire hydrant, fire extinguishers and fire alarm system. The equipment is discussed further below. Fire protection in the vicinity of the helicopter landing site would be in accordance with CAAP 92-2[1] and/or NFPA 418-2006.

Fire Hose Reels

AS 3962-2001 notes a number of requirements for fire hose reels. In particular, the length of hose on any hose reel should be 36 m, at least one hose reel should be located on the shoreline side of the first berth and also at the seaward end of each walkway. The maximum distance between any two reels should be 30 m, and at least two reels should be accessible from each berth. These requirements would be taken into account during detailed design.

The fire hose reels would be connected to the 'domestic' water supply, whereas the fire hydrants *(see below)* would be connected to a special hydrant service. An example of a fire hose reel installation is shown in **Photo 1** above.

Fire Hydrant

AS 3962-2001 notes that a fire hydrant should be located at the head of each access gangway. Accordingly, a fire hydrant is proposed at the north-western corner of the hardstand. The fire hydrant system would have its own independent water supply service.

Fire Extinguishers

AS 3962-2001 notes that fire extinguishers should be provided at 'appropriate locations'. These locations would be agreed with the relevant authorities but at least two extinguishers would be provided at the fuel and pump-out berth, and at the workshop.

The extinguishers would be suitable for other fire hazards not able to be contained by water from hose reels. They are likely to be a Dry Powder type and/or a $C0_2$ type extinguisher. The holding capacity for each extinguisher would be approximately 9 litres or equivalent. An example of a cabinet housing a fire extinguisher is shown in **Photo 2** below.

Photo 2– Cabinet Housing and Fire Extinguisher

View of a cabinet housing a fire extinguisher similar to that proposed for the Trinity Point Marina Development, situated at HolmePort Marina, Church Point. A services pedestal is visible behind the fire extinguisher cabinet, and a fuel bowser and fuel hutch is visible in the background *(October 2004).*

Fire Alarm System

It is proposed that an audible fire alarm system be incorporated in the marina. The details of the system would be agreed with relevant authorities.

2.3.7 Security

The floating marina and breakwater structure would be generally available to the public during the day. A security gate at the access gangway leading to the marina berths would be locked at night to provide a level of security particularly against vandalism, property damage and theft. A key card system would operate the security gates at night, available to boat owners and marina staff.

Public access to the breakwater structure would be available at all times. A similar night time security system to that described above would be installed on the gangway from the breakwater to the public berth area. This security gate would only be operated by marina staff. Access to the breakwater would be restricted in the immediate vicinity of the helicopter landing pontoon during helicopter movements. Marina staff would close security gates to temporarily prevent access during such take offs and landings.

2.3.8 Repair and Maintenance Facilities

The repair and maintenance facilities would comprise the travel-lift, hardstand area and work shop, and would be located on the western side of the site *(refer* **Figure 4***).* These facilities are intended for minor repairs and maintenance and would not accommodate major overhauls, refits or boat buildings activities.

Boat Travel-lift
The boat travel-lift facility would be situated at the north-western corner of the hardstand area and would extend out from the lake foreshore (*approximately 40 - 45m*) into a water depth great enough to ensure that no dredging would be required. The capacity of the travel-lift would be in the range of 70 to 75 tonnes, capable of lifting a vessel up to about 25m in length with about an 8m beam.

The travel-lift support structure would comprise two steel runway beams 40 to 45m in length, supported on tubular steel piles driven to material of suitable strength. At least one of the runway beams would incorporate pedestrian access alongside the travel-lift device. **Figure 14** shows a preliminary design of components of this facility.

Hardstand Area
The hardstand area would be approximately 45 m long and have a width of between 20 and 25 m with an additional 50m long and 15m width runway area for the boat travel-lift. Activities undertaken on the hardstand would include washing down, scraping down, abrasive blasting, sanding, painting, mechanical/electrical repairs and fit outs as well as fibreglass, timber and metal work.

The hardstand surface area would be segmented into three separate zones to facilitate waste collection and treatment. This is further discussed in **Section 2.3.14**.

The hardstand would be able to accommodate an average of about 7 to 9 vessels at any one time, depending on the size of the vessels involved. The proposed level of the hardstand is 1.2m above Australian Height Datum *(1.2m AHD*).

The hardstand would be fenced for safety and security. The entire hardstand area and surrounding security measures would be screened by vegetation to limit visual impact. Proposed planting is specified in the landscape concept plan and planting schedule (see **Section 2.3.16**).

Work Shop
A work shop building servicing the marina would be incorporated into the north western edge of the marina village building development adjacent to the hardstand area. A two storey building is proposed, containing the following uses:

- on the ground floor, workshops to suit boat maintenance operations such as shipwright, rigger, trimmer, inboard and outboard mechanical services, engineering, painter and electrician, and a plant room and amenities;
- offices associated with the workshops or other marine related activities, common room and amenities for marina patrons; and
- on the first floor, a 2 bedroom apartment for living quarters for the marina manager.

Figure 15 and **Figure 16** presents architectural concepts for the plan layout of the ground and first floors of this workshop building respectively. **Figure 17** indicates elevations of the building structure, in relation to surrounding buildings. The workshop building is at the northern extremity of the two elevations show on **Figure 17**.

Volume I of the EAR documentation provides information about the architectural styles and the rationale behind the building designs. Assessment of the impact of the architectural designs is also outlined in **Volume I**.

2.3.9 Helicopter Landing Pontoon

As shown in **Figure 4**, a floating helicopter landing platform *(helipad)* is proposed on a pontoon on the eastern side of the marina breakwater. The helipad would be a 25m by 25m floating steel pontoon anchored to the lake bed, with an access gangway directly from the breakwater walkway. **Figure 18** presents conceptual design details of the helipad. Anchors would be steel piles driven into the lake bed similar to piles for the breakwater and pontoons. Anchor piles would be cut off at the lake bed level.

2.3.10 Fuel, Sewage and Bilge Pump-out Facilities

Fuelling Facilities

A fuelling berth would be provided, as indicated on **Figure 4**, on the floating pontoon arrangement at the end of marina Arm A. A dual bowser located on the wharf deck would dispense diesel and unleaded petrol *(ULP).* This facility would be for the refuelling of boats only. There would no refuelling of helicopters at the site.

All fuel handling and storage is to be designed in accordance with AS 1940-2004 - The storage and handling of flammable and combustible liquids.

Location of the fuelling and pump-out facilities on the floating marina berths is desirable from a safety perspective, a matter referred to in AS 3962-2001. AS 3962-2001 also notes the need for particular precautions when supplying fuel over water, such as use of double containment lines. All of these precautions would be adopted in the design and installation of fuel facilities.

Photo 3 and **Photo 4** below show examples of a floating fuel berth and safety and environmental protection equipment.

Photo 3 – Floating Berth

Example of a floating fuel berth – HolmePort Marina, Church Point. Here there are three separate bowsers. The sign provides instructions on safe refuelling procedures. A services pedestal is visible in the immediate foreground *(October 2004)*

Fuel storage would be provided in two steel tanks located above ground on a sealed area adjacent to the boat maintenance hardstand area at the western extremity of the site. The tanks would have integral secondary containment in accordance with AS 1940 – 2004 (*i.e. be double – skinned to prevent any leakage in the case of rupture of the primary inner tank*). The locations of these are indicatively shown on **Figure 4**. A 20,000 - 25,000 L capacity tank would be used for diesel storage, for which there is greater demand. A 10,000 - 15,000 L tank would be used for ULP. The fuel bowser would be installed in accordance with the requirements of relevant authorities. In particular, the following requirements would be met:

- not less than two fire extinguishers would be provided, selected from the following type and minimum size:
  - 9 kg dry chemical type;
  - 9 kg halogenated hydrocarbon type; and/or
  - 9 litre foam type.
- drip trays would be provided under and around the bowser. Trays would be of sufficient size to hold the contents of any jerry cans being filled;
- a holding tank would be provided to collect and retain waste from the drip trays;

- provision would be made for regular emptying and disposal of the holding tank to an approved system or site;
- an oil/fuel boom would be provided to contain any accidental fuel spillage; and
- an oil absorbent material would be provided to absorb petroleum products spilt on the water surface.

Photo 4 – Environmental Management Equipment

Fire hose reel and environmental management equipment *(fuel spillage clean-up material adjacent to the fuel berth)* – HolmePort Marina, Church Point *(October 2004)*

Sewage Pump-out and Oily Bilge Pump-out Facilities

A sewage pump-out facility would be provided at the same berth as the fuel facilities. Such an arrangement provides for improved environmental management, functional efficiency and cost efficiency. All craft from time to time must take on fuel and the installation of the sewage pump-out facilities at the same berth encourages its' use.

The sewage pump-out facility would consist of a pump-out unit to empty holding tanks on craft and a waste slops hopper for manual collection of chemical toilet waste.

There are various proprietary pump-out systems available with a choice of pump size. The pump would typically be a diaphragm type with a waterproof motor. A suction hose would be connected between the craft's holding tank and the pump and the effluent would be discharged to the site sewage pumping station for disposal to the sewer. A drip bucket for storage of the pump-out hose end when not in use would be provided. The pump and motor housing, hose stand and electrical controls would be enclosed within a cabinet.

The chemical toilet waste slops hopper is a convenient disposal and storage cabinet which contains a hose for rinsing chemical toilets. The chemical toilet waste slops hopper would be located adjacent to the sewage pump-out unit or be incorporated with the sewage pump-out unit in a single overall unit. A pump would be provided to deliver the contents of the chemical toilet waste storage hopper to the sewerage system.

The sewage pump-out system does not have holding tanks to cause an odour problem. The facility incorporates a water supply for rinsing the slops hopper and drip bucket. With regular rinsing of these items and the suction hose there would be no odour problems associated with the pump-out facility.

The sewage pump-out facilities would be for use of all craft at the marina although craft would require an on-board holding tank to make use of the sewage pump-out. The NSW Government has a policy requiring sewage holding tanks in all recreational craft fitted with a toilet. In the medium term, the majority of craft longer than 8 metres can be expected to be fitted with holding tanks.

In addition to the above, a Marina Occupation Licence to be finalised by the marina operator would require that flushing heads (*toilets*) on craft not be used while craft are at berths. Fines would be imposed for non-compliance with this measure. The ultimate action would be eviction from the berth if the owner does not comply. Adequate land-based toilet, shower and laundry facilities are proposed within the development for use by marina patrons.

A bilge water pump-out system would be provided adjacent to the sewage pump-out facilities. It would consist of a separate pump, hose and delivery lines. The pump would typically be a diaphragm type and be located at the pump-out berth. A long flexible suction hose would be provided to extend to boat bilges. As for the sewage pump-out system, a drip bucket would be provided for storage of the suction hose end when not in use. The bilge water would be pumped to the oily waste storage tank for recycling by a commercial contractor.

In addition to the above precautions for disposal of bilge water, the Marina Occupation Licence to be finalised by the marina operator would ban the direct discharge of bilge water within the berthing area. Specifically, the Rules & Regulations would require that automatic bilge pumps in vessels must be fitted with an isolation switch and that these must be left in the “off” position while the vessel is at berth. This is contrary to normal use but is considered a reasonable safeguard for which owners should be expected to bear the small inconvenience. As in the case of flushing heads, fines would be imposed for non compliance with the above measure and the ultimate penalty for non compliance would be eviction of the craft.

A floating boom would be maintained at the site to contain any surface pollutants in the event of an accidental leakage of bilge water. Oil absorbent material would also be maintained at the site to absorb any petroleum contained within the boom.

2.3.11 Village Centre Buildings

The village centre would incorporate a restaurant, function rooms, meeting rooms, a café, commercial offices, retail and public amenities. These structures are discussed further in **Volume I** of the EAR documentation.

2.3.12 Tourist and Residential Accommodation

Immediately to the south of the village centre, in the same building cluster, short term tourist accommodation would be provided. Building structures presenting opportunities for both resort and serviced apartment style lodging are proposed. Residential apartments are also included in the three building clusters further to the south of the tourism accommodation area.

These structures are discussed further in **Volume I** of the EAR documentation.

2.3.13 Timber Decks/Boardwalks

The Marina, Marina Village Centre and remainder of the Trinity Point tourist development would be connected through a series of elevated decks and boardwalks.

These structures are discussed further in **Volume I** of the EAR documentation.

2.3.14 Waste and Waste Management

General
A summary of the wastes expected to be produced by the marina and mixed use development, their classification according to the Waste Classification Guidelines, Part 1: Classifying Waste and proposed waste management are provided in **Table 2-2**.

Table 2-2 – Waste and Waste Management

Waste expected to be produced by the development	Waste Classification	Proposed Waste Management
Domestic sewage	Liquid Waste	Domestic sewage will be discharged into the Hunter Water sewer system.
Sewage pump-out and chemical toilet wastes from vessels	Liquid Waste	Small private pumping station and rising main will service the pump out facility and transport wastewater into the Hunter Water sewer system.
Household/ commercial waste that contains putrescible organics	General Solid Waste – Putrescible	Bins for the solid waste - non-recycled collected by local council
Household/ commercial waste that does not contain food	General Solid Waste - Non-Putrescible	Bins for the solid waste - recycled and non-recycled collected by local council
Drained oil	Liquid Waste	A first flush tank would be provided to capture the initial 15mm of runoff from the hardstand\ workshop area *(as well as any water used for vessel wash down)*. Captured stormwater would be treated using a proprietary treatment package and reused for vessel repair/wash down purposes. Excess water would be discharged to the sewer under a trade waste agreement.Oily Waste will be discharged manually via a covered slop hopper into oily waste storage tank for recycling by a commercial contractor
Oily bilge waste	Liquid Waste	Oily bilge will be pumped via a pump-out berth

Waste expected to be produced by the development	Waste Classification	Proposed Waste Management
		from vessels and discharged into oily waste storage tank for recycling by a commercial contractor
Grease trap waste resulting from preparation of food	General Solid Waste – Non-Putrescible	Dry basket arrestors in sinks and on floor wastes with wastes draining to grease trap. The grease trap is to be located adjacent to the car park to allow tanker access for regular clean-out by a commercial waste contractor.

The waste management facilities are further discussed below.

Sewage

Domestic sewage would be generated by the office and marina amenities located in Marina Village buildings *(including wastewater from toilets, basins, showers and laundry)* and from apartments in both the tourist and residential sectors of the development. This wastewater would drain by gravity to a new site wastewater pumping station (*WWPS*), Morisset Park 4, to be located north of Trinity Point Drive, on the lake side of the intersection of Trinity Point Drive and Mirraby Drive. This WWPS would be owned and operated by Hunter Water Corporation.

The Morisset Park 4 WWPS would be provided with duty and stand by pumps rated at 30L/s with automatic level controls. The pumping station would transfer a wastewater flow via a 150mm diameter rising main to the discharge access chamber constructed in the park area north-east of the intersection of Lakeview Road and Macquarie Road. From the rising main discharge chamber, the wastewater would be transferred via a new DN225 gravity main and discharged into a new access chamber constructed in the existing DN300 sewer line N17758 located behind the properties fronting Chifley Road.

Trade Waste

The trade waste generated by the site comprises three streams, namely:

- wastewater from the marina village centre kitchens/café/restaurant;
- sewage pump-out and chemical toilet waste from the dedicated vessel pump-out berth; and
- effluent from the hardstand area first flush/wash down water treatment/water reclamation facility.

Generally, dry cleanup techniques would be sufficient in the workshops, with direct collection of oil and grease from engine maintenance. Cleaning of mechanical parts would be undertaken within purpose designed parts-cleaning basins. The workshop floor areas would be graded to individual sumps that would be provided to retain any accidental spillage of liquids within the workshops. In the event of a spillage these sumps would be manually cleaned out using absorbent materials. These sumps are not connected to the trade waste system that discharges to the sewer.

Kitchen Wastes

Hunter Water requires pre-treatment of waste waters generated in kitchens prior to discharge to the sewer as trade waste. Typical requirements for the marina village centre would include:

- provision of grease traps on the sewer draining from any kitchens;
- dry basket arrestor on floor wastes in the food preparation and handling areas with floor wastes draining to the grease trap serving the kitchen; and
- dry basket arrestors in sinks.

The grease trap would be located adjacent to the car park to allow tanker access for regular clean-out by a commercial waste contractor.

Sewage Pump-out and Chemical Toilet Wastes from Vessels

A small private WWPS would be required to service the proposed boat pump-out facility. This WWPS would be owned and operated by the Marina under a trade waste agreement with Hunter Water.

The trade waste from the marina pump out facility would be transported via a DN50 rising main to the connection point on the Trinity Point gravity sewer *(access chamber J3595)*. The Trinity Point sewer would drain by gravity to the Morisset Park 4 WWPS.

It is noted that a proposed private pumping station servicing the pump-out facility at the marina would occasionally discharge into the Morisset Park 4 WWPS system. As a result there would be a potential odour impact from this private pumping station transporting septic sewage into the system. Design of this pumping station would include odour control and a designated time for pumping into the common sewage system *(preferably in the morning to avoid NE winds transporting odours).*

Hardstand Area First Flush / Wash Down Water

The hardstand area would be divided into three drainage areas. An area of 180 m^2, immediately adjacent to the boat travel-lift facility, would be dedicated as a wash down area. High pressure hoses would be used in this area to clean all vessels prior to further maintenance work. The remainder of the hardstand would be graded into two sections, one in front of the workshops and the other adjacent to the wash down area.

The purpose of segmentation of the work areas is to contain any solid wastes generated within the respective maintenance areas and therefore facilitate efficient housekeeping. The guiding policy is to minimise the production of liquid trade waste by regular clean-up of solid wastes in the dry. Other measures are outlined in **Section 2.3.18.**

When wash down of craft is occurring, the pumps from the first flush collection system would be operated by level controls. Quick break type detergents would be utilised during wash down.

There are a number of proprietary trade waste treatment / water reclamation systems on the market that can be used. The plant would be designed to be housed in a plant room within the Workshop building. A final selection would be made subject to Tender. Nevertheless, the available trade waste treatment plants have a number of common features including:

- fine screening to remove barnacles and other large particles, grit, shavings, etc;
- oil / water coalescing plate interceptor which removes oil and settleable materials from waste waters *(an alternative would be to use dissolved air floatation to remove floatables and a settling tank to remove smaller particles)*;

- pH adjustment and precipitation of heavy metals;
- filtering to remove residual metals *(typically sand filters and activated carbon)*; and
- collection of particulate matter in solid waste bins and oily waste in 200 L drums for disposal by a commercial waste contractor. Sludges can be tankered off site in liquid form or dried in filter bags.

Hunter Water would require access to a separate trade waste sampling point and flow meter for this waste water stream. These facilities would be provided adjacent to the package pumping station.

Potable Water Substitution
In addition to use of AAA-rated water saving devices the use of potable water on the site would be minimised by two potable water substitution facilities, namely:

- collection of roof water from Buildings in a below ground tank for use in toilet flushing and for supplementary vessel wash down water; and
- treatment of hardstand area first flush / wash down waters to reclaimed water standard for use as the primary source of vessel wash down water. This approach also minimises the discharge of pollutants to the sewer.

Oily Waste Recycling
An oily waste recycling tank would be provided within the repair and maintenance area. Oily wastes generated from maintenance facilities would be discharged to the tank manually via a covered slops hopper. Oily bilge water from vessels using the pump-out berth *(discussed further in* **Section 2.3.10***)* would be pumped into the tank.

Signs would be installed at appropriate locations indicating the position of the slops hopper and requirement for oily waste recycling. The tank would be emptied by a commercial oil recycling contractor.

Solid Wastes and Recycling
Solid waste and recycling bins would be provided within the repair and maintenance area for collection of solid wastes and recyclable materials. A separate bin storage area would be provided for domestic solid wastes.

Signs would be installed at appropriate locations indicating the position of bins and requirement for solid waste disposal or recycling. The bins would be emptied by commercial contractors.

2.3.15 Access and Parking

Boat Access
As shown in **Figure 4**, in addition to the staged provision of 308 permanent and casual private berths, a public berthing facility would be provided adjacent to the breakwater structure providing approximately 120m of floating pontoon wharf. The breakwater would also have full public access. This would allow the general boating public access to the site and associated facilities.

Access to Bardens Bay and the entrance to the marina is of a depth that is significantly greater than the minimum required for the design vessel distribution used in the layout of the marina.

In terms of access from the ocean *(via Swansea Channel)* it is recognised that despite ongoing dredging of the Channel to maintain navigation depths being an established practice, issues remain surrounding the regularity of the maintenance dredging and depths. It is noted that a tender has recently been called for this work.

Vessel draught is a design parameter that guided the Marina layout. However, it does not necessarily drive actual boat sizes realised once built. This is determined by the market *(boat owners)*. The Marina design hasn't precluded the option of berthing large vessels based on current Swansea Channel depths given that future dredging of the Channel is proposed. There are already vessels of the size proposed for the Marina on the Lake demonstrating that there are some boat owners who do not wish/need to access offshore areas. Current navigation restrictions through the Swansea Channel do not stop the use of Lake Macquarie for boating, as is evidenced by the current usage and high demand for marina berths. As such, the maintenance of navigation through Swansea Channel is not needed for the Trinity Point Marina although it is considered desirable for general navigation purposes for the Lake as a whole by the wider boating community.

Vehicular Access

Vehicular access to the site would be from the round-a-bout at the eastern end of the proposed Trinity Point Drive. The main entrance to the under-croft parking provided for the marina and associated tourist accommodation buildings would be from Trinity Point Drive. Under-croft parking would only be available for cars. Service vehicles would not be able to access this parking area. Access beyond the main entrance would be restricted to staff, service and delivery vehicles.

Loading and turning bays for marina operations related vehicles would be provided on the western side of the marina village and maintenance area buildings. Vehicular access would also be provided to the hardstand area when required *(primarily for fuel delivery)*. Access through the hardstand area would be gated and managed through marina operations staff.

The maximum size vehicle for the marina operation area would be a rigid single unit *(SU)* truck. Specifications for which are shown in **Figure 19.**

Pedestrian Access

Pedestrian access to the site would be via the boardwalk network within the development from the following areas:

- lake foreshore reserve;
- under-croft car parking areas;
- street/boardwalk interfaces; and
- the associated residential development.

Foreshore Access

The marina access arm and breakwater access area are both physically and visually accessible to the general public, being located adjacent to the "Marina Green" *(refer to* **Section 2.3.16***)*. As noted in **Section 2.3.16**, the area between the breakwater and stairs leading to the Marina Forecourt would be turfed and become a level, passive, open, public space between the commercial precinct the water.

The marina and the area of the travel lift runway which crosses the foreshore reserve are accessible to the public but for security and safety reasons public access would be managed. Management measures would amount to temporarily restriction to public access in the vicinity of the marina maintenance area travel-lift facility when the travel lift is in operation *(swinging gate* *operation)* and access to the marina berths would be via a key card at night *(as noted in* **Section 2.3.7***)*.

Photo 5 – Public Access Management Measures

Example of a management system used for travel lift operations - NCYC, Newcastle Harbour. A gated system closes the foreshore public walkway when boats are being transferred by travel lift. At all other times the gated system is used to isolate the public from the work areas for safety and security *(October 2008)*

Access for People with Disabilities

Access that enables by people with disabilities to participate in activities within the development is one of the objectives of the proposal and is to be compliant with the Building Code of Australia *(Part D3)* and AS 1428.1.

