WorleyParsons®
resources & energy

Greater Taree CITY COUNCIL

Greater Taree Coastline Management Study

Black Head to Crowdy Head

301017-00051

October 2010

Infrastructure & Environment
8-14 Telford Street
Newcastle East, NSW 2300, Australia
PO Box 668 NEWCASTLE NSW 2300
Telephone: +61 2 4907 5300
Facsimile: +61 2 4907 5333
www.worleyparsons.com
ABN 61 001 279 812

WorleyParsons®
resources & energy

Greater Taree CITY COUNCIL

SYNOPSIS

This report follows on from the *Black Head to Crowdy Head Coastline Hazard Definition Study* (WorleyParsons 2010) and presents management options to address coastline hazards affecting the Greater Taree Coast. A number of options were examined for the areas most at risk, Diamond Beach and Old Bar Beach, where residential development located on the foredune is sited seaward of the 50 year hazard line and in some cases seaward of the immediate (2008) hazard line. Property protection options considered are listed below, with several of these being put forward by the community. Protection options were costed over 50 years (taken to be the design life of existing dwellings and the protection works), with planned retreat proposed as the management option beyond the 50 year planning period (as redevelopment/ new development would be required to be relocatable or landward of the 100 year hazard line).

Diamond Beach (southern end): temporary geotextile revetment; buried seawall; beach nourishment; and groyne field and beach nourishment.

Old Bar Beach (in the vicinity of Lewis Street): revetment (with and without beach nourishment); massive beach nourishment; Farquhar Inlet entrance structure and beach nourishment; groyne field and beach nourishment; and offshore reef and beach nourishment.

In addition to these, the following planned retreat options were considered: rezoning, Local Environmental Plan provisions and development controls for future development; purchase/ partial acquisition of existing properties; and relocation of holiday park structures and public infrastructure.

Preferred options, as adopted by Council, will be included in a draft Coastline Management Plan. The Coastline Management Plan will also include an Emergency Action Plan.

PROJECT 301017- 00051 – GREATER TAREE COASTLINE MANAGEMENT STUDY

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Preliminary Draft to ECMC	H Nelson	K Newton		Dec 2009	N/A	
B	Final Draft	H Nelson	D Messiter	D Messiter	Aug 2010		
C	Final	H Nelson	D Messiter	D Messiter	Oct 2010		

WorleyParsons®
resources & energy

Greater Taree CITY COUNCIL

CONTENTS

Tables

Figures

Appendices

1. INTRODUCTION

1.1 Coastline Management Process

This Coastline Management Study follows on from the *Coastline Hazard Definition Study* (WorleyParsons 2010). It provides background information for the associated Coastline Management Plan and was prepared in accordance with relevant policy and legislation (see **Section 2**). This Study presents options for management of the following coastline hazards along the Greater Taree coast: storm erosion; long term recession due to sediment loss and sea level rise; and inundation due to wave run-up and associated overtopping of the dune system.

The Coastline Management Plan (to be prepared) will comprise the preferred options, as adopted by Greater Taree City Council. An Emergency Action Plan (EAP) will form an appendix to the Coastline Management Plan.

1.2 Study Area

The Greater Taree City Council (GTCC) Local Government Area (LGA) includes some 47km of coastline between Black Head in the south and Diamond Head in the north. It features sandy beaches (Black Head, Diamond, Saltwater Beach, Old Bar, Manning Point, Harrington and Crowdy Bay) between rocky headlands and associated reefs (Black Head, Red Head, Saltwater, Wallabi Point and Crowdy Head). In addition, the large reef *Urana Bombora* is located off Old Bar Beach (see **Figure 1.1**). Typical dune heights along the coast are 8m. Low-lying areas between headlands and behind the dune system are generally around 5m above Australian Height Datum (AHD). AHD is approximately equal to mean sea level. There are also areas of coffee rock (indurated sands) at Diamond Beach. Nearshore water depths between offshore shoals are about -5.9m AHD.

The two entrances to the Manning River, Farquhar Inlet (in the south, adjacent to Old Bar) and Harrington Inlet (in the north) fall within the study area. Harrington Inlet has a training wall on the northern side of the entrance and is permanently open, while Farquhar Inlet is untrained and is therefore periodically open and closed. A number of creeks and lagoons are located along the beaches including Black Head Lagoon, Khappinghat Creek (at Saltwater), First Rock Gully Creek (north side of Wallabi Point) and Racecourse Creek (at Old Bar). Between the two arms of the Manning River are two large islands, Mitchell's Island on the north-eastern side of Scotts Creek (extending to Manning Point Beach) and Oxley Island on the south-western side.

Coastal villages and settlements located within the study area are Hallidays Point (which includes Black Head, Red Head and Diamond Beach), Wallabi Point, Old Bar, Manning Point, Harrington and Crowdy Head. Khappinghat Nature Reserve, Saltwater National Park and Crowdy Bay National Park are also located in or adjacent to the study area. Manning Entrance State Park covers the coastal strip fronting Old Bar, Old Bar Park, Farquhar Inlet, Farquhar Park (on the northern side of the inlet) and the coastal strip of Manning Point Beach to the Manning Point spit on the southern side of Harrington Inlet. Harrington Beach State Park covers Pilot Hill, the Harrington Back Channel, Harrington Lagoon, the Big 4 Harrington Beach Holiday Park, the coastal strip to Crowdy Head and Crowdy Head lighthouse and boat harbour. Pockets of coastal rainforest (see **Section 3** for more information) are found in several locations along the Greater Taree coast.

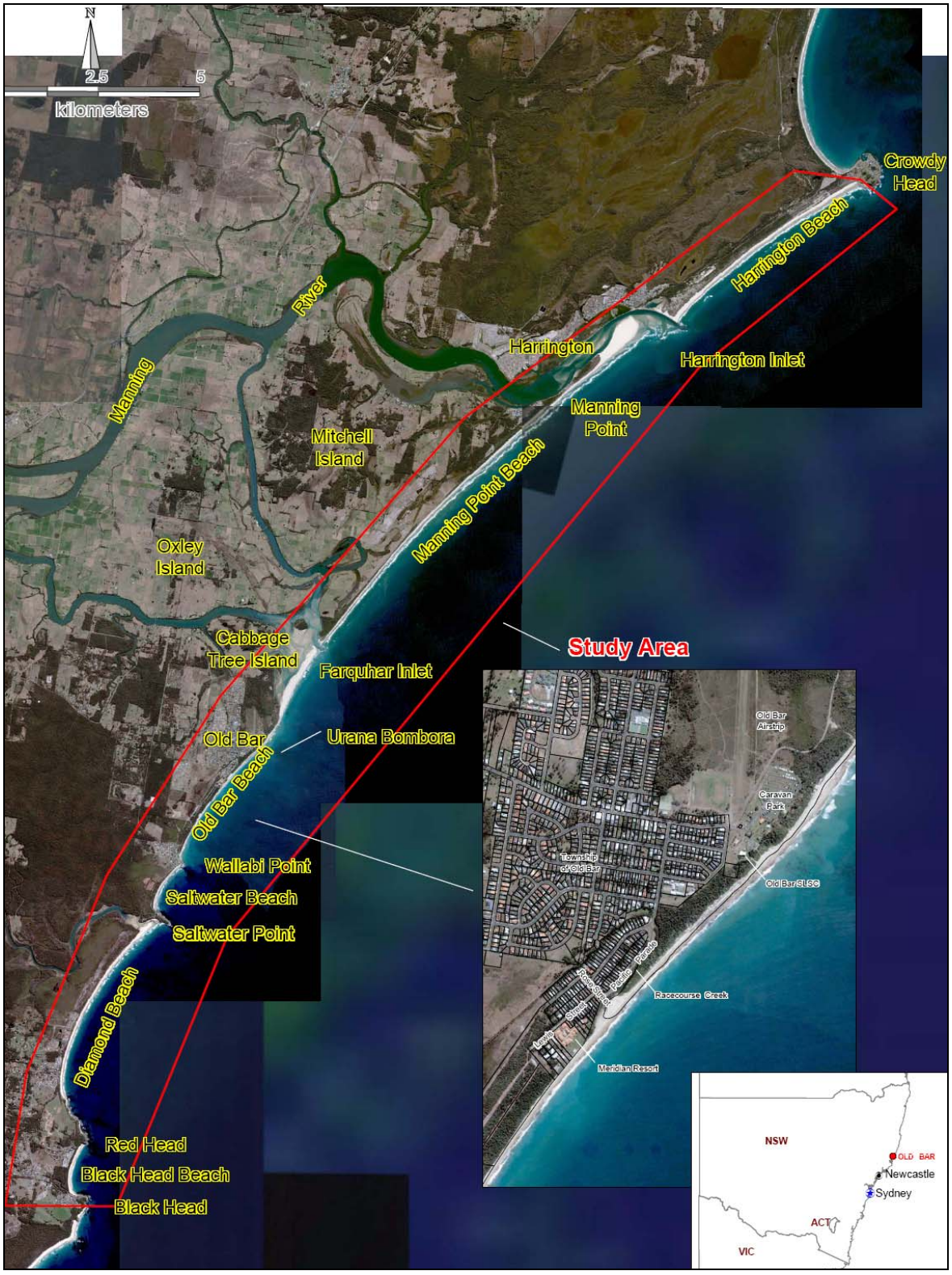


Figure 1.1 Locality Map

2. PLANNING AND MANAGEMENT FRAMEWORK

Following is a discussion on legislation, policy and plans of most relevance to management of coastal hazards along the Greater Taree coast.

2.1 Coastal Protection Act 1979

The *NSW Coastal Protection Act* 1979 includes provisions dealing with the preparation of Coastal Zone Management Plans and specifies matters that must be dealt with in a Coastal Zone Management Plan (Section 55C). These include:

- protecting and preserving beach environments and beach amenity and ensuring continuing and undiminished public access to beaches, headlands and waterways;
- emergency actions of the kind that may be carried out under the *State Emergency and Rescue Management Act* 1989*,* or otherwise, during periods of beach erosion, including the carrying out of related works, such as works for the protection of property affected or likely to be affected by beach erosion, where beach erosion occurs through storm activity or an extreme or irregular event.

Proposed amendments to the *Coastal Protection Act* (see **Section 2.6.2** for more information) include the following new Section 55C (2):

A coastal zone management plan must not include the following:

a) matters dealt with in the State Disaster Plan under the *State Emergency and Rescue Management Act 1989* in relation to the prevention of, preparation for, response to and recovery from emergencies.*

b) proposed actions or activities to be carried out by any public authority or relating to any land or other assets owned or managed by a public authority, unless the public authority has agreed to the inclusion of those proposed actions or activities in the plan.

**i.e. activities carried out/ coordinated by the State Emergency Service (SES) relating to protection of life and transport of removable household and business items when the Bureau of Meteorology (BoM) has issued a severe weather warning for dangerous surf or storm surge*.

2.2 Crown Lands Act 1989

Foreshore public land along the Greater Taree coast consists of a number of Crown reserves and includes State Parks (as noted in **Section 1.2**) managed under the *Crown Lands Act 1989*. This Act is the principal legislation protecting and governing how these lands may be used and managed, including the use/ protection of natural resources. The Act contains a number of principles for Crown land management which include encouraging the public use and enjoyment of appropriate Crown land.

2.3 NSW Coastal Policy 1997

The Coastal Policy has nine goals including that '*coastal processes and hazards are recognised and accommodated* (including climate change)'. Strategic actions include the incorporation of Coastline Management Plans into Local Environmental Plans (LEPs) and the consideration of physical and ecological processes when assessing development applications. The policy also states that:

- *development (other than for essential public purposes such as surf life saving clubs) on beach foredunes is to be prohibited; and*
- *public access to beaches is not to be impeded by tourist resort developments.*

2.4 SEPP No. 71: Coastal Protection

State Environmental Planning Policy (SEPP) No. 71 sets out matters for consideration in relation to activities in the coastal zone including:

- the suitability of development given its type, location and design and its relationship with the surrounding area; and
- the likely impact of coastal processes and coastal hazards on development, and any likely impacts of development on coastal processes and coastal hazards.

SEPP 71 requires councils to consider the impact of coastal processes and coastal hazards when preparing LEPs and assessing development in the coastal zone.

2.5 NSW Sea Level Rise Policy Statement 2009

This Policy specifies sea level rise planning benchmarks of an increase above 1990 mean sea levels of 40cm by 2050 and 90cm by 2100 and states that these benchmarks are to be used when undertaking coastal hazard assessments in accordance with the Coastline Management Manual.

As noted in the Policy Statement, the *Sea Level Rise Policy Statement supersedes the 1988 NSW Coastline Hazard Policy. Most of the objectives from that policy were included in the NSW Coastal Policy 1997, which remains current. Other objectives from the NSW Coastline Hazard Policy are updated by this Sea Level Rise Policy Statement.*

2.6 Reforms to Coastal Erosion Management in NSW

The following is based on information from the Department of Environment, Climate Change and Water (DECCW) website, the information sheet "Reforms to Coastal Erosion Management", DECCW 2009/704; a Briefing Session held by DECCW in Newcastle on 7 April 2010; and the following documents:

- *Minister's Requirements under the Coastal Protection Act 1979* (Draft July 2010)
- *Guide to the statutory requirements for emergency coastal protection works* (Draft Sept 2010)
- *Review of the Infrastructure SEPP Discussion Paper* (March 2010)

- *Coastal Protection and Other Legislation Amendment Bill 2010* consultation draft (26 March 2010) and key changes to the Bill advised by email on 15 June 2010 from DECCW.

2.6.1 Emergency Protection Works

The Draft *Minister's Requirements under the Coastal Protection Act 1979* (previously referred to as the "Code of Practice" in the DECCW information sheet) set out appropriate temporary measures that can be used to protect property under imminent threat from coastal erosion.

Further advice to beachfront land owners is provided in the *Guide to the statutory requirements for emergency coastal protection works*. As noted in the Guide, the intent of emergency works is to protect existing dwellings (not gardens/ landscaping or free standing structures such as pools and sheds) and commercial buildings under imminent threat (provided the works do not result in off-site adverse environmental impacts), whilst more permanent management solutions are considered and implemented. Emergency protection works essentially consist of either beach nourishment or toe protection works using bags filled with sand from a commercial source (i.e. sand can not be taken from the beach). A description of these works will be included in the Emergency Action Plan, which will accompany the Coastline Management Plan.

Note that emergency coastal protection works can only be placed at locations identified in the Guide, understood to be where five or more dwellings are located within the immediate hazard zone. No locations are nominated within the Greater Taree LGA.

2.6.2 Coastal Protection and Other Legislation Amendment Bill 2010

Under the *Coastal Protection and Other Legislation Amendment Bill* (26 March 2010 as amended in June 2010), proposed amendments to the following Acts and Regulations are as follows (note, this draft Bill has been subject to further consultation and discussion in the NSW Parliament).

***Coastal Protection Act 1979*:**

- Defines 'Coastal Authorities' (Council and other coastal land managers) and authorised officers and their powers to issue orders to remove structures/ materials from the beach, stop work and restore the beach.
- Increases penalties for failure to comply with orders, with maximum penalties of approximately $250,000 for individuals and $500,000 for corporations.
- Provides for, and defines emergency coastal protection works and the maximum period they may be in place (one period of up to 6 months, Development Application (DA) required for longer periods).
- Emergency protection works by a landowner will require a certificate from the local council or DECCW prior to placement, and the council is to be notified when works are being undertaken.
- Coastal Zone Management Plans (CZMPs) are to be certified, rather than approved by the Minister.
- Includes additional matters to be dealt with in coastal zone management plans, such as:

the impacts from climate change on risks arising from coastal hazards and on estuary health, as appropriate

where the plan proposes the construction of coastal protection works (whether funded by the council or a private landowner or both) the proposed arrangements for maintenance of the works and for managing associated impacts such as changed or increased beach erosion elsewhere or a restriction of public access.

Coastal Protection Regulation 2004 (amendments for consistency with *Coastal Protection Act*)

Local Government Act 1993

- Provides for an annual levy for rateable land benefitting from coastal protection works/ service (whether or not the works are constructed by council, land owners or jointly constructed, regardless of where they are constructed, i.e. private or public land, neighbouring land). Charges are outside the system of rate pegging, and cover the private benefit share of design, construction and operational costs.
- Exemption from liability for councils is extended to cover: any thing done or omitted to be done regarding beach erosion or shoreline recession on public land; failure to upgrade coastal management works in response to projected or actual impacts of climate change; failure to enforce the removal of illegal or unauthorised structures on public land; and provision of information relating to climate change or sea level rise.
- Defines coastal protection service as the maintenance of coastal protection works (which include beach nourishment) and the management of the impacts of these works (such as increased erosion elsewhere).

Local Government (General) Regulation 2005

- Specifies that a coastal protection service must ensure that works do not result in: any significant long term coastal erosion impacts on beaches or on adjoining land; or any impacts on public access to the adjoining beach.

Conveyancing (Sale of Land) Regulation 2005

- Contract for sale of land is to state that the property is subject to a coastal protection services charge.

Environmental Planning and Assessment Regulation 2000

- Clause 228, factors to be considered under Part 5 assessment are expanded to include any impact on coastal processes and coastal hazards, including those under projected climate change conditions.

SEPP Infrastructure

The proposed amendments to this SEPP would allow landowners to apply for approval to erect long-term coastal protection works. Approval of these works may be granted where the potential offsite impacts of the works can be managed and the landowner will fund any ongoing works, including beach nourishment.

Under the *Review of the Infrastructure SEPP Discussion Paper*, recommended amendments to Division 25 Waterway or foreshore management activities include those outlined below. The

Discussion Paper states that works would need to be consistent with the NSW Government's Coastal Erosion Protection Package. *It is assumed this means that the works would need to be consistent with a Coastal Zone Management Plan and that any other proposed works would require development consent under Part 3A or Part 4 of the Environmental Planning and Assessment Act 1979.*

129A Development permitted with consent

Development by individuals or corporations, for the purpose of works required for long-term coastal protection to reduce coastal erosion of their properties, may be considered development permitted with consent where the consent authority is satisfied that:

(a) the works are consistent with Best Practice Guidelines for Design and Assessment of Coastal Protection works*, and

(b) the potential offsite impacts of the works can be managed, and

(c) the landowner will fund any ongoing works, including beach nourishment that may be required to minimise offsite impacts and maintain the works.

129B Complying development

Development for the purpose of works required for coastal protection and hazard reduction by individuals or corporations may be considered complying development but only if the development:

(a) will be of low or minor environmental impact, including off-site impacts, and

(b) is certified as complying with the *Best Practice Guidelines for Design and Assessment of Coastal Protection works**, and

(c) will be in place for a period of no more than 5 years.

129C Exempt development

Development for the purpose of temporary works required for coastal protection and hazard reduction by individuals or corporations may be considered exempt development but only if the development is:

(a) temporary minor development, and

(b) complying with the *Code of Practice for Emergency and Minor Coastal Protection Works***, and

(c) will remain in place for a period of no more than 12 months.

Notes:

**the Best Practice Guidelines are being prepared by DECCW and will be reviewed by the Department of Planning (DoP) prior to endorsement for the purpose of this SEPP.*

***the Code of Practice is now called the Minister's Requirements under the Coastal Protection Act 1979.*

Draft Minister's Requirements under the Coastal Protection Act 1979

- This was previously referred to as the "Code of Practice" in the DECCW information sheet. The Minister's requirements specify trigger points when emergency works are permitted, i.e. when

the distance between the most seaward part of any wall of the building and the most landward extent of the sand dune erosion escarpment (trigger distance) is less than 10 m.

The *Minister's Requirements* also specify works are to be removed if the alignment of the sand dune erosion escarpment adjacent to the works:

- is located more than 3 m landward of the works; or
- is, in the opinion of an authorised officer, reasonably likely to move from public land onto private property (other than the property benefitting from the works), without the written permission of the owner, where the escarpment was not located on this property when the works were begun.

2.6.3 NSW Coastal Planning Guideline: Adapting to Sea Level Rise 2010

The Coastal Planning Guideline was released through the Department of Planning and relates to coastal erosion, tidal inundation and coastal flooding for areas currently at risk, and areas that may be at risk in the future, due to sea level rise. The Guideline adopts six coastal planning principles for sea level rise adaption:

- Assess and evaluate coastal risks taking into account the NSW sea level rise planning benchmarks.
- Advise the public of coastal risks to ensure that informed land use planning and development decision-making can occur.
- Avoid intensifying land use in coastal risk areas through appropriate strategic and land use planning.
- Consider options to reduce land use intensity in coastal risk areas where feasible.
- Minimise the exposure of development to coastal risks
- Implement appropriate management responses and adaptation strategies, with consideration for the environmental, social and economic impacts of each option.