The following design elements would typically be included by the architect:

- wheelchair accessible parking spaces of appropriate width;
- a lift *(or stairway platform lift)* to gain access to upper levels of the Marina Village Buildings;
- no steps between the workshop floor and adjacent hardstand area;
- a wheelchair accessible toilet/shower facility; and
- compliant ramp access between marina village buildings and boardwalk structures and between the boardwalk structures and the floating marina pontoons.

Further details associated with the internal fit out of sanitary facilities, surface materials, lighting, signage and the like would be included at the construction certificate stage all in accordance with the Building Code of Australia.

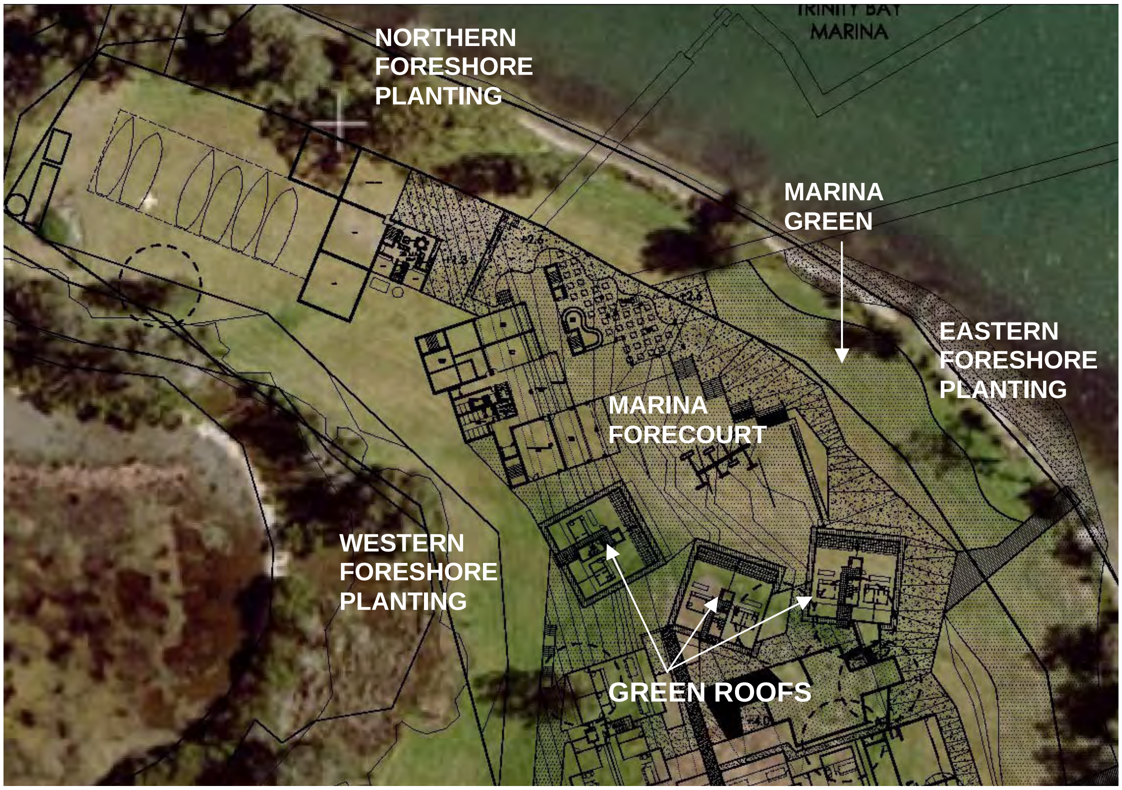
Parking

Car parking provision is to be designed in accordance with AS 2890.1. The marina would have 90 spaces plus staff parking A preliminary car parking plan is presented in **Figure 3** for the entire development area.

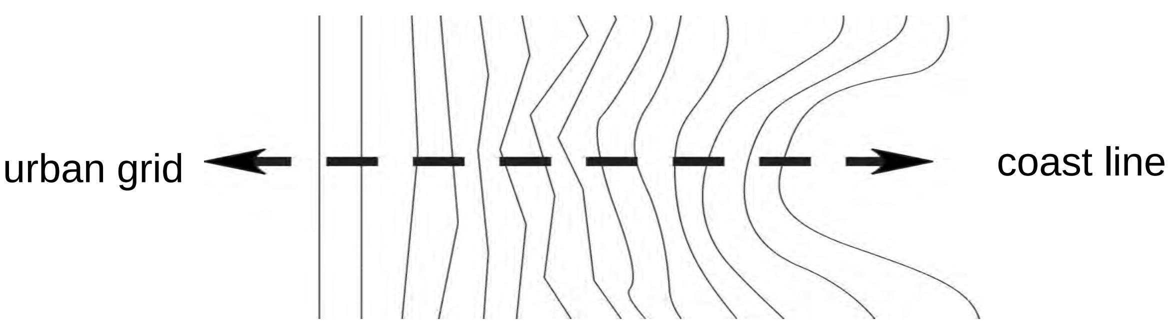
2.3.16 Landscaping

Generally

The landscape proposal for the areas within and surrounding the marina precinct respond to the use of the space and proximity to the foreshore. Generally landscape works would draw on a strong graphic form within the public domain areas, blending into bands of surfaces and planting on the outer areas and edges. Landscape works would provide a balance of passive and active social spaces, stormwater treatment zones and defined access to the foreshore through stands of native vegetation. Vegetation used would be consistent with Lake Macquarie City Council's DCP i.e. generally be native, and in areas adjoining bushland, locally indigenous.



Planting and Site Form
The landscape design unifies the distinct clusters of buildings across the site and provides a gradual transition between the urban 'grid' and the lake's 'organic' shaped edges. In this way the design and form is rigid on the western edges and informal on the eastern edges. The transition occurs across the courtyards and roof gardens into the boardwalk areas. Plants would be used to inform the form with exotic and cultivated native plants used predominantly in the formal areas with indigenous planting adjoining the lake edge.



Eastern Foreshore Planting

The eastern foreshore planting would act as a screen between the site and the lake to provide an important barrier for strong morning sun and maritime winds. The existing foreshore trees would be protected across the site. A staged supplementation program would be developed to augment the existing ageing trees. The south and south-eastern areas would be fenced, turf grasses removed and area replanted with suitable indigenous plants to minimise erosion while discouraging access to the foreshore in undesignated areas. Timber decks would be provided intermittently to focus access to the foreshore in protected areas. Where possible stormwater would be directed away from the foreshore to avoid scouring and unnecessary erosion along the foreshore embankments. Access to the water would be available beside the breakwater with a stone shingle beach, the coarse stones would not encourage users to linger on the foreshore but would allow free access for maintenance.

Marina Green
The area between the Breakwater and the stairs leading to the Marina Forecourt would be turfed. This would become a level, passive, open, public space between the commercial precinct and the water. A buffer between the boardwalk and the foreshore would be planted with low indigenous coastal plants stabilising the foreshore and providing a soft barrier between the lake and the pedestrian areas without interrupting views.

North and Western Foreshore Planting
This area consists of the interface of the proposed development and the unnamed inlet to the north west of the site. No access would be available directly between the proposed development and the unnamed inlet, and infill screening in the form of tree planting is proposed to minimise the exposure of the subject development from the west. Therefore existing indigenous vegetation would be protected beyond the proposed built area. Weeds and turf grass would be removed and mass planting of both salt-marsh and wetland plants would occur between the access road and Bardens Bay.

Urban and Building Development
More description of landscaping of the urban and building development is provided in **Volume I** of the EAR documentation including full plant schedules for the entire development.

2.3.17 Lighting

Outdoor lighting would be designed in accordance with AS4282 (*Control of the Effects of Outdoor Lighting)*.

2.3.18 Stormwater

General
The proposed management of stormwater on the hardstand area was discussed in **Section 2.3.14**. A first flush stormwater collection and treatment system is proposed.

Roof water from Marina Village Buildings and solid boardwalk areas above the proposed under-croft carparking would be collected in a below-ground tank for use in toilet flushing and garden irrigation, as noted in **Section 2.3.14**. Surplus roof water would be discharged to the bio-retention swales prior to final discharge to Bardens Bay.

A stormwater management plan and flooding assessment was prepared for the entire Trinity Point Mixed Use development and is included in **Appendix W.** This stormwater management strategy can be summarised as follows:

A water sensitive urban design (*WSUD*) would be adopted. Given the close proximity of the development site to Lake Macquarie, and considering that there are no major established catchments, stormwater management for the site would focus on preventative measures and source controls rather than conveyance and downstream controls. Collectively, these control measures would provide a high level of water quality management for all runoff generated on-site. Additionally, opportunities exist to implement a stormwater harvesting scheme, which would reduce the volume of runoff as well as mains water demands for the proposed development.

For stormwater management purposes, the proposed development would be segregated into three management areas:

- development area: - incorporates all development areas other than the hardstand area. Land use areas would include, multistorey dwellings, landscaped gardens, boardwalk areas as well as roads and pathways;
- hardstand area:- marina hardstand areas would facilitate vessel maintenance operations, which are potentially polluting activities. Hence, this area would have a separate stormwater management strategy; and
- revegetation area:- a minimum 20-30 metre riparian vegetation buffer between the developed area and the lake is proposed. This area would be revegetated with native vegetation, hence no stormwater treatment is required.

As noted on Figure 4 of **Appendix W**, it has been assumed that the proposed roadway to the west of the development would have stormwater treatments as per the remainder of the residential subdivision of which it is a part *(i.e. roadside swales as per the previously approved DA by LMCC)*.

Marina Village and Mixed Use Development
Proposed stormwater control measures for both the Marina Village Centre and adjacent residential Mixed Use developments are outlined as follows:

Preventative Measures – the following preventative measures would be adopted as development controls to reduce the generation of pollutants under normal conditions as well as provide contingency in the event of an accidental spill of potentially polluting substances:

- minimise areas of impervious surfaces;
- use of drought tolerant native plant species;
- establish a fertiliser management plan;
- use industry best practice arrangements for the dispensing of fuel *(e.g. integral secondary containment tanks and delivery lines, provision of drip trays, provision of oil/fuel boom and oil absorbent material)* as outlined in **Section 2.3.10** and **Section 2.3.14**;
- provide adequate rubbish bins and waste disposal services to encourage responsible disposal of waste and rubbish;
- establish measures to reduce pet droppings in the development area; and
- establish a public education system, which informs residents and guests of the stormwater management issues and encourages environmentally responsible behaviour.

Source Controls - the following source control measures have been considered for the Development:

- rooftop gardens – rooftops could be employed to achieve a reduction in runoff volume and treatment of runoff by infiltration into the soil media. Should green roofs be implemented, they would be predominantly vegetated with drought tolerant, non-fertilised gardens, which would provide water quality improvements, thermal efficiency and aesthetic benefits. An alternative to green roofs would be to harvest rainwater directly from the impervious roof surfaces, and to increase the downstream bio-retention area to compensate for the loss of potential green roof areas;
- rainwater harvesting - would capture roof and boardwalk runoff for reuse within the development for non-potable purposes;
- permeable pavement - could be used for uncovered walkways and parking bays; and
- bio-filtration swales – all site runoff would be treated in bio-retention areas which would be integrated into the lakeside walkway. Bio-filtration areas consist of vegetation and an enhanced filtration media.

Construction Phase - during construction, sediment and erosion control structures would be designed and installed in accordance with the NSW Department of Housing "*Managing Urban Stormwater – Soils and Construction*" *(Blue Book)* and Lake Macquarie City Council guidelines (*namely Councils DCP 1*). These controls would ensure that there are no significant adverse impacts on receiving water quality during the construction stage. An erosion and sediment control plan would accompany a Construction Certificate application for the development. Special attention should be given to the protection of bio-retention swales until the site was fully stabilised.

Maintenance of Public Access - Figure 4 of **Appendix W** shows the Interaction between the Boardwalk and the Bio-retention system. As shown, the bio-retention system is not intended to limit interaction between the public and private space. The bio-retention system will be tucked beneath and adjacent to the Boardwalk, with a number of access locations between the public open space and the boardwalk. The Boardwalk is not concrete but timber boards in the majority of these locations, such that water and flow between the boards down into the bio-retention swale. Parts of the bio-retention swale could be turfed as a grassed swale, which could allow additional access over the swale area. The plans shown to date are sufficient for a Concept Plan Application, more detail to the satisfaction of Council could be provided at the Project Application stage.

Specific Controls for the Workshop / Hardstand

The workshop/hardstand area is a potential source of pollutants toxic to marine life. Hence, strict stormwater controls would be required, these are outlined as follows:-

Preventative Measures – the following preventative measures would be adopted to minimise generation of pollutants from the vessel repair operations:-

- mist shrouds would be used in the wash down bay to minimise the migration of any wash down waters outside the hardstand area;
- abrasive blasting and painting would be undertaken within tarp or workshop enclosures and would be closely monitored on windy days to prevent drifting dust;
- where practical, vacuum sanders would be used to remove paint from hulls and collect paint dust;
- sacrificial anodes would be removed or covered before water blasting;

- the majority of solid contaminants *(e.g. paint shavings, marine growths, etc)* which can accumulate on the hardstand would be regularly swept up in the dry *(rather than wash down)* and stored in solid waste bins for collection by a commercial waste contractor;
- tributyltin *(an antifouling paint which is highly toxic to marine life)* would not be used onsite; and
- the hardstand area would be set above the 5 year ARI Lake Macquarie flood level to prevent frequent inundation.

Containment and Treatment Controls – a first flush tank would be provided to capture the initial 15mm of runoff from the hardstand\workshop area (*as well as any water used for vessel wash down*). Captured stormwater would be treated using a proprietary treatment package and reused for vessel repair/wash down purposes. Excess water would be discharged to the sewer under a trade waste agreement.

Details of the proposed Stormwater Management Plan (*SWMP*) are outlined in **Appendix W**.

2.3.19 Hours of Operation

The proposed hours of operation of the marina development are as follows:

- administration : seven *(7)* days a week, 8.00 am to 6.00 pm
- marina shop : seven *(7)* days a week, 8.00 am to 6.00 pm *(subject to lessee)*
- boat repairs* : six *(6)* days a week, 7.00 am to 6.00 pm Monday to Friday, 9.00 am to 1.00 pm Saturday. No work Sundays or public holidays
- office tenancies: 9.00 am to 5.00 pm Monday to Friday *(subject to lessee)*

*(significant noise emitting activities such as boat lifting, abrasive hull blasting and mechanical services)

Operating hours of the floating marina would be seven *(7)* days a week, twenty four *(24)* hours a day. Helicopter movements to the marina would be restricted to those times listed above for administration activities, except during weekends and public holidays, where they would be restricted to between the hours of 10 am and 4 pm (*other than emergency services requirements*). Boat movements would be unrestricted.

Under Section 50 of the Management of Waters and Waterside Lands N.S.W. it is an offence to use a vessel as a houseboat in navigable waters without the written consent of NSW Maritime or unless authorised by an occupation licence.

Operating hours of the tourist development facilities would be as set out in **Volume I** of the EAR documentation.

2.4 SITE PREPARATION AND CONSTRUCTION ASPECTS

2.4.1 Village Centre/Mixed Use Accommodation Construction

The current conceptual nature of the development means there is minimal detail with respect to structural aspects of the construction methods for the village centre and nearby multistorey buildings. However, It is anticipated that standard construction techniques would be adopted.

2.4.2 Construction Hours

The construction activities would involve a range of construction methods and equipment. A number of the main activities are discussed below. An outline is also provided of the proposed erosion and sediment control systems which would be employed.

Construction activities would be restricted to the following times:

Monday to Friday	7.00 am to 6.00 pm
Saturday	8.00 am to 1.00 pm

No work on Sundays or Public Holidays.

Note that construction activities with high noise output would be scheduled to times when impact on residents is likely to be lowest. e.g. no heavy work before 9am *(refer* **Section 7.2***)*.

2.4.3 Site Conditions

In general, the lower lying areas of the site are underlain by weak alluvial soils. The presence of shallow groundwater combined with the poor ground conditions in the lower lying areas of the site present potential access and constructability issues on the site, and hence it is likely that bridging layers would be required to form working platforms on which construction equipment could operate, and to support at-grade features such as pavements, surface slabs (*e.g. workshop hardstand area*) etc.

Furthermore, the upper topsoil in this area of the site forms a partial crust over the underlying loose and wet sandy soils, and hence should not be completely removed. Care should be taken when stripping topsoil prior to construction, to avoid over stripping the surface of the surface crust. For larger construction plant and equipment, as discussed above, some form of bridging layer is most likely to be required during construction (*typically 0.5m thickness of recycled crushed concrete or similar*). The incorporation of a geogrid may assist in minimising the thickness of the bridging layer.

The relatively shallow groundwater (*at depths as shallow as 0.4m*), combined with potential ground and surface water level fluctuations during periods of extended rainfall (*e.g. during the recent June 2007 flood, lake water levels reached approximately RL 1.1 m AHD*), means that a number of structural elements, such as slabs, shallow footings, etc, may need to be designed to accommodate potential buoyancy or uplift forces, depending on site grades.

In addition, due to the shallow groundwater levels, excavations may require dewatering. Further investigations in the Marina Village area would be required to confirm the requirements of dewatering, due to the relatively high groundwater level, and soft soil conditions. De-watering at the site would need to consider acid sulphate soils (*refer* **Appendix H**).

For building structures, piles would support a series of ground beams, the structure would then be built on top of the ground beams but there would be no connection between the buildings and foundations *(i.e. no reinforcement tying the two together)* due to mine subsidence requirements.

Pile Installation

The design of building structures within the Marina Village area would likely result in the need to consider deep (*piled*) foundations for the majority of the structures proposed. Piles would need to be supported on, or in, the underlying bedrock *(depths ranging from about 9.6 m to 13.1 m)*. Due to the presence of saturated sand within the soil profile, unsupported bored pile holes are not considered suitable. Suitable pile types are listed below, and are described in more detail in **Appendix F**.

- bored concrete piles *(lined - e.g. temporary support using bentonite)*;
- concrete screw-cast piles *(e.g. Frankipile's Atlas Piles)*; or
- driven piles *(typically timber, concrete or steel)*.

The piles for the buildings and land based structures would be installed using tracked machinery. The land-based tracked machinery would be delivered to site by truck.

Boardwalk structures would be founded in one of the following three ways:

- on the concrete super-structure of the marina car park;
- on road base; and
- elevated on timber piles embedded in a mass concrete footing.

Timber jetty structures would require timber piles to be driven by piling machinery to achieve a greater embedment depth than the boardwalk structures *(some of the more elevated boardwalk structures may also require this method)*. The embedment depth would be specified at the detailed design stage. Geotechnical investigations have been completed, and details of soil and rock strength parameters are available in **Appendix F**.

Concrete Works

The concrete works required for land based construction for the marina would be a combination of precast and in-situ reinforced concrete.

Precast concrete could be used in the construction of building structures and would reduce construction time. The precast units would be manufactured off site and delivered to site by truck. They would be lifted into place by mobile crane *(subject to detailed structural design)*.

In-situ concrete is proposed for the topping slab for the hardstand and building floor slabs. It would be delivered to site in transit mixers. Trucks would be used for delivery of steel reinforcement and formwork for use in the in-situ concrete works.

Timber Work

Timber for use as headstocks, girders and decking in the boardwalks and jetties would be delivered to site either by truck or possibly by barge, and installed from land and water using land-based or barge-mounted equipment.

Any timber framework/panelling for building structures would be delivered to site and unloaded by truck. Mobile cranes would be involved in the installation of building frames and roofing.

Earthworks

The earthworks at the site for the Marina section of the development would comprise the spreading and compaction of Virgin Excavated Natural Material *(VENM)* to raise ground levels within sections of the Marina Village site, and minor excavations for installation of services and storage tanks associated with the water and waste management system described in **Section 2.3.14**. No filling below existing Mean High Water Mark (*MHWM*) would be undertaken, i.e. no reclamation. There would not be expected to be any removal of soils from the Marina Village section of the site. We note that current estimates indicate that excavations to form the underground carparking as part of the residential development, may necessitate the removal of some 30,000m^3 of material from the site *(refer* **Figure 20** and **Figure 21***)*. More detail on earthwork quantities would be confirmed during later stages of the design.

Excavations to form the carparks within the residential area of the site would intersect the existing groundwater table within the lower part of Block E, and the western section of Block D *(refer* **Figure 20** *and* **Figure 21***)*. We note that some dewatering of these excavations would most probably be required, based on the groundwater monitoring undertaken by Douglas Partners *(refer* **Appendix G** - *Additional Groundwater Sampling and Testing – Project 39823.04 – 21 May 2008*). **Figure 21** shows the extent to which the maximum groundwater levels will be intercepted by the proposed excavations. We note that the majority of the site excavations will be carried out above maximum groundwater levels recorded, with the main area requiring de-watering being "Block E" only.

A relatively small quantity of VENM would need to be imported to the site. The exact amount is subject to further design. This would need to be properly engineered fill, comprising clean granular material having a maximum particle size of 75 mm, or sand. This material would be compacted into place. It is also likely the surface layer of any existing fill on site would be excavated and re-compacted. This is expected in the areas where previous dams/ponds have been decommissioned, plus also in areas where the ground would have been disturbed from construction and demolition of previous buildings. Any uncontrolled filling would be removed from structural areas and re-compacted in layers to the requirements of AS3798. Any imported or new filling would also be undertaken to the requirements of AS3798.

All fill material imported to the site would be transported by trucks. Fill would be spread by excavators and/or front end loaders, compaction would be carried out using vibratory rollers.

Foreshore Protection

Protection of the foreshore at the site may be required in one of two forms. Foreshore vegetation enhancement or the importation of larger sized material for beach nourishment (*e.g. coarse sand / gravel / cobbles*).

The use of a vegetated edge treatment is the preferred method of foreshore protection. However, whether this is appropriate in all areas and the sizing of imported sediments for beach nourishment *(as an alternative)* would be based on further investigations. Beach nourishment would require stabilisation at the toe to ensure material does not migrate in the cross shore direction impacting on seagrass. The use of a geo-fabric underlay may be necessary dependant on detailed design and landscaping edge treatment requirements.

The use of beach nourishment (*most likely as a cobble sized sediment beach*) as foreshore protection may also present an opportunity to incorporate the foreshore protection as a landscaping feature, as indicated in **Section 2.3.16**. This would allow foreshore users to access the waters edge rather than being restricted from access by vegetated foreshore protection.

Erosion and Sediment Control

A range of well accepted erosion and sediment control measures would be introduced during the construction works to prevent the loss of material from the site to the adjacent foreshores. Such measures are described in standard guideline documents such as the "Blue Book", prepared by the Department of Housing and LMCC DCP 1 requirements. The measures would typically include:

- a 'stabilised site access' would be constructed at the entrance to the site to restrict transport of soil from the site;
- filter fabric fences to prevent the transport of soils from the site to surrounding streets;
- temporary fencing incorporating shade cloth as a windbreak to mitigate against windblown erosion and dust;

- use of water carts to dampen soils and reduce windblown erosion if necessary;
- sediment basins sized for the appropriate soil type, in accordance with Blue Book requirements; and
- use of a turbidity barrier within Bardens Bay to prevent migration of any fine sediments disturbed by pile driving activities or by the motion of the pile driving barge.

2.4.4 Marina Construction

General

The marina construction activities are relatively straight-forward. The main activities would comprise installation of piling, installation of the pontoon units, and installation of services and the access gangway.

The marina construction would coincide with the construction of the marina village centre.

The breakwater would incorporate tubular steel piles which would be driven or vibrated into the underlying bed material of suitable strength. Piles would typically be 450 mm diameter, with 12.5 mm wall thickness, and would have a 1 mm epoxy coating. The maximum water depth for piling is approximately 6m below mean lake level *(-6.0 m AHD)*. Current geotechnical information indicates that the depth to material of suitable strength to embed piles, is at approximately -10m AHD. Therefore overall pile installed lengths would be approximately 15-16m.

Piles would be installed in pairs at typically 4m intervals along the breakwater. Timber headstocks would span at two levels between each pair of piles, which would in turn support whalers and tie-rods, providing the attachments points for the timber slats forming the breakwater. Slats would typically consist of 200x100mm double treated hardwood. Hardwood slats on the outside of the breakwater would be installed with 50mm gaps. Hardwood slats on the inside of the breakwater would be installed with no gaps. This double slatted arrangement allows for the minimisation of wave reflections from the breakwater.

Slats would be required on both sides *(i.e. the marina side and the lake side)* for the majority of the length of the breakwater, however a section of the south-eastern corner of the breakwater would either have no slats, or a single layer of slats to allow for water and sediment movement through the breakwater in the zone of long-shore sediment transport. The depth of the slats would typically be down to approximately -4.0m AHD for the breakwater. Detailed design would provide the opportunity to refine the design, to have varying slats depths and maximise the nearshore open section. This would be in response to a spatially varying wave climate to optimise the competing objectives of wave attenuation and water exchange within the marina area.

Bearers onto the piles and upper headstock would support a timber decking which would be continuous over the entire length of the breakwater, except in the region where the breakwater spans the fringing seagrass bed. A section of aluminium mesh walkway would be used in this area to maximise light penetration for sea grass. Edges of the breakwater decking would consist of a two rail hardwood handrail on the marina side and a hardwood kerb on the lake side. The breakwater decking would typically be at RL 1.1m AHD.

Steel tubular piles would also be used for the marina arms. Floating pontoons would be constructed in sections offsite and towed into position. Similarly, the helicopter pad would be constructed offsite and towed into position for anchoring.

Pile Installation
Piling for the floating marina, helipad, travel-lift rails and breakwater would comprise circular steel piles. The total number of piles for the floating marina would be about equal to the number of berths to be provided. A pile layout for the floating marina berths is indicated in **Figure 10**. The breakwater would be comprised of approximately two piles *(in parallel)* every 4m length of breakwater.

Piles would be delivered to site by truck and unloaded by crane, or may be unloaded at a remote location within Lake Macquarie and towed to site on a barge. Piles would be installed from a floating barge. Helipad anchors would be steel piles driven, or vibrated, into the lake bed similar to piles for the breakwater and pontoons. Four anchor piles would be cut off at the lake bed level for connection of mooring chains.

Installation of Pontoon Units
All pontoon units would be manufactured off site. They would be delivered to site by truck and launched into the water by crane or would be launched at a remote location within Lake Macquarie and towed to site. Similarly, the floating helipad pontoon would be manufactured offsite and towed to site.

Installation of Services and Access Ramp
The access ramp would be delivered to site by truck as one unit and installed by crane. The access gangway would be located at the end of a timber jetty structure connecting the marina berths to the marina village boardwalk area. Similar to the breakwater, bearers onto the jetty piles and upper headstock would support a timber decking. In the region where the jetty spans the fringing seagrass bed a section of aluminium mesh walkway would be used.

Installation of service pedestals, fire fighting equipment and the like, including service cables and pipe work, is essentially a manual task.

Preliminary Construction Program
Construction of the marina berths is to be undertaken in a staged manner, as discussed in **Section 2.3.3** and illustrated by **Figure 5**. The construction program for the initial stage of the marina would require an overall duration of approximately 40 weeks. Subsequent stages would require approximately 20 weeks for each additional marina arm and breakwater extension.

Typical plant and equipment used in the construction of the marina would include:

- floating barge with hammers *(i.e. leader and impact hammer)*;
- floating barge, small work boat *(or pontoon)*;
- crane;
- trucks and light commercial vehicles; and
- hand held power tools.

A preliminary construction program for marina construction activities has been prepared and shows the duration and sequencing of the main construction activities, and the typical plant that would be utilised on site for each activity in Stage 1 *(***Figure 22***)* and subsequent stages *(***Figure 23***).*

2.5 CONSIDERATION OF ALTERNATIVES AND JUSTIFICATION FOR THE PROPOSAL

2.5.1 General

In this section a number of the environmental impacts or consequences of adopting alternatives to the preferred alternative are outlined. Consideration is also given to the consequences of not carrying out the proposal.

Further information regarding the justification for the proposed development as a whole, including consideration of the principles of ecologically sustainable development, is included in **Section 8**.

2.5.2 Regional Requirement for Marinas

Appendix Z presents a detailed demand analysis that was undertaken to guide the progression of the marina design component of the proposed development. Outcomes with regard to regional requirements are summarised in this Section.

In the 10 years from 1996 to 2006 NSW recreational vessel registrations showed an averaged annual growth of 3.1%. For the two year period 2004-2006, average annual growth in boat ownership for NSW as a whole was 3.3% and for the Hunter 4.37%. For the three years 2003-2006, average annual growth in boat ownership for the Lake Macquarie and Newcastle LGAs was 4%.

From 1995/96 to 2005/2006 the number of private moorings in NSW grew by an average of 1.21% per annum to 15,450. From 2003/2004 to 2005/2006 the number of private moorings in the Hunter Region grew by an average of 2.71% per annum to 3,186. However, commercial moorings in the Hunter over the same period remained relatively stable and numbered 207 in 2005/2006. During 2005/2006, the Hunter Region accounted for 41% of the additional 200 private moorings in NSW. The number of private swing moorings in Lake Macquarie in 2006 was approximately 2300, with growth exceeding 2.5% per annum since 2003. .

NSW Maritime advised that the relatively small growth in mooring sites for NSW as a whole is due to restrictions in some areas and increased berthing facilities and modernisation of marinas *(marinas being more efficient for boat storage as berths take up a far smaller area than swing moorings)*.

Based on 2006 data the approximate berth demand for the Lake Macquarie LGA *(483 available berths including hardstand at 95% occupancy for a population of 192,950)* can be estimated as 2.38 berths per 1,000 population. This is higher than the estimated ratio of berth demand for the Hunter but lower than that for Port Stephens. The data for Port Stephens indicates berth demand per 1,000 population grew from 3.18 to 5.66 per 1,000 population between 1991 and 2005. During this time Port Stephens has undergone a tourist 'boom' and now provides off-shore game fishing as well as whale and dolphin watching and other leisure activities. The increase in berth demand for Port Stephens indicates that considerable latent demand existed and this may also be the case for Lake Macquarie.

It is noted that some of the information in **Appendix Z** relating to predicted increases in wet berths at existing marinas was based on a survey of marina operators/owners at the time of the study about their expansion plans. Generally this information could be considered commercial in confidence and there was no obligation for operators to tell the conductors of the survey the truth. However, it was reported as anecdotal evidence of expansion plans at existing marinas. Since the undertaking of the survey LMCC has provided data which confirms proposed berth increases at the existing marinas. This data suggests an additional 200 berths are proposed.

A range of berth demand predictions was undertaken for the berth demand study *(refer* **Appendix Z***)*. The study indicated that at present there existed a latent demand for approximately 171 to 376 berths. At the time that the Trinity Point Marina project became operational *(2011)*, the demand was estimated at around 166 to 398 berths. The demand study conservatively concluded that a marina facility with a range 200 to 250 berths, with potential to expand to around 300 berths by 2016 be recommended (*note 2016 demand was estimated at between 221 and 537 berths*).

The evidence of greater expansion plans at existing marinas supports the demand figures reported in **Appendix Z** and hence the need for further marina facilities on the lake. The existing marina expansion plans, in addition to the Trinity Point Marina development proposal for up to 308 berths by 2016, are still within total demand ranges reported. Further more, the expansion of existing marina berths would not significantly increase the number of berths or facilities provided in South Western Lake Macquarie, an area considered to potentially experience significant demand pressures from the Sydney catchment in the future.

The demand study, as reported in the summary, of **Appendix Z**, was conservative in nature in the findings, and the methods used to derive the findings. *(i.e. the demand for berthing is probably significantly higher than reported)*. The predictions do not allow for a substantial latent demand that may be released from Sydney. The staging of the TP marina in response to demand is the strategy adopted to allow actual realised demand drive the development of berth expansion.

2.5.3 Location of the Marina

There is really no practical alternative to the location chosen for the marina within the Trinity Point Mixed Use development precinct. The entire foreshore edge of the proposed development area was initially assessed for site suitability based on the following main criteria:

- existence of sensitive vegetation *(seagrass, saltmarsh, mangroves, etc)*;
- bathymetry of nearshore water area and need for dredging;
- topography of adjacent land; and
- exposure to wind and wave impacts.

The proposed floating marina has been located at the northern end of the development site, which is logical from an access, operational and environmental management perspective. There are no practical alternative locations, if marina berths are to be provided, as the remainder of the site foreshore has significant constraints in a number of the above criteria. This is indicated by the preferred location (*north*) easily outscoring others, as shown in the decision matrix in **Table 2-3** below:

Table 2-3 – Marina Location Decision Matrix

Location	Sensitive Vegetation	Bathymetry (dredging required)	Topography	Exposure	Score*
South	3	3	1	1	8
East	1	2	2	2	7
North	4	5	5	3	17
West (within small inlet)	0**	1	5	5	11**

*Scoring System: 0-unacceptable constraint, 1- high constraint, 2-moderate constraint, 3-low constraint, 4-very low constraint, 5-no constraint
** a score of 0 in any of the categories rules the location out of further consideration.

The proposed location is the most suitable at the Trinity Point site for the following reasons:

- little impact on sensitive vegetation;
- no dredging required; and
- no topographical constraints (i.e. access constraints).

Other factors that were considered in the design and siting of the marina have been compiled on a constraints map illustrated by **Figure 24**.

Trinity Point is a unique site on Lake Macquarie as it is one of very few edges of the lake that are zoned for the purpose of tourism and one of few that also has the capacity for a Marina that can be constructed without significant environmental impacts such as loss of sea grass and disturbance through dredging operations.

2.5.4 Type of Maintenance and Repair Facility and Form of Construction

A hardstand area and boat lift facility, rather than a number of slipways, enables vastly improved environmental controls to be installed and is a clear preferred alternative.

2.5.5 Layout of the Marina Berths

The proposed layout of the marina berths was influenced by the range of factors or constraints, as listed in **Section 2.3.3**, as well as visual impact, and boat size distribution in accordance with projected demand *(***Appendix Z***)*. Having established the available waterway area, provision of berths in the manner shown (*refer* **Figure 4***)* represents an arrangement which best accommodates these influencing factors and constraints, some of which are competing.

2.5.6 Floating Versus Fixed Marina Berths

Two principal alternatives exist for the structure of marina berths; floating structure *(as proposed)* and fixed structure, i.e. walkways and fingers that are at a fixed level supported by piers.

A floating system has been adopted for a combination of reasons:

- it provides safer and more convenient access to and from craft, accordingly there are amenity and occupational health and safety benefits;
- it enables better tying up of craft *(the craft and the deck of the marina remain at the same relative level at all states of the tide)*;

- the floating system has much less visual impact compared to a fixed system particularly at lower tide and lake levels; and
- it provides additional aquatic habitat *(floating pontoon surfaces)*.

2.5.7 Dry Stack Boat Storage

Dry stack boat storage was initially considered for the project proposal for the site to increase the total number and size range of boats catered for at the marina site, in response to demand study recommendations *(***Appendix Z***).* However, it was not included in the project proposal due to space constraints, and more importantly as it was considered to have too great an impact on visual amenity, foreshore access and noise *(due to the large number of movements of boat lifting/launching equipment)*.

Dry stack boat storage is not considered an alternative to wet berth mooring arrangements as it caters for a different market *(smaller boat sizes)*. It is considered an alternative to trailerable size boats which are generally launched from boat ramps. The removal of the boat dry stack storage from the project proposal did not influence the number of floating berths proposed for the marina.

2.5.8 Consequences of Not Carrying Out the Proposed Development

A high level of demand has been shown to exists for mooring facilities in the south of Lake Macquarie *(***Appendix Z***).* If these moorings are not planned and provided for in a controlled environment such as a marina facility, pressure for the provision of moorings and associated boating facilities/services may see the proliferation of ad-hoc and illegal attempts to satisfy the demand. Examples of illegal and ad-hoc measures that could eventuate include:

- unapproved private jetties/mooring/launching arrangements;
- uncontrolled on water boat repairs and maintenance;
- uncontrolled on water refuelling; and
- illegal discharge of sewage and bilge waters from vessels.

The unavailability of modern marina berthing arrangements and associated facilities would continue to mount pressure on NSW Maritime and LANDS to release areas for swing moorings. The use of swing moorings is far inferior to marina berths in terms of spatial area, environmental controls, safety and security, and access, and is against best practice management.

In addition, should the proposed marina development not proceed, a number of other community and environmental benefits would not be achieved:

- provision of lifting facilities for vessels up to 75t;
- provision of maintenance and repair facilities;
- provision of additional sewage pump-out and oily bilge pump-out facilities;
- provision of a fuelling facility in the southern section of the Lake Macquarie waterway;
- provision of marina berths, for which there is a demand;
- a land/water interface for the local community to enjoy the foreshore;
- restaurant / café and other lakeside attractions;
- an interface wharf for public craft to access the foreshore of the site and benefit from facilities provided;
- additional employment and training opportunities in the maritime industry and associated commercial facilities; and
- possible public berthing and water transport opportunities.

3 LOCALITY & PLANNING CONTEXT

3.1 PLANNING CONTEXT

The proposed development falls under Part 3A of the *Environmental Planning & Assessment Act (EPA) 1979* as discussed below in **Section 3.1.3**. A more detailed outline of the Strategic Planning Context is provided in **Volume I**. See also **Appendices L** and **M** which address the compliance of the entire development with relevant strategies, policies and guidelines and the Director General's environmental assessment requirements.

An outline of the planning context as it relates to the Marina component is provided below.

3.1.1 Legislation

Water Management Act 2000
The Water Management Act repealed the *Rivers and Foreshores Improvements (RFI) Act 1948* and incorporates the RFI Act provisions relating to permits for works affecting the banks or bed of a water body. However, under Part 3A of the *Environmental Planning & Assessment Act 1979* an approval under Section 91 of the *Water Management Act* is not required.

Piling would be the only activity affecting the bed of Bardens Bay *(see* **Section 5.1.3** *regarding sediment disturbance)*. Excavation would be confined to footings and the installation of services. Fill would be introduced to raise the ground surface level within the marina land based area (*i.e. in proximity to the banks of Bardens Bay)*. Refer to **Section 5.1.2** and **Appendix W** Stormwater/Flooding Management Plan which contains details on proposed erosion and sediment controls.

Crown Lands Act 1989
The principles of Crown land management are that:

- environmental protection principles be observed in relation to the management and administration of Crown land;
- the natural resources of Crown land *(including water, soil, flora, fauna and scenic quality)* be conserved wherever possible;
- public use and enjoyment of appropriate Crown land be encouraged;
- where appropriate, multiple use of Crown land be encouraged;
- where appropriate, Crown land should be used and managed in such a way that both the land and its resources are sustained in perpetuity; and
- Crown land be occupied, used, sold, leased, licensed or otherwise dealt with in the best interests of the State consistent with the above principles.

Section 8, which sets out the justification for the proposal, addresses these principles, for example, the proposed development incorporates:

- environmental controls to achieve "no net impact" on Bardens Bay;
- landscaping with indigenous plant species;
- public foreshore access and public boat berthing facilities; and

- mixed uses including business, residential, tourist and open space uses.

The Act also sets out Crown land assessment requirements to establish land capability, appropriate uses and where practicable the preferred use or uses. This is based on physical characteristics and other matters affecting the land; the principles of Crown land management; Department of Lands' policies; and the views of other government agencies/public authorities which have expressed an interest in the land. Assessment of the capabilities of land includes assessment of the land's use for community or public purposes, environmental protection, nature conservation, water conservation, forestry, recreation, tourism, grazing, agriculture, residential purposes, commerce, industry or mining.

As noted in **Section 2.5.3** the entire foreshore of the development site was assessed for suitability for marina development. To minimise disturbance to the biophysical environment, criteria taken into account in marina siting included:

- presence of sensitive vegetation *(seagrass, saltmarsh, mangroves etc)*;
- near shore bathymetry and any need for dredging;
- topography of adjacent land; and
- exposure to wind and wave impacts.

Legislation etc relating to Flora and Fauna

Relevant legislation:

- NSW Threatened Species Conservation Act *(TSC)* 1995
- NSW Fisheries Management Act *(FMA)* 1994
- Commonwealth Environment Protection and Biodiversity Conservation *(EPBC)* Act 1999.

Relevant international treaties:

- RAMSAR Convention on Wetlands *(Intergovernmental Treaty)*
- China-Australia Migratory Bird Agreement *(CAMBA)*
- Japan-Australia Migratory Bird Agreement *(JAMBA).*

Relevant guidelines include:

- Threatened Species Assessment Guidelines, DPI 2008
- Lake Macquarie Flora and Fauna Survey Guidelines, LMCC 2001.

A discussion on the likelihood of threatened and migratory species occurring within the study area can be found in **Section 3.3.12**. There are no RAMSAR wetlands in the vicinity of Trinity Point. Potential marina impacts on threatened species and communities are considered negligible *(see* **Section 5.6.5***)*. Refer to **Appendices R** Aquatic Ecological Investigations and **Appendix S** Terrestrial Ecological Assessment which provide details on the flora and fauna survey methods used for these specialist studies.

3.1.2 NSW Government Policies

NSW Coastal Policy 1997

Nine goals were adopted for the Coastal Policy including recognising and accommodating the natural processes of the coastal zone. The Policy notes that the impacts of natural coastal processes and hazards *(including sea level rise)* are to be addressed in coastline and estuary management plans.

Wave climate, sediment movements and climate change *(including sea level rise)* are discussed in **Sections 3.3.6**, **3.3.7** and **3.3.8**. The assessment of impacts can be found in **Section 5.2**. Further details are provided in **Appendices AB** and **Appendix Y** Coastal Processes Study.

The foreshore at the site has been shown to be currently of a mildly erosive nature. The marina structure would result in minor, localised changes to sediment transport rates. This would include some benefits due to the protection provided by the marina structure. Localised foreshore protection measures would also be employed to stabilise the foreshore *(see* **Section 5.2.4** *and* **Appendix AB** *Numerical Modelling Investigations)*.

Dredging is not required for construction or maintenance of the marina and flood planning levels for the site have taken sea level rise into account.

Appendix L contains a summary table on Coastal Policy objectives and responses in relation to the Trinity Point Development.

NSW Groundwater Policy Framework Document *(DLWC 1997)*
The policy makes reference to the ecologically sustainable management of the State's groundwater resources, including to slow and halt, or reverse any degradation in groundwater resources; and ensure long term sustainability of the systems biophysical characteristics. Component policies include the *Dependent Ecosystems* and *Groundwater Quality Protection* policies.

NSW Groundwater Dependent Ecosystem Policy
This policy contains five principles including the following: that planning, approval and management of developments and land use activities should aim to minimise adverse impacts on groundwater dependent ecosystems by not polluting or causing adverse changes in groundwater quality.

NSW Groundwater Quality Protection Policy
Principle Four of this policy relates to new developments and encourages the siting of particular activities and land uses in a way that minimises the risk to groundwater.

Management of fuel, sewage *(including chemical toilet wastes from vessels)*, bilge water, trade waste, kitchen waste, oily waste, hardstand drainage, stormwater and accidental spills are discussed in **Sections 2.3.10**, **2.3.14**, **2.3.18**, **5.3** and **5.4** *(see also* **Appendix W** *which includes a Stormwater Management Plan for the entire site)*. **Sections 2.3.18**, **5.3** and **5.4** outline preventative measures to reduce the generation of pollutants and source controls to treat and recycle stormwater. The proposed measures to manage surface water and potential pollutants would ensure there were no impacts on groundwater quality.

State Rivers and Estuaries Policy *(NSW Government 1993)*
The intent of the State Rivers and Estuaries Policy is to encourage the sustainable management of the natural resources of the State's rivers, estuaries, wetlands and adjacent riverine plains so as to reduce or halt impacts such as declining water quality and damage to river banks and channels. Means for achieving the policy objectives include adoption of the best available management practices and appropriate safeguards.

The policy lists a number of component policies including the Estuary Management Policy and Wetlands Policy.

NSW Estuary Management Policy
The general goal of the Estuary Management Policy is to achieve an integrated, balanced, responsible and ecologically sustainable use of the State's estuaries. Specific objectives include the protection of estuarine habitats and ecosystems and maintenance of the necessary hydraulic regime. The sustainable use of estuarine resources includes commercial and recreational uses as appropriate.

NSW Wetlands Policy
The general goal of the Wetlands Policy is the ecologically sustainable use, management and conservation of wetlands in NSW for the benefit of present and future generations. To assist in achieving this, a number of principles were adopted including the following: that water entering natural wetlands will be of sufficient quality so as not to degrade the wetlands. The policy document also notes the importance of wetland vegetation in protecting foreshores from erosion. Land use and management practices that maintain or rehabilitate wetland habitats and processes are encouraged under the policy.

The discussion above on the Coastal and Groundwater policies lists report sections where matters relevant to the *Rivers and Estuaries Policy* are addressed. Overall the marina would not adversely affect coastal processes and would not be expected to have any adverse impact on water quality. As noted in **Section 5.3.4**, the proposed development is considered to have a number of positive benefits in regard to water quality, as opposed to ad-hoc development of swing moorings within Lake Macquarie, provided the proposed mitigation measures are implemented and effectively managed.

3.1.3 State Environmental Planning Policies

State Environmental Planning Policy *(Major Projects) 2005*
This SEPP was formerly known as SEPP (*State Significant Development).* It defines certain developments as major projects under Part 3A of the EP&A Act. The SEPP also lists State significant sites. The marina is classified as a major project under this SEPP on the basis of the number of berths proposed, that the site is within a sensitive coastal area as determined by the SEPP, and that the capital investment value exceeds $50 million.

State Environmental Planning Policy No. 11 – Traffic Generating Developments
Development listed in Schedules 1 and 2 of SEPP No. 11 is to be referred to the Roads & Traffic Authority for its views prior to determination. The proposed Trinity Point Marina Development is not listed in Schedule 1 or Schedule 2 of SEPP No. 11. Notwithstanding, a car parking and traffic report has been prepared by Better Transport Futures and is included as **Appendix T**.

The subject site is not affected by any road widening or road realignment under Division 2, Part 3 of the Roads Act 1993, or under LMCC LEP 2004. Moreover, the subject site is not affected by any road widening or road alignment under any resolution of Council.

State Environmental Planning Policy No. 71 – Coastal Protection
The site is located within the Coastal Zone and SEPP 71 applies. This Policy aims to further the implementation of the NSW Government's Coastal Policy. SEPP aims include to:

- protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast
- ensure that new opportunities for public access to and along coastal foreshores are identified and realised to the extent that this is compatible with the natural attributes of the coastal foreshore
- ensure that the visual amenity of the coast is protected

- protect and preserve beach environments and beach amenity
- protect and preserve the marine environment of New South Wales
- ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding area.

Section 8 summarises the biophysical and socio-economic implications and benefits of the proposal. As listed below, relevant specialist reports and sections within this report address the policy aims.