The guideline states that the installation of structural protection works should be consistent with an approved Coastline Management Plan or Emergency Action Plan (including any works proposed by private foreshore land owners). In addition 'soft engineering' options are preferred to hard engineering works, if protection of both assets and coastal habitats can still be achieved.

Zoning and Local Environmental Plans

The guideline provides examples of zoning options in coastal risk areas which may be appropriate e.g:

- RE1 Public Recreation.
- E2 Environmental Conservation Zone for rural or undeveloped land in coastal risk areas, which provides the highest level of protection, management and restoration for such lands, while allowing uses compatible with those values.

- E3 Environmental Management Zone for rural land in coastal risk areas, particularly seaward of the immediate hazard line.

The guideline notes that the range of permitted uses should not be drawn too restrictively as they may, depending on circumstances, invoke the *Land Acquisition (Just Terms Compensation) Act 1991* and the need for the Minister to designate a relevant acquiring authority.

For risk areas on coastal floodplains that have not yet been zoned for urban uses, retaining low intensity rural zones with large lot sizes may be more appropriate than intensifying land use by allowing residential or other uses.

Development standards, such as minimum lot size, can be used to ensure land use is not intensified without the need for rezoning.

The Standard Local Environmental Plan (LEP) Instrument contains:

- Clause 5.5 which requires that, when assessing development within the NSW Coastal Zone, the consent authority considers the effect of coastal processes and coastal hazards and potential impacts, including sea level rise on the proposed development, and arising from the proposed development (additional LEP clauses can be added to apply local provisions to specific locations identified on an overlay map).
- Clause 6.5 whereby coastal risk areas may be identified in a LEP by a foreshore building line or a flood planning area, with development controls specified in the LEP, and performance criteria specified in a related Development Control Plan (DCP).

Development Control Plans

Where a LEP outlines principal development standards (such as height of buildings, minimum subdivision lot size and floor space ratio) a DCP can make more detailed provision with respect to development. For example, more detailed development controls can be applied to sections of the coastal risk area (such as the immediate hazard line, 2050 hazard line and 2100 hazard line). These development controls could cover construction methods or materials, size of the development, the need for development to be relocatable or temporary, and the location of utilities or services within the site.

Planning Criteria for Proposed Development in Coastal Risk Areas

The Guideline sets out the following criteria:

- development avoids or minimises exposure to immediate coastal risks (i.e. areas seaward of the immediate hazard line);
- development provides for the safety of residents, workers or other occupants onsite from risks associated with coastal processes;
- development does not adversely affect the safety of the public off-site from a change in coastal risks as a result of the development;
- development does not increase coastal risks to properties adjoining or within the locality of the site;

- infrastructure, services and utilities onsite maintain their function and achieve their intended design performance;
- development accommodates natural coastal processes including those associated with projected sea level rise;
- coastal ecosystems are protected from development impacts; and
- existing public beach, foreshore or waterfront access and amenity is maintained.

Strategies to address these criteria will vary on a case by case basis and could include:

- configuring the development site layout to minimise exposure to coastal risks e.g. ensuring that buildings and infrastructure are placed in low risk areas on site and provide open space and landscaping between buildings and areas of higher hazard risk;
- installing and maintaining protection works;
- constructing buildings or structures that are easily decommissioned, disassembled or relocatable either on site or off-site as required;
- providing for safe exit routes during storm events; and
- designing buildings with all habitable floors above flood planning levels.

It should be noted that in some instances a site may be deemed unsuitable for further development, as illustrated in the guideline and reproduced in **Figure 2.1**, and time and/ or trigger limited development consent conditions could be applied to allow ongoing sustainable use of coastal areas until such time as coastal risks threaten life and property.

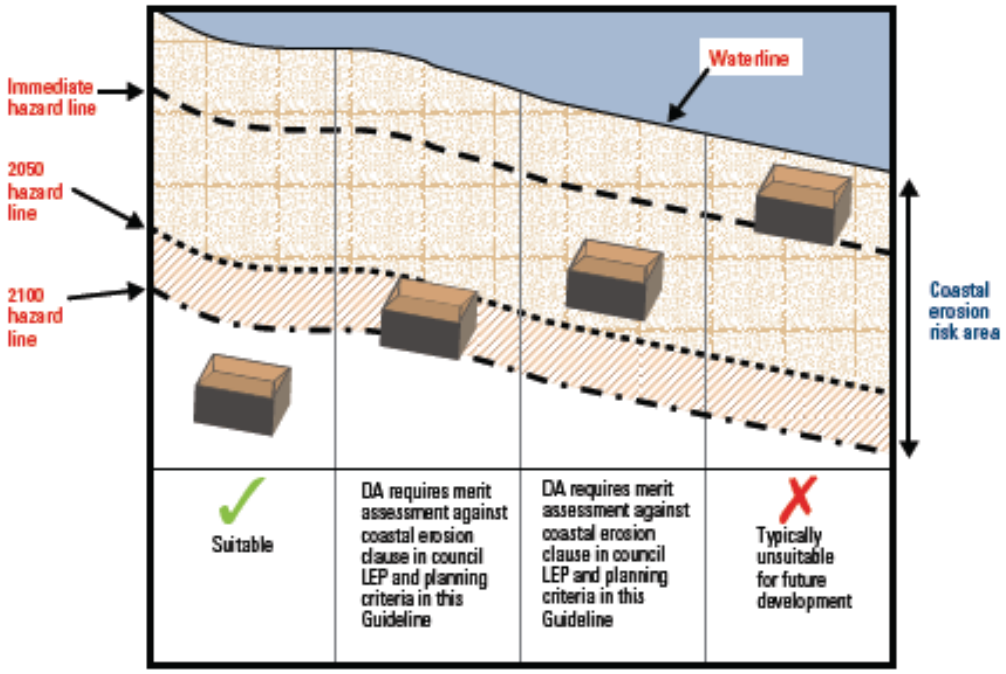


Figure 2.1 Coastal Hazard Planning Areas and DA Assessment

It is noted in the guideline that the following types of development proposals in coastal risk areas would require further detailed assessment of risks to life, property or the environment:

- construction of new residential, commercial, retail or industrial buildings or structures or substantially increasing the floor space ratio of existing buildings or structures;
- subdivision, with consideration for proposed building envelopes, access and service easements;
- institutional developments, especially where evacuating people may be particularly difficult e.g. hospitals, schools, child care or aged care facilities;
- material change of use that substantially increases the number of people living or working on site;
- manufacture or storage of hazardous or dangerous materials or waste disposal; or
- sewerage treatment works, substations and other key infrastructure essential in emergency response and recovery.

2.6.4 Draft Coastal Guidelines

The *1990 Coastline Management Manual* and the *1992 Estuary Management Manual* will be replaced with new *Coastal Zone Management Planning Guidelines.* This document will provide guidance on how coastal hazard information can be expanded to identify additional areas projected to be at risk in the future from coastal hazards and flooding due to sea level rise (the Greater Taree Coastline Hazard Definition Study took into account sea level rise in the determination of hazard lines and hence includes areas at risk in the future from coastal processes due to sea level rise).

2.7 Mid North Coast Regional Strategy 2009

The Strategy (2006-31) divides the region into four distinct subregions: Clarence; Coffs Coast; Hastings - Macleay Valley; and Manning Valley - Great Lakes (incorporating the LGAs of Greater Taree and Great Lakes). It identified that the greatest population growth pressure will be experienced around Coffs Harbour, Port Macquarie and Great Lakes/ Taree.

The demand to live near the coast will continue to result in the majority of the anticipated growth occurring in existing identified growth areas of Old Bar and Tea Gardens–Hawks Nest, with some growth in the existing areas of Harrington and Hallidays Point - Diamond Beach localities. Proposed urban areas at Old Bar and within the Hallidays Point locality are shown in yellow on **Figures 2.2** and **2.3**, with growth area boundaries shown in red. The Mid North Coast Strategy also identifies Crowdy Head and Manning Point as growth areas.

Although some locations are identified as growth areas in the Strategy, they are not necessarily proposed for urban development. For example, some areas are identified within coastal hazard zones are proposed for sportsfields and primary production.

Strategy outcomes include that LEPs make provision for adequate setbacks in areas of coastal erosion risk and ocean-based inundation in accordance with Coastal Zone Management Plans, and that LEPs zone areas subject to high hazard to reflect the limitations of the land.

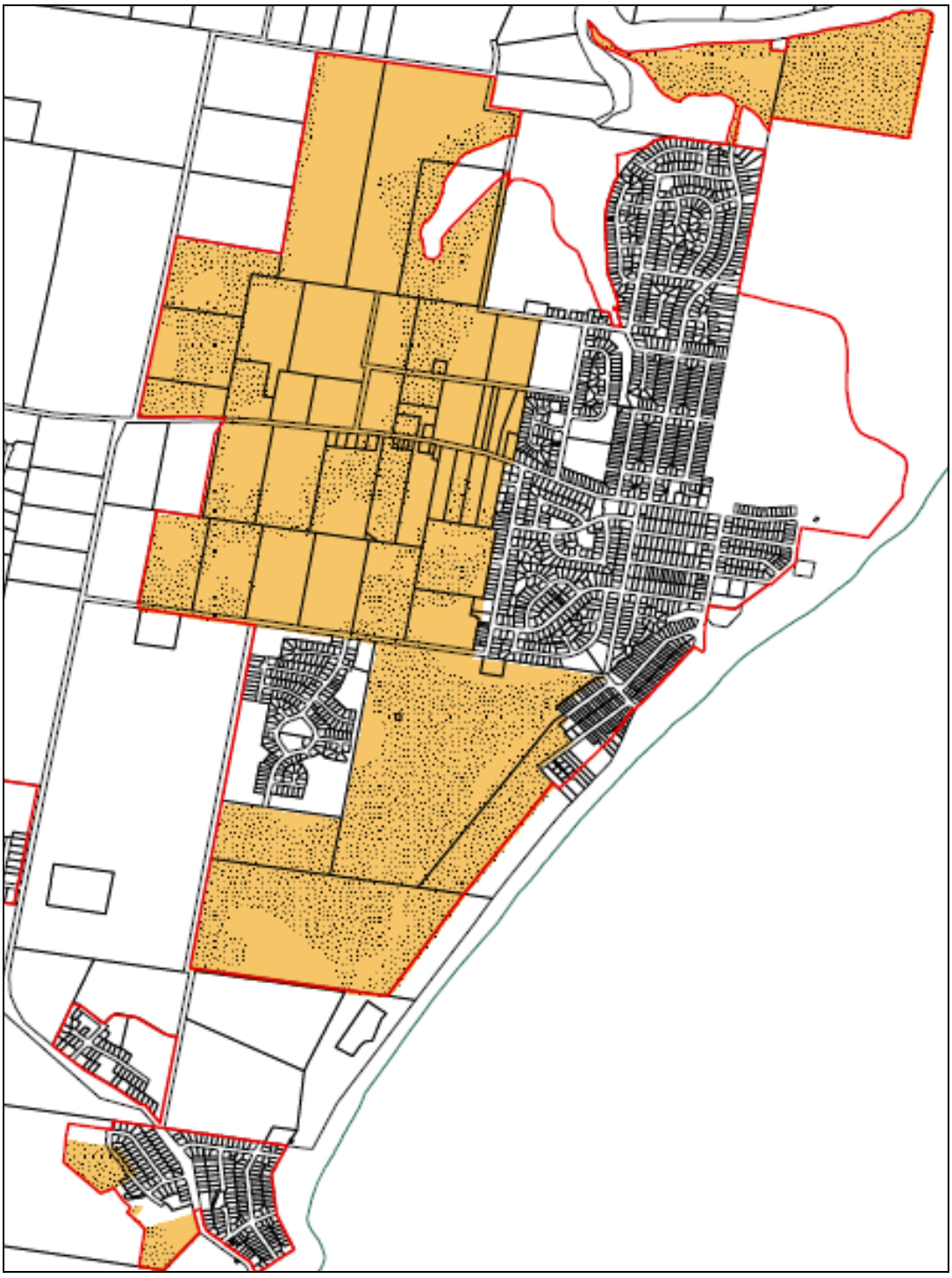


Figure 2.2 Proposed Urban Areas – Wallabi Point/ Old Bar

Figure 2.3 Proposed Urban Areas – Hallidays Point

2.8 North Coast Urban Design Guidelines 2008

The *North Coast Urban Design Guidelines* were prepared to support the *Mid North Coast Regional Strategy* and set out principles to apply to all future development including to:

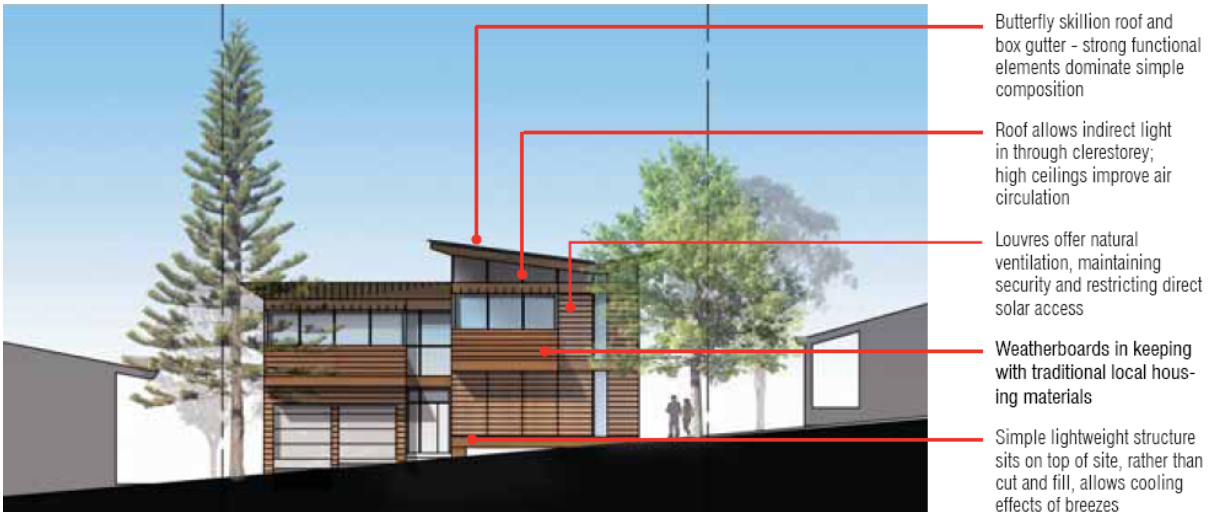
- maintain and protect the key natural features throughout and around the settlement (coastal environment, river landscape, forested areas) to ensure the unique character they provide for the town is retained;
- prevent future growth in areas of high environmental or natural resource value and areas prone to flooding, erosion and inundation;
- maintain public open space and public access along foreshores, reserves and bushland and set development back from areas of high ecological value;
- encourage plant species which are compatible with the local climate, topography and natural vegetation;
- prevent privatisation of foreshore and riparian edges;

- ensure interconnectivity of parks, public spaces, main streets, services, infrastructure and natural features;
- ensure development responds sensitively to the density and scale of the existing settlement;
- ensure planning and development respond to the local topography and climate.

Principles to apply to all housing types include the following:

- encourage elevated, lightweight construction in response to climate and breezes;
- provide flexible sun-shading devices, louvres and natural ventilation systems to allow passive environmental control;
- provide semi-sheltered outdoor spaces of usable dimensions to mediate between indoors and outdoors; and
- establish building orientation towards street front in keeping with the local settlement pattern with consistent scale, materials and setbacks, whilst maintaining built form diversity and contributing to the settlement character.

Examples of light weight structures are provided in the guidelines and are reproduced in **Figure 2.4**.



Raised, lightweight structure allows for undercroft parking; clerestory allows sunlight from the east and view to the coast

Reinforce local character with continued lightweight material and form

Figure 2.4 Examples of Light Weight Structures in the Coastal Zone

2.9 Environmental Planning and Assessment Act 1979

Under the *EP&A Act* 1979, projects are classified as:

- "Major Development" (development which falls under Part 3A of the Act);
- Projects which require development consent (development under Part 4 of the Act); or
- Projects that do not require consent ("activities" under Part 5 of the Act).

Works by private landholders within the coastal zone would generally require development consent. However emergency protection works proposed under legislative changes, as discussed in **Section 2.6.2**, would be permitted without consent provided certification was obtained from council or DECCW.

In addition to general environmental considerations, Clause 92 of the *EP&A Regulation* 2000 requires a consent authority to take into consideration the *NSW Coastal Policy* in determining a development application. For Part 5 activities (i.e. not requiring consent), proposed amendments to the *EP&A Regulation 2000* (see **Section 2.6.2**) state that factors to be considered under a Part 5 assessment (Clause 228) are to include any impact on coastal processes and coastal hazards, including those under projected climate change conditions.

Currently for works carried out by, or on behalf of, a public authority (which includes a local council), *SEPP (Infrastructure)* permits a range of activities without development consent. These include:

- coastal management and beach nourishment, including erosion control, dune or foreshore stabilisation works, headland management, weed management, revegetation activities and foreshore access ways; and
- emergency works including works required as a result of flooding, storms or coastal erosion.

2.10 Greater Taree Local Environmental Plan (LEP)

2.10.1 LEP Coastal Zone Provisions

Greater Taree City Council prepared a new LEP in accordance with the DoP's standard template. The Greater Taree LEP 2010 commenced on 25 June 2010.

Clause 5.5 of the LEP relates to the coastal zone and is reproduced below.

(1) The objectives of this clause are as follows:

(a) to provide for the protection of the coastal environment of the State for the benefit of both present and future generations through promoting the principles of ecologically sustainable development,

(b) to implement the principles in the NSW Coastal Policy, and in particular to:

(i) protect, enhance, maintain and restore the coastal environment, its associated ecosystems, ecological processes and biological diversity and its water quality,

(ii) protect and preserve the natural, cultural, recreational and economic attributes of the NSW coast,

(iii) provide opportunities for pedestrian public access to and along the coastal foreshore,

(iv) recognise and accommodate coastal processes and climate change,

(v) protect amenity and scenic quality,

(vi) protect and preserve rock platforms, beach environments and beach amenity,

(vii) protect and preserve native coastal vegetation,

(viii) protect and preserve the marine environment,

(ix) 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,

(x) ensure that decisions in relation to new development consider the broader and cumulative impacts on the catchment,

(xi) protect Aboriginal cultural places, values and customs, and

(xii) protect and preserve items of heritage, archaeological or historical significance.

(2) Development consent must not be granted to development on land that is wholly or partly within the coastal zone unless the consent authority has considered:

(a) existing public access to and along the coastal foreshore for pedestrians (including persons with a disability) with a view to:

(i) maintaining existing public access and, where possible, improving that access, and

(ii) identifying opportunities for new public access, and

(b) the suitability of the proposed development, its relationship with the surrounding area and its impact on the natural scenic quality, taking into account:

(i) the type of the proposed development and any associated land uses or activities (including compatibility of any land-based and water-based coastal activities),

(ii) the location, and

(iii) the bulk, scale, size and overall built form design of any building or work involved, and

(c) the impact of the proposed development on the amenity of the coastal foreshore including:

(i) any significant overshadowing of the coastal foreshore, and

(ii) any loss of views from a public place to the coastal foreshore, and

(d) how the visual amenity and scenic qualities of the coast, including coastal headlands, can be protected, and

(e) how biodiversity and ecosystems, including:

(i) native coastal vegetation and existing wildlife corridors, and

(ii) rock platforms, and

(iii) water quality of coastal waterbodies, and

(iv) native fauna and native flora, and their habitats, can be conserved, and

(f) the effect of coastal processes and coastal hazards and potential impacts, including sea level rise:

(i) on the proposed development,

(ii) arising from the proposed development, and

(g) the cumulative impacts of the proposed development and other development on the coastal catchment.

(3) Development consent must not be granted to development on land that is wholly or partly within the coastal zone unless the consent authority is satisfied that:

(a) the proposed development will not impede or diminish, where practicable, the physical, land-based right of access of the public to or along the coastal foreshore,

(b) if effluent from the development is disposed of by a non-reticulated system, it will not have a negative effect on the water quality of the sea, or any beach, estuary, coastal lake, coastal creek or other similar body of water, or a rock platform, and

(c) the proposed development will not discharge untreated stormwater into the sea, or any beach, estuary, coastal lake, coastal creek or other similar body of water, or a rock platform.

2.10.2 LEP Land Use Tables

Under the Greater Taree LEP 2010 coastal land is generally zoned E2 Environmental Conservation. Other foreshore land use zones include E3 Environmental Management, RE1 Public Recreation, SP3 Tourist and RU1 Primary Production. Objectives and permitted uses for these land use zones follow.

E2 Environmental Conservation objectives:

- To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.
- To prevent development that could destroy, damage or otherwise have an adverse effect on those values.

Permitted without consent	Permitted with consent	Prohibited
Home occupations	Dwelling houses; Environmental facilities; Environmental protection works; Flood mitigation works; Roads.	Business premises; Hotel or motel accommodation; Industries; Multi-dwelling housing; Recreation facilities (major); Residential flat buildings; Retail premises; Seniors housing; Service stations; Warehouse or distribution centres; any other development not specified as permitted with or without consent.

E3 Environmental Management objectives:

- To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values.
- To provide for a limited range of development that does not have an adverse effect on those values.

Permitted without consent	Permitted with consent	Prohibited
Home occupations.	Bed and breakfast accommodation; Dwelling houses; Environmental facilities; Environmental protection works; Extensive agriculture; Farm buildings; Forestry; Roads.	Industries; Multi-dwelling housing; Residential flat buildings; Retail premises; Seniors housing; Service stations; Warehouse or distribution centres; any other development not specified as permitted with or without consent.

RE1 Public Recreation objectives:

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

Permitted without consent	Permitted with consent	Prohibited
Environmental protection works; Flood mitigation works.	Boat sheds; Building identification signs; Caravan parks; Charter and tourism boating facilities; Child care centres; Community facilities; environmental facilities; Helipads; Information and education facilities; Kiosks; Marinas; Recreation areas; Recreation facilities (indoor); Recreation facilities (major); Recreation facilities (outdoor); Restaurants; Roads; Water recreation structures.	Any development not specified as permitted with or without consent.

SP3 Tourist objectives:

- To provide for a variety of tourist-oriented development and related uses.
- To facilitate and encourage tourist-based development so as to increase the economic base within the City of Greater Taree.
- To provide employment opportunities in the tourism sector as part of a balanced growth strategy for the City.
- To facilitate the provision of limited permanent accommodation to improve off-season viability of tourist-based development.

Permitted without consent	Permitted with consent	Prohibited
Nil.	Business premises; Car parks; Caravan parks; Charter and tourism boating facilities; Child care centres; Community facilities; Entertainment facilities; Environmental facilities; Environmental protection works; Food and drink premises; Function centres; Information and education facilities; Kiosks; Marinas; Neighbourhood shops; Passenger transport facilities; Recreation areas; Recreation facilities (indoor); Recreation facilities (major); Recreation facilities (outdoor); Registered clubs; Roads; Tourist and visitor accommodation; Water recreation structures.	Any development not specified as permitted with or without consent.

RU1 Primary Production objectives:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within the zone and land uses within adjoining zones.
- To permit small scale rural tourism uses associated with primary production and environmental conservation with minimal impact on primary production and the scenic amenity of the area.
- To maintain the rural landscape character of the land.
- To protect and enhance the native flora, fauna and biodiversity links.

Permitted without consent	Permitted with consent	Prohibited
Extensive agriculture; Forestry; Home occupations; Horticulture; Viticulture.	Agriculture; Bed and breakfast accommodation; Cellar door premises; Cemeteries; Correctional centres; Crematoria; Dual occupancies (attached); Dwelling houses; Environmental facilities; Environmental protection works; Extractive industries; Farm buildings; Farm stay accommodation; Flood mitigation works; Funeral chapels; Funeral homes; Helipads; Home-based child care; Home businesses; Home industries; Mining; Restriction facilities; Roads; Roadside stalls; Rural industries; Rural workers' dwellings.	Livestock processing industries; Any other development not specified as permitted with or without consent.

2.11 Greater Taree Development Control Plan (DCP) 2010

This Greater Taree Development Control Plan 2010 was adopted by Council on 14 October 2009 and came into force upon the gazettal of the Greater Taree LEP 2010 (25 June 2010).

Part C of the DCP addresses subdivision and states that subdivision design is to ensure a number of objectives are met including that any risks to development are identified, adequately addressed and responded to at the Development Application (DA) stage, including minimising the risk of:

- periodic inundation or flooding to development;
- damage to urban development due to unstable ground conditions; and
- damage to urban development from coastal hazards including transmigration, coastal erosion and/ or climate change.

Part D of the DCP addresses coastline management, with objectives being to:

- limit new development in areas that might now or in the future be subject to coastal hazards and risks;
- consider the impact of new development on natural coastal processes; and
- consider the implications of climate change in all new development.

DA Submission requirements

Where a Coastal Management Plan is in place, development is to be guided by this plan in regard to any works to be carried out in the hazard area.

Where a Coastal Management Plan is not yet in place, or where a Coastal Management Plan does not specifically provide requirements and controls for development, any proposed development on an allotment that is affected by the identified Coastal Zone Hazard Area or Coastal Zone Hazard Investigation Area is to be accompanied by an assessment of the impact and suitability of such development within a risk assessment framework, addressing issues including sea level rise/ climate change, coastal recession, erosion, flooding and landslip.

Performance criteria

1. Where a setback is identified for a Coastal Zone Hazard Area, development will not be permitted waterside of this setback with the exception of hazard mitigation works and structures identified in the Coastal Management Plan for that area.
2. Where there is no specific setback for a Coastal Hazard Area, the assessment outlined above is to identify an appropriate development setback.

Coastal zone hazard areas

Figures 2.5 to **2.7** show the coastal zone hazard areas identified in the DCP. The Diamond Beach and Old Bar coastal hazard areas are based on previous studies (GTCC 1990 and Riedel & Byrne 1981) and the North Diamond Beach investigation area is based on the Coastline Hazard Definition Study (WorleyParsons (WP) 2010).

Building Setbacks

Part H of the DCP addresses building setbacks for residential development. The minimum front street boundary setback is generally 5m for one and two storey single detached dwellings and dual occupancy in urban areas. Side and rear setbacks are a minimum of 900mm for single storey development and 1600mm for two storey development. For multi-unit dwellings the minimum front street boundary setback is generally 7m. The setback for dwellings in large lot residential areas is generally 10m. However, Council may vary setback distances in urban areas depending on the setback of adjacent dwellings and for large lot residential areas depending on topography or other features.

2.12 Climate Change Development Assessment Practice Note

Council has developed an internal, interim procedure for assessment of development, based on the current 100 year impact line, or where no impact line is available, the hazard lines identified by WP (2010). Essentially an application will be:

- Refused if the development envelope is seaward of the current 100 year hazard area or where there is no current impact line, the WP immediate hazard line.
- Considered on merit where development is within the current hazard area or where there is no current hazard area, the area between the WP immediate and 2058 hazard line. A site specific coastal hazard assessment report is required for new development. For minor development (e.g. decks and other light weight structures), a suitable retreat or relocation strategy is required.
- Considered on merit between the WP 2058 and 2108 hazard lines provided they include a suitable retreat or relocation strategy.

Figure 2.5 Diamond Beach Coastal Hazard Area

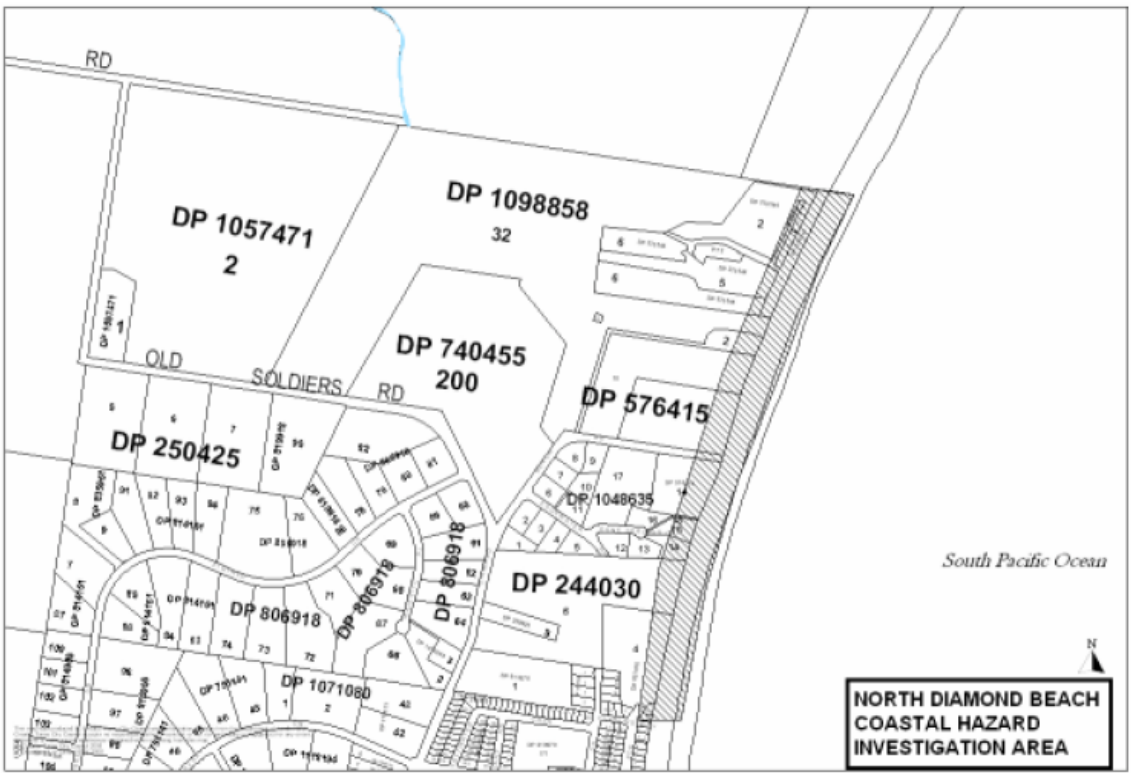


Figure 2.6 North Diamond Beach Coastal Hazard Investigation Area

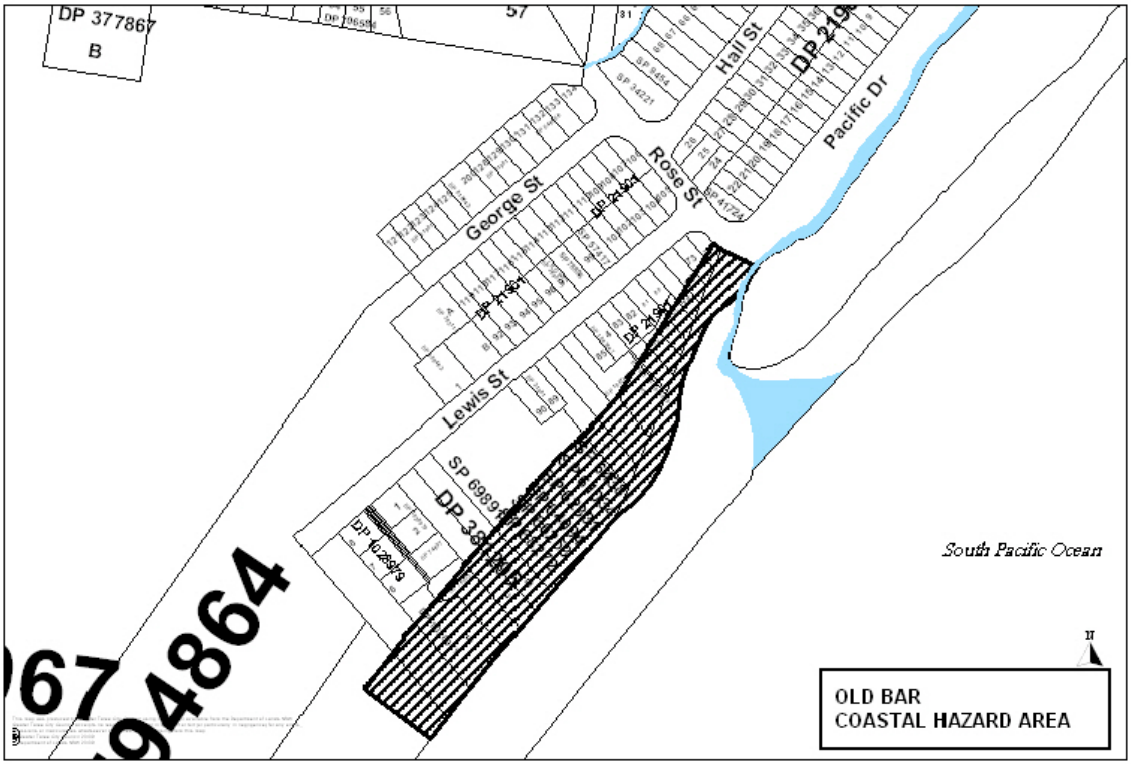


Figure 2.7 Racecourse Creek/ Lewis Street, Old Bar Coastal Hazard Area

3. STUDY AREA VALUES

3.1 Community Values

Old Bar residents, through a survey conducted in association with public meetings held in December 2008, identified a number of values which are applicable to the entire GTCC coast. These included:

- recreational values (e.g. surfing, swimming, picnicking, diving, walking);
- scenic beauty, coastal views;
- accessibility to the beach;
- iconic estuaries;
- affordability;
- lifestyle (peaceful and relaxed village atmosphere);
- not overdeveloped;
- coastal climate; and
- biodiversity and threatened species values.

Information on these, and other values, follows.

3.2 Aboriginal Sites

The original occupiers of the Manning Valley were speakers of the Birpai Aboriginal language. This name is now used to signify the people. Although distinct groups inhabited a range of environments from coastal, estuarine, riverine and inland areas they shared this common language. The Birpai moved between neighbouring lands for ceremonial activities and episodic and periodic food gathering (Klaver & Keffernan 2009).

Many Aboriginal sites (e.g. scarred trees, artefact scatters, shell middens, stone tool manufacturing sites and ceremonial sites) are located in coastal areas of GTCC LGA. A number of Aboriginal burial sites occur along beaches (Klaver & Keffernan 2009). Artefacts including 'flakes', remnant 'cores' and 'stone axes' have also been recorded (Orogen 2007).

The Saltwater area (used as a traditional camping area) was extremely important to the Birpai Aboriginal people from 1932 to the 1960s. During this time the Aboriginal people of the area were relocated to Aboriginal Reserves where they could not leave without permission. However, each year Aboriginal families would be allowed six weeks over the Christmas and Easter periods to camp and live their traditional way of life at Saltwater. At Saltwater traditional knowledge was shared with younger generations, thus the area continues to be an important place for the Aboriginal people of the GTCC LGA. There are a number of traditional sacred sites at Saltwater including a beach cave where elders are buried and other secret locations (Klaver & Keffernan 2009).

3.3 Natural and Non-Indigenous Cultural Heritage

As noted in **Section 1.2**, pockets of coastal rainforest are present in a number of areas along the Greater Taree coast. These areas are protected under *SEPP No. 26 Littoral Rainforest* and are considered an Endangered Ecological Community (EEC) under the NSW *Threatened Species Conservation (TSC) Act* 1995 (i.e. *Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions*). In addition, *Littoral Rainforest and Coastal Vine Thickets of Eastern Australia* is listed as Critically Endangered under the Federal *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. More than 50 species of rainforest trees and shrubs have been recorded at Red Head, including the understorey shrub Veiny Wilkiea, *Wilkiea huegeliana*, which is the larval food plant for the regent skipper butterfly, *Euschemon rafflesia* spp. *rafflesia.* This butterfly species is only found as far south as Kempsey.

In addition, several coastal wetlands listed under *SEPP No.14 Coastal Wetlands* are located at Farquhar and Harrington Inlets. Saltmarsh associated with these wetlands is listed under the *TSC Act* (i.e. *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions*). Mangroves and seagrasses are protected under the *Fisheries Management (FM) Act* 1994.

Some areas of the GTCC coast are listed on the Register of the National Estate for these and other natural and cultural heritage values. The Statements of Significance from the Australian Heritage Database (DEWHA 2009) for each of the areas listed (covering ecological and non-indigenous heritage values) are summarised in **Sections 3.3.1**-**3.3.4**.

3.3.1 Old Bar – Farquhar Inlet

Old Bar - Farquhar Inlet is highly valued by the community for its contribution to the area's natural scenic values. No significant habitation occurs at the Farquhar Inlet entrance, unlike many other river entrances in NSW. Therefore the entrance remains in a natural state, with sand islands, intertidal mud flats and mangroves lining the bank.

The littoral rainforest remnants at Old Bar – Farquhar Inlet are good representatives of the once extensive stands of littoral rainforest that existed in the area. Littoral rainforests represent one of the most threatened vegetation formations in NSW, representing only 0.6% of the remaining rainforest in NSW. One of the remnants supports the vine *Cynanchum elegans* which is listed as endangered in NSW.

The vegetation of Old Bar Park – Farquhar Inlet protects an important Quaternary embayment consisting mainly of a breached bar and lagoon system. Six wetlands within the estuary and river mouth are listed under *SEPP No.14*. The estuary also contains seagrass beds, mangroves and saltmarsh and is a significant nursery area for fish.

The estuarine habitats of the Old Bar – Farquhar sandbar islands are important habitat and breeding sites for a number of rare or threatened migratory and wading birds, including the little tern (*Sterna albifrons*) and the beach stone-curlew (*Escacus neglectus*). The Old Bar – Farquhar population of the little tern comprises approximately 30% of the estimated NSW population. Eight bird species listed on the Japan Australia Migratory Bird Agreement (JAMBA) and the China Australia Migratory Bird Agreement (CAMBA) have been recorded in the area including the great knot (*Calidris*

tenuirostris), broad billed sand piper (*Limicola falcinellus*) and the lesser sand-plover (*Charadrius mongolus*).

The area also supports at least ten species of birds listed as vulnerable in NSW under the *TSC Act* 1995. They are the pied oystercatcher (*Haematopus longirostris*), sooty oystercatcher (*Haematopus fuliginosus*), superb fruit-dove (*Ptilinopus superbus*), rose-crowned fruit-dove (*Ptilinopus regina*), wompoo fruit-dove (*Ptilinopus magnificus*), powerful owl (*Ninox strenua*), glossy black cockatoo (*Calyptorhynchus lathami*), lesser sand-plover (*C. mongolus*), large sand plover (*Charadrius leschenaultia*) and the osprey (*Pandion Haliaetus*).

Old Bar Park – Farquhar Inlet also supports a diversity of habitat types. In addition to littoral rainforest, 17 vegetation communities occur. These support a high diversity of plants compared to other regional coastal reserves on the NSW north coast. A considerable 450 native plant species have been recorded in the 163 hectares of Old Bar Park alone.

Seven plant species in Old Bar Park occur at their recorded geographic limit of distribution. These include heath myrtle (*Baeckea stenophyla*) (southern limit); saw-sedge (*Gahnia radula*) (northern limit); *Tetraria capillaris* (northern limit), *Xanthosia tridentata* (northern limit) and *Diplocyclos palmatus* (southern limit). The Old Bar Racecourse Gully littoral rainforest remnant supports bearded tylophora (*Tylophora barbata*), representing the southern distribution limit of this species.

The rare and disjunct grassy heathland at Old Bar Park supports a large population of the herb austral toadflax (*Thesium australe*) which is listed as vulnerable at State and national level. The *Banksia aemula* shrubland in Old Bar Park supports geebung (*Persoonia katerae*), an endemic species to the Manning and Myall River coastal area. Twenty-two species of terrestrial orchid have been recorded in the south-west section of Farquhar Park where clay intrusions dominate the otherwise sandy soil profile.

Old Bar Airfield (c1925) is of historical significance (listed as State significance in the heritage schedule to the Greater Taree LEP 2010) because of its key role in the development of Australia's air mail and aerial passenger services; as the site of an historic air pageant in 1930; and for its military use during WWII as a refuelling and coastal mapping and surveying station for the RAAF. The windsock, which is located off site, is a significant element of the significance of the airfield. The airfield is directly associated with aviation pioneers Sir Charles Kingsford-Smith, Captain C.T.P. Ulm, Jean Batten and Nancy Bird Walton who often used the airstrip. Kingsford-Smith and Ulm also had planes in the 1930 air pageant and used the airfield as a refuelling point.

3.3.2 Harrington Inlet - Manning Point

The littoral rainforest on Manning Point is also a good example of the once extensive stands of littoral rainforest which existed in the area. It is also important for research and has been the subject of important studies. These include the only pollination ecology study of subtropical rainforests in Australia, and a survey of dung beetles of small coastal rainforests. The place is a holotype locality for the jewel beetles *Helferella miyal* and *Maoraxia littoralis* (a holotype is the individual organism that was used in the naming of a new species).

Estuarine habitats like the Harrington Inlet sandbar islands are important habitat and breeding sites for a number of rare or threatened migratory and wading birds, including the nationally endangered little tern (*S. albifrons*), the beach stone-curlew (*Escacus magnirostris*) and black-necked stork

(*Ephippiorynchus asiaticus*) which are listed as endangered in NSW. Ten listed vulnerable bird species have been recorded in the area. In addition, bird species recorded in the area which are listed on JAMBA and CAMBA include the great knot (*C. tenuirostris*), little tern (S. albifrons), lesser sand-plover (*C. mongolus*) and broad-billed sandpiper (*L. falcinellus*), in addition to the sanderling (*Calidris alba*) which is listed on JAMBA only.