Natural and Cultural Attributes, Beach and Marine Environments

- Appendix AD Archaeological Assessment *(***Section 5.12.1** *and* **Volume I***)*
- Appendix R Aquatic Ecological Investigations *(***Sections 3.3.12** *and* **5.6***)*
- Appendix S Terrestrial Ecological Assessment *(refer to* **Volume I***)*

Recreational and Economic Attributes, Visual Amenity, Appropriate Development

- Appendix AE Landscape and Public Domain Statement *(refer to* **Volume I***)*
- Appendix K Visual Impact Assessment *(***Sections 3.3.16** *and* **5.10** *and* **Volume I***)*
- Appendix L NSW Design Guidelines for Appropriate Buildings in a Coastal Context *(comments in relation to the Trinity Point Development)*
- Appendix O Socio-Economic Study *(***Sections 5.14, 5.15** *and* **Volume I***)*
- Appendix Z Marina Berth Demand Study *(***Section 5.14.2***)*

As noted previously, the marina would not affect threatened aquatic species or communities or adversely affect water quality. Public foreshore access and facilities would be provided. A summary of the visual impact of the marina from different viewing points is included in **Section 5.10**. Impacts would be ameliorated through screening buildings where appropriate, landscaping and conservation/enhancement of natural foreshores and wetland features.

Regional Environmental Plans and Strategies

The following Regional Environmental Plans and Strategies apply to the development *(more detail is provided in* **Volume I***)*.

- Lower Hunter Regional Strategy; and
- Hunter Regional Environmental Plan.

3.1.4 Local Environmental Plans, Strategies and Guidelines

The following local environmental planning controls and strategies apply to the development. More detail on the environmental planning instruments is provided in **Volume I**. A brief discussion on the strategies, management plans and guidelines is provided below.

- LMCC Lifestyle 2020
- Lake Macquarie LEP 2004
- Lake Macquarie City Council - DCP 1 including Flood Management Provisions
- Lake Macquarie Estuary Management Plan
- Lake Macquarie Mooring Management Plan
- Lake Macquarie Foreshore Stabilisation and Rehabilitation Guidelines.

Lake Macquarie Lifestyle 2020 Strategy

The Strategy guided the development of the Lake Macquarie Local Environment Plan 2004 and Development Control Plans No. 1 and No. 2. It includes strategic directions covering the environment *(natural and built)* and socio-economic matters. With regard to “Water Bodies” and “Waterways” it states the following.

The Lake and coastline and the creeks, lagoons, channels and beaches which combine to form these water bodies and waterway systems are outstanding assets for the City.

The ecological, scenic and recreational qualities of these water bodies and waterways are to be protected from the impact of pollution and detrimental development so that they remain in a healthy state for the benefit of all living things that rely upon and enjoy them.

It is intended to increase public access to waterways and water bodies. However, because parts of these corridors are held in private ownership, public access might not be available. Where possible, development proposals that benefit from a water frontage are to enhance public access to the water body or waterway, while protecting habitat values associated with these assets.

As noted previously, the marina would not affect threatened aquatic species or communities or adversely impact on water quality. Public foreshore access and facilities would be provided *(see* **Section 2.3.15** *Access and Parking and* **Section 5.11.4** *Public Berths)*.

Lake Macquarie City Council Flood Management
Council's DCP No.1, Section 2.1.7 deals with flood management and sets out performance criteria and acceptable solutions. Acceptable solutions include that:

- development is consistent with the principles contained in the NSW Floodplain Development Manual *(2005)* and any relevant Local Flood Study, Floodplain Management Study or Plan.
- Development will not result in adverse impacts on adjoining flood plains and land.

Refer to **Section 5.2.2** and **Appendix W** for the site flood assessment, flood planning levels and discussion on development of flood warning and preparation measures. The principles contained in the *Floodplain Development Manual* and other relevant policies and guidelines were taken into account in the preparation of the flood assessment, together with the results of the *Lake Macquarie Flood Study (MHL 1998).*

Lake Macquarie Estuary Management Plan *(WBM 1997)*
The aims of the Estuary Management Plan include to:

- maintain or improve existing water quality in Lake Macquarie consistent with expected waterway use;
- maintain or improve the ecological status of Lake Macquarie; and
- maintain or enhance the foreshores of Lake Macquarie to protect the ecological, recreational and visual amenities.

Management Plan actions relevant to new foreshore development and boating facilities are as follows:

- rigorously enforce sediment and erosion control requirements on construction sites
- require water sensitive urban design techniques in new development areas and infill development
- provide more boat sewage discharge facilities around the lake
- liaise with relevant government agencies and boat owners to ensure that all new moorings are of a type that would not damage seagrasses
- create riparian buffer zones
- enhance and maintain foreshore vegetation.

Sediment and erosion control and water sensitive urban design are addressed in **Section 5.3**, sewage pump-out facilities are described in **Section 2.3.10**, and foreshore buffer zones and vegetation in **Sections 2.3.16** and **5.10.2**. See previous discussion under Groundwater Policy which identifies other report sections dealing with water quality.

Lake Macquarie Mooring Management Plan *(Waterways Authority, circa 2002)*
This plan sets out a number of general conditions for the location of moorings, protection of the environment and provision of boating infrastructure including:

- The provision of an appropriate level of vessel shelter from severe wind and waves.
- Adequate swing spacing between moorings to prevent vessel damage.
- Minimal interference to passive and/or other competing uses for the surrounding waterway/s.
- A fairway in bays through moorings to link public wharves/commercial marinas/yacht clubs etc to the open navigation areas.
- Adequate space between the shoreline and/or structure *(wharves, or jetties)* adjacent to public and private lands.
- Safe boating requirements, such as speed restrictions, navigation marks and no wash areas for vessels using waterways in or adjacent to designated mooring areas.
- Protection of key fish habitats and promotion of ecologically sustainable development as per the FMA.

With regard to Bardens Bay, points noted in the Mooring Management Plan include the following:

- The bay is very popular for a range of boating activities and the majority of the area has been left free of moorings.
- A small group of moorings will be permitted on the southern side of the bay, and the majority on the western and northern shores. These mooring will be permitted two or possibly three wide in these areas.
- Existing moorings already define the proposed limits of the moorings within this bay.
- This area contains two shallow lagoons into which moorings won't be placed.

Vessel shelter from severe wind and waves is discussed in **Section 2.3.3**; navigation, safe boating measures, impacts on existing moorings and other waterway uses and seagrass beds *(only the travel lift would pass over seagrasses)* in **Sections 5.6.3** and **5.11.2** and **5.11.3** and Ecologically Sustainable Development principles are addressed in **Section 8.4**.

Lake Macquarie Foreshore Stabilisation and Rehabilitation Guidelines *(LMCC 2006)*
The guidelines note that 'soft' options *(e.g. creation of beaches)* are the preferred option to address foreshore erosion and suit most conditions in Lake Macquarie. Reinstatement or rehabilitation of foreshore vegetation is also encouraged.

As noted in **Appendix AB**, recommended foreshore stabilisation measures are:

- periodic nourishment of the foreshore up drift of the marina using sand from the associated sand 'lobe' formed within the marina; or
- nourishment of the up drift foreshore with an imported sediment of increase mean size to limit actual sediment transport from this location; or
- restoration of foreshore vegetation and vegetation management to ensure maximum stabilising vegetation is maintained.

Landscaping treatments *(including buffers and stabilisation planting)* are discussed in **Section 2.3.16**.

3.1.5 Other Relevant Policy and Guideline Documents

Australian Standard 'Guidelines for Design of Marinas', AS 3962-2001
This Standard provides designers, manufacturers and operators of marina and berthing facilities with a set of guidelines for recreational marinas and small commercial vessels up to 50 m in length. Guidance is also given for onshore facilities such as dry boat storage, boatlifts, boat ramps and associated parking facilities.

The Standard has been utilised to assist in the design of the proposed marina facilities.

Environmental Action for Marinas, Boatsheds and Slipways *(DECC 2007)*
The purpose of this guide includes to assist marina operators understand environmental risks and take action to improve environmental management. The guide lists a number of key issues as follows. Sections where management of these operational issues are addressed are indicated:

- water pollution caused by allowing any material other than rainwater to enter waterways, see Section 2.3.18
- air pollution and land contamination related to solvent or paint use or the release of particles as a result of sanding and blasting for boat maintenance, see Section 5.4.1
- handling and disposing of dangerous goods such as solvents, fuel and paint waste, see Sections 2.3.10 and 5.13
- waste management, including reuse, recycling and disposal, see Section 2.3.14
- noise affecting the amenity of the surrounding community, see Section 5.8.2
- water use, see Volume I and Section 5.4.2 in relation to stormwater harvesting
- greenhouse gas emissions from energy use, see Volume I
- design, installation and operation of underground petroleum storage systems, not applicable but see Section 2.3.10 for details on above ground fuel storage.

Guidelines for Establishment and Use of Helicopter Landing Sites *(HLS)* – CAAP 92-2*(1)* CASA 1996

These guidelines contain basic principles relating to HLS design for safe operation during day and night use. The guideline, together with other relevant guidelines, was taken into account in the design of the marina helipad *(see* **Appendix AA***)*.

Policy Guidance Note – Waterways Authority
The former Waterways Authority *(now NSW Maritime Authority)* prepared a Policy and Guidance Note in relation to certain aspects of marina design. These are as follows and have been taken into account, together with AS 3962-2001, in the design of the proposed marina facilities:

- Policy : Depths in Berths and Fairways *(January 2000)*; and
- Guidance Note 8.3.02 - Engineering Assessment of Applications including Marinas.

Waste Classification Guidelines *(DECC 2008)*
To support recent changes to waste regulation in NSW, DECC replaced the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes (EPA 1999)* with the *Waste Classification Guidelines*.

Six waste classes are used:

- Special waste
- Liquid waste
- Hazardous waste
- Restricted solid waste
- General solid waste *(putrescible)*
- General solid waste *(non-putrescible)*

Wastes generated by the Marina development would be:

- Liquid waste: such as sewage from boats and amenities associated with the marina repair and maintenance facilities, and liquid waste from the hardstand area.
- General solid waste *(putrescible)*: such as litter and food waste from the marina repair and maintenance facilities and associated amenities.
- General solid waste *(non-putrescible)*: materials used in boat repair and maintenance such as plastic, rubber, metal, untreated wood, paper or cardboard; rags and oil-absorbent materials that contain non-volatile petroleum hydrocarbons; synthetic fibre waste from materials such as fibreglass; cured and set thermosetting polymers and fibre-reinforcing resins, glues, paints and coatings. Also grit, sediment, litter and gross pollutants collected in, and removed from, stormwater treatment devices.

Waste management is discussed in **Section 2.3.14** and summarised in **Section 5.5.3**.

Acid Sulphate Soils Manual *(ASSMAC 1998)*
These guidelines set out matters including:

- how to decide if acid sulfate soils are present, if they are likely to be disturbed by works and if an acid sulfate soil management plan should be prepared because of the level of risk; and
- how to develop mitigation strategies.

Refer to **Section 5.1.4** which identifies activities that may potentially disturb acid sulphate soils and **Appendix H** which contains a detailed Acid Sulphate Soil Management Plan.

NSW Floodplain Development Manual 2005
The manual supports the NSW Government's Flood Prone Land Policy. It provides a process for the development of sustainable strategies to manage human occupation and use of floodplains, consistent with risk management principles.

Strategies include:

- Property modification measures such as zoning and development controls *(e.g. minimum floor levels)*.
- Response modification measures such as community flood awareness and readiness, flood predictions and warnings and emergency response planning.
- Flood modification measures such as levees.

See previous comments on LMCC flood management.

3.2 SITE DESCRIPTION AND LOCALITY INFORMATION

3.2.1 Land Use

General Locality

'Trinity Point' is located approximately 6km east of Morisset town centre within the Lake Macquarie LGA. Morisset is recognised in the *Lower Hunter Regional Strategy (DoP, 2006)* as an emerging regional centre that is expected to grow into a major centre. The Morisset Planning District *(refer Figure 2 in* **Appendix O***)* is currently subject to a number of significant residential, commercial, and industrial rezoning and development applications and approvals, potentially delivering considerable population growth and expanded commercial centres.

The Trinity Point Mixed Use Development site is located on the Morisset peninsula with water frontage to the north, east and south on lower Lake Macquarie. Adjoining lands to the west are typically low density residential in character. A district retail/ commercial centre known as Bonnells Bay Village is located within 2km of the site.

Trinity Point Site

The marina component is located within Lot 31, DP 1117408; Part Lot 32, DP 1117408 *(access to the water by way of easement)*; and Part Lot 33, DP 1117408 *(proposed round-a-bout and entry road, "Trinity Point Drive")*. The land-based marina site is zoned 6 *(2)* Tourism and Recreation and owned by Johnson Property Group. The water-based component of the marina development is zoned 11 Waterways under the LMCC LEP and is controlled as Crown Land.

The Trinity Point site has been used for church institutions and associated agricultural activities. The most recent use *(1947-1999)* was as a school for disadvantaged and disabled children under the Hospitallers of St. John of God *(see* **Appendix AD***)*. The site is now vacant as the St John of God buildings have been demolished. Refer to **Volume I** for further information on the history of the site.

3.2.2 Waterway Use

Lake Macquarie

Lake Macquarie is the setting for much of the area's recreational activities with approximately 40 boat launching ramps and 16 sailing clubs, six marinas and a number of public jetties, boat sewage pumpout facilities, swimming enclosures, sheltered/quiet anchorage and mooring for commercial fishing boats and fishing charters. Boating activities on the Lake include yacht and dinghy racing, sailing for pleasure, cruising *(commercial and private vessels)*, fishing, waterskiing, jet skiing, canoeing, rowing, sail boarding, swimming, diving and snorkeling.

Moorings in Lake Macquarie are located around the Lake's bays and inlets. The Lake Macquarie Mooring Plan *(Waterways Authority, 2002)* noted that, at the time of publication, there were 2,175 registered moorings situated in 42 distinct areas within the Lake. The mooring areas cover a total of 716 ha of the 11,000 ha waterway area *(or 6.5% of the waterway area)*. The six existing marinas vary in size with berth numbers ranging from 18 to 160. Refer to **Section 5.14.3** for further information on marinas and current facilities.

Commercial fishing within Lake Macquarie ended in 2002 when the Lake was declared a Recreational Fishing Haven. The northern part of the lake and Swansea Channel are popular recreational fishing locations. The fish caught by recreational anglers in Lake Macquarie are similar to other estuaries in NSW and are dominated by eight species: Yellowfin Bream, Dusky Flathead, Luderick, Snapper, Tailor, Tarwhine, Whiting and Leatherjackets (*see* **Appendix R** *Aquatic Ecological Investigations*)

Swansea Channel links the open ocean with Lake Macquarie. It is relatively narrow with depths in the range of 2 to 3 m below Indian Spring Low Water *(ISLW)* and is subject to periodic dredging to maintain navigation depths. Shoals across the channel entrance can also limit the depth of water to about 1.5 m at low tide. Swansea Bridge is a low structure and is opened regularly on weekends and public holidays and by arrangement on weekdays to allow yachts to pass.

Bardens Bay

Waterways Authority *(2002)* noted that mainly locals use the waters within Bardens Bay for activities including fishing from small boats, waterskiing and aquaplaning. Many local people own boats and moor in front of their homes which have absolute water frontage. The majority of moorings are on the western and northern side, with a small group of moorings on the southern side of the bay.

A boat launching ramp is located on the south-western corner of the Bay off Lakeview Road.

During the seagrass survey for Trinity Point, The Ecology Lab observed three of the fish species generally caught by recreational anglers. Ross *(1995)* indicated that bream, flathead and whiting are the most common fish species off Bluff Point.

3.3 OVERVIEW OF THE AFFECTED ENVIRONMENT

3.3.1 Topography

Trinity Point is located on relatively flat low lying land. The site encompasses approximately 1.5km of the south-western foreshore of Lake Macquarie. A confined shallow unnamed embayment, is located to the north-west. Along the southern side of the foreshore, the land rises steeply to a bluff off the south-east point *(Bluff Point)* which is approximately 8m high.

3.3.2 Vegetation

Vegetation along the foreshore area of Bardens Bay comprises mangroves, saltmarsh and Swamp Oak Floodplain Forest. The remainder of the site has minimal groundcover with a scattering of trees along the foreshore and across the site. Refer to **Section 3.3.12** which provides further information on foreshore vegetation and habitats.

3.3.3 Water Depths

Water depths in the vicinity of the proposed site, in metres below AHD, are shown in **Figure 4.**

Water depths within the proposed marina site vary from zero at the shoreline to a maximum of approximately 5.8m below AHD *(-5.75m AHD)* near the east corner. Water depths increase from zero to 3m below AHD within approximately 30m of the shoreline. Anecdotal evidence reported by one long time resident of the area suggests that dredging may have occurred at the site in early 1900s which shaped the bathymetry in this way. Verification of this report could not be made during investigations.

3.3.4 Water Levels

General

Still water levels at the subject site are dependent on a number of factors, including storm surge[1] and wave setup[2], astronomical tide[3] and catchment runoff *(which is dependent on catchment rainfall and catchment conditions)*. The combination of all these factors in storm events causes extreme still water levels. Water levels are further increased above the still water level at the shoreline by the process of wave runup. The magnitude of wave runup is affected by a range of factors including shoreline type.

Tidal Planes

Swansea Channel, the ocean inlet to the lake, while only some 4km long, is narrow and shallow, thereby constricting conveyance of astronomical tide into the lake, resulting in relatively small tidal variation in the lake. The characteristics of the tidal hydraulics of Lake Macquarie were described in the Lake Macquarie Estuary Process Study *(AWACS, 1995)*. In this study it was found that maximum spring tidal ranges within the lake typically reached about 0.2m.

Appendix Y presents analysed tidal plane data obtained from MHL for Marmong Point and Belmont for the period from 1986 to 2005, and discusses unique characteristics of variations in Lake Macquarie water levels in detail. **Table 3-1** provides the average for each tidal plane for Marmong Point. Given the variation in the tidal levels on the Lake it can be misleading to discuss average levels. For this reason, an envelope, or range within which this tidal level has varied over the last 19 years is therefore also given. **Table 3-2** similarly provides average tidal planes and the range for each tidal plane for Belmont.

Table 3-1 - Tidal Plane Data for Marmong Point

Tidal planes	**Average Level *(mm AHD)***	**Range of levels recorded between 1986-2005**	
		Min. *(mm AHD)*	**Max. *(mm AHD)***
Higher high water summer solstice *(H.H.W.S.S.)*	162	75	245
Mean high water springs *(M.H.W.S.)*	107	27	184
Mean high water *(M.H.W.)*	99	19	174
Mean high water neaps *(M.H.W.N.)*	90	12	165
Mean sea level *(M.S.L.)*	56	-18	128
Mean low water neaps *(M.L.W.N.)*	22	-48	91
Mean low water *(M.L.W.)*	13	-55	82
Mean low water springs *(M.L.W.S.)*	5	-62	72
Indian spring low water *(I.S.L.W)*	-34	-97	29

Source: MHL

[1] Storm surge is the term given to the combined result of wind setup and the inverse barometric pressure effect. Wind setup is the "piling up" of water against the shoreline due to wind action. The inverse barometric pressure effect is the increase in water level due to a drop in atmospheric pressure.

[2] Wave setup is the increase in water level inside the wave breaking zone due to conversion of wave kinetic energy to potential energy.

[3] Astronomical tide is the regular rise and fall of sea level in response to the gravitational attraction of the sun, moon and planets, and the rotational effect due to the spin of the earth on its axis. Tides along the NSW coastline are semi-diurnal, with high and low water approximately equally spaced in time and occurring twice daily *(that is, on average, there are two high tides and two low tides in any 24 hour period)*. There is also significant diurnal inequality in NSW coast tides, a difference in height of the two high waters or the two low waters of each tidal day.

Table 3-2 - Tidal plane data for Belmont

Tidal planes	Average Level *(mm AHD)*	Range of levels recorded between 1986-2005	
		Min. *(mm AHD)*	Max. *(mm AHD)*
Higher high water summer solstice *(H.H.W.S.S.)*	143	84	216
Mean high water springs *(M.H.W.S.)*	88	36	156
Mean high water *(M.H.W.)*	80	29	146
Mean high water neaps *(M.H.W.N.)*	72	23	137
Mean sea level *(M.S.L.)*	38	-7	100
Mean low water neaps *(M.L.W.N.)*	4	-38	63
Mean low water *(M.L.W.)*	-4	-46	54
Mean low water springs *(M.L.W.S.)*	-12	-54	45
Indian spring low water *(I.S.L.W)*	-51	-92	2

Source: MHL

Anecdotally, it is said that tidal levels do not vary significantly throughout the main body of the Lake. The Trinity Point site is a similar distance from Swansea Channel as the Marmong Point site and would therefore be expected to experience similar tidal levels.

Design Still Water Levels

Manly Hydraulic Laboratory *(MHL)* modelled the lake as part of the Lake Macquarie Flood Study, Part 1 - Design Lake Water Levels and Wave Climate *(MHL, 1998)*.

A hydraulic numerical model was developed using RMA-2 to simulate the flooding behaviour of Lake Macquarie under various combinations of local wind, astronomical tide; storm surge; ocean wave setup; and catchment runoff. Based on the RMA-2 model results, design levels were adopted for the entire lake.

Table 3-3 summarises the design still water levels determined from the modelling for various annual exceedance probabilities *(AEP's)*.

Table 3-3 - Lake Macquarie Design Still Water Levels *(m AHD)*

Extreme	1% AEP	2% AEP	5% AEP	100% AEP
2.65	1.40	1.25	1.00	0.40

3.3.5 Water Flows

Tidal Conditions

Appendix AB presents the results of the numerical modelling of tidal flows over a 30 day tidal cycle including two peak spring and two peak neap flows. This modelling shows that tidal currents in Lake Macquarie reduce abruptly at the upstream end of the Swansea Channel due to friction losses in the channel and the large volume of the main lake body.

Tidal flows have negligible effect on the hydrodynamics of areas that are a considerable distance from Swansea Channel. In Bardens Bay peak tidal velocities are less than 0.01 metres per second *(m/s)*, or 0.02 knots.

Wind Driven Flows

Appendix AB also presents the results of numerical modelling of wind induced currents in Lake Macquarie. The 50th percentile average wind speeds from all directions were applied to the model in separate cases to examine the everyday effects of wind on the current structure of the lake. Resultant currents within Bardens Bay were of the order of 0.01m/s - 0.05m/s *(0.02 - 0.1knots)* with the higher currents prevalent in the shallower nearshore areas. Generally wind effects created a flow into Bardens Bay along the western shore and exiting along the eastern shore.

A high energy wind scenario was also simulated to examine the effects of a less frequently occurring event on the current structure of the lake. Resultant currents in Bardens Bay were of the order of 0.01m/s - 0.1m/s *(0.02 - 0.2knots)* with a similar flow pattern and distribution as described above for everyday conditions.

3.3.6 Wave Climate

The sources of wave activity contributing to the wave climate at the site comprise local wind generated waves and boat wake. Ocean swell does not penetrate to the main body of Lake Macquarie to any degree.

The local wind generated wave climate at the marina site was determined by Patterson Britton using as a basis the STWAVE numerical model set up for undertaking numerical modelling investigations of the proposed Trinity Point site ***(Appendix AB)***.