Harrington Inlet and South Spit Point are highly valued by the community for their aesthetic values. The littoral rainforest, mangrove islands, sandbars, and the distinctive landmark of Pilot Hill are important for their scenic, symbolic, cultural and social associations. Important features include the Maritime cemetery located on Pilot Hill (the graves on Pilot Hill are listed in the Greater Taree LEP 2010 as being of local heritage significance), Pilot Hill as the location of the signal mast associated with the Pilot Station and Harrington Inlet for its fishing and recreational opportunities.

Harrington Inlet is important for its association with John Oxley, who discovered the inlet in 1818; Assistant Surveyor John Armstrong, whose report opened up the northern bank of the Manning River to settlement; and British Civil Engineer Sir John Coode, whose recommendations in 1889, to make the entrance safe, resulted in the design and construction of the northern training wall and breakwater by the Public Works Department (between 1824 and 1941 over 50 ships were lost, with the wrecks of the *Coolon* 1917, *Minimbah* 1910 and *Burrawong 1909* located within the entrance).

3.3.3 North Harrington Littoral Rainforest

The rainforest at North Harrington is a significant invertebrate habitat. The site is the only known locality for five species of beetle. These include a member of a primitive genus, *Helferella manningensis*, two beetles belonging to undescribed genera within the Lagriidae and Rhipiphoridae, the jewel beetle *Paratrachys australia* and *Trachys blackburni*, which has not been found anywhere else since its discovery last century. An undescribed neocuris jewel beetle (*Coleoptera buprestidae*) is also known only from this site and a littoral rainforest remnant at Manning Point immediately to the south.

North Harrington also provides habitat for the regent skipper butterfly and an uncommon beetle, *Maorax littoralis*. In addition, the site supports a native fly species, *Asarchina aegrotat*, which has a highly disjunct distribution, with the nearest known populations found in south-east Asia, and one record from the tip of Cape York Peninsula.

North Harrington is an important research site and a number of studies have been undertaken in beetle, fly and bat biology and ecology, and dispersal of rainforest plants and pollination coevolution. The littoral rainforest is the holotype locality of three insect species and the paratype locality of two beetle species (a paratype is a specimen, other than the holotype, that was used to name a new species). The littoral rainforest also provides habitat for the southern angle headed dragon (*Hypsilurus spinipes*).

3.3.4 Crowdy Head Lighthouse

Crowdy Head Lighthouse, built in 1879, is significant as a lighthouse designed by the Colonial Architect James Barnet. It shows typical characteristics of this style such as the oversailing bluestone platform supported by corbels. The lighthouse is significant as one of five small lighthouses built on the NSW north coast in the late nineteenth century and exhibits a simple and practical approach to

lighthouse construction, rather than the popular association with the more impressive and massive lighthouse structures of the time. The Crowdy Head Lighthouse is listed in the Greater Taree LEP 2010 as being of local heritage significance.

3.4 Species of Ecological Significance

Using data from the *Survey Guide to Threatened Species of the Greater Taree Local Government Area* (GTCC 2006) and the 'Atlas of NSW Wildlife Database' (DEC 2007), a number of flora and fauna species listed as endangered (Schedule 1) or vulnerable (Schedule 2) under the *TSC Act* 1995 and the *EPBC Act* 1999 are either known or predicted to inhabit coastal areas of the GTCC LGA (refer to **Table 3.1**).

Table 3.1 Flora and Fauna of Conservation Significance

Common Name	Species Name	Status	Habitat	Known Occurrences in the GTCC LGA
Flora				
White-flowered Wax Plant	*Cynanchum elegans*	TSC Act: Endangered EPBC Act: Endangered	Littoral rainforest, coastal tea tree – banksia coastal scrub, open forests and woodlands	Numerous occurrences in the area
Dwarf Heath Casuarina	*Allocasuarina defungens*	TSC Act: Endangered EPBC Act: Endangered	Tall wet heath on sand, hills near coast, headlands on adjacent sand plains	
Rainforest Cassia	*Senna acclinis*	TSC: Endangered EPBC: Not Listed	Edges of subtropical and dry rainforest	
Nabiac Casuarina	*Allocasuarina simulans*	TSC Act: Vulnerable EPBC Act: Vulnerable	Heathland on coastal sand	
Australian Toadflax	*Thesium australe*	TSC Act: Vulnerable EPBC Act: Vulnerable	Grasslands, grassy woodlands and sub-alpine grassy heathlands	Old Bar Park
Trailing Woodruff	*Asperula asthenes*	TSC Act: Vulnerable EPBC Act: Vulnerable	Damp sites often along river banks	
Magenta Lilly Pilly	*Syzygium paniculatum*	TSC Act: Vulnerable EPBC Act: Vulnerable	Subtropical or littoral rainforest on sandy soils or stabilised dunes	
Netted Bottlebrush	*Callistemon linearifolius*	TSC Act: Vulnerable EPBC Act: Not Listed	Open forest and scrubland, damp places	
Fauna				
Birds Bush Stone Curlew	*Burhinus magnirostris*	TSC Act: Endangered EPBC Act: Not Listed	Open woodland	She-oak forest and wet grasslands at Harrington, Crowdy Head, Hannam Vale and near Lansdowne
Beach Stone Curlew	*Esacus neglectus*	TSC Act: Critically Endangered EPBC Act: Not Listed	Open beaches, mudflats, mangroves, sandflats and exposed reefs	Manning Estuary at Harrington and at Old Bar
Little Tern	*Sterna albifrons*	TSC Act: Endangered EPBC Act: Migratory	Coastal waters, bays, shallow inlets, and salt or brackish lakes	Farquhar Inlet - Old Bar, Harrington sand spit - Manning Point, Diamond Beach

Table 3.1 Flora and Fauna of Conservation Significance

Common Name	Species Name	Status	Habitat	Known Occurrences in the GTCC LGA
Fauna				
Birds				
Black-necked Stork	*Ephippiorhynchus asiaticus*	TSC Act: Endangered EPBC Act: Not Listed	Wetlands, mangroves, swamps, mudflats and dry floodplains	Numerous records in the locality
Australasian Bittern	*Botaurus poiciloptilus*	TSC Act: Vulnerable EPBC Act: Not Listed	Estuarine and freshwater wetlands with tall dense vegetation	
Black Bittern	*Ixobrychus flavicollis*	TSC Act: Vulnerable EPBC Act: Not Listed	Riparian vegetation in major coastal rivers	Lansdowne River near Coopernook and the Manning River at Harrington
Osprey	*Pandion haliaetus*,	TSC Act: Vulnerable EPBC Act: Not Listed	Riverine, estuarine and oceanic waters for foraging	Recorded frequently in coastal areas of the GTCC LGA
Square-tailed Kite	*Lophoictinia isura*	TSC Act: Vulnerable EPBC Act: Not Listed	Open forests, riverine woodlands, scrubs, heathlands	Hallidays Point
Sanderling	*Calidris alba*	TSC Act: Vulnerable EPBC Act: Not Listed	Tidal mudflats, sandbars and shallow river margins	Manning estuary at Harrington
Black-tailed Godwit	*Limosa limosa*	TSC Act: Vulnerable EPBC Act: Migratory	Broad oceanic beaches, tidal mudflats and coastal lagoons	Manning Estuary at Harrington
Terek Sandpiper	*Xenus cinereus*	TSC Act: Vulnerable EPBC Act: Migratory	Sheltered estuaries and lagoons, sandbars, reefs near islands, coastal swamps and salt fields	Manning Estuary at Harrington and Old Bar.
Broad-billed Sandpiper	*Limicola falcinellus*	TSC Act: Vulnerable EPBC Act: Migratory	Sheltered coastal estuaries, intertidal mudflats and muddy coastal creeks	Manning Estuary
Great Knot	*Calidris tenuirostris*	TSC Act: Vulnerable EPBC Act: Migratory	Sheltered coastal mudflats, sandy bars and beaches and shallow saline and freshwater wetlands	Manning Estuary
Pied Oystercatcher	*Haematopus longirostris*,	TSC Act: Vulnerable EPBC Act: Not Listed	Estuaries and Beaches	Manning Estuary at Harrington, Beaches including Manning Point, Saltwater, Old Bar, Diamond Beach and Crowdy Bay
Sooty Oystercatcher	*Haematopus fuliginosus*	TSC Act: Vulnerable EPBC Act: Not Listed	Rocky marine shorelines, islets, cliffs, reefs and sandy beaches	Diamond Head, Harrington and Blackhead
Lesser Sand Plover	*Charadrius mongolus*	TSC Act: Vulnerable EPBC Act: Migratory	Mudflats, sandy beaches, estuaries and mangroves	Manning Estuary at Harrington
Large Sand Plover	*Charadrius leschenaultia*	TSC Act: Vulnerable EPBC Act: Migratory	Coasts / shores, marshes	Manning Estuary at Harrington
Magpie Goose	*Anseranas semipalmata*	TSC Act: Vulnerable EPBC Act: Not Listed	Fresh, brackish or saline waters of rivers, lakes, estuaries and inshore coastal waters	Numerous records in the locality

Table 3.1 Flora and Fauna of Conservation Significance

Common Name	Species Name	Status	Habitat	Known Occurrences in the GTCC LGA
Fauna				
Birds				
Rose-crowned Fruit-Dove	*Ptilinopus regina*	TSC Act: Vulnerable EPBC Act: Not Listed	Rainforest, monsoon and paperbark forests, eucalypt woodlands, vine groves, fruit trees	
Wompoo Fruit-Dove	Ptilinopus Magnificus	TSC Act: Vulnerable EPBC Act: Not Listed	Rainforest	
Painted Honeyeater	*Grantiella picta*	TSC Act: Vulnerable EPBC Act: Not Listed	Open forest and woodland	Manning Point
Glossy Black Cockatoo	*Calyptorhynchus Lathami*	TSC Act: Vulnerable EPBC Act: Not Listed	Variety of sclerophyll forest types	Near Old Bar
Barking Owl	*Ninox connivens*	TSC Act: Vulnerable EPBC Act: Not Listed	Forests, woodlands	
Powerful Owl	*Ninox strenula*	TSC Act: Vulnerable EPBC Act: Not Listed	Open forest, open woodland, tall moist forest and rainforest	Numerous records within the locality
Masked Owl	*Tyto novaehollandiae*	TSC Act: Vulnerable EPBC Act: Not Listed	Open forests and woodlands	
Eastern Grass Owl	*Tyto capensis*	TSC Act: Vulnerable EPBC Act: Not Listed	Found in tall grass including tussock grasslands, swamps, coastal dues, grass tussocks in swampy areas, tree lines creeks	
Amphibians:				
Wallum Froglet	*Crinia tinnula*	TSC Act: Vulnerable EPBC Act: Not Listed	Vegetated coastal swamps and wet heath	Crowdy Bay, Harrington and Diamond Head
Mammals:				
Grey-headed Flying Fox	*Pteropus poliocephalus*	TSC Act: Vulnerable EPBC Act: Vulnerable	Subtropical and temperate rainforest, tall sclerophyll forests, woodlands, heath and swamps	Coastal areas and lowlands in the GTCC LGA
Eastern Freetail Bat	*Mormopterus norfolkensis*	TSC Act: Vulnerable EPBC Act: Not Listed	Woodland, dry and wet sclerophyll forest	Harrington and Hallidays Point
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanenis*	TSC Act: Vulnerable EPBC Act: Not Listed	Well timbered habitats including rainforest, paperbark swamps, heaths, woodlands and sclerophyll forests	Numerous coastal and montane areas of the GTCC LGA
Little Bent-wing Bat	*Miniopterus australis*	TSC Act: Vulnerable EPBC Act: Not Listed	Moist and dry sclerophyll forest, woodland, rainforest, Melaleuca swamps and dense coastal Banksia	Crowdy Bay National Park
Greater Broad-nosed Bat	*Scoteanax rueppellii*	TSC Act: Vulnerable EPBC Act: Not Listed	Woodland, moist and dry eucalypt forest and rainforest	Forests of the coastal lowlands and escarpments

Table 3.1 Flora and Fauna of Conservation Significance

Common Name	Species Name	Status	Habitat	Known Occurrences in the GTCC LGA
Fauna				
Mammals: Common Blossom-bat	*Syconycteris australis*	TSC Act: Vulnerable EPBC Act: Not Listed	Coastal littoral rainforest and adjacent heathlands	Crowdy Head, Harrington, Saltwater and Blackhead
Koala	*Phascolarctos cinereus*	TSC Act: Vulnerable EPBC Act: Not Listed	Eucalypt woodlands and forests	Coastal areas including Hallidays Point, Crowdy Bay, Old Bar and Harrington
Yellow Bellied Glider	*Petaurus australis*	TSC Act: Vulnerable EPBC Act: Not Listed	Tall eucalypt forest and woodland	
Squirrel Glider	*Petaurus norfolcensis*	TSC Act: Vulnerable EPBC Act: Not Listed	Coastal woodlands	
Brush-Tailed Phascogale	*Phascogale tapoatafa*	TSC Act: Vulnerable EPBC Act: Not Listed	Dry forests and woodlands with open and sparse groundcover of herbs, grasses, shrubs and leaf litter	Hallidays Point
Rufous Bettong	*Aepyprymnus rufescens*	TSC Act: Vulnerable EPBC Act: Not Listed	Dry open forests and woodlands with a grassy open understorey in coastal areas	
Eastern Chestnut mouse	*Pseudomys gracilicaudatus*	TSC Act: Vulnerable EPBC Act: Not Listed	Heathland and woodland with dense understorey	Old Bar
Spotted-tailed Quoll	*Dasyurus maculatus maculatus*	TSC Act: Vulnerable EPBC Act: Endangered	Dry and moist sclerophyll forest, rainforest. Coastal heathland and riparian forest	

3.4.1 Recovery Plans and Priority Actions

DECCW has prepared a number of Recovery Plans and Priorities Action Statements (PAS) for Threatened Species. PAS specific to the GTCC area, and of most relevance in consideration of management options, relate to the Beach Stone Curlew, i.e.:

- Prevent dredging of large intertidal sandflats in the vicinity of Beach Stone Curlew habitat.
- Do not construct river training walls on the entrance to Farquhar Inlet.
- Protect foraging and roosting sites within Farquhar Inlet on Crown land.

3.5 Recreational Values

Recreational activities associated with the GTCC beaches, coastal rainforest, national parks and nature reserves include bushwalking, fishing, surfing, swimming, other water sports, four wheel driving and whale / dolphin watching (www.gtcc.nsw.gov.au/webcomm). This is consistent with the following recreational values identified by Old Bar residents, in the survey questionnaire, which were:

- swimming/ bathing in the ocean and rivers;
- surfing;
- walking on the beach and in areas of coastal vegetation;
- bike riding;
- 4WDing on the beach;
- fishing;
- picnics/ playgrounds;
- whale, dolphin and bird watching;
- diving; and
- camping.

Major foreshore parks (generally with toilets, barbeques, playgrounds and picnic facilities) within the study area are:

- Black Head Reserve, Main Street, Blackhead.
- Diamond Beach Park, Anniversary Parade.
- Saltwater Reserve, Saltwater Road, Saltwater.
- Old Bar Park, Old Bar Road, Old Bar.
- Oxley Reserve, Beach Street, Harrington.
- Muir Park, Crowdy Road, Crowdy Head.

Old Bar is often the venue for surfing contests and Saltwater/ Wallabi Point is a popular surfing spot when the swell is up from the east to south. At Black Head there is a beach break and a short point break (Warren 1999).

There are a number of four wheel drive (4WD) access points to the beaches with access generally restricted between 8 am and 6 pm during school holidays (except winter holidays) on patrolled beaches and to permit holders within national parks/ nature reserves.

Beach fishing is widespread along the Greater Taree coast. Harrington is particularly popular for beach fishing and river fishing along the breakwater. Similarly, its seaside and riverside location makes Manning Point popular for recreational fishing activities.

There are many camping options along this stretch of coast ranging from tourist/ holiday parks to basic bush camping sites. Farquhar Park camping area is located on the northern side of Farquhar Inlet (access is via Manning Point down the beach at low tide or by boat). Crowdy Bay National Park (to the north of the study area) has camping at Diamond Head, Indian Head, Kylies Beach, and at the southern end of the park at Crowdy Gap Cultural Camp. Other Holiday/ tourist parks include the following:

- Red Head: Beachfront Holiday Resort.
- Diamond Beach Holiday Park.
- Old Bar: Lani's On the Beach (Crown Reserve).
- Manning Point: East's Big 4 Ocean Shores Holiday Park, Weeroona Holiday Park, Manning Point Holiday Cabins, Manning Point Ocean Caravan Park.
- Harrington: Big 4 Harrington Beach Holiday Park (Crown Reserve).

3.6 Coastal Industry and Tourism

The Hunter Valley Research Foundation (HVRF 2005) found that despite the growth in the tertiary sector (service sector), agriculture, forestry and fishing remain important to the local economy. Crowdy Head provides the only deep sea boat harbour between Coffs Harbour and Port Stephens, with fishing boats bringing in their catch to the Crowdy Head Fish Cooperative. Manning Point is a major centre for oyster production in the Manning Valley.

Tourism is a key industry and directly reflects the "image" and placement of Greater Taree within the broader region and the State (HVRF 2005). The Mid North Coast (which includes Bellingen, Coffs Harbour, Great Lakes, Greater Taree, Port Macquarie-Hastings, Kempsey, Nambucca and Port Stephens) received over 2.9 million domestic overnight visitors (11.7 million visitor nights) for the 12 months ending in September 2009.

Staying with friends or at a relatives' property (34.8%) was the most popular accommodation, followed by a caravan park or commercial camping ground (20.3%), then rented house or unit (16.3%) (www.tourims.nsw.gov.au). In 2008, the most popular tourism regions for domestic visitors using caravan or camping accommodation were the NSW South Coast (2.7 million visitor nights) followed by the NSW Mid North Coast (2.5 million visitor nights) (www.tra.australia.com).

The many coastal holiday parks, resorts and holiday houses along this coastal stretch provide tourist accommodation and associated direct and indirect economic benefits to the region. For example eating out at restaurants (55.5%) was the most popular activity nominated by visitors, followed by going to the beach (47.6%). Domestic overnight visitors spent $1.4 billion annually in the region. On average they spent $119 per night (www.tourism.nsw.gov.au).

Events which are focused on the coast also attract visitors to the area. These include the annual Old Bar Festival which is held over the October long weekend. This festival celebrates the area's beach culture, attracting a large gathering of kombi vans. A sand modelling competition is also held during the summer holiday period.

4. MANAGEMENT OPTIONS

4.1 General Options

The Coastline Management Manual (NSW Government 1990) identifies a range of management options in various categories i.e: environmental planning, development control, dune management and protective works. It should be noted that a combination of options is usually required to address coastal hazards and the objectives of legislation and policy discussed in **Section 2**. A preliminary screening of options can be made with reference to the coastal processes operating in the region and identification of those options which address the coastline hazards identified for the GTCC coast (taking into account the State Government's sea level rise benchmarks, as noted in **Section 2.5**). The options examined are discussed in more detail in **Sections 5** to **10** for various localities along the coastline. Although not included in each section, dune management works and activities are recommended where informal beach access points and scour from stormwater occur and are leading to dune erosion.

As discussed in **Section 3**, the coastline supports a number of vegetation communities of conservation significance and provides habitat for a number of coastal birds and waders protected by legislation and international agreements. Accordingly, it should be noted that protection works may result in unacceptable environmental impacts. **Table 4.1** provides a discussion on the range of options generally considered for coastline hazard management.

Table 4.1 Hazard Management Options

Option	Comment
Protective Works:	*All protective works have high capital costs and ongoing maintenance costs and may not be consistent with environmental legislation and policy and ecologically sustainable design (ESD) principles.*
Seawalls	• impose a landward limit to erosion and are best designed as continuous structures over the full length of an embayment • should be located higher up the beach profile so they are covered by sand in all but extreme events • are not well suited to the protection of isolated properties as erosion occurs at either end of the structure potentially putting additional areas at risk • result in short-term loss of beach (due to scouring at the base of the seawall in storm events and associated flattening of the beach profile allowing high tides/ waves to reach the seawall until the beach has rebuilt), impacts on beach access,

Option	Comment
	visual impacts during storm events and long term loss of beach amenity due to shoreline recession • raise social equity questions if funded through rates and taxes, i.e. public money being used directly for the benefit of a perceived select section of the community (as noted in **Section 2.6.2**, the NSW Government plans to introduce a "coastal protection service charge" for benefitting landowners) • need to be combined with beach nourishment to address end effects and shoreline recession
Training walls and breakwaters	• do not address offshore sand losses • may be effective where there is high longshore transport or losses into an entrance • stabilise estuary entrances reducing short to medium term fluctuations on shoreline alignments due to entrance conditions (i.e. open, closed) and reduce loss of marine sand to the entrance • until entrance bypassing occurs, downdrift side of entrance is starved of sand resulting in erosion • impact on estuarine processes (ecology, water quality and hydraulics) resulting from changes to tidal range, water levels, current speeds, flushing behaviour and salinity levels - for estuaries with multiple entrances training of one entrance may cause another to close • impact on surfing conditions (may be positive or negative depending on design) • result in a deeper channel being scoured adjacent to the wall with potential navigation benefits
Groynes	• do not address offshore sand losses • ineffective where longshore transport with limited sediment supply exists • result in alteration of alongshore profile with accretion on the updrift side and erosion on the downdrift side • visually intrusive, impact on beach access, safety implications for swimmers and surfers • require beach nourishment and dune management to accommodate changes in the beach and dune system
Beach nourishment	• maintains beach amenity • dependent on an acceptable sand source being available into the future • current State Government policy and legislation (*Offshore Minerals Act 1999*) prohibits the commercial extraction of offshore marine sands (Sydney Coastal Councils Group has completed a study illustrating the benefits of utilising offshore marine sands for long term beach nourishment which it intends to use in a business case with a view to enabling implementation of beach nourishment programs)

Option	Comment
	• may provide navigation/ water quality benefits to adjacent estuaries if they are used as the sand source • as there is no containment structure sand is lost offshore during storm events and can be moved quickly alongshore • ongoing with more frequent nourishment needed as sea level rises
Offshore breakwaters	• forms include above water structures which provide protection against storm waves, e.g. “T-groyne” structures (which are connected to the shore for ease of construction and maintenance) and artificial reefs which cause larger waves to break further out to sea thereby dissipating energy • do not address offshore sand losses • ineffective where longshore transport with limited sediment supply exists • do not address shoreline recession due to sediment loss and sea level rise • result in downdrift erosion where longshore transport exists for “T-groyne” structures • use is generally limited to the protection of sheltered areas not exposed to full wave attack • impact on surfing conditions • have not been adopted as a management option on the NSW coast due to the above and the high cost of construction on the open coast
Artificial headlands	• result in alteration of alongshore profile with accretion on the updrift side and erosion on the down drift side • result in short-term loss of beach, beach access, visual impacts during storm events and long term loss of beach amenity due to shoreline recession • need to be combined with beach nourishment to address end effects and shoreline recession
Environmental Planning:	*This is the ideal form of coastal management whereby development is located outside the hazard zone but, under current legislation, is usually only achievable for greenfield sites.*
Buffer zones	• accommodate shoreline fluctuations due to coastal processes • allow maintenance of frontal dunes • maintain public foreshore access • require appropriate reservation or zoning • under current legislation (*Environmental Planning & Assessment Act 1979* and *Regulation 2000*) rezoning of existing

Option	Comment
	developed areas or prohibition of uses in a particular zone does not extinguish existing use rights for which development consent was previously granted – in addition rebuilding or alterations and additions may still be possible with development consent • for developed areas this is likely to require land dedication (through a Voluntary Planning Agreement (VPA) associated with a development application) or acquisition of private property
Property purchase	• although voluntary purchase (whereby an owner offers their property for sale to government) is listed as an option in the Coastline Management Manual, purchase of properties has usually occurred through rezoning and acquisition (including for open space), or purchase on the open market • past State and local government schemes have involved rezoning, demolition of structures and restoration of dunes • under current legislation, *Land Acquisition (Just Terms Compensation) Act*, the current market value is used to determine compensation in the case of property acquisition making this option beyond the resources of local government due to high beachfront market values • only small numbers of properties have been purchased due to the relatively high cost of oceanfront properties however growing recognition of the risks to beachfront properties would be expected to reduce their value • although voluntary purchase or relocation is included in several existing coastline management plans, implementation has been limited - e.g. for the *Wooli Village Coastline Management Plan* (1997) no properties have been relocated by owners or purchased by Council • voluntary purchase schemes do not prevent private sale to non-government purchasers and hence, while the property market and values are strong, there is no financial incentive for owners to seek government purchase • as properties are on-sold to private purchasers the expectation is that their asset will increase in value over time as per past and current property market conditions – this can lead to more pressure to develop/ redevelop and invest in coastal property, contrary to the coastal hazards • alternative property purchase schemes require political will and legislative changes, e.g. support for long-term programs (up to 50 years), access to low interest loans, changes to permitted means of raising revenue • alternatives include long term environmental levies for property purchase, purchase and lease-back or rental until such time as hazards are realised (to cover/ contribute to purchase and loan costs)

Option	Comment
Development Control Conditions:	*Development controls form a part of all coastline management plans and are applicable to areas subject to existing and future development.*
Building setback	• ensure structures are located behind hazard lines – minor structures such as decks, sheds, landscaping may be permitted seaward of building setback lines • need to recognise that hazard lines will roll back over time, i.e. the 2050 year hazard line is predicted to be the immediate hazard line in 40 years • new buildings should be located as far landward as possible on the lot • for existing development additions should be located behind the building setback
Building types	• piered or piled structures • light weight structure which can be relocated • relocatable buildings
Dune enhancement/ protection	• sand excavated for development used to build or repair the frontal dune • fencing and revegetation to prevent accessways from individual properties • site stormwater drainage directed to the landward side of structures • removal of unapproved structures on adjoining foreshore reserves and rehabilitation of dunes with endemic species • provision of formal accessways for emergency protection works (e.g. sand bagging)
Inundation measures	• minimum floor levels, flood proofing, use of water resistant building material etc. to minimise damage from coastal inundation
Foundation design	• piled foundations to withstand undermining during extreme events and reduced foundation capacity of the area behind an erosion scarp
Planned retreat	• ideally new development should not be located within the 100 year hazard zone – however, strategies could include land swaps and voluntary planning agreements whereby land is dedicated to council and leased for the purpose of a new dwelling until it becomes at risk • requires a change in mind set, i.e. coastal property valued for the lifestyle it provides over a set period (depending on its location relative to hazard lines) rather than as a financial investment

Option	Comment
	• requires attitudes to change with regard to desirable housing, i.e. shift back to modest, light weight, low cost, piered structures along the coast (as illustrated in the *North Coast Urban Design Guidelines*, see **Section 2.8**), rather than 'McMansions' • the Coastline Management Manual states that planned retreat is implemented through a limit on the time a development consent is valid or conditions under which consent is valid (e.g. while there is X distance between the beach erosion scarp and the building footprint) after which consent lapses and the structure must be moved back, relocated or demolished • difficulty in enforcing lapsed consent • creates pressure for protective works to maintain buffer to development • it is likely that individual property owners will construct ad-hoc protection measures which impact on beach amenity and increase risks to adjacent properties • litigation and removal costs associated with unauthorised works • without rezoning and specific development controls this does not address rebuilding, additions and alterations which may increase the value of assets at risk and extend the life of assets at risk in the coastal zone • rezoning and development conditions may be challenged by private property owners • far less practical in situations where land is already developed • although planned retreat is included in several existing coastline management plans implementation has been limited due to the reasons listed above (such as pressure to protect properties/ illegal works to protect properties at risk and high market values) and due to the relatively long period without a storm as severe as in 1974 when a number of properties were lost on the NSW coast (and hence community perception that the risk from coastal hazards is low), and the belief in some sectors of the community that climate change (including sea level rise) is not occurring or is not occurring at as fast a rate as IPCC predications
Dune Management:	*Dune management forms a part of all coastline management plans as vegetated frontal dunes provide a reserve of sand which mitigates erosion impacts during storm events, thereby limiting the landward intrusion of waves. They also act as a barrier to oceanic inundation. Dune management works should be generally consistent with the Coastal Dune Management Manual (DLWC 2001).*

Option	Comment
Dune reconstruction, revegetation, protection and maintenance	• fencing, planting and formal tracks can be used to control pedestrian and vehicle access reducing susceptibility to 'blow outs' which become at greater risk of erosion during storm events • accessways need to be appropriately sited and designed – e.g. orientated at an angle to prevailing winds, board and chain construction to prevent erosion and which can be easily adjusted to account for fluctuations in foredune slope • in areas previously sand mined dunes can be reconstructed, reshaped and vegetated to increase their height to protect against overtopping and to provide a sand buffer during storm events • stabilisation of dunes with vegetation prevents loss of sand by wind action and reduces the landward extent of the storm erosion scarp • scour from stormwater outlets (which cause erosion of the beach berm) can be addressed by dissipation structures to reduce scour or where feasible redirecting stormwater into drainage swales in the back beach area and hence eventual infiltration of stormwater into the dune system • need to address issues such as clearing vegetation for views, informal camping, noxious weeds
Do nothing	• costs to individuals and the community from storm damage, emergency services activities, clean-up costs • increasing damage and repair costs associated with maintaining infrastructure (roads, water, sewerage etc.) within hazard zones/ to properties in hazards zones as sea level rises • psychological impact of living in a hazard zone • political pressure on government to protect private property • it is likely that individual property owners will construct ad-hoc protection measures which impact on beach amenity and increase risks to adjacent properties • litigation and removal costs associated with unauthorised works • inevitable loss of adequate building footprint on foreshore lots due to shoreline recession

5. BLACK HEAD TO RED HEAD

5.1 Key Features

Black Head Beach is located at the southern end of Black Head Bay. Black Head SLSC is located at the southern end of the beach, along with an ocean pool and a boat ramp. The beach is patrolled during the summer months. Permits are required for vehicle access to the beach with the exception of boat launching from the boat ramp. Black Head Reserve/ Black Head Lagoon Flora Reserve is located adjacent to the beach. A dune regeneration area exists in front of the reserve. A pedestrian bridge links the reserve to the beach, crossing Black Head Lagoon. Black Head Lagoon flows onto the beach near the SLSC.

Facilities at the reserve and adjacent to the beach include formal car parking, a children's playground, toilet block, fish cleaning table, picnic and barbeque facilities. Norfolk Island pines are a feature along Main Street.

Red Head Beach, which is located at the northern end of Black Head Bay, is an unpatrolled beach. There is a Rainforest Nature Walk (with a loop walking track) at Red Head (off the end of Red Head Road) and a viewing platform and stairs to the beach. There are also informal beach access points (sand tracks) from the Holiday Park and houses along Scenic Drive.

5.2 Beach Characteristics

Black Head - Red Head Beach is 1.6km long, faces east to south-east in the north and is backed by a single foredune. During southerly waves it receives some protection from Black Head (located at the south), with wave heights increasing to a peak of around 1.5m at the northern end. The beach has persistent rips along the north-central portion and off Red Head (at the north). Rips only form in the south during and following higher waves, which also produce a strong rip against Black Head (Short 2007).

Black Head Lagoon entrance channel is usually closed to the sea (opening around four to six times a year based on a photographic record by Love (1985)) and can move towards the rocky southern headland under north-east swell conditions. Erosion of the banks above the lagoon where it exits to the sea is evident.

Rock protection, consisting of randomly placed boulders, has been provided along the frontage of Black Head SLSC. In areas where rock protection has not been provided erosion is evident. The headland slope above the Black Head ocean pool is quite steep. A fence has been erected around the pool to prevent any loose rocks rolling down the slope into the pool area.

During a site inspection in August 2009, the incipient dune at Black Head was colonised by spinifex. Foredune vegetation was generally continuous except for a blow out about two-thirds up the beach from Black Head, possibly associated with informal access from the Red Head Big 4 Beachfront Holiday Resort. At the northern end of the beach the erosion scarp was up to around 2.5m high.

Between Red Head and the southern end of Diamond Beach there are two small and moderately protected beaches lying at the base of cliffs. These are dominated by rocks and reef. The northern

most of these beaches is backed by vegetated bluffs rising to 20m. A small headland separates this beach from Shelly Beach to the south (Short 2007).

Rock protection around Black Head SLSC

Fenced slope adjacent to ocean pool

Looking north from Black Head

Blowout near Holiday Park at Red Head

Looking south from Red Head

Dune scarp at Red Head beach access

5.3 Land Use Zoning

Under the Greater Taree LEP 2010, the foreshore area is zoned E2 Environmental Conservation. This includes the Black Head Flora Reserve north of the lagoon (the area to the south is zoned RE1 public recreation, along with the SLSC building). The holiday park at Red Head is zoned RU1 Primary Production. As noted in **Section 2.10.2**, caravan parks are not permitted in the RU1 zone but existing use rights apply to the existing holiday park. Adjoining residential development in the villages of Black Head and Red Head is zoned R1 General Residential.

5.4 Summary of Coastal Processes

Black Head Beach is a relatively stable, closed system with minor long term accretion. Isolated locations of minor historical recession (-0.1 to -0.2 m/yr) have occurred in the central to northern portion of the beach, possibly due to persistent rips in these locations and/ or anthropogenic changes associated with pedestrian access, as noted in **Section 5.2**. The long term minor accretion is likely to be due to leaky bypassing around Black Head supplying sediment from the south (Nine Mile Beach), consistent with the net northerly littoral transport along the NSW coast. This bypassing is most likely to occur during large southerly storm wave events.

5.5 Areas and Structures at Risk

In defining the hazard lines no allowance was made for long term recession due to sand loss as the beach system is essentially stable, as noted in **Section 5.4**. However, the beach is susceptible to periodical erosion from storm events, together with long term recession due to sea level rise. The following storm demand and recession rates were estimated in the Hazard Definition Study (refer to **Appendix A 1.1** for the hazard lines):

Storm demand:	220 m^3/m run of beach
Recession due to sea level rise:	45 m by 2108, for a sea level rise of 0.9 m.

The following areas and structures (see **Table 5.1**) at Black Head and Red Head are potentially at risk from coastal erosion and recession over the planning periods indicated.

In addition to areas potentially affected by coastal erosion and recession, the northern half of Black Head Beach (within the dune area), where the dune height is approximately 5m AHD, may experience overwash due to wave runup under a 0.9m sea level rise coupled with a 1 in 100 year ARI storm event (see **Appendix A 1.2**).

Table 5.1 Black Head to Red Head Assets at Risk

Immediate (2008)	50 Year Planning Period	100 Year Planning Period
Black Head SLSC and associated assets (boatramp, rock pool etc.) Stormwater outlets to Black Head Lagoon entrance Black Head Lagoon Park facilities and sewerage pumping station Pedestrian bridge over Black Head Lagoon to beach Main Street roadway at Black Head	Main St and properties between Albert St and Ocean St (9) Foreshore row of cabins at Beachfront Holiday Resort (Big 4) Red Head Properties at the seaward end of Scenic Avenue (4) Red Head Black Head SLSC and associated assets Stormwater outlets to Black Head Lagoon entrance Black Head Lagoon park facilities and sewerage pumping station Pedestrian bridge over Black Head Lagoon to beach Watermains along Main St	Main St properties between Albert St and southern corner(12) Foreshore row and some second row cabins at Beachfront Holiday Resort (Big 4) Red Head Properties at the seaward end of Scenic Avenue (6) Stormwater drain at Red Head Black Head SLSC and associated assets Stormwater outlets to Black Head Lagoon entrance Black Head Lagoon park facilities and sewerage pumping station Pedestrian bridge over Black Head Lagoon to beach Watermains along Main St

5.6 Management Options

5.6.1 Review Adequacy of Rock Protection to SLSC

The SLSC seawall consists of randomly placed rock rubble and is approximately 100m in length. As the crest level appears low it is recommended that an investigation be undertaken to determine an appropriate crest level and design criteria for future upgrading (taking into account sea level rise).

5.6.2 Coastal/ Geotechnical Engineer's Assessment

It should be noted that the hazard lines presented in **Appendix A 1.1** (and assets at risk identified in **Table 5.1**) do not take into account the stabilising influence of the rocky headlands. Accordingly, redevelopment, alterations and additions to properties along Main Street (Black Head) and Scenic Avenue (Red Head) may be possible without increasing risks from coastal hazards. Accordingly, development applications in these areas should be accompanied by a site specific coastal/ geotechnical engineer's report.

5.6.3 Planned Retreat – Existing Assets

Relocation of resort structures

Within the holiday park, cabins etc. should be relocated and/ or the number of cabins gradually reduced overtime so that a vegetated dune buffer is maintained seaward of the resort. As caravan parks are prohibited in the RU1 zone this provides the opportunity to setback structures from the 100 year hazard line, as part of any future redevelopment of the site.

Relocation of public facilities and infrastructure

When the upgrade of any facilities at Black Head Reserve is proposed, consideration should be given to relocating the carpark and toilet block landward of the 100 year hazard line. Other movable items (such as play equipment and shelters) can be moved as and when needed. Floor levels of new buildings or structures, where practical, should be above predicted inundation levels (oceanic and catchment flooding). Any Plan of Management covering the reserve should reflect this.

Relocation of the sewage pumping station should also be investigated as part of any future augmentation of the sewerage system or when replacement of the pumping station is required. Any upgrading etc. of Main Street and the watermain along Main Street should be subject to a coastal/ geotechnical engineer's report.

6. DIAMOND BEACH

6.1 Key Features

Diamond Beach south comprises mainly residential dwellings. The beach is patrolled during the summer school holidays. At the end of Diamond Drive, at the southern end of the beach, there is a small carpark with a lookout and beach access. There is also a beach accessway within the Diamond Beach Holiday Park at the northern end of Golden Drive and several informal tracks through the dune from beachfront properties to the south.

Access to an area of coastal rainforest is via a walking track off Emerald Drive and from the beach via a sand track and includes a section of boardwalk. A small intermittently closed creek flows through the rainforest to the beach at the southern end of the residential development. Little terns may nest on the beach.

Development at Diamond Beach north is predominantly tourist uses with the Diamond Beach Resort and the Diamond Beachfront Holiday units located in Diamond Beach Road, south of Seashells Beachfront Resort. The Australis Diamond Beach Resort is north of Seashells. Most resorts at north Diamond Beach have constructed beach accessways.

Khappinghat Nature Reserve is located at the northern end of the Diamond Beach embayment, south of Khappinghat Creek. Access is via a loop track which encloses an area excluded from the Nature Reserve (previously sand mined).

6.2 Beach Characteristics

Diamond Beach is 5.5km long and faces east to south-east (in the north) near Saltwater Point. Khappinghat Creek drains against the Saltwater Point headland (See **Figure 1.1**). The beach is backed by low foredunes at the southern end (Diamond Beach village) with, as noted in **Section 6.1**, a small, intermittently closed creek draining across the beach. It receives waves averaging 1.5m in the north, decreasing at the very southern end owing to the slight protection from Red Head and some reefs off the headland. It has a double bar system in the north-centre and a single bar to the south. The inner bar is dominated by rips throughout its length with 20 or more rips common along the beach, as well as a permanent rip against Saltwater Point in the north, which is supplemented by tidal flows from the creek when it is open (Short 2007).

In the early to mid 1970s sand was removed by beach scraping from the beach south of the Australis Resort and from the northern part of the beach fronting Khappinghat Nature Reserve. The dunes were also sand mined between the northern end of Diamond Drive and Khappinghat Creek, as noted in **Section 6.1**.

During a site inspection in August 2009, the erosion scarp at the southern end of Diamond Beach was less than 1m high, with approximately 50m between this and residential properties located on the foredune. At Diamond Beach north, the Australis Resort beach access was closed due to the height of the dune scarp. Indurated sands (or coffee rock) were evident in the dune scarp. A number of informal tracks through the dune were also noted at Diamond Beach north. The photograph below illustrates the loss of dune vegetation at one such track.

Creek at the southern end of Diamond Beach

Low dunes at southern end of Diamond Beach

High dunes at Diamond Beach north

Informal access at Diamond Beach north

6.3 Land Use Zoning and Tenure

Under the Greater Taree LEP 2010, the foreshore area north to Khappinghat Nature Reserve is zoned E2 Environmental Conservation (this includes the eastern portion of the holiday park). Around the creek and its tributaries, land is zoned RE1 Public Recreation. There is a small area zoned R1 General Residential and a small area zoned SP3 Tourist within the RE1 zone. Adjacent private land is zoned R1 General Residential (including existing residential development and the “Seascape” site and part of the development site, 210 Diamond Beach Road) and RU1 Primary Production (including the western portion of the holiday park). The Australis Resort is zoned SP3 and the tourist resorts to the south, RU1. Subject to special conditions, residential development is permitted within the Australis Resort site. To the north, the area enclosed by the loop track is zoned E2. Surrounding this is land zoned E1 National Park and Nature Reserve (Khappinghat Nature Reserve).

6.4 Summary of Coastal Processes

Diamond Beach is generally stable with minor, long term recession occurring in the south and north. The beach has historically been stable in the centre, consistent with the presence of exposed indurated sands or 'soft rocks' in this area. Diamond Beach may be described as almost being a closed system. The amount of sediment moving into and out of the embayment is small compared to the general longshore drift along the NSW coast.