The STWAVE model was used to forecast wave parameters at the site for operational conditions *(using hindcasting from historical wind data from Williamtown airport)*, and three Average Recurrence Interval *(ARI)* design wind events *(1 year, 50 and 200 years)* from seven wind approach directions *(NW, N, NE, E, SE, SSE and S)*. Design wind events were derived from AS/NZS 1170.2 *(2002)* for use in hindcasting of extreme wave events at the site.

The local wind generated wave parameter exceedance based on hindcasting of historical wind data for the site is provided in **Table 3-4**.

Table 3-4 - Wave Parameter Exceedance

Probability of Exceedance *(%)*	Breakwater		Eastern Foreshore		Northern Foreshore		Associated Wave Period *(Tp) (s)*
	H_s *(m)*	Predominant Direction	H_s *(m)*	Predominant Direction	H_s *(m)*	Predominant Direction	
0.001	0.82	SE	0.75	SE	0.55	NE-SE	3.5
0.01	0.42	NW, E-SE	0.40	NW, E-SE	0.25	NE-SE	3.5
1	0.21	NW, E-S	0.21	NW, E-S	0.13	NE-SE	3.0
5	0.15	NW, E-S	0.15	NW, E-S	0.09	NW, NE-SE	3.0
50	0.07	All	<0.05	All	<0.05	All	3.0
75	<0.05	All	<0.05	All	<0.05	All	3.0

The local wind generated design wave climate based on ARI wind speeds derived from AS/NZS 1170.2 *(2002)* at the site is provided in **Table 3-5**.

Table 3-5 - Design Event Wave Parameters

Design Wind Direction	1yr ARI		50yr ARI		200yr ARI	
	Hs *(m)*	Tp *(s)*	Hs *(m)*	Tp *(s)*	Hs *(m)*	Tp *(s)*
NW	0.25	3.1	0.40	3.2	0.41	3.2
N	0.21	3.1	0.38	3.2	0.40	3.2
NE	0.23	3.1	0.40	3.2	0.42	3.2
E	0.36	3.3	0.63	3.7	0.65	3.7
SE	0.43	3.3	0.95	3.6	0.95	3.6
SSE	0.41	3.6	0.85	4.0	0.86	4.0
S	0.33	3.3	0.70	3.7	0.72	3.8

The size of the waves generated at the site by vessels moving past is a function of the speed of travel, displacement and hull shape of the vessel and the distance of the facility from the vessels sailing line. Field measurements of wave height and period for various types of vessels have been collected on a range of projects with which Patterson Britton has been previously involved. The maximum wave height and period generated by a range of vessels likely to sail past the site is summarised in **Table 3-6** below.

Table 3-6 - Boat Generated Wave Heights and Period

Vessel Type	Wave Period *(s)*	Max. Wave Height *(m)*
Recreational Power Craft	2.5	0.8
Charter Vessels	2.5	0.4

Generally, due to the low vessel speeds at the site, the maximum boat wake wave height and associated wave period at the site would not be expected to exceed 0.4 m and 2 to 3 seconds respectively. However, water skiing activities (*including wake boarding)* are known to occur within Bardens Bay and therefore, when this high energy activity is taking place, the maximum boat wake wave and associated wave period could be of the order of 0.8m and 2 to 3 seconds respectively.

3.3.7 Sediment Movements

Numerical modelling investigations of the proposed Trinity Point site ***(Appendix AB)*** have indicated that the foreshore at the site is mildly erosive. Sediment is transported from the foreshore areas north of Bluff Point in a northward direction and is deposited at the end of the recurved spit coastal plan formation, on which the site is situated, in the small bay to the west of the site. Shoreline recession, as a result of this net loss of sediments from the foreshore areas, is estimated to be in the range of 0.15 - 0.25 m/yr. The presence of sea grass beds in the nearshore zone indicate that this sediment transport is limited to the sub aerial *(above mean lake level)* portion of the foreshore.

The Lake Macquarie Estuary Processes Study (*AWACS, 1995*) reports that sedimentation in areas of the lake away from the direct influence of creek outlets to be about 1mm/year. The site of the proposed marina development at Trinity Point is situated well away from any fluvial delta at the outlet of an urban creek catchment. Accordingly, mechanisms of sediment movement and deposition in such areas do not currently affect the site and would not be expected to do so for a very long time into the future, i.e. well beyond the life of the proposed marina facilities.

Based on the above, it can be expected that sedimentation rates at the site are very low. This is supported by the existence of seagrass, the preservation of steep slopes from historical dredging (*anecdotal evidence*), and diver observations which have indicated a lack of any sign of large scale bed movement.

Average sedimentation rates in the vicinity of the proposed floating marina would be expected to be of the order of 1.0 mm/yr.

3.3.8 Impact of Climate Change

Potential Sea Level Rise

The *International Panel for Climate Change* (*IPCC*) has predicted that average global sea level rise due to climate change will range from 0.18m to 0.79m by between 2090 and 2100 (*DECC, 2007*). The upper limit of sea level rise incorporates an allowance for ice flow melt. Additional modelling undertaken by the CSIRO indicate that sea level along the NSW coast is expected to rise by more that the global average (*by up to an additional 0.12m*). Therefore, the predicted range of sea level rise along the NSW coast is in the range of 0.18m to 0.91m by between 2090 and 2100 (*DECC, 2007*).

Accordingly, for floodplain risk management applications, DECC recommends that sensitivity analyses be undertaken for the following three cases of sea level rise by 2090 to 2100:

- 0.18m increase (*low level impact*)
- 0.55m increase (*mid-range impact*)
- 0.91m increase (*high level impact*)

According to the Lake Macquarie Floodplain Management Study (*LMCC, 2000*), the standing water level in Lake Macquarie is typically at 0.1m AHD. The ocean tide has a ± 0.5m variation, but this has minimal impact on the water level in the lake *(± 0.05m)*. This suggests that the lake is relatively insensitive to short term fluctuations in ocean level.

However, as Lake Macquarie is hydraulically connected to the ocean, any sea level rise would result in the equivalent rise in the standing water level in Lake Macquarie. Hence, the sea level rise allowances list above can be directly added onto the current flood level predictions to account for sea level rise. DECC have requested that both the 50 year and 100 year sea level rise scenarios be reported for all flood level calculations. It was conservatively assumed that rate of sea level rise would be constant (*i.e. a linear relationship*), hence, the 50 year predicted rise was assumed to be half of the predicted 100 year sea level rise. Refer to **Appendix W** for the 50 and 100 year low, mid-range and high level ocean impacts as reported in the *'Practical consideration of Climate Change*' guideline (*DECC, 2007*).

Appendix AB reports that the long term recession of the exposed eastern foreshore as an adjustment to sea level rise at the site can be estimated as within the following ranges, based on sea level rise scenarios discussed above:

- up to 3.5m by 2057; and
- up to 7.0m by 2107.

For the protected western shoreline within the small unnamed inlet to the north west of the site, the drowning of low lying land would most likely occur as the mechanism for recession. The shoreline position would be located at the existing land level contour which corresponds to the new mean sea level due to sea level rise.

Potential Increase in Rainfall

An assessment of rainfall increase has been undertaken, primarily based on information extracted from the Lake Macquarie Flood Study *(MHL, 1998)*. The DECC guideline recommends that analysis of the increase in rainfall should consider a sensitivity analysis of three scenarios: 10%, 20% or 30% peak rainfall increases and storm volume increases.

For a large catchment such as Lake Macquarie which is governed by storm volume (*and in order to be conservative*), it was assumed that an increase in rainfall intensity directly correlates to an increase in runoff volume.

A basic volumetric analysis for the 100 year recurrence flood has been used as a base from which to test scenarios of increased rainfall volume. This method has shown that a 10% increase in rainfall will result in an increase in lake flood level of some 0.06m. A 20% increase in rainfall will result in a flood level increase of approximately 0.12m in the lake. A 30% rainfall increase will result in a lake level increase of about 0.18m. This prediction is similar to the sensitivity analysis undertaken as part of the Lake Macquarie Flood Study, which estimated a 20% increase in runoff volume would result in an increase in peak flood level of 0.12m. A detailed discussion on the impact of climate change, including calculations supporting the above assumptions, is attached in **Appendix W**.

It is recommended that a mid-range increase be adopted for this project, meaning that a 20% rainfall increase is likely to result in a lake level rise of about 0.12m. Based on a conservative assumption of linear increase over the 100 years, the predicted 50 year increase in lake level resulting from increased rainfall would be 0.06m.

Combined Impact

Table 3-7 presents the estimated still water 100 year ARI flood levels which account for the combined impact of seal-level rise and increased rainfall intensity and volumes. Estimated still water levels are presented for the low, mid-range and high level climate change impacts for both the 50 year and 100 year timeframes.

Table 3-7 – Estimated Combined Impact of Climate Change

	LOW LEVEL IMPACT	MID-RANGE IMPACT	HIGH LEVEL IMPACT
Existing 100 Year Recurrence Flood Level ***(m AHD)***	1.38	1.38	1.38
50 Year Sea Level Rise *(m)*	0.09	0.28	0.46
Increase in Flood Level due to Increase in Rainfall Volume *(m)*	0.03	0.06	0.09
50 Year Recurrence Flood Level by 2040 to 2050 ***(m AHD)***	1.5	1.7	1.9
100 Year Sea Level Rise *(m)*	0.18	0.55	0.91
Increase in Flood Level due to Increase in Rainfall Volume *(m)*	0.06	0.12	0.18
100 Year Recurrence Flood Level by 2090 to 2100 ***(m AHD)***	1.6	2.1	2.5

The potential impacts of climate change can vary significantly with location (*DECC, 2007*). DECC recommends that a range of factors be considered when managing the impacts of climate change at a particular location. These include any potential changes in flood behaviour, frequency, hazard and damages that may occur due to climate change and whether these impacts can be managed now or in the future as the impacts of climate change manifest.

The development of a marina facility at Trinity Point can be considered to have reduced sensitivity to the impacts of climate change, based on the following local factors:

- Due to its location at the edge of Lake Macquarie, it is not expected that any new floodways will be developed in the vicinity of the marina as a result of increased lake water levels. As a result, it is not likely that increased flood levels would translate to other changes in flood behaviour, such as increased flow velocity.
- The increase in flood hazard associated with increased water levels could be effectively managed by implementing flood evacuation procedures that adapt to any long term changes in water level. Due its lakeside location, the flood evacuation route from the marina is not expected to be cut-off as a result of increased lake water levels (*i.e. a continuously rising evacuation route away from the lakes' edge will be provided*).

- Any increase in flood damages resulting from increased frequency of flooding would be limited to structures and infrastructure that is privately-owned by the marina. Community infrastructure is not likely to become more susceptible to climate change impacts due to the marina development.

Based on the above factors, it is recommended that a combined mid-range impact of climate change be considered for design of the Trinity Point Marina. This involves the adoption of a mid-range impact on lake water level due to sea level rise combined with a mid-range impact due to increased rainfall intensity/volume (*refer* **Table 3-7**).

Accordingly, the combined effect of potential increases in rainfall and sea level that have been adopted for this study translates to a total increase in lake water level of approximately **0.7** metres (*refer* **Table 3-7**).

It is recognised that science associated with current climate change predictions has potential uncertainties of the order of magnitude of the predictions. As result, it is recommended that all habitable floor levels in the Trinity Point development be constructed above the flood planning level where possible to accommodate this uncertainty.

Higher Order Impacts

Waves at the site are fetch limited *(not depth limited)* and as such an increase in mean water level in the lake would not increase possible wave heights that impact the site. The impact of higher order climate change impacts such as increased, or changed, storminess and weather patterns is difficult to predict. However, **Appendix AB** reports that due to the asymptotic nature of extreme wind events and the fetch limited wave environment, wave events of 50yr ARI, or greater, are of a similar magnitude. This indicates that if increased storminess is realised as a result of potential climate change, the change to extreme wave event magnitudes would be minimal. However, the ARI of such events may reduce *(i.e. extreme events may occur more often)*. Increased erosion of the foreshore may be possible if this phenomena is realised due to the episodic *(event driven)* nature of wave related erosion. Ongoing stabilisation of the foreshore would mitigate this impact.

Other higher order climate change impacts at the site include the possibility that an increase in sea level may lead to the increased hydraulic efficiency of the trained Swansea Channel. Firstly through the direct effect of increased cross sectional area due to the sea level increase and then possibility the resultant increase scour potential leading to further increases in cross sectional area and hydraulic efficiency. Possible outcomes for Lake Macquarie *(and therefore the Trinity Point site)* could be an increase in tidal range for locations further upstream. Due to the large volume and extent of Lake Macquarie relative to the hydraulic efficiency of the Swansea Channel *(even if improved with a rise in sea level)* changes in tidal range at the site are likely to be marginal. Furthermore, due to the controlling factor of the ocean tail water level and the Swansea Channel on flood levels within the lake *(MHL, 1998)* there is the possibility that flood planning levels may reduce *(relative to mean sea level)* if an increase in the hydraulic efficiency of the entrance is realised. The outcomes *(or whether they will have a positive or negative impact)* of this possible phenomena can not be easily forecast due to the complexities of coastal entrances and their unique equilibrium with the ocean and upstream dynamics which influence their behaviour.

3.3.9 Geotechnical Conditions

A geotechnical investigation of the development area was carried out by Douglas Partners in September - November 2007, with additional testing undertaken in May 2008. The investigation for the proposed Marina included:

- six cone penetration tests within the proposed marina village area *(CPT 1 to 6)*;
- four on-land bores within the proposed marina village area *(Bores 101/A and 102/A)*; and
- three over water bores within the proposed marina area *(Bores 201 to 203)*.

In addition, further investigations were also carried out across the site for the land based proposals. These field investigations included:

- three on-land bores within the proposed tourist development *(Bores 103 to 105)*;
- ten test pits across the site *(Pits 301 to 310)*.

Drawing No. 2 of **Appendix F** shows the Douglas Partners test locations.

Offshore Area

In general, the lake bed sediments comprised a mixture of sand, silt and clay in varying proportions. The over-water bores *(Bores 201 to 203)* encountered soft lake sediment which ranged in thickness from about 1.7 m to 3.0 m. The underlying residual soils generally comprised clay, gravelly clay and clayey sand, which was in turn underlain by bedrock at depths which ranged from 5.8 m to 7.9 m below the lake bed.

The underlying bedrock was encountered at depths ranging from 5.8 to 7.9 m below lake bed level, with refusal encountered at a depth of between 9.6 and 12.6 m in each of CPTs 1 to 3, which were near the lake edge.

Indicative rock strength parameters for pile design are included in **Appendix F**, as well as soil exposure classifications.

Marina Village

Bores 101 and 102, and Pits 301 to 306 generally encountered sandy soils with variable proportions of clay, silt and gravel to depths of about 5 m. In the bores, the sandy soils were underlain by clay, sandy clay and gravelly clay. Rock was encountered in the bores at depths of 12.8 m and 11.4 m respectively.

The profile in CPT 1 indicates the presence of very soft to soft clay between about 1.8 m and 3.1 m depth, in the vicinity of the travel-lift and workshop.

In general, the lower lying areas of the site are underlain by weak alluvial soils, with groundwater present at depths of about 0.5 to 1.0m. Zones of very loose sandy soils, and very soft to soft clayey and silty soils were encountered to depths of up to about 5.5m, with conditions below this depth improving, but still including zones of loose sandy soils and/or firm clays to depths of generally about 6 to 8 m, but up to about 11.5m *(BH 101 and CPT 2)*.

These soils present limitations for the support of the proposed structures *(low-rise, high-rise and pavements)* because they would settle under loads from buildings, filling or their own self weight. These soils may also be at risk of liquefaction if subjected to a seismic event, however, Douglas Partners would need to undertake additional investigations to assess this further.

Conditions improve gradually as site elevations rise to the south.

Bores 103 to 105, and Pits 307 to 310 generally encountered filling *(with the exception of Pit 309)* to depths of up to 1.15 m over generally sandy and clayey soils. The clay in Pit 309 graded to clayey sand/extremely weathered sandstone below about 1.0 m, and backhoe refusal was encountered at 1.8 m depth. Rock was also encountered in Bores 104 and 105, with pebbly sandstone encountered below 4.2 m in Bore 104, and residual clay grading to an extremely low strength conglomerate below 4 m in Bore 105.

The presence of shallow groundwater combined with the poor ground conditions in the lower lying areas of the site also present potential access and constructability issues on the site. It is considered that the upper topsoil in this area forms a partial crust over the underlying loose and wet sandy soils, and hence should not be completely removed during the works. For larger construction plant and equipment, some form of bridging layer is most likely to be required during construction.

The relatively shallow groundwater (*at depths as shallow as 0.4m*), combined with potential ground and surface water level fluctuations during periods of extended rainfall (*e.g. during the recent June 2007 flood, lake water levels reached approximately RL 1.1 m AHD*), means that a number of structural elements, such as slabs, shallow footings, etc, may need to be designed to accommodate potential buoyancy or uplift forces, depending on site grades.

Bedrock

Table 3-8 summarizes the depth to the top of bedrock and/or refusal in each of the test pits and boreholes.

Table 3-8 - Summary of Rock Depths

Project Component	Test Pit/ Borehole	Approximate Surface RL *(m)*	Depth to Top of Rock *(m)*	Depth to Refusal *(m)*
Marina	201	-5.86	5.8	-
	202	-5.15	6.9	-
	203	-5.35	7.9	-
Marina Village	1	0.67	-	11.4
	2	0.81	-	12.6
	3	0.92	-	9.6
	4	0.99	-	13.1
	101	1.27	12.8	-
	102	0.89	11.4	-
Blocks A to D	5	0.78	-	10.6
	6	1.05	-	10.6
Blocks E to G	103	2.49	NE to 5.95	-
	104	3.82	4.2	-
	105	6.62	4.0*	-

Notes to Table 3-8:

NE – Not encountered
* Approximate depth at which soil started transitioning/grading to rock

Groundwater

Groundwater testing indicated that groundwater levels generally varied across the site, depending on topography. Those areas closest to the lake level in elevation (*i.e. the lower lying areas*) had observed groundwater levels closest to mean lake level (*i.e. range 0 to 0.3m AHD*), while those in higher areas of the site generally had slightly more elevated groundwater levels (*0.4 to 1.0 m AHD*).

Groundwater level fluctuation measured over the period 5/10/07 to 15/05/08 by Douglas Partners indicated changes in groundwater level of up to 0.3m (refer **Appendix G** - *Additional Groundwater Sampling and Testing – Project 39823.04 – 21 May 2008*). **Figure 21** shows the extent to which the groundwater levels vary across the site. Note that it is possible that groundwater level fluctuations are greater than those recorded over the period mentioned above, particularly during lake flood events.

Conductivity *(EC)* values measured by Douglas Partners for groundwater seem to indicate that the source of the groundwater is non – saline (*i.e. EC readings in the range typically 0.6 to 6.8 mS/cm, with an outlier at 21.1 mS/cm, probably caused by contamination from drilling mud.* Typical readings from freshwater are in the range < 0.3 to 5 ms/cm, while saline lake waters would typically be in the range 40-45 mS/cm. Again, it should be noted that during periods of elevated lake water levels *(flooding)*, groundwater salinity could possibly elevate to well above normal fresh water levels.

The pH readings for groundwater varied considerably, with readings ranging from 4.1 to 4.2 in BH 104 to 7.2 to 7.7 in BH 101A, indicating the presence of acid generating soils in some parts of the site. Refer to **Appendix H** for Acid Sulphate Soils report and Acid Sulphate Soils Management Plan. The consideration of ASS management are critical to any de-watering and excavation works on the site. De-watering will be subject to license requirements by the Department of Water and Energy under Part 5 of the Water Act.

3.3.10 Sediments

In order to determine the physical and chemical properties of the sediments within the footprint of the proposed development, sampling and analysis of 15 surface samples was undertaken by Douglas Partners on 25 September 2007 *(refer **Drawing 2** of* **Appendix G***).*

The sediment samples were collected by professional divers arranged by Patterson Britton & Partners. Locations of sampling were confirmed using a hand held GPS unit. Specification of the sediment sampling an analysis plan was undertaken by Patterson Britton & Partners, this document is provided in **Appendix AC**. Full details of the sediment sampling and test results are provided in **Appendix G**.

In addition to collecting samples for geochemical testing, Douglas Partners made a visual classification of each sample.

The chemical analysis included testing for the following:

- Polycyclic Aromatic Hydrocarbons *(PAH)*:
- Organochlorine Pesticides *(OCPs)*;
- Organophosphorus Pesticides *(OPPs)*;
- Polychlorinated Biphenyls *(PCB)*;
- Metals: Arsenic *(As)*; Antimony *(Sb)*; Cadmium *(Cd)*; Chromium *(Cr)*; Copper *(Cu)*; Lead *(Pb)*; Nickel *(Ni)*; Silver *(Ag)*; Selenium *(Se)*; Zinc *(Zn)*; and Mercury *(Hg)*;
- Tributyltin *(TBT)*; and
- Total Organic Carbon *(TOC)*;

The results of the sampling and analysis show that the lake bed sediments at the proposed marina site comprise a mixture of sand, silt and clay in varying proportions. The results of the chemical analysis are shown in **Table 3-9** and **Table 3-10**, compared to the appropriate sediment quality guidelines. The ANZECC (*2000)* Water Quality Guidelines for Fresh and Marine Waters include sediment quality guidelines. The ANZECC *(2000)* sediment quality guidelines provide low and high interim sediment quality guideline (*ISQG*) trigger values. If the ISQG Low Trigger Value is not exceeded for a particular contaminant, it is unlikely that it would result in any adverse impacts to organisms inhabiting that sediment.