The large reef system off Red Head appears to be acting as a submerged barrier. Subsequently, there is likely to be negligible sand supply from the south and refracted wave energy reaching the beach, stabilising the southern end and reducing the net northward movement of sediment. Similarly, the reef system at Saltwater Point acts as a submerged barrier at the northern end of the beach minimising the likely bypassing of sediment around this headland. Bypassing may occur under certain conditions such as a major flood event where Khappinghat Creek breaks through, moving sufficient entrance bar material seaward; or a large southly storm wave event, followed by predominantly southerly waves.

A negligible amount of Holocene sediment, on or behind, the foredune indicates that aeolian (wind born) sediment transport does not contribute significantly to the sediment budget. Similarly, offshore sediment sampling indicated a negligible amount of sediment is being lost offshore (Riedel & Byrne 1981).

6.5 Areas and Structures at Risk

The following storm demand and recession rates were estimated in the Hazard Definition Study. Note that recession rates transition to zero at the rocky headlands which separate Diamond Beach from the small beaches to the south and Saltwater Beach to the north.

Storm demand:	220 m^3/m run of beach
Recession due to sediment loss:	0.1 m/year for the southern half of the beach (Diamond Beach residential area, North Diamond Beach tourist developments, southern end of Khappinghat Nature Reserve)
	0 m/year in the centre of the beach embayment (within Khappinghat Nature Reserve)
	0.2 m/year along the remainder of the Nature Reserve to Khappinghat Creek
Recession due to sea level rise:	45 m by 2108, for a sea level rise of 0.9 m

Appendix A 1.1 and **A 2.1** show the hazard lines for south and north Diamond Beach. **Table 6.1** lists the areas and structures potentially at risk from coastal erosion and recession over the planning periods indicated.

In addition to areas potentially affected by coastal erosion and recession the southern end of Diamond Beach, land to the south of the creek (mostly public reserve) and beachfront properties along Jubilee Parade, between Golden Drive and Diamond Drive, are likely to experience overwash due to wave runup under a 0.9m sea level rise coupled with a 1 in 100 year ARI storm event (see **Appendix A 1.2** and **A 2.2**):

Table 6.1 Diamond Beach Assets at Risk

Immediate (2008)	50 Year Planning Period	100 Year Planning Period
Properties on seaward side of southern end of Jubilee Pde (6)	All properties on seaward side of Jubilee Pde (25) Seaward row of units/ structures within Diamond Beach Holiday Park at northern end of Jubilee Pde Stormwater outlet to creek Carpark at end of Diamond Dv Seaward edge of lots between the holiday park and Australis Resort	Jubilee Parade roadway and all properties on seaward side Seaward and second row of units/ structures within Diamond Beach Holiday Park Stormwater outlet to creek Carpark at end of Diamond Dv Diamond Beachfront Holiday Units, Diamond Beach Rd, most easterly house/ unit and eastern end of accommodation block Diamond Beach Resort, easterly most buildings and eastern end of building parallel to Diamond Beach Rd Seaward part of Seashells Beachfront Resort building House/ buildings on northern side of Seashells Resort main building Most seaward buildings in the Australis Diamond Beach Resort Watermain along Jubilee Pde Watermain to the Diamond Beach Resort and Diamond Beach Holiday Units

6.6 Management Options

6.6.1 Do Nothing / Emergency Response

An earlier draft of the *Draft Guide to the statutory requirements for emergency coastal protection works* (September 2010), referred to in **Section 2.6.1**, considered coastal protection works in the form of sand-filled, geotextile containers in a 'temporary' revetment configuration. The *ad hoc* placement of temporary, non-engineered structures would not normally be recommended by a coastal engineer. **Section 6.6.6** examines the option of a buried, engineered seawall in preference to a "do nothing/ emergency response" strategy.

However in the case of south Diamond Beach temporary protection works may be a good short-term option, considering the following:

- the relatively small number of dwellings at immediate risk
- the beach is likely to recover following a coastal storm event
- beach nourishment could be used to assist beach recovery following a storm event (if necessary)
- the likely ability to raise special levies for coastal protection works including beach nourishment
- the recession hazard at Diamond Beach is mainly due to sea level rise and is likely to be realised over a relatively long period of time.

Appendix C1.1 and **Appendix C1.2** indicate a conceptual plan and section design, respectively, of temporary works to protect properties at immediate risk from coastal erosion and recession. Note that due to the nature of the structure it could be damaged during a large storm event which would compromise the level of protection provided.

Preliminary estimates for the life cycle cost, over 50 years, of a constructed sand filled geo-textile container revetment, approximately 200 m in length, is in the order of **$1.2 million.** A detailed breakdown of the cost estimate for this option is included in **Appendix C1.3**.

This approach, in the short-term, would maintain flexibility in the face of uncertainty surrounding shoreline response associated with sea level rise predictions. It would avoid construction of a seawall prematurely which may impact on the beach system, without ruling out the possibility of such a structural solution (see **Section 6.6.6**) if found to be necessary in the future. If a major storm did occur requiring emergency protection as described above as part of an EAP, the opportunity could be taken following the storm event to construct a properly engineered, buried seawall as part of restoration activities. This would effectively change the ongoing management strategy from "do nothing/ emergency response" to "structural protection".

6.6.2 Coastal/ Geotechnical Engineer's Assessment

In the case of alterations or additions to existing structures at north Diamond Beach (which should be located on the landward side of existing structures where these encroach on the 100 year hazard line), development applications should be accompanied by a coastal/ geotechnical engineer's report, as site specific conditions may enable development to be carried out without increasing the risk to existing structures.

6.6.3 Planned Retreat – Future Development

South Diamond Beach

Rezoning

It is noted that lots on the eastern side of Jubilee Parade are seaward of open space and environmental conservation zonings either side and, in the long term, a consistent alignment would be preferable. Ideally this would also involve identification of the land on the LEP Land Reservation Acquisition Map. However, this would invoke the *Land Acquisition (Just Terms Compensation) Act 1991.* See **Section 6.6.5** which addresses purchase/ acquisition of properties along Jubilee Parade). If this course of action was taken and dwellings were removed, there could still be opportunities for a return on some of the foreshore land if there was sufficient area for camping or caravan sites. This traditional use of coastal foreshore land is consistent with the coastline hazard (i.e. involves temporary, moveable tourist accommodation) and the existing adjacent land use, Diamond Beach Holiday Park.

LEP Provisions

As noted in **Table 4.1**, the *Coastline Management Manual* (NSW Government 1990) states that planned retreat is implemented through a limit on the time a development consent is valid or conditions under which consent is valid (e.g. while there is X distance between the beach erosion scarp and the building footprint) after which consent lapses and the structure must be moved back, relocated or demolished. To achieve this, specific provisions for areas identified in a mapping layer would need to be included in the LEP (e.g. areas seaward of the 100 year hazard line).

The EAP (to be included in the Coastline Management Plan) will provide an indication of the buffer distance required between a dwelling and the immediate hazard line to ensure building foundations are located in the stable beach profile) and hence the potential trigger for lapse of consent.

Development Controls

Council's DCP can be used to provide further detail on LEP provisions or guide development where there are no specific area provisions in the LEP. However, under a DCP, landowners could not be compelled to relocate structures at risk, as they would still have a valid consent. As shown in **Appendix A 1.1** the immediate hazard line at south Diamond Beach essentially coincides or is close to the seaward property boundaries.

More specific development controls for south Diamond Beach are recommended to maintain beach amenity, maximise the timeframe over which beachfront lots can be occupied, minimise losses to private assets and costs associated with removal or demolition of building structures impacted by coastline hazards. Accordingly, any additions to existing properties should be of light weight construction and located landward of the existing building footprint (this would require an easing of building setbacks from the road frontage).

Any redevelopment should be landward of the 50 year hazard line (which may be possible on some lots, provided street setbacks are relaxed) and be in the form of an elevated single dwelling of light weight construction (for example, timber construction on piers) which would ensure that floor levels were above inundation levels and enable the structure to be relocated, if desired, once it became at risk. In addition to compatibility with the coastline hazard, light weight construction for dwellings

located in coastal villages is consistent with the *North Coast Urban Design Guidelines* (NSW Government 2008) as discussed in **Section 2.8** and shown in **Figure 2.4**.

North Diamond Beach

Development Controls

Most development at the northern end of Diamond Beach is either landward, or just encroaches on, the 100 year hazard line. It is recommended that a buffer zone (or building setback from the 100 year hazard line) be adopted for any new development. As the allotments are large, any new structures associated with future redevelopment of any of the sites could be located landward of the 100 year hazard line. In addition, any future subdivision should not create lots which would become at risk from coastline hazards within the 100 year planning period.

It is also recommended that the *Mid North Coast Regional Strategy 2009* proposed growth area boundary and seaward extent of proposed urban areas at north Diamond Beach (as shown in **Figure 2.2**) be consistent with the 100 year hazard line.

6.6.4 Planned Retreat – Existing Development and Assets

South Diamond Beach

Relocation of caravan park structures as they become at risk

Within the Diamond Beach Holiday Park, cabins etc. should be relocated and/ or the number of cabins gradually reduced overtime so that a vegetated dune buffer is maintained seaward of the park. As caravan parks are prohibited in the E2 and RU1 zones this provides the opportunity to setback structures from the 100 year hazard line, as part of any future redevelopment of the site.

6.6.5 Property Purchase / Acquisition

This option involves purchasing 25 properties (including two strata townhouses) along Jubilee Parade, based on current land value (see further discussion in **Section 11.1** on adoption of land values rather than market values). For assessment purposes it is assumed this occurs at the end of year one with the estimated cost being **$19.9 million**.

6.6.6 Buried Seawall

A seawall could be considered along the foredune frontage of properties on the seaward side of Jubilee Parade. Whilst seawalls perform well in arresting the continued recession of the foreshore and protect against storm erosion, they often exacerbate erosion of the beach immediately seaward of the structure. Also it is well documented that where structures are not continuous along a section of otherwise erodible foreshore, end effects often occur (i.e. increased erosion at the transition between the hard structure and erodible foreshore).

Given that the shoreline along this section of coastline at the southern extremity of Diamond Beach is not experiencing significant long term recession, it would be advisable to locate a seawall as far landward as possible to protect dwellings from short-term erosion during a design storm event. This would allow the beach to fluctuate naturally on a day to day, season to season basis without the seawall interfering with coastal processes.

It is considered that a vertical contiguous piled (buried) seawall would be the most appropriate structure at this location. This would assist in maintaining visual and beach amenity for both beachfront property owners and beach users. Following exposure of the wall during a design storm event, beach nourishment and dune rehabilitation could be undertaken to restore the natural beach state and re-bury the wall.

The dune crest along the south end of the Diamond Beach is relatively low (approximately 4m AHD in some locations). This would need to be considered in the design of the seawall and whether the structure would need to be higher than the dunes. However, it is assumed that a certain level of overtopping of the structure and landward inundation during a design storm event would be acceptable to the owners of properties at risk, if visual amenity was maintain by keeping the crest level low (i.e. buried). Inundation would still need to be considered in the development of an EAP for the location.

It is envisaged that the initial seawall would be in the order of 500m long (see **Appendix C2.1** and **C2.2** for conceptual plan and section design, respectively). This would protect all residential properties along Jubilee Parade, even those not at immediate risk from storm erosion. This would need to done such that end effects from the seawall during a design storm would not exacerbate storm erosion at the holiday park This raises the issue of whether the holiday park further to the north requires protection. However, given the moveable nature of most structures this is considered unnecessary. An EAP would need to consider evacuation measures during a storm erosion event.

Restoration Beach Nourishment

If a design storm event exposed the structure, a beach nourishment and dune rehabilitation program would need to be considered to mitigate impacts on beach amenity. From preliminary calculations it is considered that a volume of approximately 100,000 m^3 of native equivalent sand would be required to restore the width of beach in front of the constructed seawall. The regularity of nourishment etc. cannot be determined given the random nature of major storm events. For assessment purposes it has been assumed nourishment would be required once every 25 years.

As postulated increases in sea level are realised, the frequency with which the wall would interact with coastal processes, become exposed and require dune nourishment and restoration would increase. Accordingly a more regular maintenance nourishment program may be required in the future.

Preliminary estimates for the life cycle cost over 50 years of a contiguous piled seawall approximately 500m long, with maintenance beach nourishment, is in the order of **$14.8 million**. This assumes sand for beach nourishment could be dredged from Khappinghat Creek within Saltwater National Park. Due to conservation values and legislative restrictions this is unlikely to be possible.

As an alternative to a sand borrow area within the National Park, an option to import sand from a remote source by truck was considered. A preliminary life cycle cost, over 50 year, for this alternative option is in the order of **$21.4 million**.

Detailed breakdowns of cost estimates for these options are included in **Appendix C2.3** and **C2.4**.

6.6.7 Beach Nourishment

Protection of properties at risk by beach nourishment alone by dredging Khappinghat Creek entrance was considered (see **Appendix C3.1** for concept). Preliminary calculations (**Appendix C3.2**) indicate that a volume of approximately 85,000 m^3 would be required to nourish the southern portion of Diamond Beach. This initial nourishment volume includes an allowance for 10 years of recession, due to sediment loss and sea level rise and addresses storm erosion by keeping the immediate hazard line 7.5m seaward of its current location.

In addition periodic re-nourishment, approximately 40,000 m^3 every 10 years, would be required to maintain protection. Preliminary estimates for the life cycle cost, over 50 years, of initial and maintenance beach nourishment is in the order of **$4.6 million**.

As noted in **Section 6.6.6**, it is unlikely that Khappinghat Creek could be used as the source of beach nourishment sand. It is also unlikely that suitable sand volumes could be dredged without significant environmental impacts. As an alternative an option to import sand from a remote source by truck was considered. A preliminary life cycle cost estimate, over 50 years, for this alternative is in the order of **$17.8 million**. Detailed breakdowns of the cost estimates for these options are included in **Appendix C3.3** and **C3.4**.

6.6.8 Groyne Field

Groynes are structures that are aligned perpendicular to the shoreline to act as a physical barrier to sediment transport, effectively trapping sand on the updrift side of the structure. Groyne fields (i.e. multiple groynes) are typically constructed on receding shorelines where significant longshore transport exists, usually in one direction. Capture of sand by the groyne field to maintain the shoreline position (where it is required) leads to sacrificial erosion of the shoreline downdrift of the terminal (last) groyne.

Coastal processes investigations for Diamond Beach have indicated that there is net south to north longshore transport. However, there is limited supply of sediment at the southern extremity. This means initial nourishment would be required to provide an adequate buffer to protect properties at risk.

A groyne field (see **Appendix C4.1** and **C4.2** for conceptual plan and section design, respectively) along Diamond Beach would effectively compartmentalise the beach into two smaller beaches within the southern developed portion of the embayment. The second groyne (northern) would be required to translate sacrificial downdrift erosion to non-developed areas (i.e. within Khappinghat Nature Reserve/ Saltwater National Park).

If effective containment of sediment within the groyne field was achieved following initial nourishment, the following benefits may be realised:

- the need for subsequent nourishment campaigns would be reduced; and
- an increase in the width of the beach may be available for public use and as a buffer for property protection during a storm erosion event.

Groyne structures can also be implemented as temporary geofabric container structures to assess their effectiveness and fine-tune design parameters (length, orientation and location).

However, groyne fields may be ineffective or cause problems at Diamond Beach as:

- offshore transport of sediment still occurs during storm events;
- they may exacerbate the development of rip currents during storm events causing more sand to transported in the offshore direction, increasing recession rates;
- downdrift erosion will occur; and
- groyne fields will not mitigate loss of sand and recession due to sea level rise.

Including initial and maintenance nourishment (from Khappinghat Creek) a preliminary estimate for the life cycle cost, over 50 years, of the groyne field option is in the order of **$17.1 million**. Although periodic maintenance nourishment to maintain the level of protection to account for long term recession would not be required (assuming the groyne field would mitigate this), it would be necessary to mitigate recession due to sea level rise and offshore losses. This cost has been included in the preliminary estimate and volumes.

For the reasons noted previously, an option to import sand from a remote source by truck has been considered. A preliminary life cycle cost estimate, over 50 years, for this alternative is in the order of **$27.8 million**. Detailed breakdowns of the cost estimates for these options are included in **Appendix C4.3** and **C 4.4**.

7. SALTWATER BEACH TO WALLABI POINT

7.1 Key Features

Saltwater National Park is located at the southern end of Saltwater Beach, adjacent to Khappinghat Creek. The creek provides safe swimming and the beach is popular for surfing. The picnic area has toilets, gas barbeques and tables. The headland walking track traverses littoral rainforest. As noted in **Section 3.2**, Saltwater has a strong cultural significance to Aboriginal people and part of the park has been declared an Aboriginal place.

There is a carpark at the southern end of the beach within the National Park, three formal timber accessways/ lookouts and boat launching facilities (concrete ramps) on the creek and beach.

Midway along the beach there are a couple of formal and informal accessways and informal car parking areas.

Wallabi Point (2.5km south of Old Bar) is a small beachside village adjacent to a popular surfing beach. On the southern side, there is vehicle access to the beach and a small carpark, picnic area, lookout and stairs to the beach. On the northern side of the point there is vehicle/ pedestrian access to the beach adjacent to First Rock Gully Creek, which flows to the beach near the end of Pacific Street.

7.2 Beach Characteristics

Saltwater Beach (or Wallabi Beach) is a 1.4km long, south-east facing beach located between the low northern Wallabi Point and the southern more prominent 18m high headland, Saltwater Point. A double bar system is maintained usually cut by eight rips, together with permanent rips against both headlands (Short 2007). Erosion of the foredune was evident along the entire beach in August 2009, especially where informal access tracks were present. The southern end and northern half of the beach were characterised by a very rocky surface (cobbles and boulders) while the mid and southern sections of the beach were much more sandy.

Cobbles and boulders at southern end

Boat ramp at southern end of beach

Informal access tracks

Sandy mid-section

Cobbles and boulders at Wallabi Point

Creek on north side of Wallabi Point

7.3 Land Use Zoning and Tenure

Under the Greater Taree LEP 2010, the foreshore in the south is zoned E1 National Park and Nature Reserve (Saltwater National Park). The foreshore to the north is zoned E2 Environment Conservation backed by residential land (zoned R1) at Wallabi Point and the RU1 zoning (Primary Production) to the south.

7.4 Summary of Coastal Processes

Saltwater Beach is a relatively closed system. It has experienced historical recession of 0.2 m/year in the central portion and is generally stable at the ends. Minor long term sediment loss is likely to be due to leaky bypassing of Wallabi Point to the north, or offshore losses during less frequent storm wave events.

7.5 Areas and Structures at Risk

The following storm demand and recession rates were estimated in the Hazard Definition Study.

Storm demand:	220 m^3/m run of beach
Recession due to sediment loss:	0.2 m/year in the central third of the beach embayment between the boundary of Saltwater National Park and approximately the middle of the rural allotments. Recession rates transition to 0 m/year at the rocky headlands to the north (Wallabi Point residential area) and south
Recession due to sea level rise:	45 m by 2108, for a sea level rise of 0.9 m

Hazard lines for Saltwater–Wallabi Point are shown in **Figure A3.1**. **Table 7.1** lists the areas and structures potentially at risk from coastal erosion and recession over the planning periods indicated.

Table 7.1 Saltwater – Wallabi Point Assets at Risk

Immediate (2008)	50 Year Planning Period	100 Year Planning Period
Stormwater outlet, south side Wallabi Point	Properties (4) at Wallabi Point (at seaward end of Marine Drive, Ocean Drive and Saltwater Road) Saltwater Road Water main to rural properties Frontage to rural properties Stormwater outlet, south side Wallabi Point	Properties (9) at Wallabi Point (at seaward end of Marine Drive, Ocean Drive and Saltwater Road) Stormwater outlet to First Rock Gully Creek entrance Saltwater Road Water main to rural properties Frontage to rural properties Stormwater outlet, south side Wallabi Point Sewer and water mains along Seaview Parade

In addition to areas affected by coastal erosion and recession, small sections of the beach in the south (including Saltwater Road), middle (dune opposite rural properties) and north (public reserve at Wallabi Point and southern section of Seaview Parade including southern most properties) may be subject to inundation from overwash under a 0.9m sea level rise coupled with a 1 in 100 year ARI storm event (see **Appendix A 3.2**)

7.6 Management Options

7.6.1 Coastal / Geotechnical Engineer's Assessment

As noted for Black Head Beach, the hazard lines presented in **Figure A3.1** (and assets at risk identified in **Table 7.1**) do not take into account the stabilising influence of rocky headlands. Accordingly, redevelopment, alterations and additions to properties along Marine Drive and Ocean Drive may be possible without increasing risks from coastal processes. Accordingly, development applications should be accompanied by a site specific coastal/ geotechnical engineer's report. In addition, any upgrading of roads and services should take into account coastline hazards.