Table 3-9 - Summary of Sediment Laboratory Results

Sample Location	PID (ppm)	Moisture Content (%)	Total Organic Carbon (%)	Metal/Metalloid (mg/kg)											Tributyltin (µg Sn/kg
				Antimony	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Selenium	Zinc	Arsenic	
SS1	1.1	42	2	<PQL	1.5	4.9	12	7	<PQL	3	<PQL	<PQL	46	6	NT
SS2	0.8	33	1	<PQL	0.6	7.6	13	9.9	<PQL	3.7	<PQL	<PQL	48	16	NT
SS3	1.1	35	1	<PQL	0.7	7.8	14	10	<PQL	3.9	<PQL	<PQL	51	18	<PQL
SS4	0.9	38	0.8	<PQL	0.6	6.7	10	9.1	<PQL	3.9	<PQL	<PQL	47	**22**	NT
SS5	1.1	26	1	<PQL	0.6	6.4	9.4	8	<PQL	3.5	<PQL	<PQL	44	15	<PQL
SS6	1.1	33	1	<PQL	<PQL	8	14	9.8	<PQL	3.8	<PQL	<PQL	56	12	NT
SS7	1.7	66	2	<PQL	1.3	17	22	18	<PQL	7.5	<PQL	4	110	18	NT
SS8	1.2	65	3	<PQL	**1.6**	18	23	20	<PQL	7.9	<PQL	<PQL	130	15	NT
SS9	0.8	66	3	<PQL	1.4	18	33	23	<PQL	7.7	<PQL	2	140	15	NT
SS10	1.2	65	4	<PQL	1.4	17	30	22	<PQL	7.1	<PQL	2	140	13	NT
SS11	0.9	69	3	<PQL	**1.9**	23	37	28	<PQL	9.4	<PQL	3	170	18	NT
SS12	1.3	65	3	<PQL	**1.7**	19	22	21	<PQL	8.5	<PQL	3	120	17	<PQL
SS13	1.2	66	4	<PQL	**1.7**	21	34	25	<PQL	8.9	<PQL	2	160	17	NT
SS14	1.2	62	3	<PQL	0.8	15	14	14	<PQL	7.3	<PQL	2	72	15	NT
SS15	0.8	63	3	<PQL	**1.8**	21	31	26	<PQL	8.6	<PQL	3	160	16	NT
QA1	-	33	0.7	<PQL	0.7	7.6	10	9.6	<PQL	4.3	<PQL	<PQL	52	20	NT
TB1	-	1	<PQL	<PQL	<PQL	0.6	0.6	<PQL	<PQL	<PQL	<PQL	<PQL	0.93	<PQL	NT
Laboratory PQL		1	0.05	2	0.5	0.5	0.5	2	0.15	0.2	1	2	0.5	3	0.5
ANZECC Sediment Quality Guidelines ISQG – Low Trigger Value	-	-	-	2	1.5	80	65	50	0.15	21	1	NC	200	20	5
ANZECC Sediment Quality Guidelines ISQG – High Trigger Value	-	-	-	25	10	370	270	220	1	52	3.7	NC	410	70	70

Notes to Table 3-9:
All results expressed on a dry weight basis
NC . No Criteria
PQL . Laboratory Practical Quantitation Limit
Shaded results indicate exceedence of ANZECC (2000) Sediment Quality ISQG Low Trigger Value (**Ref 1**, **Appendix G)**
QA1 . Replicate sample of SS5
TB1 . Trip Blank sample

Table 3-10 - Summary of Sediment Laboratory Results for OCP, OPP, PCB and PAH in Soil

Sample Location	Organics (µg/kg)																						
	Acenaphthene	Acenaphtalene	2 – Methylnaphthalene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Low Molecular Weight PAHs	Benzo(a)anthreacene	Benzo(a)pyrene	Dibenzo(a,h)anthracene	Chrysene	Fluroanthene	Pyrene	High Molecular Weight PAHs	Total PAHs	Total DDT	p.p'-DDE	o,p'-+p,p'-DDD	Chlordane	Dieldrin	Endrin	Lindane	Total PCBs
SS1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	20	<80	10	20	<PQL	10	20	20	<90	<170	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS2	<PQL	<PQL	10	<PQL	<PQL	<PQL	20	<80	10	20	<PQL	20	30	20	<110	<190	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS3	<PQL	<PQL	10	<PQL	<PQL	<PQL	20	<80	10	20	<PQL	20	30	20	<110	<190	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS4	<PQL	<PQL	10	<PQL	<PQL	<PQL	20	<80	10	20	<PQL	20	30	20	<110	<190	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS5	<PQL	<PQL	10	10	<PQL	<PQL	40	<100	20	30	<PQL	30	50	40	<180	<280	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS6	<PQL	<PQL	20	10	<PQL	<PQL	10	<80	20	20	<PQL	30	40	40	<160	<240	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS7	<20	<20	30	<20	<20	<20	60	<190	30	40	<20	40	80	60	<270	<460	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS8	<20	<20	20	<20	<20	<20	70	<190	30	40	<20	50	90	70	<300	<490	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS9	<20	<20	60	30	<20	<20	140	<310	70	80	<20	90	160	130	<550	<860	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS10	<20	<20	60	30	<20	20	130	<300	50	60	<20	80	140	110	<460	<760	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS11	<20	<20	50	30	<20	<20	120	<280	60	70	<20	80	140	180	<550	<830	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS12	<20	<20	30	<20	<20	<20	60	<190	30	50	<20	50	90	80	<320	<510	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS13	<20	<20	40	30	<20	<20	110	<260	60	70	<20	70	130	110	<460	<720	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS14	<20	<20	20	<20	<20	<20	50	<170	20	30	<20	40	60	50	<220	<390	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SS15	<20	<20	40	30	<20	<20	100	<250	50	60	<20	70	130	110	<440	<690	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
QA1	<PQL	<PQL	20	<PQL	<PQL	<PQL	30	<100	20	20	<PQL	20	40	30	<140	<240	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
TB1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Laboratory PQL	10	10	10	10	10	10	10	70	10	10	10	10	10	10	60	130		1	1	1	1	1	1	10
ANZECC Sediment Quality Guidelines ISQG – Low Trigger Value (Ref 1)	16	44	NC	85	19	160	240	552	261	430	63	384	600	665	1700	4000	1.6	2.2	2	0.5	0.02	0.02	0.32	23
ANZECC Sediment Quality Guidelines ISQG – High Trigger Value (Ref 1)	500	640	NC	1100	540	2100	1500	3160	1600	1600	260	2800	5100	2600	9600	45000	46	27	20	6	8	8	1	NC

Notes to Table 3-10:
All results expressed on a dry weight basis
NC . No Criteria
PQL . Laboratory Practical Quantitation Limit
Shaded results indicate exceedence of ANZECC (2000) Sediment Quality ISQG Low Trigger Value (**Ref 1**, **Appendix G**)

Sediment contamination results may be summarised as follows:

- the concentrations of all organic compounds were below the ISQG Low Trigger Values for all sampling sites;
- the concentrations of all trace metals for all sites within the proposed marina were below the ISQG Low Trigger Values, except for some slightly elevated levels of cadmium for locations: SS8, SS11, SS12, SS13 and SS15. However, these slightly elevated values were only just above the ISQG Low Trigger Value (*measured values of between 1.6 to 1.9 mg/kg, compared to the ISQG Low Trigger Value of 1.5 mg/kg*). Also, SS4 had slightly elevated levels for Arsenic, but again this was only just over the ISQG Low Trigger Value (*measured value of 22 mg/kg, compared to the ISQG Low Trigger Value of 20 mg/kg).* All results were below the ISQG – High Trigger Values;
- importantly, concentrations of copper and zinc were below ISQG Low Trigger Values at all sampling locations;
- tributyltin *(TBT)* was not detected, or below the Laboratory Practical Quantitation Limit for all sampling locations; and
- the results do not show any spatial pattern or obvious “hot spot” that needs to be taken into account in the on-going design of the marina.

While some minor exceedances were observed within individual results for the heavy metals testing, a statistical analysis was undertaken by Douglas Partners, including the estimation of the 95% upper confidence limit *(UCL)*. The results of the statistic analysis showed that the calculated 95% UCL for each analyte was below the ANZECC *(2000)* ISQG – Low Trigger Values.

3.3.11 Water Quality

The Trinity Point site is located on the south-western shore of Lake Macquarie. Currently, the site is sparsely vegetated in part due to past cattle grazing. The site generally grades towards the lake, with no established drainage paths. Seagrass beds exist in the vicinity of the site, as described in **Section 3.3.12**.

Substantial studies of the water quality of Lake Macquarie have been undertaken by others. A good summary is outlined in the *Lake Macquarie Estuary Process Study* (*AWACS, 1995*), As part of the Trinity Point Marina EA, surface and groundwater quality sampling and analysis programmes have been initiated. The surface water quality monitoring programme is discussed in detail in **Appendix W**. In addition, a geochemical analysis of on-shore and marine sediments was undertaken as part of groundwater and geochemical investigations undertaken by Douglas Partners *(refer to* **Appendix G***)*.

It is noted that while the results to date should be considered indicative only (*as there have only been two rounds of sampling and testing undertaken as part of the proposed overall monitoring strateg*y), the initial results outlined below have been compared to long term trends provided by others, in order to gain an appreciation of the existing environment.

Dissolved Oxygen

Investigations conducted by others observed that dissolved oxygen in Lake Macquarie ranged from 71% to 139% in the surface waters and between 0.9% and 147% for bottom water (*AWACS, 1995*). ANZECC (*2000*) guidelines stipulate values for the protection of aquatic ecosystems of between 80-90% saturation. Initial monitoring results as part of this study, measured dissolved oxygen values in surface water at the Trinity Point site ranging between 8.3 and 9.9 mg/L (*refer to*

Appendix W). Assuming a water temperature of 20 degrees Celsius, this converts to a dissolved oxygen level of between 91 to 109 % saturation, which is within ANZECC (*2000*) guidelines.

Nutrients

The *Lake Macquarie Estuary Process Study* (*AWACS, 1995*) reports annual mean concentrations of surface and bottom nutrients (*Ammonia, Oxidised Nitrogen, and Orthophosphate*) that generally exceeded ANZECC (*2000*) guidelines, except for Oxidised Nitrogen, which generally complied with the guidelines.

Nutrient concentrations in the lake are likely to vary considerably, depending on inputs from uncontrolled stormwater runoff, sewer overflows, septic system overflows, and wastewater treatment plant discharge. Other variables include release of nutrients from lakebed sediments due to bottom stirring (*wind / wave action*) particularly following periods of low dissolved oxygen.

Initial monitoring results (*refer to* **Appendix W)** indicate that total phosphorus levels exceed those for a slightly disturbed estuarine or marine ecosystems conditions, and that for total nitrogen levels exceed those expected for slightly disturbed marine ecosystems, but are typical of those expected in slightly disturbed estuarine conditions.

Chlorophyll-*a*

AWACS *(1995*) reported annual mean concentrations of Chlorophyll–*a* ranging from 2.2 to 4.97 µg/L. The ANZECC *(2000)* guidelines stipulate that for estuaries, the trigger value should be 4 µg/L, and therefore , the lake does not comply with the guidelines at all times. The tributaries of Lake Macquarie had values in excess of 10 µg/L, and sometimes as high as 50 to 100 µg/L, and therefore were well in excess of the guidelines.

Suspended Sediment and Turbidity

AWACS *(1995*) reported annual mean concentrations of suspended sediment between 3.1 to 7.9 mg/l, with the highest value being recorded at 123.6 mg/l. Some of the tributaries had even higher values of between 5 to 40 mg/L with some as high as 300 mg/l in Cockle Creek in the north of the lake. Initial monitoring of TSS undertaken at the subject site (*refer to* **Appendix W**) observed concentrations generally within the annual mean concentration range listed above.

There are no Total Suspended Solids values for comparison in the ANZECC (*2000*) guidelines, however for estuaries, ANZECC (*2000*) guidelines for turbidity values range between 0.5 – 10 NTU, and for shallow lakes as high as 20 NTU. Results of water quality testing undertaken for the Trinity Point site (*refer to* **Appendix W**) showed turbidity readings of between 3.1 to 87.7 NTU, with a mean value of approximately 16 NTU indicating that turbidity levels *(and typically suspended solids associated with turbidity)* at the proposed marina site generally complies with ANZECC (*2000*) guidelines for a shallow lake.

Heavy Metals

Limited data is available on lake water quality in terms of metals contaminants. AWACS *(1995*) reported high levels of cadmium, lead and selenium, particularly for the northern areas of the Lake, around Cockle Creek, adjacent to the Sulphide Corporation discharge. A summary of water quality data reported by AWACS in 1995 is provided below:

- The most significant heavy metal input to the Lake is that via Cockle Creek from the lead smelter.

- Heavy metal concentrations in samples from the sewerage treatment works at Toronto, Edgeworth and Marmong Point were quite variable and appeared to contribute only zinc which is the least toxic of the metals studied.

- Lead, zinc and cadmium concentrations varied significantly from very high readings in the north, to the lowest readings in the south, away from the old lead smelter at Cockle Creek.

- Copper concentrations were found to be high near Wangi and Pulbah Island and these were attributed to an atmospheric input, possibly fly ash from the nearby power stations.

- Testing of lake sediments confirmed significant contamination of the Cockle Creek sediments for lead, zinc, copper and cadmium. The distribution of contaminants in the surface sediments show clear trends southward with decreasing concentrations. As well as this major trend, localised problem areas included:
  - water pollution around larger jetties, and boat launching ramps;
  - sediment influx at heads of bays containing wetlands, and in areas of bays secluded from wind and wave action; and
  - pollution associated with the discharge of fly ash – particularly for copper, zinc and lead - concentrations of copper in lake bed sediments reached as high as 150 mg/kg, with typical values likely to be encountered at the Trinity Point site reported in the range 5 - 50 mg/kg in bottom sediments.

Initial results from sampling undertaken at the proposed site observed concentrations of copper, cobalt, chromium tin and zinc at, or above, the 95% trigger values defined in ANZECC (*2000*). **Table 3-11** summarises heavy metal concentrations in the water column for Trinity Point reported by Douglas Partners in September 2007 (*refer* **Appendix G**).

Table 3-11 - Summary of Laboratory Results for Lake Water Chemistry

Location	Analyte (µg/L)																	Analyte (mg/L)				
	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Copper	Cobalt	Lead	Manganese	Molybdenum	Nickel	Selenium	Zinc	Tin	Mercury	Nitrate as N	Chloride, Cl	Sulphate, SO4	Total Phosphorus as P	Total Nitrogen
SS3	1.4	2.8	11	<PQL	5700	0.11	12	2.6	2.6	<PQL	<PQL	9.3	5.2	8.5	15	<PQL	<PQL	<PQL	17,000	2,500	<PQL	<PQL
SS12	2.0	2.7	11	<PQL	5700	<PQL	12	2.8	2.6	<PQL	<PQL	9.7	5.1	9.5	15	0.03	<PQL	<PQL	18,000	2,500	<PQL	<PQL
Laboratory PQL	1	1	1	1	1	0.1	1	1	1	1	1	1	1	2	1	0.03	5E-04	1	1	1	1	10
95% Trigger values for marine waters	ID	ID	NIG	ID	ID	5.5	4.4*	1.3	1	4.4	ID	ID	70	ID	15	0.006^	0.4	ID	ID	NIG	5@	120@
90% trigger values for marine waters	ID	ID	NIG	ID	ID	14	20*	3	14	6.6	ID	ID	200	ID	23	0.02^	0.7	ID	ID	NIG	15@	300@

Notes on Table 3-11

ID Insufficient Data
NIG Not in Guidelines (ANZECC (2000) Water Quality Guidelines)
\# Guideline Trigger values for Chromium (CrVI)
^ Guideline Trigger values for Tributyltin (as µg/L of Sn)
@ Default Trigger values under Table 3.3.2 of the ANZECC (2000) Water Quality Guidelines
Shaded results indicate exceedence of ANZECC (2000) 95% trigger values for marine waters

The results shown in **Table 3-11** indicate that the level of heavy metal contaminants in the water column at the Trinity point site are slightly elevated for chromium, copper, zinc and cobalt, with sample SS12 being particularly elevated for Tin.

Summary

Overall, the water quality of the Lake at Trinity Point appears to be typical of those levels reported for southern Lake Macquarie. In general, Lake Macquarie does not meet a lot of the criteria for the protection of aquatic ecosystems under ANZECC *(2000)* guidelines, in particular dissolved oxygen, nutrients, chlorophyll-a and some heavy metals. Only slight differences were found at the Trinity Point site, with dissolved oxygen levels generally conforming with ANZECC *(2000)* guidelines at the time of study (*although it is noted that this was for surface waters, as opposed to bottom waters*); turbidity levels exceeding guidelines; and some metals exceeding guidelines.

3.3.12 Aquatic Ecology

An assessment of the aquatic ecology of the Trinity Point site has been undertaken by The Ecology Lab. A full copy of the report is provided in **Appendix R**. In addition, studies on avifauna (*as part of terrestrial ecological studies*) have been undertaken by *Harper Somers O'Sullivan*. A full copy of the HSO report is available in **Appendix S**.

Distribution of Aquatic Ecological Habitats

The distribution of the principal aquatic habitats *(seagrasses, mangroves and saltmarsh)* for the Trinity Point site is shown in Figure 1a of **Appendix R**.

Surveys undertaken by *The Ecology Lab* (**Appendix R**) identified the following main aquatic habitats in the immediate vicinity of the proposed Marina (*refer Figure 1b of* **Appendix R**):

- nearshore seagrass bed (*width typically 10-16m*);
- saltmarsh (*on the western side of the proposed travel lift*);
- mangrove community, further to the west of the development area (*again, not related to the Marina itself*); and
- deeper sub-tidal muddy sand substratum with no vegetation cover.

Vegetation of Riparian and Intertidal Habitats

There is currently limited riparian vegetation within the proposed Marina site. However, there is significant riparian and intertidal vegetation within and around the small bay to the north-west of the proposed Marina site, in the form of mangroves and saltmarsh.

Only one species of mangrove (*Grey Mangrove: Avicennia marina*) was found at the site. The distribution of mangroves around the bay was not continuous with a number of small breaks along the shoreline. Each stand of mangroves was generally only 1-2 trees wide and up to approximately 5m high.

Five species of saltmarsh, including samphire (*Sarcocornia quinqueflora*), sand couch (*Sporobolus virginicus*), seablite (*Sueuda australis*), creeping brookweed (*Samolus repens*) and *Juncus* sp. were found around the bay. Of these, the dominant species was samphire. The saltmarsh within the bay was generally found on the landward side of the mangroves, with some overlap in several areas. Its distribution was continuous around the entire bay to the west of the proposed Marina site. At its widest point the saltmarsh stand was approximately 35m, while at its narrowest point was only a couple of metres.

Overall the mangrove and saltmarsh areas were generally regarded as healthy.

Submerged Habitats

There are two forms of submerged habitats in the vicinity of the proposed Marina. In the nearshore areas, the habitat is dominated by a sand and clayey sand substratum, overlayed by seagrass beds with a width ranging from 10 to 16 m from the lake shore. Further offshore, the water deepens, and the substrata becomes clayey silt *(mud)*. In the case of the deeper, mud substratum there is no existing seagrass cover.

Two seagrass species, Eel Grass *(Zostera capricorni)* and Paddle Weed *(Halophila sp.)* occur in the vicinity of Trinity Point, with the *Zostera* being the dominant species. The invasive green alga species, *Clerpa taxifolia*, was not observed in the study area.

In the nearshore areas, within the seagrass bed, there is evidence of some substantial epiphytic algae loading (*in particular Ulva sp. - refer* ***Plate 4,*** **Appendix R**). This can be sometimes attributable to excess nutrients within the water column, which can be utilised more effectively by the epiphytic algae than the seagrass (*thus promoting the growth of the algae*).

Despite this epiphytic algal loading around some areas of the northern and eastern foreshore, and some slight discolouration of the seagrasses in the unnamed inlet to the north west of the site (*possibly due to shallow water in this location causing possible exposure of the seagrass to direct sunlight during low water conditions*), the existing seagrasses were considered generally healthy.

Comparison of the density and morphology of the seagrass habitats compared to two other reference locations within Lake Macquarie (*at Wyee Point and Frying Pan Point*) indicated that the density and morphology of the seagrass beds at Trinity Point are comparable and are in no way unique to other parts of Lake Macquarie.

Aquatic Benthic Invertebrates

The most comprehensive study of the benthic invertebrate communities of Lake Macquarie was conducted by MacIntyre *(1959)*. MacIntyre divided the lake bed into three zones: seagrass beds, mud slopes and mud basins. The majority of the marina development is located within the mud basin zone, and this is the zone that was targeted for sampling by The Ecology Lab in October 2007 (*refer* **Appendix R**). MacIntyre found that the zone was dominated by polychaetes (*predominantly Lumrineridae, Maldamidae and Sigalionidae*), bivalve molluscs (*Cardiidae and Myochamidae*) and ophiuroids (*brittle star*s). A survey of fossil shell assemblages *(Roy, 1981)* found that mussel and cockle shells were the dominant dead shell component of the muddy bed of Lake Macquarie. The same dead shells were seen in large numbers in the deep *(5m depth)* sediment samples collected in the survey undertaken by The Ecology Lab in October 2007. Another survey conducted by The Ecology Lab *(1991)* in the nearby Lake Petite indicated that the most common taxa found were polychaetes (*Opheliidae and Spionidae*), along with dead bivalves (*Tellinidae*) and mud whelks (*Batillariidae*).

Sampling undertaken by The Ecology Lab in October 2007 also indicated a variance in the taxa from shallower, near shore environment, to the deeper offshore habitat. Overall, the findings indicated healthy, but variable benthic communities that are likely to be strongly influenced by sediment type *(e.g. sandy nearshore sediments, versus muddy offshore sediments*), water depth or a combination of these and other factors. The taxa found were similar to those present in similar habitats in other parts of Lake Macquarie.

Fish

There have also been a large variety of studies undertaken in several estuaries along the NSW coastline, notably Pittwater, Port Jackson, Botany Bay and Jervis Bay from which the consensus is that the subtidal habitats of these estuaries support much the same fish faunas.

The recreationally and commercially important fish utilising the eight main habitats found in Botany Bay are directly applicable to the Lake Macquarie habitats and are summarised as follows:

- species with all life-history stages dependent on estuaries for all their main ecological requirements *(e.g. dusky flathead, trumpeter whiting, silver biddy, flat-tail, yellow-eye and freshwater mullet, fan-bellied leatherjacket, long-snouted flounder, black sole and estuary perch)*;
- species with all life-history stages generally dependent on estuaries for all their main ecological requirements except spawning (*e.g. sand whiting, yellow-fin bream, luderick, sand mullet and sea mullet*);
- species which are dependent on estuarine habitats as juveniles but whose adults generally inhabit areas outside the estuary (*e.g. snapper, tarwhine, mulloway, large- and small-toothed flounder, pilchard, variable and yellow-finned leatherjackets and blue groper*);
- species which depend on estuarine habitats primarily for spawning, but are commonly found outside estuaries (*e.g. sea garfish, herring, anchovies*);
- species for which all life-history stages can be found in estuaries (*e.g. trevally, john dory, school whiting, deep-bodied leatherjacket, hair-tail, sand flathead and long-nosed flathead*);
- species that are present in estuarine habitats primarily as juveniles (*e.g. tailor, yellowtail, red gurnard, robust whiting, nannygai, Australian salmon, teraglin, red morwong and rough and chinaman leatherjackets*); and
- species which are present in estuarine habitats primarily as adults (*e.g. long-finned seapike*).

The majority of the above commercially and recreationally important fish have been recorded in Lake Macquarie and a number have been observed during the dive-surveys undertaken for this study including yellow-fin bream, luderick, whiting and mullet. Pipefish commonly occur within seagrass beds and seahorses are often attached to algae, however no pipefish or seahorses were observed during surveys.

Water Birds

Several water bird species were observed during surveys by HSO in 2001 and 2003 or were reported from the area (**Appendix S**). These included the Black Swan (*Cygnus atratus*), Australian Pelican (*Pelecanus conspicillatus*), Intermediate Egret (*Ardea intermedia*), Little Egret (*Egretta garzetta*), Cormorants (*Phalacrocorax* spp), Royal Spoonbill (*Platalea regia*), Silver Gull (*Larus novaehollandiae*) and Crested tern (*Sterna bergii*), Wood Duck (*Chenonetta jubata*), White-bellied Sea-eagle (*Haliaeetus leucogaster*).

Most of these birds use boats and marina structures, along with mangrove trees, shoaling sand and mud flats for roosting. Other avifauna recorded within riparian zones in the study area included species such as the Superb Fairy Wren (*Malurus cyaneus*), Yellow Thornbill (*Acanthiza lineata*) and Satin Bowerbird (*Ptilonorhynchus violaceus*).

Threatened Species and Populations
Threatened species and populations which may occur in the study area are listed under several State and Federal Acts:

- NSW Threatened Species Conservation *(TSC)* Act 1995;
- NSW Fisheries Management Act 1994 *(FMA)*; and
- Commonwealth Environment Protection and Biodiversity Conservation *(EPBC)* Act 1999*.*

Two threatened terrestrial fauna species were recorded within the study area during syrveys, being the Eastern Freetail Bat *(Mormopterus norfolkensis)* and the Large-footed Myotis *(Myotis adversus)*. A further six threatened terrestrial fauna species as listed below were considered likely to occur within the study area by HSO Report (*refer* **Appendix S**):

• Osprey (*Pandion haliaetus*);
• Swift Parrot (*Lathamus discolor*);
• Grey-headed Flying Fox (*Pteropus poliocephalus*);
• Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*);
• Little Bentwing Bat (*Miniopterus australis*); and
• Greater Broad-nosed Bat (*Scoteanax ruepellii*).