7.6.2 Development Controls

As noted in **Section 7.5** the frontages to rural properties along Saltwater Road are at risk from storm erosion and recession. Accordingly, any subdivision of these lots should not result in allotments where building footprints would be seaward of the 100 year hazard line.

8. OLD BAR BEACH

Old Bar is the closest beach to Taree (16kms) and is located on the southern side of the Farquhar Inlet. Old Bar is the largest settlement along the Greater Taree Coast.

8.1 Key Features

The Mid North Coast Water's exfiltration ponds are located between Wallabi Point and Old Bar behind the frontal dune.

Old Bar Park is located within the Manning Entrance State Park (which covers the area from Old Bar to the southern side of Harrington Inlet). Old Bar Park has frontages to both the ocean and Farquhar Inlet. It contains a developed picnic area at Mudbishops Point, a Caravan Park – Lani's on the Beach (located approximately 100m north of the main surf beach), beach carpark (catering for approximately 100 vehicles), Taree-Old Bar SLSC, patrol/ emergency vehicle beach access, main day use area between the caravan park and SLSC (including a kiosk, picnic and playground facilities, skate park, swimming pool, community hall and amenities block) and an historic airfield as noted in **Section 3.3.1**. Formal pedestrian accessways to the beach are located at the Caravan Park and SLSC. The surfing beach is patrolled in summer.

North of Lani's on the Beach (along Old Bar Road) are a number of 4WD access tracks to the beach and a wooden lookout structure. Little Terns nest on the sand spit adjacent to Farquhar Inlet.

Viewing platform/ formal beach access

Taree-Old Bar SLSC

8.2 Beach Characteristics

Old Bar Beach faces south-east and extends for approximately 4km between a 'soft rock' headland known as 2nd corner (north of this is the Farquhar spit and Inlet) and Wallabi Point. There is a slight foreland at Old Bar in the lee of the rocky Urana Bombora (see **Figure 1.1** for location). A double bar system generally exists, with the usually attached inner bar cut by rips every 200-300m (Short 2007). Farquhar Inlet is unstable and has a history of repeated closure, spit growth and infilling. The entrance to Racecourse Creek has been trained using gabions. Sections of the hind dunes south of development at Lewis Street were mined from the 1970s up until 2000.

Erosion scarp Lewis St March 2008

Fallen Norfolk Island Pine June 2008

April 2009 storm Lewis St (east coast low)

Stormwater outlet at SLSC

Racecourse Creek April 2008

Racecourse Creek training wall June 2008

8.3 Land Use Zoning

Under the Greater Taree LEP 2010, most of the foreshore along the coast and into Farquhar Inlet is zoned E2 Environmental Conservation including the sewerage treatment plant and exfiltration ponds, and part of the lots along Lewis Street (area seaward of the approximate location of the immediate

hazard line). The SLSC and adjacent foreshore, caravan park and airstrip area are zoned RE1 Public Recreation. Adjoining areas are zoned R1 General Residential or RU1 Primary Production.

The *Mid North Coast Regional Strategy 2009* indicates areas south of Lewis Street as proposed urban areas, with the growth area boundary including the landward half of the seaward land on Lewis Street. It is recommended that the growth area boundary be consistent with the 100 year hazard line and hence new urban areas would be located landward of the 100 year hazard line.

8.4 Summary of Coastal Processes

Old Bar Beach has historically been receding at an increasing rate with limited periods of recovery. The most rapid recession has occurred just to the north of the exfiltration ponds (on average approximately 1 m/yr). Recession at locations either side of Urana Bombora has been on average 0.5 m/yr.

Detailed hydrographic survey undertaken by DECCW showed that, despite appearances, the area between Wallabi Point and Farquhar Inlet is not part of a single beach system. Urana Bombora (and associated reef) acts as a 'headland'. In addition there is another reef feature just to the north of Wallabi Point. Refer to Figure 3A in May 2010 Addendum to Coastline Hazard Report. These features act to form a beach compartment (albeit incomplete) between Wallabi Point and Urana Bombora and accordingly influence wave, hydrodynamics and subsequent sediment transport processes at Old Bar Beach.

Analysis of these bathymetric features and numerical modelling of specific wave events indicated the possible formation of a large rip cell with potential to carry sediment offshore during major storms from the south-east quadrant. When modelled, the rip cell head generally formed in the central to southern portion of the beach adjacent to where the most significant recession rates have been identified. Storm wave direction was indicated as a significant factor in whether sediment carried by the rip cell was predominately lost to the offshore zone or partially recirculated within the nearshore beach compartment. During storm events from the south-east and east-south-east direction, modelling indicated the possible permanent loss of sediment offshore, i.e. sand was deposited in deep water where it could not return to the beach under natural processes.

This loss mechanism is supported by the observation of a large rip cell of high turbidity (high suspended sediment load) during a site visit on 21 April 2009 when significant erosion of Old Bar Beach occurred. Recorded wave direction during this event at Sydney was east-south-east (the Crowdy Head wave rider buoy within the study area does not record wave direction). Additionally, comparison of cross-shore profiles along Old Bar Beach and Manning Point Beach indicated a significant flattening of the offshore slope at depths of around 8m below mean sea level for Old Bar Beach (indicating possible deposition of sediment).

Although offshore transport may be the dominant mechanism for the ongoing sediment loss at Old Bar Beach there is also likely to be alongshore sediment bypassing, both north and south of Urana Bombora under storm waves with directions other than from the south-east and east-south-east sectors. The amount of sediment bypassing Urana Bombora is likely to be influenced by the beach state on either side (including the open/ closed status of the entrance to Farquhar Inlet).

During calmer periods, sediment transport through onshore bypassing of Urana Bombora may occur due to the zigzag motion of sediment along the beach face caused by the uprush from breaking

waves running obliquely up the beach face and the backwash returning under gravitational action straight down the beach face.

Due to the predominant south-east wave direction along the NSW coastline, a net northward movement of sediment occurs due to alongshore transport mechanisms. Significant reef systems, offshore and to the south, indicate limited pathways for sediment to enter the Old Bar Beach compartment and replace lost sediment.

8.5 Areas and Structures at Risk

The following storm demand and recession rates were estimated in the Hazard Definition Study.

Storm demand:	220 m^3/m run of beach for the central portion of the beach from the northern end of the two most southern ponds at the Mid North Coast exfiltration ponds to the SLSC.
	180 m^3/m run of beach from the SLSC to Farquhar Inlet.
Recession due to sediment loss:	1.4 m/year from the northern end of the two most southern exfiltration ponds to just north of the most northern pond (transitioning to 0 m/yr at Wallabi Point).
	transitioning from 1.4 m/year to 0.6 m/year between the exfiltration ponds and the southern boundary of the Meridian Resort.
	0.6 m/year from the southern boundary of the Meridian Resort to the SLSC.
	0.3 m/year from the SLSC to Farquhar Inlet.
Recession due to sea level rise:	45 m by 2108, for a sea level rise of 0.9 m.

Appendix 3.1 and **4.1** show the hazard lines for Old Bar Beach. **Table 8.1** lists the areas and structures at risk from coastal erosion and recession over the planning periods indicated.

In addition to areas affected by coastal erosion and recession, the following areas may be subject to overwash from wave runup under a 0.9m sea level rise coupled with a 1 in 100 year ARI storm event (see **Appendix A 3.2** and **A 4.2**):

- near the middle of Old Bar Beach (seaward of the sewage treatment ponds) where the dune system is low-lying (approximately 5m AHD) as a result of historical sand mining (it is noted also that the area behind the dune system is also low-lying at approximately 4.5m AHD);
- dunes fronting the Lewis Street properties which are low-lying with wave runup potentially reaching the current seaward edge of these properties;
- the various beach accessways to Old Bar Beach near the SLSC; and
- the low-lying area at the southern end of the entrance to Farquhar Inlet (public reserve).

Table 8.1 Old Bar Assets at Risk

Immediate	50 Year Planning Period	100 Year Planning Period
South end of Pacific Pde roadway Seaward yards (and building footprints of dwellings already demolished) of properties on seaward side of Lewis St (14 plus Meridian Resort) Stormwater outlet near Taree Old Bar SLSC	Mid North Coast Water exfiltration ponds Properties on seaward side of Lewis Street (23 plus Meridian Resort) Sewer and water mains along Lewis St, in vicinity of Pacific Pde and the eastern end of Rose St Properties (12) at the southern end of Pacific Street Eastern frontage of Lani's on the Beach caravan park SLSC and associated amenities (toilet block/ change rooms, part of carpark etc.) Stormwater outlet near SLSC	Exfiltration ponds All properties on seaward side and landward side of Lewis St Properties (4) on Rose St All properties on Pacific Pde All properties on seaward side of Hall St Properties on Ungala Rd (6) Sewer and water mains along Lewis St, in vicinity of Pacific Pde and the eastern end of Rose St Old Bar Public School Eastern frontage of caravan park SLSC and associated amenities (including playground) and stormwater outlet

8.6 Management Options

8.6.1 Do Nothing/ Emergency Response

The *ad hoc* placement of temporary, non-engineered structures constructed in an emergency situation would not normally be recommended by a coastal engineer as a means of protection due to concerns regarding, structural integrity, health and safety risks during placement, inconsistencies in alongshore alignment of protection, exacerbation of erosion in unprotected areas and other environmental impacts.

Contrary to the discussion for Diamond Beach (**Section 6.6.1**), a temporary revetment is not considered a good short-term policy for Old Bar Beach considering the following:

- the present ongoing significant recessive nature of the beach (due to natural recession and not sea level rise induced recession as a result of climate change);
- recent unexplained acceleration in recession rates;
- the demonstrated inability of the beach to recover from erosion events; and
- effective privatisation of the foreshore that would result.

A “Do Nothing/ Emergency Response” strategy at Old Bar Beach is likely to ultimately lead to permanent sand filled geo-textile revetment structures. This would be considered an unacceptable protection structure by a coastal engineer for the reasons discussed above. Given that the outcome of a “Do Nothing/ Emergency Response” plan would be the construction of a hard structure to protect dwellings at risk, it may be prudent to considered as an alternative, the immediate construction of an engineered revetment as a component of a long term management strategy (see **Section 8.6.5**). Construction in a non-emergency situation significantly reduces risk associated with the following:

- decision-making by management under extreme pressure;
- non-optimum structural integrity/ quality of the type of protection constructed;
- extent of protection provided;
- safety and environmental issues; and
- liability issues.

As discussed further in **Section 8.6.5**, as a trade off for the permanent protection of private property, public access could be maintain through the dedication of a coastal reserve along the crest of the seawall to maintain public foreshore access. The environmental impacts of the seawall could be mitigated though periodic nourishment of the beach.

8.6.2 Planned Retreat – Future Development

Rezoning

As shown in **Appendix A 3.1** and **A 4.1**, most properties seaward of Lewis Street are within the 50 year hazard line, as are several properties along Pacific Parade (although for some lots along Pacific Parade actual structures may be landward of the hazard line). The entire dune system at Lewis Street has been cleared and developed and the area is at immediate risk from coastal erosion as shown in the photographs in **Section 8.2**. In recognition that development is at risk in this location, the Greater Taree LEP indicates an E2 Environmental Conservation Zone covering the seaward portion of land along Lewis Street. However, dwelling houses are still permitted in this zone with consent, as per the land use tables in the Greater Taree LEP 2010 (see **Section 2.10.2**). Ideally this land should be identified on the LEP Land Reservation Acquisition Map. This however, would invoke the *Land Acquisition (Just Terms Compensation) Act 1991* (see **Section 8.6.4**) which addresses purchase/ acquisition of properties at Old Bar).

LEP Provisions

As noted in **Section 6.6.3** planned retreat can be implemented through a limit on the time that development consent is valid or conditions under which consent is valid. To achieve this, specific provisions for areas identified in a mapping layer would need to be included in the LEP (e.g. areas seaward of the 100 year hazard line).

The EAP (to be included in the Coastline Management Plan) will provide an indication of the buffer distance required between a dwelling and the immediate hazard line to ensure building foundations are located in the stable beach profile and hence the potential trigger for lapse of consent.

Development Controls

As noted in **Section 6.6.3**, Council's DCP can be used to provide further detail on LEP provisions or guide development where there are no specific area provisions in the LEP. However, under a DCP, landowners could not be compelled to relocate structures at risk, as they would still have a valid consent. Obviously, no development should be permitted seaward of the immediate hazard line.

More specific development controls for Old Bar Beach (Lewis Street/ Pacific Parade area) landward to the 100 year hazard line are recommended (although a few properties are marginally affected by the 100 year hazard line north of Pacific Parade, they are afforded some protection by rock reef features associated with Urana Bombora and so development in these areas should be considered on merit). Any additions to existing beachfront properties in the Lewis Street/ Pacific Parade area should be of light weight construction and located landward of the existing building footprint (this may require an easing of the building setback on the Lewis Street road frontage).

Any new or major redevelopments should be landward of the 50 year hazard line and be of light weight construction (for example, timber construction on piers) to enable relocation, if desired, once structures became at risk. As discussed previously, in addition to compatibility with the coastline hazard, light weight construction for dwellings located in coastal villages is consistent with the *North Coast Urban Design Guidelines* (NSW Government 2008) see **Section 2.8** and **Figure 2.4**.

8.6.3 Planned Retreat – Existing Development and Assets

Relocation of structures on some lots may be possible so that they are landward of the 50 year hazard line. However, some battleaxe lots (at least two) are substantially affected by the immediate hazard line and development is not viable in the medium term in these locations. Accordingly purchase of properties should be considered. This is also the case for the seaward row of units in the Meridian Resort which are located between the immediate and 50 year hazard lines (see **Section 8.6.4** relating to property purchase/ acquisition). General information on the rationale for using land value rather than market value for property purchase and planned retreat options is given in **Section 11.1.1**, as well as the land value adopted for the Meridian Resort.

Lewis Street – Acquisition for Beach Access

The immediate hazard line on the seaward side of Lewis Street is landward of all properties except for No.s 2 and 4. Partial acquisition is proposed to maintain legal public access to the beach as the shoreline recedes to approximately the seaward wall of the most seaward dwellings (approximate location of the 10 year hazard line). See **Appendix C5**.

For the assessment, compensation for partial acquisition for public access has been taken to be the percentage of land affected, multiplied by the overall land value. Apart from maintaining beach access, this also provides some compensation for the removal/ relocation of structures and dwellings out of the easement and to a point landward of the 50 year hazard line, or redevelopment landward of the 50 year hazard line where sufficient land area remains. It is acknowledged that, in a number of instances, there would not be a sufficient building footprint landward of the 50 year hazard line and this has been taken into account as additional compensation for acquisition of entire properties for beach access in 10 years time (see below).

Pacific Parade – Acquisition for Road Access

In the case of properties along Pacific Parade, it has been assumed that there would be some intervention to maintain road access to properties affected by the 50 year hazard line in the next 10 years. It is envisaged that this would entail narrowing and moving the road surface landward.

For the assessment it has been assumed that the area between the property boundary and the 5m setback would be acquired, with the cost based on the percentage of land acquired, multiplied by the land value. Compensation would provide some up front assistance to owners to plan for future relocation.

Longer Term Acquisition for Continued Beach Access

This relates to properties where the entire lot, or close to the entire lot is seaward of the 50 year hazard line. It is based on existing lot boundaries (at least one lot contains two dwellings but the land is not subdivided into two lots/ is not a strata subdivision). This compensation for acquisition for continued beach access would be additional to the upfront compensation described above.

For the purpose of the assessment, compensation payout is taken to occur in year 10. In reality, some properties may need to be acquired earlier, while some could be acquired later.

For assessment purposes, the market value of land on the date of acquisition (estimated to be in 10 years time) is taken to be zero, as it is assumed there would be insufficient land area left for residential development (i.e. insufficient building footprint). Accordingly, compensation relates to acquisition and relocation costs (see **Appendix B** for further details). However, there may be up to six lots along Lewis Street (No.s 16 to 26) and seven lots along Pacific Parade (No.s 23 to 25, depending on whether road access is still available) where existing dwellings could remain/ dwellings could be moved/ rebuilt in the interim. In addition, some of the Meridian Resort apartments landward of the beachfront apartments may be able to be retained in the interim, or part of the site could be redeveloped in the interim.

The estimated cost, over the 50 year planning period, associated with both immediate and 10 year acquisition of properties is **$9.9 million**.

Relocate exfiltration ponds when they become at risk

The Old Bar Sewerage Treatment Plant is located within Kiwarrak State Forest, inland from the coast. However, the exfiltration ponds are generally located between the immediate and 100 year hazard lines. Suitable alternative sites should be investigated to enable relocation of these ponds once they become at risk. It is also recommended that the distance between the ponds and seaward edge of the vegetated dune be monitored to assist in planning for relocation (estimated to be in the order of **$2.5 million**). In addition, any upgrading/ augmentation of water and sewer mains should take into account the coastline hazard.

Relocate caravan park structures as they become at risk

Within Lani's Caravan Park, cabins etc. should be relocated and/ or the number of cabins gradually reduced overtime so that a vegetated dune buffer is maintained seaward of the park. As the park is Crown Land the lease boundaries can be reviewed and revised over time to accommodate coastal processes.

8.6.4 Property Purchase

The cost associated with purchasing all properties between the immediate and 50 year hazard lines, over the 50 year planning period, is estimated at **$21.9 million**. Although only around half the Meridian Resort is seaward of the 50 year hazard line, the total land value of the resort was used in the assessment to account for the higher market value associated with the use of the site for medium density development (see **Section 11.1.1** for more discussion). This figure also includes costs associated with relocation of Mid North Coast Water's exfiltration ponds.

8.6.5 Revetment

A revetment could be considered along the foredune frontage of properties on the seaward side of Lewis Street, extending to the Pacific Street roadway (coastal processes in this area are complicated by the presence of the entrance to Racecourse Creek), see **Appendix C6.1** and **C6.2** respectively for a plan and section. As noted in **Table 4.1** and **Section 6.6.6**, whilst revetments perform well in arresting the continued recession of the foreshore and storm erosion, they often exacerbate erosion of the area immediately seaward of the structure and have 'end effects' (i.e. increased erosion at the transition between the hard structure and erodible foreshore).

Given the significantly erosive (and receding) environment along Old Bar, the construction of a revetment is likely to result in the development, over time, of an artificial headland (as illustrated conceptually in **Appendix C6.3**). This would occur as erodible material is removed from in front of, and at the ends of, the revetment. This would also create stability issues and, as recession of the foreshore occurs, the revetment is likely to be outflanked at some point in the future. This is likely to require an extension of the revetment to protect all properties on Pacific Parade (as indicated in **Appendix C6.1**) further to the north, and a return wall to the south.

A sloped, rubble mound revetment would be the most appropriate structure at this location. It would aid in reducing stability issues due to erosion in front of the structure as wave reflection is not as significant on a sloped structure, compared to a solid vertical seawall. It would also readily facilitate future extension requirements.

The loss of the beach adjacent to the revetment raises public amenity and access issues and it is recommended that if this protection option was implemented, a secure right of passage for the public along the revetment crest (which would become the foreshore) be negotiated with benefitting land owners. Public access could take the form of an elevated boardwalk/ cycleway, or similar arrangement.

Other impacts associated with this option may include changes to the Racecourse Creek entrance as a result of end effects accelerating the loss of the dune between the creek and the ocean (and loss of littoral rainforest around the creek), as well as accelerating the risk to the Mid North Coast Water's exfiltation ponds.

It is envisaged that the initial revetment would be in the order of 680m long (see **Appendix C6.1**), with a possible extension to approximately 870m as foreshore recession (and subsequent outflanking) is realised.

A preliminary estimate of the life cycle cost, over 50 years, for a full length rock revetment is in the order of **$16.5 million**. A detailed breakdown of the cost estimate for this option is included in

Appendix C6.4. Note that this includes costs associated with relocating the Mid North Coast Water's exfiltration ponds.

An alternative construction technique utilising sand filled geotextile containers for the revetment structure was considered in an attempt to reduce capital costs. **Appendix C6.5** illustrates a typical cross-section. Although capital costs are reduced, due to the harsh open coast environment and the life expectancy of sand filled geotextile containers, a total replacement of the structure would be required during the 50 year life cycle. Accordingly, the resultant life cycle cost of both construction techniques are similar (within the bounds of the cost estimate based on highly conceptual designs).

Revetment with Beach Nourishment

Due to the impacts of revetments on beach access and amenity, they are often considered in conjunction with periodic beach nourishment programs to mitigate these impacts, as illustrated conceptually in **Appendix C6.6**. From preliminary calculations a volume of approximately 150,000 m^3 of native equivalent sand would be required every five years to maintain the current width of beach in front of the revetment.