Waterbirds known to occur in Lake Macquarie which are listed under the TSC Act *(LMCC, 2007)* included the endangered Australian Painted Snipe (*Rostratula benghalensis*) and the vulnerable Comb-crested Jacana (*Irediparra gallinacea*), Lesser Sand Plover (*Charadrius mongolus*), Greater Sand Plover (*Charadrius leschenaultii*), Pied Oystercatcher (*Haematopus longirostris*) and Sooty Oystercatcher (*Haematopus fuliginosus*). The Eastern Curlew *(Numenius madagascariensis)* has also been previously recorded in Lake Macquarie *(Australian Water and Coastal Studies 1995, reported* in **Appendix R***).* Of these species, those listed under the China-Australia *(CAMBA)* and Japan-Australia *(JAMBA)* migratory bird agreements are the Lesser Sand Plover, Greater Sand Plover and Eastern Curlew. These agreements oblige the Australian Government to undertake a range of actions including the preservation of important habitats.

The Australian Painted Snipe occurs in freshwater marshes, the Comb-crested Jacana in freshwater wetlands, the Pied Oystercatcher on ocean beaches and the Sooty Oystercatcher on rocky coastline. None of these habitats occur at Bardens Bay. The two plovers and Eastern Curlew occur on intertidal sand and mudflats. The site provides only marginal habitat at low tide for these species, accordingly it is considered very unlikely that they would occur in the vicinity of the proposed marina.

Listed aquatic species (*refer* **Appendix R**) for the Lake Macquarie area are the Grey Nurse Shark (*Carcharias Taurus*), Loggerhead Turtle *(Caretta caretta)*, Green Turtle *(Chelonia mydas)*, Dugong *(Dugong dugon)* and Green Sawfish (*Pristis zijsron*). The latter is presumed extinct. Protected species are the Australian Grayling (*Prototroctes maraena*), also listed on the EPBC Act, Bleeker's Devil Fish (*Paraplesiops bleekeri*) and Estuary Cod (*Epinephelus coioides*). However, none of these fish occur in the type of habitat present at Trinity Point. The Australian Grayling is primarily a freshwater fish and the other species prefer marine habitats, and if present in Lake Macquarie, would not be found beyond Swansea.

The marine turtles have both been recorded in Lake Macquarie but tend to prefer warmer waters. In addition, Lake Macquarie is outside the nesting range of both these species. Consequently it is unlikely that there is a viable local population within or near Bardens Bay. The Dugong also prefers warmer waters and although there is seagrass habitat within the study area *(Dugongs* *graze on seagrasses)*, this species has only been recorded in Swansea Channel *(two records)*. Similarly, it is unlikely that a viable local population of Dugongs would occur in the area.

Other protected species under the FMA included Syngnathiformes *(seahorses, seadragons, pipefish, pipehorses, ghost pipefishes and sea moths)*. It is likely that seahorses *(Syngnathidae)* would occur in the fringing seagrass bed in the vicinity of the proposed marina. As no seagrass beds would be fragmented and the area of direct disturbance is very small, it is unlikely that any seahorses would be impacted.

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is considered an endangered ecological community *(EEC)* under an amendment to the *Threatened Species Conservation Act* in 2004. Coastal saltmarsh occurs around the unnamed inlet to the north west of the site. Swamp Oak Floodplain Forest *(SOFF)* is also listed as an EEC and occurs on the lake edge. The SOFF EEC within the site varies in condition from highly disturbed *(isolated Swamp Oak trees within grassland)* to areas where minor understorey components are present *(see* **Appendix S***)*.

3.3.13 Traffic and Parking

Access to the site would be via Henry Road and an extension to Trinity Point Drive off Morisset Park Road, which connects to Fishery Point Road. Fishery Point Road then connects to Macquarie Street (*Main Road, MR 133*) approximately 4.5km west of the site (*refer* **Figure 1**). MR 133 provides access to Morisset town centre, the Northern Main Rail Line and the F3 Freeway.

Traffic surveys were conducted at key intersections, on 30 October 2007, by Better Transport Futures *(refer* **Appendix T***)* and the results are shown in **Table 3-12**. The 2002 *RTA Guide to Traffic Generating Developments* sets out levels of road service based on the number of lanes and vehicles per hour up to maximum capacity. For roads with a single lane each way, the level of service ranges from A *(200 vehicles per hour)* to E *(maximum capacity of 1400 vehicles per hour).*

Table 3-12 - Traffic Volumes

Road	Direction	Peak Flow	Mid-block Road Capacity (1)	Volume/ Capacity
Morisset Park Road (east of Silky Oak Drive)	Eastbound	78 (AM) 119 (PM)	900 (one-way)	0.086 AM 0.132 PM
	Westbound	58 (AM) 42 (PM)	900 (one-way)	0.064 AM 0.467 PM
Fishery Point Drive (west of Morisset Park Road)	Eastbound	185 (AM) 603 (PM)	900 (one-way)	0.205 AM 0.670 PM
	Westbound	519 (AM) 227 (PM)	900 (one-way)	0.577 AM 0.252 PM
Fishery Point Drive (east of Macquarie Street)	Eastbound	217 (AM) 671 (PM)	900 (one-way)	0.241 AM 0.745 PM
	Westbound	593 (AM) 351 (PM)	900 (one-way)	0.659 AM 0.390 PM

1. RTA 2002, Urban Road Conditions Level of Service D.

As shown in **Table 3-12** the current peak hour traffic flows in the general vicinity of the site are relatively low and there is spare capacity in the local road network.

3.3.14 Acoustical Environment

An acoustic assessment for the entire site was prepared by ArupAcoustics *(refer to* **Appendix P***)*. The area surrounding Trinity Point has a prevailing noise environment dominated by natural sounds, with little road traffic (*the closest industrial noise source observed was the Vales Point Power Station, across Lake Macquarie to the south of the site*). These characteristics are consistent with a 'Rural' area as defined in the *NSW Industrial Noise Policy* (*NSW EPA, 2000*).

3.3.15 Air Quality

An air quality assessment for the entire site was prepared by Arup Sustainability *(refer to* **Appendix Q***)*. Lake Macquarie is part of a regional airshed covering the Greater Metropolitan Area *(Wollongong to Newcastle)*, and as such can receive pollutants from all these areas depending on wind patterns. The air quality at the site may be particularly affected by local sources of emissions including industrial sites and areas with heavy vehicle traffic. There are several coal fired power stations within the vicinity of the site. The nearest of these is Vales Point some 5km south of the site. Munmorah and Eraring power stations are 11km and 7km from the site respectively. Emissions from these power stations are less localised because of the dispersing effects of the high stacks.

The nearest EPA air quality monitoring station at Wallsend, Newcastle measures the following air pollutants:

- Ozone *(O_3)*
- Nitrogen oxides *(NO, NO_2 and NO_3)*
- Sulphur dioxide *(SO_2)*
- Fine particles *(by nephelometry)*
- Fine particles *($PM_{2.5}$ and PM_{10} using a tapered element oscillating microbalance)*

Monitoring results for Wallsend during the 12 months from January to December 2006 showed that there were no exceedances of the NSW long term reporting goal or NEPM Standard level for ozone, nitrogen dioxide or sulfur dioxide with only one minor exceedance of the NEPM Standard level for PM_{10} recorded in November 2006.

The existing air quality at the site and nearby sensitive receptor is therefore likely to be of good quality with only occasional exceedance of criteria for particulate pollution likely to be the result of regional meteorological conditions.

3.3.16 Visual Amenity

The following description of visual amenity is summarised from Dr Richard Lamb & Associates *(refer to* **Appendix K***)*.

The site has few natural features and is a remnant cultural site, rather than a natural landscape. Vegetation consists predominantly of cultural plantings of figs, palms and Norfolk Island Pines at the southern end, with smaller ornamental and other domestic plantings such as cactus and aloe which are associated with, or have overgrown the sundial gardens associated with the former St John of God usages of the site. The southern end of the site drops off steeply to an area of gently sloping foreshore that is associated with the swimming baths of the former school and the grotto *(see* **Section 3.3.18** *for further details)*.

Discontinuous foreshore vegetation, consisting mainly of mature casuarinas and eucalypts, helps give the site a natural appearance when viewed from across Lake Macquarie. The area of thickest remnant foreshore vegetation surrounds the saltmarsh at the unnamed inlet to the north west of the site. There are some minor rock shelves on the south-eastern foreshore at Bluff Point. Minor undercutting is occurring along the waterline.

The northern, eastern and southern foreshores of the site are the most exposed to views inwards from both the waterway and surrounding areas including Morisset Park, Brightwaters, Summerland Point, Wyee Bay and Mannering Park. Existing trees along the foreshore provide screening of the site from these areas.

The site is considered of moderate scenic quality. Many views in the locality contain varied topography and vegetation, extensive waterbodies, varied water edges and areas of higher scenic integrity *(naturalness)*. However, the scenic quality is decreased, for example, by urban areas, manicured lawns and large scale industrial structures.

3.3.17 Aboriginal Archaeology

Two registered Aboriginal sites occur within the development site, one within the marina village component. This site is registered as an isolated stone artefact but has been identified as part of a wider site through test excavations, which revealed sub-surface deposits *(refer to* **Appendix AD***).* Site inspections by representatives of the Awabakal community also identified other sites, including additional lenses of midden and grinding grooves *(not within the marina component)*. Concerns were also raised about the potential for burial sites, particularly in sandy deposits on the northern part of the site .

The Aboriginal sites at Trinity Point are considered of:

- low to moderate scientific significance depending on the extent of disturbance *(the artefacts at the marina site were considered of low significance due to disturbance)* ;
- high public significance as they offer an opportunity for public education and interpretation of Aboriginal occupation of the area; and
- high cultural significance to the Awabakal community as documented though consultation and demonstrated by the registration of the Awabakal Traditional Owner group as non-native title claimants.

3.3.18 Heritage

Very little evidence of prior occupation remains as the former St John of God buildings were demolished and the site is now vacant. An historic grotto, lake bathing area and sundial would be retained, with the bathing area restored as part of the proposed development. These items are outside the marina component and research potential within the marina site is considered minimal *(refer to* **Appendix AD***).*

3.3.19 Demographics

More information on population profiles is included in **Volume I**. Key Insights Pty Ltd (**Appendix O**) reports that compared to the Lake Macquarie LGA and NSW as a whole, population growth has been particularly strong in the Morisset Park, Morisset Peninsula and Morisset Planning District as shown in **Table 3-13**. Refer to Figure 2 in **Appendix O** which shows these population catchment areas.

Table 3-13 - Population Growth in Catchment Areas

Census Year	Morisset Park	Morisset Peninsula	Morisset Planning District	LGA	NSW
2001	711	7,091	19,160	177,185	6,311,168
2006	781	7,569	20,734	183,140	6,549,177
Growth	**9.8%**	**6.7%**	**8.2%**	**3.4%**	**3.8%**

In the 15 years between 1991 and 2006, the Morisset Peninsula population increased significantly with 2,671 people moving into the area. However, population growth has slowed slightly in the last five years. The median age of all population catchments referred to in **Table 3-13** is higher than the NSW average. This is common in locations away from metropolitan areas as people in the 15 to 29 years age bracket move away for study or work, and people in the 45 to 64 years age bracket move into the area prior to, or during retirement. However, for Morisset Park and Morisset Peninsula, the proportion of children in the 0 to 14 years age group is slightly higher than the State average.

Work destinations for Lake Macquarie LGA Residents *(from 2001 Census data reported in Hunter Valley Research 2005-2006)* indicate that most work within the Lake Macquarie LGA (*45.8%*) and Newcastle area (*32.2%*), with 17.1% travelling outside the Hunter Region for work. The remainder work in Port Stephens, Maitland, Cessnock and Singleton LGAs. The dominant fields of employment in the catchment areas are 'health care & social assistance', 'retail trade', 'education & training', 'construction' and 'manufacturing'. While 'mining' is not a dominant field of employment Morisset, like neighbouring areas such as Toronto, has a substantially higher level of mining employment than the State as a whole.

4 IDENTIFICATION AND PRIORITISATION OF ISSUES

4.1 OVERVIEW OF THE METHODOLOGY

4.1.1 Review of Background Information

A range of background information was reviewed as part of the identification and prioritisation of issues for preparation of the Trinity Point Marina and Mixed Use *Environmental Assessment Report* (*EAR*) - *Volume II Marina Component*. This information included:

- relevant environmental guidelines issued by government authorities including the EIS Guideline 'Marinas and Related Facilities';
- review of EISs and other environmental documentation prepared for marina projects elsewhere, including approved projects in Pittwater, Sydney Harbour, Port Hacking, Newcastle and Shellharbour;
- review of Commission of Inquiry and Land and Environment Court determination reports, and conditions of approval, for similar projects in Sydney Harbour, Port Hacking and Shellharbour;
- review of Environment Protection Licences issued to existing marinas (*and helipads*) under the Protection of the Environment Operations (*POEO*) Act 1997;
- review of the local planning instruments relating to strategic directions and local zonings for the site;
- Kendall Grange Masterplan;
- LMCC DCP 1;
- review of relevant standards and guidelines for marinas including Australian Standard AS 3962-2001 – Guidelines for Design of Marinas, and Guidance Notes issued by the NSW Maritime Authority (*formerly NSW Waterways*); and
- Occupational Health and Safety Act 2000 and Occupational Health and Safety Regulation 2001.

4.1.2 Stakeholder Consultation

Consultation is considered to be an important component in the development of the proposed Concept Plan. The DG's Requirements specified consultation with the following agencies etc.

- Commonwealth Department of Environment, Water, Heritage and the Arts
- Department of Natural Resources (*DNR*);
- Department of Environment and Climate Change (*DECC*);
- Department of Water and Energy;
- Department of Planning (*DoP*) Hunter Regional Office, Newcastle;
- Department of Primary Industries (*DPI*);
- Department of Lands (*LANDS*);
- Heritage Council;
- Mine Subsidence Board;
- NSW Aboriginal Land Council and local Aboriginal land councils and traditional owners groups
- NSW Road and Traffic Authority (*RTA*);

- Lake Macquarie City Council (*LMCC*);
- Civil Aviation Safety Authority;
- NSW Maritime Authority
- Hunter Water Board; and
- Energy Australia.

Consultation with these agencies etc has taken place since November 2006. In addition, meeting were held with the following groups:

- Southlakes Business Chamber and Community Alliance;
- Central Coast Community Environment Network;
- Morisset Park and District Action Group; and
- Bonnells Bay and Sunshine Progress Association.

The results of consultations with these Groups are contained in the Socio-Economic report *(***Appendix O***)*.

From Tuesday 20 November to Thursday 22 November 2007, JPG's Public Relations officer doorknocked approximately 150 homes in Lakeview Road, Edgewater Road, Park Avenue, Buttaba Road and Henry Road. Approximately 50 residents were consulted during this exercise. Feedback from this doorknocking exercise is attached in **Appendix O**.

In addition to meeting with the Community Group leaders a Community Consultation Day was held on site on Sunday 25th November 2007. All of the Consulting Team were available on the day to answer questions and a display incorporating visuals of the proposed concept and all reports was made available. The day was well attended by the public and it was estimated some 200 people visited. At the same time they were afforded the opportunity to walk around the site if they desired.

A survey sheet was available for completion to those who wished to make comment. The results of the survey (*49 respondents*) have been tabulated and presented in the Social & Economic report attached at **Appendix O**.

The following key outcomes can be noted from the survey:

- 80% of people believed that the proposed development was of benefit with the majority believing the main benefits are related to economics and employment; and
- overall attitude towards the development resulted in 52% of people being very positive or neutral about the proposed development and 43% being negative or very negative about the proposed development.

Issues and concerns from all consultation have been considered and addressed as part of the Environmental Assessment.

4.1.3 LMCC Committee Presentations

With regard to issues specifically related to the marina, foreshore and lake, presentations were made to the following two LMCC Committees:

- Estuary and Coastal Management Committee; and
- Aquatic Services Committee.

This consultation has been undertaken with these peak reference bodies to ensure the details of the views raised by the committees were considered, and attempts made to specifically address any concerns.

Estuary and Coastal Management Committee

Presentation to the Lake Macquarie Estuary and Coastal Management Committee occurred on the 7 March 2007 outlining the project proposal and studies undertaken up to that point in time. After the presentation the following statement was made by the Committee:

"The committee resolved that the development appears to represent an overdevelopment of the site, and is concerned over potential impacts on foreshore areas and lake processes."

In response, a further report was commissioned to specifically address the concerns of the committee in relation to potential impacts on foreshore areas and lake processes, including detailed numerical modelling of processes and impacts. This information is included as **Appendix AB** of the EA documentation.

A further presentation to the committee on 2 July 2008 outlined the outcomes of the specific study aimed at addressing the committees concerns and other related matters. Following which, the following statement was issued by the committee:

"The committee resolved the following concerning the proposed development:

1. that members be provided with access to the draft Environmental Assessment documentation.
2. NSW Maritime, Dept of Lands and Council to prepare a future boating use and boating infrastructure analysis, and that this analysis be provided to a future meeting for the purposes of assessing cumulative impacts of boating use .
3. The committee reaffirms its previously raised concerns as per its previous resolution of 7 March 2007."

Aquatic Service Committee

A presentation to ASC was undertaken on 16 July 2008 outlining the project proposal and studies undertaken up to that point in time. The main issues raised in general discussion included the following:

1. concerns regarding the size of the overall development (although it was agreed that there was demand for marina berths on the lake)
2. concerns relating to the capacity of Lake Macquarie generally to accommodate increases in boat numbers and the impact on amenity.
3. need for a sub committee to look at the documentation in detail for a thorough response to the proposal.

Both the Estuary and Coastal Management Committee and the Aquatic Services Committee raised concerns about the cumulative impacts of boat use of Lake Macquarie in general. However, it was recognised that there is no Government planning direction relating to what the total number of boats acceptable for the Lake. It was also recognised that it is not the developer's responsibility to drive such policy making. In the absence of any policy direction in this regard, **Section 5.11** and **Section 5.16** discuss and assess the impact from this issue.

4.2 OUTCOMES OF THE PROCESS

4.2.1 Identified Issues

The following is a list of the issues identified during the consultation process in relation to the Marina *(refer* **Appendix O**), not necessarily in any priority order:

- design and scale of the marina;
- noise;
- acid sulphate soils;
- contaminated material;
- waste management;
- local recreational opportunities in relation to the foreshore reserve;
- generation of tourism in relation to recreational boating;
- traffic and parking;
- access to bay – related to navigation;
- water quality;
- air quality;
- hazardous materials;
- visual impact;
- stormwater runoff (*including ESD measures such as water sensitive urban design*) and waste management;
- impact on swing moorings;
- public berthing opportunities/facilities;
- dredging and reclamation;
- heritage sensitivity;
- native title; and
- marine ecology.

4.2.2 Key Issues

Based on the results of consultation, site specific characteristics and previous experience relating to marina developments, a number of key issues were identified for detailed analysis. It is relevant to note that they generally reflect local issues:

- design and scale of the marina;
- helicopter noise;
- local recreational opportunities in relation to the foreshore reserve and public berthing facilities;
- traffic impact and parking issues related to the marina;
- access to bay - related to navigation;
- water quality;
- stormwater runoff (*water sensitive urban design*) and waste management; and
- marine ecology.

While more emphasis has been placed on the above key issues, all issues listed have been addressed in this EAR.

5 ENVIRONMENTAL ASSESSMENT

5.1 LANDSURFACE ISSUES

5.1.1 General

A number of issues potentially arise in respect of the proposed development which could generally be referred to as 'land surface issues'. These comprise:

- removal of excavated material from the site;
- introduction of fill to raise the land levels on the site;
- disturbance of sediments; and
- acid sulphate soils.

It is noted that no dredging is proposed as part of the development.

5.1.2 Removal of Excavated Material

Section 2.4.3 indicates that an estimated 30,000m^3 of material would be necessary to be excavated on the site. The bulk of this excavation is to take place in the area outside of that specifically addressed in this volume of the EA documentation. **Section 5.1.3** below describes the requirement at different locations for fill material. Where at all possible excavated and fill materials would be balanced over the site to minimise the need to remove/import material from/to the site. However, based on the current level of design it is likely that an excess excated volume would remain.

The site auditor reported that former buildings were located in the area proposed for development *(including the car parks).* Accordingly any excavated material would be Virgin Excavated Natural Material *(VENM).* The auditor's report also noted that ponds and tanks in other areas of the site were remediated by removal of tanks and surrounding backfill and replacement with VENM. This indicates that any excess excavated material could be used beneficially on a number of other construction sites around the area, and would not be considered a "waste" to be disposed of.

Following detailed site design, appropriate reuse of this material would be specified including identification of potential receiving sites.

5.1.3 Introduction of Fill

Fill is required to raise the ground surface within the marina land base area and proposed hardstand area to achieve final levels consistent with the proposed function of these areas and the Stormwater and Flood Management Report (*refer* **Appendix W**).

As noted in **Section 5.1.2,** there may be an opportunity to reuse excavated material from on site to achieve the desired fill levels. However, if the importation of material is necessary it would be VENM and would not be placed below Mean High Water Mark (*MHWM*). The exact amount is subject to further design. This would need to be properly engineered fill, comprising clean granular material having a maximum particle size of 75 mm, or sand. Any imported or new filling would also be undertaken to the requirements of AS3798. Providing appropriate erosion and sediment controls are installed and maintained, as noted in **Appendix W**, no adverse impacts of the filling process would be expected.

5.1.4 Disturbance of Sediments

Sediments within the proposed marina footprint have been shown to have low levels of contaminants (*refer* **Section 3.3.10**).

Some minor disturbance of these sediments may occur from piling activities and due to the motion of the barge*(s)* during the construction of the Marina. A turbidity curtain could be installed around the works to contain any migration of fine sediments away from the site. These devices have been shown to be very effective in containing plumes of suspended fine sediments. However, the heavy metal concentrations in the sediments are low and typically less than guideline values for concern (*refer* **Section 3.3.10**)**.** Therefore it is considered that piling operations could be conducted without the need for a turbidity curtain.

Also, release of heavy metal contaminants into the water column from the sediments would not be expected since the physical/chemical conditions governing the partitioning of the metals between soluble and particulate phases, e.g. pH, would not be significantly altered during the construction activities.

5.1.5 Acid Sulphate Soils

Any excavation of soils on site within the lower lying areas of the site (*e.g. Marina Village area*) for purposes of installation of the carparks, services, footings, and tanks associated with the water and waste management system would be within potentially acid sulphate soil generating material. Appropriate controls have been outlined in the Douglas Partners investigations, including a detailed Acid Sulphate Soil Management Plan – refer to **Appendix H.**

Wherever possible, the development would seek to avoid disturbance of Acid Sulphate soils, by setting design levels appropriately above the areas of high acid content.

Where disturbance is unavoidable, controls including controls on de-watering outlined in the Douglas Partners report would be instigated, including monitoring requirements under the Acid Sulphate Soil Management Plan – refer to **Appendix H**.

5.1.6 Site Contamination

A site contamination assessment and remediation validation report was undertaken previously by David Lane Associates (*refer* **Appendix I**). In addition, a Site Auditor's Report was undertaken by JBS Environmental (*refer* **Appendix J**). This report concluded the following:

- the remediation and validation are considered to have met the requirements of the Contaminated Sites: Guidelines for the NSW Site Auditor Scheme *(2nd Edition) (DEC 2006)*;
- the site is considered suitable for the proposed residential land-use with gardens and accessible soil, as defined in Table 6-A Schedule B*(7B) (NEPC 1999)*;
- the suitability of the site for residential use is not subject to any ongoing management or monitoring of land contamination issues; and
- there is unlikely to be migration of contaminants from the site which may result in any unacceptable risks to surrounding human or ecological receptors.

As such, the site should not be subject to any contamination constraints. In addition, the above was taken into account in the design of the offshore sediment sampling analysis plan, which was prepared by Patterson Britton as a brief to Douglas Partners who undertook the sampling and testing (*refer* **Appendix AC**).

5.1.7 Land Surface Issues - Environmental Risk Rating

As outlined above, the overall environmental risk rating associated with the land surface issues is considered to be low to moderate. Proposed filling is minimal, dredging / reclamation is not required and marine sediments have low levels of contamination. In addition, it has been demonstrated that the existing site has been fully remediated. The only land based risk is Acid Sulphate Soils. Disturbance of these soils has been minimised as much as possible in the design, and an Acid Sulphate Soil Management Plan has been devised.

5.2 HYDRODYNAMIC PROCESSES

A number of potential issues arise in respect of the proposed development which can be discussed under hydrodynamic processes. These comprise:

- wave climate;
- elevated water levels *(flooding)*;
- hydrodynamics of the lake (*water movements*); and
- sediment transport processes, including sedimentation.

5.2.1 Wave Climate

The wave climate at the site comprises predominantly local wind generated waves and boat wake waves and has been described in **Section 3.3.6**. Three matters arise in respect of wave climate and the proposed development:

- acceptability of the wave climate for installation of a floating marina;
- impact of the proposed development on wave climate within the remainder of Bardens Bay; and
- influence of wave climate on elevated water levels and flooding.

Acceptable Wave Climate for Floating Marinas

The wave climate at the site has been compared to the criteria for a ‘good’ wave climate at floating marinas presented in the *Australian Standard AS 3962-2001 ‘Guidelines for Design of Marinas’*. This and further investigation (**Appendix X**) have established the following:

- a breakwater would be required for any craft berthed exposed to waves from the east through to south sector; and
- a partial depth double skirted fixed structure would best be suited to this location due to factors relating to design wave climate (*particular wave lengths*), reflected wave reduction considerations, water exchange, cost and environmental impact considerations.

The above matters have been incorporated in the design of the floating marina and, accordingly, the existing wave climate would not be expected to impact adversely on the craft within the marina. As numerical modelling investigations identified spatial variation in the wave climate at the site and as a ‘moderate’ wave climate is acceptable at floating marinas *(under the Australian Standard AS 3962-2001 ‘Guidelines for Design of Marinas’),* there may be further scope to optimise the breakwater design during detailed design, in relation to the competing objectives of wave attenuation, water exchange and construction cost.

Wave Climate in Bardens Bay

The proportion of Bardens Bay immediately west of the proposed marina would be situated in the lee of the floating marina and would therefore benefit from the wave protection afforded by the breakwater *(and by the craft berthed at the marina)*. This includes any boats on swing moorings located in this area, residential foreshore areas and jetties.

Based on the existing wave climate described in **Section 3.3.6** and the wave attenuation performance of similar double skirted breakwater systems *(established from previous physical modelling data)*, wave heights in the lee of the marina would be expected to reduce by about 70 to 80% following installation of the marina.

The influence of the marina and associated breakwater on the wave climate within Bardens Bay reduces on the northern and eastern foreshores. Some reflection of wave energy is possible from the breakwater structure in these areas. **Appendix AB** presents numerical modelling of wave reflections based on the wave reflection performance of similar double skirted breakwater systems established from previous physical modelling data. These investigations indicate that there would be no significant impact on the surrounding areas of Bardens Bay in terms of increase significant wave heights as a result of the breakwater.

Impacts from boat generated waves along the foreshores of Bardens Bay following marina development are not expected to increase significantly from the existing situation. There is likely to be an increase in boat traffic in Bardens Bay associated with the presence of an increased number of boats berthed in the bay *(at the marina).* However, the impact of boat waves from boat traffic is significantly less than what would be produced by the total number of boats due to the following factors:

- boat movements on any given day would be a small proportion of the number of berthed boats *(ranging from <5% on a mid-week winter day to a possible maximum of 25-30% on the busiest summer holidays)*;
- the marina would provide only a limited proportion of boats in the size distribution *(10%)* which would produce waves up to the estimated maximum 0.8m reported in Table 3-6; and
- a substantial proportion of these boats would be sailing vessels with minimal wash *(40% has been estimated for the proposed marina from the berth demand study* **Appendix Z***)*.

There are existing high impacts from boat waves due to the nature of boat traffic at the site. The site experiences high use from water skiing activities *(including wake boarding)* which create large wake due to the high speed at which these activities take place. These activities usually take place in close proximity to the shoreline thus adding to the scale of impact, as users search for “good water” which is usually in shallower, more protected locations.

The location of the proposed marina, associated breakwater and boat exclusion zone *(see* **Figure 24***)* has benefits in mitigating boat wave impacts *(existing and post marina development)* as they would:

- encourage boat traffic through the middle of the bay maximising the distance waves travel to the shoreline;
- reduce wave heights by at least 50% by the time they reach the shore *(previous studies undertaken by Patterson Britton have indicated a reduction of boat wave height between 41% and 55% over a distance of 12 times the length of vessel)*; and
- encourage high impact traffic such as water skiing activities away from sensitive areas *(shoreline midden, seagrass beds)* and the shoreline in general.

Influence of Wave Climate on Elevated Water Levels and Flooding
The wave climate at the site influences the elevated water levels and consequently the potential for inundation or flooding of the shore based facilities. This is discussed further in **Section 5.2.2** but it is worth noting here that the existence of a marina breakwater is a benefit in relation to appropriate floor levels for the site. A wave deflector is also proposed for the eastern extremity of the under-croft car parking for the marina village *(refer* **Figure 25***).*

5.2.2 Lake Flooding

General
Elevated still water levels at the site are dependent on a number of factors including astronomical tide, storm surge, wave setup, and catchment runoff (*which is dependant on catchment rainfall and catchment conditions*), and have been discussed in **Section 3.3.4.** Water levels are further increased above still water level by the process of wave runup (*refer to* ***Section 3.3.6***). Furthermore, climate change induced sea level rise and increased rainfall can potentially increase flood levels in the estimated design life of the development (*refer to* ***Section 3.3.8***).

Establishment of Flood Planning Levels
A flood assessment for the site was undertaken in the *Stormwater and Flooding Management Plan* attached in **Appendix W**. Estimated design flood levels are to define flood planning levels for the site. Adopted flood planning levels vary depending on the design flood frequency, the provision of wave attenuation measures, as well as the design life of the subject infrastructure (*which would define which sea level rise scenario is adopted*). In some cases, the subject infrastructure can be easily modified if sea level rise is realised (*for example: marina piles can be extended*). In which case, no sea level rise allowance is necessary. Additionally, a 0.5 meter freeboard is applied to infrastructure which is likely to be significantly damaged if inundated during a flood. This freeboard was conservatively applied in addition to the wave allowance to provide a buffer against uncertainties in flood level predictions, wave heights and potential effects of climate change.

Table 5-1 details the proposed flood planning levels and outlines the methodologies adopted in the assessment of a range of flood liable infrastructure proposed for the development. Figure 8 in **Appendix W** details the proposed flood mitigation measures in a spatial sense.

It is recognised that science associated with current climate change predictions has potential uncertainties of the order of magnitude of the predictions. As result, it is recommended that all habitable floor levels in the Trinity Point development be constructed above the flood planning level where possible to accommodate this uncertainty. Where possible, flexibility in the design of infrastructure to accommodate the uncertainty is also recommended.

It is noted that following the undertaking of the flood assessment for the Trinity Point development site, Lake Macquarie City Council *(LMCC)* have more recently released a document which outlines flood planning level amendments in response to climate change *(LMCC, 2008a)*. This document recommends adopting the high impact sea-level rise prediction of 0.91m for a 100 year timeframe. However, there is no allowance for increased rainfall or wave action. As such, LMCC recommends a flood planning level of 2.79m AHD for the 100 year timeframe which is similar to the 2.8m AHD presented in **Table 5-1.** Therefore, the flood planning levels recommended for habitable floor levels for the Trinity Point Site comply with that LMCC guideline.

Subsequently, following review of the flood assessment for the Trinity Point development site, LMCC revised the above guideline document to incorporate the impact of predicted increases in rainfall intensities. The resulting document is titled, "*Draft Guidelines for Development in Areas adjoining Lake Macquarie that are Vulnerable to the impacts of Sea Level Rise and Increased*

Rainfall" *(LMCC, 2008b)*. **Appendix W** compares the adopted minimum flood planning levels fro Trinity point (*as presented in* **Table 5-1***)* with this most recent guideline. In summary the outcome of this comparison is as follows:

- adopted minimum habitable floor levels *(2.8m AHD)* are similar to guideline recommendations *(2.85m). (Note: small deficit has no impact on design given the recommendation to construct floor levels for the Trinity Point site above the minimum adopted level due to climate change uncertainty)*;
- adopted minimum commercial floor levels *(2.8m AHD)* are 0.5m greater than the guideline recommendations *(2.27m AHD)*;
- entrances to basement car parks *(supporting medium density housing)* are to be constructed to preclude floodwater at levels up to 2.35m AHD. This is achievable at the Trinity Point site and would be ensured in detailed design *(including additional requirements pertaining to evacuation, pump-out systems and electrical installations above 2.35m AHD)*;
- adopted minimum floor levels for industrial areas *(1.1m AHD)* with electrical installations above 2.42m AHD is a alternative solution to the guideline recommended level *(2.27m AHD)*. The adopted level complies with the floodplain development manual and the DECC guideline relating to climate change considerations (DECC, 2007) based on a risk assessment approach and hence is consistent with the LMCC guideline recommendations;
- the risk based approach for deriving the adopted minimum level for the Marina Village under-croft car spaces is similar to the approach outlined in the most recent LMCC guideline for non habitable floor levels.

A flood warning and preparation guideline would be prepared. This document would outline flood preparation measures (*such as removing parked vehicles from car parking areas and closing the marina*) to be based on flood level and metrological forecasts. Given the long time to peak of flooding, there would be sufficient time to implement these measures. This offers a cost effective means to mitigate the risk of property damage during a Lake Macquarie flood event.

Table 5-1 - Proposed Flood Planning Levels

Infrastructure	Design Flood Frequency Average Recurrence interval (ARI)	Design Still Water level *(m AHD)*	Design Wave Height Allowance *(m)*	Potential Climate Change Impact *(sea level rise and inc. rainfall)*		Design Life	Free Board *(m)*	Adopted Minimum Flood Planning Level *(m AHD)*	Comments
				50 year *(+0.34 m)*	**100 year *(+0.67 m)***				
Habitable Floor Levels	100 year	1.38	0.2	1.92	2.25	100 years	0.5	2.8	Habitable floor levels would be difficult to raise, hence a 100 year sea level rise allowance has been adopted
Hardstand Area, Workshop & Associated Parking Spaces	5 year	0.7	0.05	1.09	1.42	50 years	0	1.1	These areas would be protected by either the marina breakwater or engineered barriers, hence, a reduced wave allowance is adopted. All electrical wiring would be required to be above the habitable floor flood planning level (*for 50 year design life – i.e. 2.42m AHD*)
Barriers Protecting Marina Village Under-croft Parking Spaces	5 year	0.7	0.2	1.3	1.6	100 years	0	1.6	The road to the west of the car park and the wave attenuation barrier to the east would provide flood barriers for the marina village under-croft car spaces (*refer to* **Appendix W**). Retrofitting would be difficult, so a 100 year sea level rise allowance has been adopted.
Marina Structures	100 year	1.38	0.2	NA	NA	25 years	0	1.6	Marina piles can be extended if sea-level rise is realised, hence no lake-level rise allowance is required

5.2.3 Lake Hydrodynamic Processes

General
Water movement within the south western portion of Lake Macquarie due to the effects of tide and wind were studied in the Trinity Point Marina - Numerical Modelling Investigations (**Appendix AB**). Study outcomes have been outlined in relation to Bardens Bay in **Section 3.3.7** of this volume of the EAR. In summary:

- within Bardens Bay tidal currents are very small in magnitude and less than 0.01 metres per second *(m/s)*, or 0.02 knots, even during peak flows of the spring tidal cycle; and
- the effect of wind can be significant relative to the magnitude of the tidal flows within Bardens Bay and can lead to the generation of a weak circulation flow pattern within the Bay. However these flows are still small in magnitude; generally of the order of up to 0.05m/s, and during less frequent high energy events of the order of up to 0.1m/s.

Post Development
The proposed marina development would involve construction of a piled partial depth double slatted breakwater, a floating pontoon arrangement and a piled boat travel lift support, over an area which currently comprises an open waterway.

A piled partial depth structure has been adopted for the breakwater, even though it is relatively expensive, since it would have less impact on water movement and aquatic ecology than a solid groyne structure. As the underside of the breakwater structure would be below normal lake levels, there would be impacts on water movement patterns as a result of the development. Detailed design of the breakwater structure would include the specification of a length of breakwater at the shoreward end which would remain open (*corresponding to a decreasing wave climate*) to facilitate maintenance of water flows along the foreshore.

Due to the very small (*negligible*) magnitude of the tidal currents within the Bay it can be concluded that the proposed marina would have no significant effect on tidal current behaviour. Any tidal minimal exchange would still be facilitated by the partial depth nature of the breakwater and the above-mentioned open section of the breakwater at the shoreward end.

The proposed marina would be expected to have some localised effect on water movement under wind action for several reasons:

- the breakwater and, to a lesser extent, the floating structure would interrupt the surface currents induced by the wind;
- the craft berthed at the marina would be fixed in alignment and, unlike swing moorings, would not be able to rotate to present the minimum hull profile to the wind and to any wind-driven current; and
- the grouping of the craft on the marina would provide some additional shielding of the water surface from wind action.

The net effect of the above is that when winds are blowing towards the marina from the south through east directions *(other directions being well sheltered)* there would be a more tranquil area immediately in the lee of the marina and there would be some separation of wind-induced currents around the marina *(refer* **Appendix AB***)*.

The above change in the water movement pattern under wind action is, however, considered unlikely to affect water quality, the physical well-being of natural estuarine habitats in Bardens

Bay, other physical processes such as sediment movement, or navigation, for the following reasons:

- the wind driven current magnitudes are very small, modelling simulations have indicated under high energy scenarios current speeds of only about 0.1m/s, or 0.2knots. Thus diffusive mechanisms dominate water exchange within the Bay under average conditions;
- the scale of the changes to the water movement patterns would be very small compared to the larger scale overall tidal and wind-induced current structures that drive water quality within Bardens Bay, (*i.e. water exchange between Bardens Bay and Lake Macquarie generally*); and
- connectivity or continuity would be maintained between the waterway areas to the east and west of the proposed floating marina, thus permitting current flow and water exchange to continue along the foreshore. This is achieved by having an open section at the shoreward end of the breakwater (*where natural wave protection is offered by the coastal form and extensive sea grass beds to the south of the marina*), and piled structures for support of the timber jetties and the boat travel lift structure.

5.2.4 Sediment Transport

The main sediment transport process at work at the site as detailed in **Appendix AB**, is a northward sediment transport along the foreshore of the recurved spit coastal plan that is "Trinity Point". Due to its location, the proposed development would not be affected by any sediment transport processes due to terrestrial inputs from urban catchment outlets (*refer **Section 3.3.7***).

The wave protection afforded by the proposed marina breakwater would mean that wave action at the shoreline in the lee of this structure would be reduced at times of strong winds from the east to south sector, where the largest wave events originate. This would be expected to be a benefit in that it has been identified (**Appendix AB**) that it would be necessary to provide erosion protection works along the foreshore adjacent to the proposed marina site (*refer **Section 3.3.7***) to stabilise an eroding foreshore. For the same reasons, the presence of the breakwater may also facilitate the deposition of any sediments eroded from the foreshore to the south of the marina inside the marina just downdrift of the structure inside the marina *(sediments would not build up on the updrift side of the structure due to the open section of breakwater at the shore).* This may become a maintenance issue for the marina management in terms of removal of sediments to maintain water depths. However, **Appendix AB** also recommends the stabilisation of the foreshore to the south of the marina which would mitigate this issue. This foreshore stabilisation has been included in the overall Concept Plan for the Trinity Point development site.

5.2.5 Hydrodynamic Processes - Environmental Risk Rating

As outlined above, the overall environmental risk rating associated with the hydrodynamic processes is considered to be low. A wave climate suitable for berthing can be achieved through the implementation of a breakwater structure, and wave reflection impacts minimised through breakwater design features. Existing and post development boat wave impacts are mitigated by the locality of the marina and boat exclusion zone which would direct traffic away from, and reduce impacts on, sensitive areas. Flooding issues are not worsened at the site through development and appropriate floor levels have been included in the design to minimise risk from flooding (*incorporating sea level rise impacts*). Slow catchment response times also assist in the management of flood risk. Existing flows are considered to generally be minimal (*negligible in the case of tidal flows*) with relative impacts from the development insignificant. The foreshore is current of a mildly erosive nature with stabilisation due to revegetation in the development proposal of benefit.

5.3 WATER QUALITY AND SPILL MANAGEMENT

5.3.1 General

Issues associated with water quality and spill management can be conveniently discussed in terms of the construction phase of the marina and the operational phase.

A number of water quality investigations have been undertaken for Lake Macquarie (*refer* **Section 3.3.11**) which have indicated that in general Lake Macquarie does not meet all criteria for the protection of aquatic ecosystems under ANZECC *(2000)* guidelines, in particular dissolved oxygen, nutrients, chlorophyll-a and some heavy metals. Only slight differences were found at the Trinity Point site, with dissolved oxygen levels generally conforming with ANZECC *(2000)* guidelines, turbidity levels exceeding guidelines, and some metals exceeding guidelines.

5.3.2 Construction Phase

As noted in **Section 2.3.18**, a range of well accepted erosion and sediment control measures are available *(such as those outlined in the "Blue Book" prepared by the Department of Housing)* for adoption during the construction phase to mitigate water quality impacts. In addition, a turbidity barrier could be installed if necessary around the proposed lake-based work area to contain the migration of any suspended fine sediments.

The chemicals and flammable liquids stored on site during construction could be a potential spill source. Typical environmental safeguards requirements include:

- Hazchem signs to be displayed as necessary.
- The control, usage, transportation and storage of hazardous substances must be in accordance with manufacturer's instructions and any license requirements.
- Hazardous substances to be stored neatly in a secure container.
- Segregation requirements of hazardous substances to be complied with.
- All containers, carrying hazardous substances, to be clearly and correctly labelled.
- Storage areas for fuel and other hazardous substances to be placed away from watercourses, drains or downstream locations whenever possible.
- Storage areas for fuel and other hazardous substances to be bunded to prevent discharge in the event of a spillage.
- As necessary, bund areas where motors are placed to prevent discharge of fuel or oil into any nearby stormwater facility.
- Construct pollution traps, as necessary, at entrances into stormwater drains.
- Spillage Response Kits to be ready and accessible at all times and monitored for replenishment of contents sufficient to clean up spillages to prevent discharge to watercourses and drains.

Excavations to form the carparks within the residential area of the site would intersect the existing groundwater table within the lower part of Block E, and the western section of Block D (refer **Figure 20** and **Figure 21)**. We note that some dewatering of these excavations would most probably be required, based on the groundwater monitoring undertaken by Douglas Partners (refer **Appendix G** - *Additional Groundwater Sampling and Testing – Project 39823.04 – 21 May 2008*). **Figure 21** shows the extent to which the maximum groundwater levels will be intercepted by the proposed excavations. We note that the majority of the site excavations will be carried out above maximum groundwater levels recorded, with the main area requiring de-watering being "Block E" only. This de-watering would be a licensed activity under Part 5 of the Water Act *(1912)*, and these approvals would need to be completed prior to construction.

The effects of de-watering on groundwater quality would be managed through the application of best practice de-watering and earthworks / leachate management. **Appendix H** by Douglas Partners outlines key strategies to manage the de-water process so as to limit any potential impact on groundwater, including:

- minimisation the dewatering depth required for installation *(i.e. as close as practical to the invert level of the excavation)*;
- minimise the time and volume of exposed acid sulphate soils *(e.g. staged excavation and de-watering)*;
- collection of extracted groundwater in a multi-stage sedimentation tank / basin to allow sedimentation and neutralisation *(from ASS)* prior to release;
- disposal could be via a bunded area (evaporation/ infiltration or discharged to stormwater / sewer subject to licence requirements;
- monitoring of pH and sediment *(turbidity)* would be undertaken prior to discharge
- dosing of base of excavation to limit generation of acid leachate;
- treat acid sulphate soils excavated in accordance with the ASSMP (**Appendix H**); and
- undertake monitoring in accordance with the Monitoring Programme outlined in **Appendix H.**

As well as the above measures, contingency plans have also been developed by Douglas Partners for the de-watering, which includes measures such as:

- stockpiling of additional lime on the site to allow remedial mixing of lime to neutralise acid generating material, and the excavation area; and
- during prolonged periods of heavy rainfall, stockpiled excavated material should be contained / bunded to prevent the release of leachate.

A water quality monitoring program would be developed for the construction phase in consultation with the consent authorities, DECC and DWE *(for groundwater as part of the licence application under Part 5 of the Water Act)*. A preliminary surface water quality monitoring program is included in **Appendix W**. Details of monitoring and reporting for groundwater, soil and leachate for ASS are outlined in Section 6.1.4 of **Appendix H** by Douglas Partners.

Providing appropriate measures are in place and properly maintained, it is considered that water quality impacts during construction would be acceptable.

5.3.3 Operational Phase

The proposed development is considered to have a number of positive benefits in regard to water quality in the operational phase, as opposed to ad-hoc development of swing moorings within Lake Macquarie. These positive benefits are the result of the following:

- provision of a concrete hardstand for the repair and maintenance of vessels, incorporating a first flush and wash down water collection and treatment system, rather than uncontrolled boat repair and maintenance that can occur at moorings or at private landing facilities around the lake foreshore;
- provision of a sewage pump-out facility;
- provision of oily bilge pump-out facilities;
- implementation of industry best-practice "*Water Sensitive*" design for reuse and treatment of site stormwater (*refer* **Appendix W**);
- regulations governing use of the marina berths prohibiting flushing heads while the vessels are at the berth *(fines and ultimate eviction would apply for non compliance)*;

- a spill management strategy incorporating:
  - industry best practice arrangements for the dispensing of fuel *(e.g. integral secondary containment tanks and delivery lines, provision of drip trays, provision of oil/fuel boom and oil absorbent material)*;
  - regulations governing use of the marina berths requiring automatic bilge pumps in vessels to be fitted with an isolation switch which must be left in the "off" position while vessels are at berth *(fines and ultimate eviction would apply for non-compliance)*; and
  - provision of a floating boom to contain any surface pollutants in the event of any accidental leakage of bilge water.
  - provision of oil absorbent material to absorb any petroleum contained in the floating boom.

The spill management strategy is detailed in the following schematic.