A preliminary estimate of the life cycle cost, over 50 years, for the rock revetment in combination with a nourishment program for maintenance of beach amenity is in the order of **$40.5 million** (which includes relocation of the exfiltration ponds). A detailed breakdown of the cost estimate for this option is included in **Appendix C6.7**. This assumes that sand dredged from Farquhar Inlet entrance and offshore from Old Bar Beach (sand that has been transported too far offshore to return under natural processes) would be the nourishment sources. As noted earlier, ecological impacts are likely to result from dredging Farquhar Inlet and current legislation prohibits offshore dredging.

8.6.6 Beach Nourishment

Protection of properties at risk from coastal erosion and recession through beach nourishment alone would require massive beach nourishment of the entire beach embayment from Wallabi Point to Urana Bombora. For this option Farquhar Inlet entrance and offshore sources have again been assumed to be the sand sources (see **Appendix C7.1** for concept).

Preliminary calculations (**Appendix C7.2**) indicate that a beach nourishment volume of approximately 1,000,000 m^3 would be required to maintain the existing immediate coastal hazard line seaward of its current location. This initial nourishment volume includes an allowance for 10 years of recession due to underlying recession rates and sea level rise.

Due to the amount of sand required, ongoing nourishment using the sand sources indicated above may not be feasible and so it may prove more economically viable to acquire some of the more seaward properties immediately at risk, such that the volume required to maintain protection for the remainder of the houses (set further back) is significantly less, thus reducing capital costs.

Massive beach nourishment as a management option alone would require periodic nourishment to maintain the level of protection to account for long term recession due to sediment loss from Old Bar Beach and sea level rise. This would require an additional equivalent volume of approximately 1,000,000 m^3 every 10 years. Preliminary estimates for the life cycle cost of initial and maintenance beach nourishment over 50 years is in the order of **$147.1 million**. A detailed breakdown of the cost estimate for this option is included in **Appendix C7.3**.

As noted in **Section 8.6.5** the use of Farquhar Inlet and offshore sand sources is problematic.

An initial massive nourishment campaign and frequent periodic maintenance program would be required due to the significant erosion and long term recession prevalent at Old Bar Beach (and Manning Point Beach). A permanent pipeline redistribution system could be considered in response to the anticipated high frequency of periodic maintenance nourishment. Flexibility to nourish Manning Point Beach to the north of the entrance could be included in such a sand redistribution system.

8.6.7 Farquhar Inlet Entrance Structure and Beach Nourishment

The Hazard Definition Study indicated that the location of Farquhar Inlet entrance has an impact on the erosion potential of the adjacent beach forms. An open entrance at the southern end of the entrance berm, in conjunction with an offshore ebb tide delta, may lead to a more stable beach form for the beach to the south (i.e. Old Bar Beach). On this basis, an option to formalise the entrance configuration (as illustrated conceptually in **Appendix C8.1**) could assist in slowing the erosion and long term recession of Old Bar Beach.

The construction of a southern breakwater would also assist in slowing the bypassing rate of any northward longshore drift of sand from Old Bar Beach by capturing sand and moving the beach alignment seaward. However, loss of sand from Old Bar Beach may also occur due to southward and offshore transport during major storm events.

A similar management option was considered as part of the *Entrance Opening Management Plan* for Farquhar Inlet. This plan (currently in draft format) indicated a capital cost for an arrangement similar to that illustrated in **Appendix C8.1** of approximately **$9 million**. This did not consider the construction of an internal training wall in Farquhar Inlet which would add (in the order of) an additional **$9 million**. Without a training wall there is a risk of flood waters breaking through the entrance berm at another location, making the constructed entrance redundant.

To create the entrance opening as illustrated in **Appendix C8.1** dredging would be required, at which time it would be advantageous to undertake massive beach nourishment to facilitate protection of properties at risk.

Periodic nourishment would be required to maintain this level of protection. The volumes and timing of nourishment would depend on the level of success of the trained entrance in retarding long term recession due to sediment loss from Old Bar Beach. For the assessment of this option it has been assumed that long term recession due to alongshore drift is stopped by the entrance configuration. Accordingly, only protection against long term recession due to sea level rise and offshore losses would be required. It has been estimated that this would require a volume of approximately 640,000 m^3 every 10 years (as indicated by **Appendix C7.2**), i.e. two-thirds of the massive beach nourishment option, assuming alongshore losses, offshore losses and shoreline recession due to sea level rise were approximately equal.

Preliminary estimates for the life cycle cost, over 50 years, of the combined option of a modified entrance configuration and nourishment is in the order of **$78.4 million**. A detailed breakdown of the cost estimate for this option is included in **Appendix C8.4**.

In addition to property protection, this option may provide water quality and upstream flood mitigation benefits. However, any change to the Farquhar Inlet entrance would need to be very carefully

examined as this would have an impact on the Manning River hydraulics, potentially affecting the viability of the Harrington Inlet entrance. There would also be impacts on Manning Point Beach.

This option would also impact on *SEPP No.14* wetlands, possibly Little Tern nesting habitat and Farquhar Inlet ecology (due to the marinisation of the inlet as a result of the permanently open entrance).

8.6.8 Groyne Field and Beach Nourishment

As noted in **Section 6.6.8**, groyne fields are typically constructed on receding shorelines where significant longshore transport exists, usually in one direction. The capture of sand by the groyne field to maintain the shoreline position (where it is required) leads to sacrificial erosion of the shoreline downdrift of the terminal (last) groyne.

Coastal processes investigations for Old Bar have indicated that there is significant offshore sediment transport through storm wave related mechanisms and that directionality in sediment transport alongshore can vary under different conditions. The complexity of the processes at Old Bar casts considerable uncertainty on the effectiveness of a groyne field as a method of retaining beach width and consequently protecting property and assets at risk. However, the consultation process has indicated that community members would like this option considered and assessed as part of the Coastline Management Study.

A groyne field (see **Appendix C9.1** and **C9.2** for conceptual plan and section design, respectively) along Old Bar Beach would effectively compartmentalise the beach into four smaller beaches between Wallabi Point and Urana Bombora. As there is limited supply of sediment to this length of coastline, initial nourishment of the beach compartments would be necessary.

If this option was effective in containing the movement of sediment within the groyne field following initial nourishment, the following benefits may be realised:

- the need for subsequent nourishment campaigns would be reduced; and
- an increase in the width of the beach may be available for public use and as a buffer for property protection during a storm erosion event.

Groynes can be constructed as temporary geofabric container structures to assess their effectiveness and fine-tune design parameters (length, orientation and location).

However, as noted in **Section 6.6.8**, groyne fields may be ineffective or cause problems at Old Bar Beach because:

- offshore transport of sediment still occurs during storm events (a significant mechanism for loss at the site) leading to losses from Old Bar Beach and continued recession;
- they may exacerbate the development of rip currents during storm events causing more sand to transported in the offshore direction thereby increasing recession rates;
- the most northern groyne may lead to a change in the open/ closed regime of Farquhar Inlet entrance and act as a training wall to permanently keep the entrance open (this has advantages and disadvantages);

- due to the fluctuations in sediment transport directions along Old Bar Beach, the shoreline position within these compartments could fluctuate significantly; and
- due to longshore drift and limited sand supply to Old Bar Beach, downdrift erosion would occur if the groyne field was effective in capturing sand.

Accordingly, periodic nourishment would be required to maintain the required level of protection. The volumes and timing of nourishment would depend on the level of success of the groyne field in retarding long term recession due to sediment loss from Old Bar Beach. For assessment purposes it has been assumed that long term recession due to alongshore drift is stopped by the groyne field. Accordingly, only protection against long term recession due to sea level rise and offshore losses would be required, i.e. a nourishment volume of approximately 640,000 m^3 every 10 years.

Including initial and maintenance nourishment a preliminary estimate for the life cycle cost, over 50 years, of the groyne field option is in the order of **$66.9 million**. A detailed breakdown of the cost estimate for this option is included in **Appendix C9.3**. This option also has implications for Farquhar Inlet and associated habitats.

8.6.9 Offshore Reef and Beach Nourishment

A single or series of shore parallel breakwaters could, theoretically, be used to reduce the wave climate incident at the shore and nearshore zone of Old Bar Beach, reducing sediment entrainment and alongshore transport as a result. However, such an emergent structure(s) would not lessen the complex hydraulic nature of the embayment which is significantly influenced by Urana Bombora and Wallabi Point. An offshore breakwater/ breakwater field was not considered appropriate at this location due to the following:

- prohibitive cost for open coast applications;
- it would not mitigate currents due to the hydraulic characteristics of the beach embayment during storm events and may exaggerate localised erosion by fixing the spatial location of resultant rip heads; and
- it would have significant impacts on beach and surf character.

However, a submerged structure (as discussed below) could be considered offshore from the frontage of properties on the seaward side of Lewis Street.

Submerged breakwater/ artificial reef (with nourishment)

Submerged structures are perceived as providing foreshore protection without amenity and aesthetic impacts. The notion that these structures, through multi-purpose design, can also provide habitat or recreational (surfing) benefits is becoming increasingly popular. Whilst these additional benefits are possible, the effectiveness of such structures to protect the foreshore remains uncertain. However, the consultation process has indicated that community members would like this option considered and assessed as part of the Coastline Management Study.

Ranasinghe and Turner (2006) reported in a review of shoreline response to submerged structures that “contrary to expectation, a majority of submerged structures to date have resulted in shoreline erosion in their lee. Furthermore, the key environmental and structural parameters governing the

mode (i.e. erosion or accretion) and the magnitude (i.e. size of the increase in beach width) of shoreline response to submerged structures are yet to be identified." This statement is made because of the following:

- an inconsistency in field observations from different locations and environments where submerged structures have been constructed such that empirical relationships cannot be developed; and
- a clear inability of simulated nearshore circulation patterns due to breaking waves on a submerged structure (as developed through numerical and physical modelling) to capture the full complexity of shoreline response to submerged coastal structures.

The regional coastal processes at Old Bar Beach have been shown to be significantly complex. Longshore currents within the embayment are driven not simply by obliquely incident wave approach but also by higher order flow circulation patterns as a result of wave refraction, wave breaking and differential wave setup. The significant sensitivity of the hydraulic response of the embayment to minor changes in offshore wave directions adds further complexity. The ability to confidently predict the shoreline response to a submerged coastal structure in this highly complex environment is questionable.

One of the mechanisms for erosion in the lee of submerged coastal structures noted by Ranasinghe and Turner (2006), is the development of diverging alongshore currents in between the structure and the shoreline due to flow being directed over the structure as a result of wave breaking. This mechanism is similar to that observed during highly erosive storm events at Old Bar where the development of an offshore bar and nearshore trough system (typical of the beach state at Old Bar) drives significant alongshore flow with significant volumes of suspended sediment entrained due to plunging waves breaking at the beach face and bar. If a submerged structure was to be constructed at Old Bar (most likely adjacent to properties on Lewis Street) there is a risk that the resultant processes during storm events would mimic what currently occurs.

Furthermore, there is also a risk that the hard structure would cause a constriction in the regionally developed longshore flows, increasing velocities locally, leading to scouring and enhanced erosion in the lee of the structure (i.e. in front of the Lewis Street properties).

In view of the more experimental nature of this option, a substantial investment in research and development would be required. If a submerged structure was considered for foreshore protection, it would be recommended that the design incorporates a sloping connection to the shoreline in an attempt to facilitate the convergence of wave induced currents at the shoreline to reduce the possibility of scouring due to alongshore flows. However, a shore connected structure would take on some of the detrimental characteristics of a groyne which would need to be considered.

As there is limited supply of sediment to Old Bar Beach, initial and ongoing beach nourishment would be necessary in conjunction with a submerged reef structure. If effective in modifying processes and the subsequent movement of sediment, such that there was net accretion in the lee of the submerged structure following initial nourishment, the following benefits may be realised:

- the need for subsequent nourishment campaigns may be reduced;
- an increase in the width of the beach may be available for public use and as a buffer for property protection during a storm erosion event; and

- surfing conditions may be enhanced if designed for such a purpose.

However, submerged structures may be ineffective or cause problems at Old Bar Beach because:

- offshore transport of sediment still occurs during storm events (a significant mechanism for loss at the site) leading to losses from Old Bar Beach and continued recession;
- they may exacerbate the development of rip currents during storm events causing more sand to be transported in the offshore direction increasing recession rates (possible localisation of recession);
- erosion on either side of the structure can occur due to the modification of coastal processes; and
- public safety issues arise from the design and implementation of a dual purpose structure (as a recreational facility) and navigation hazards also result.

As noted above, periodic nourishment would be required to maintain the required level of protection (as indicated in **Appendix C10.1**). The volumes and timing of nourishment would depend on the level of success of the artificial reef structure in retarding long term recession due to sediment loss from Old Bar Beach. For the option assessment it has been assumed that long term recession due to alongshore drift is stopped by the reef configuration. Accordingly, only protection against long term recession due to sea level rise and offshore losses would be required, i.e. approximately 640,000 m^3 of nourishment sand every 10 years.

Including initial and maintenance nourishment a preliminary estimate for the life cycle cost, over 50 years, of the offshore reef option is in the order of **$52.9 million**. Note that this does not include research and option development. A detailed breakdown of the cost estimate for this option is included in **Appendix C10.2**. The cost estimate of the reef structure is based on the capital cost of the Narrowneck Artificial Reef on the Northern Gold Coast (Jackson *et al.* cited in Couriel & Carley 2010) and in consideration of an alongshore extent twice the length of the Narrowneck structure. The additional length is considered necessary (from a preliminary assessment) in an attempt to protect the stretch of coastline at risk. If an artificial reef was to be considered as a preferred management option, extensive detailed investigations regarding the effectiveness of such a structure in protecting the foreshore would be required. It may be that more than one reef structure would be required so that significant adverse impacts were not experienced at other locations along the embayment foreshore.

9. MANNING POINT BEACH

Manning Point is located on the southern side of Harrington Inlet. Vehicle access is via Old Bar Road and Manning Point Road, which crosses the south channel of the Manning River to Oxley Island then Scotts Creek to Mitchell's Island. The road also crosses Millers and Sheather Creeks on Mitchell's Island.

9.1 Key Features

Manning Point is a seaside and riverside village (located on the southern side of Harrington Inlet). The area is a major centre for oyster production in the Manning Valley. The Vic Shoesmith Reserve provides the main access to the beach. The beach is not patrolled. Formal access consists of a 4WD track and adjacent pedestrian track. There are also a number of beach accessways from the caravan parks which line the beachfront. The reserve protects littoral rainforest and provides parking, an amenities block, picnic and barbeque facilities, a playground and many mature shade trees.

Over recent years the lands at Farquhar Park (northern side of Farquhar Inlet) and Manning Point have been the most successful breeding and fledgling sites in the State for the Little Tern. There is 4WD access to this beach for 10kms with the access point through Manning Point Reserve.

The town's sewerage treatment plant is located to the south of Manning Point off Oystercatchers Lane and encroaches on the frontal dune.

Flat topography of Manning Point village

Vic Shoesmith Reserve

9.2 Beach Characteristics

Manning Point Beach faces south-east and stretches from Farquhar Inlet to Harrington Inlet (**Figure 1.1**). It is a steep coarse narrow beach for a total of 10km from Farquhar Inlet, it then becomes a low sandspit for a distance of 2.5km to Harrington Inlet. This is an isolated, relatively high energy beach with two rip dominated bars and extensive river channels, bars and currents at each end. The riverfront town of Manning Point is located south of the spit. The remainder of the beach is backed by a narrow eroding dune, then the farmland of Mitchell's Island (Short 2007).

Beach erosion and dune vegetation at north

Looking north from 4WD access point

Beach erosion at middle of Manning Beach

Rocky area, mid portion of Manning Beach

Dune vegetation adjacent to access

4WD and pedestrian beach access

9.3 Land Use Zoning

Under the Greater Taree LEP 2010, the foreshore along Mitchell's Island is zoned E2 Environmental Conservation (part of this is to be acquired for national parks/ nature reserves as shown on acquisition map – sheet LRA-015C). This includes the Manning Point sewerage treatment plant and pond. At Manning Point, adjoining zones are RE2 Private Recreation (Bowling Club) and R1 General Residential. There is also a small area zoned E3 Environmental Management at the rear of lots on Manning Street, near Banksia Lane. To the south land is zoned RU1 Primary Production.

9.4 Summary of Coastal Processes

The northern third of Manning Point Beach generally appears to prograde while the southern two-thirds recedes. However, this trend can be reversed through short-term fluctuations as a result of refracted wave patterns influenced by of the state of Farquhar Inlet entrance and Urana Bombora. The state of Harrington Inlet entrance and estuary flow is an added complexity influencing the northern portion of Manning Point Beach.

As noted in the Hazard Definition Study it was observed that when Farquhar Inlet was open, the southern end of Manning Point Beach accreted whilst the northern end eroded. Harrington Beach also accreted significantly. If Farquhar Inlet entrance is open due to catchment flow, Harrington Inlet would also be in a state of high catchment flow and relatively 'open'. This would favour net bypassing of the Harrington Inlet entrance rather than estuary infilling, growth of the ebb tide delta, reduction of Manning Point Beach spit (on the southern side of the entrance as the entrance widens), recession of the northern portion of Manning Point Beach and progradation of Harrington Beach north of the Harrington Inlet entrance.

That is, Harrington Inlet entrance and spit areas act less as a sink to beach sediments. It is important to note that this can be an extremely complex system which can not be wholly represented by a simple conceptual model. During high flow events, short circuiting can occur resulting in the development of a new entrance location on the spit (to the south). Conversely, when Farquhar Inlet was closed the reverse occurred, i.e. the southern end of Manning Point Beach eroded significantly whilst the northern end accreted. Harrington Beach was still seen to accrete but this was an order of magnitude less than when Farquhar Inlet was open.

The planform of Manning Point Beach changes in response to the status of the two entrances acting as 'soft' control features. When Farquhar Inlet entrance is open (particularly when it is open at the northern end), the associated delta and wave refraction effects act to stabilise and essentially hold the southern end of Manning Point Beach out (seaward), to the detriment of the beach further north. Additionally, with Harrington Inlet entrance 'open', bypassing is favoured.

When Farquhar Inlet is closed, the sediment sink effect of the entrance berm and estuary compartment (under aeolian (wind) transport) acts as the southern control point and the southern end of Manning Point Beach recedes. The northern end of the beach progrades as the spit grows and the Harrington Inlet entrance infills, acting as the northern control point. Bypassing is reduced significantly. The planform of the whole Manning Point Beach (between the Farquhar Inlet entrance compartment and Harrington Inlet) forms a zeta shape, typical of a net northerly littoral transport beach, with limited sand supply in the south.

9.5 Areas and Structures at Risk

The following storm demand and recession rates were estimated in the Hazard Definition Study.

Storm demand:	220 m^3/m run of beach.
Recession due to sediment loss:	1.8 m/year from roughly in line with the southern end of Loten Lane for a distance of 2.5 km to the north (transitioning from 0 m/hr at Farquhar Inlet). 1.4 m/year from the above to just south of the southern most tourist accommodation at Manning Point (Manning Point Hideaway Holiday Cabins) and transitioning to 0 m/year at Harrington Inlet.
Recession due to sea level rise:	45 m by 2108, for a sea level rise of 0.9 m.

Appendix A 5.1, **A 6.1** and **A 7.1** show the Hazard Lines for Manning Point Beach. The structures and assets at risk from coastal erosion and recession at Manning Point Beach are listed in **Table 9.1**.

Table 9.1 Manning Point Beach Assets at Risk

Immediate (2008)	50 Year Planning Period	100 Year Planning Period
Nil	The eastern edge of rural land including several dams Mid Coast Water's Sewage Treatment Plant and associated structures, Manning Point	The eastern edge of rural land including several dams Properties (2) on Beach Rd (houses near middle of beach) Sewage Treatment Plant and associated structures Properties (16) on seaward side of Manning Street (north of Ocean Parade) including bowling club Properties on northern side of Manning St (9) and on Main St at eastern end of block (5) Eastern half of Easts Ocean Shores Holiday Park Manning Point Hideway Holiday Cabins

In addition to areas affected by coastal erosion and recession, the following areas may be subject to inundation under a 0.9m sea level rise coupled with a 1 in 100 year ARI storm event (see **Appendix A 5.2**, **A 6.2** and **A 7.2**):

- Overwash of some isolated low-lying dune areas along Manning Point Beach (public reserve).
- Flooding of the Manning Point spit due to elevated ocean water levels in the Manning River and overwash from the ocean.

9.6 Management Options

No protection works were considered for Manning Point Beach as, in the long term, the viability of the settlement is limited because it is subject to catchment flooding and inundation from the ocean (both of which will be exacerbated by sea level rise). This includes the settlement's sewerage treatment plant and road infrastructure. In view of this, it is recommended that Manning Point be deleted as a 'growth area' in the *Mid North Coast Strategy*.

At the time of the 2006 census, Manning Point had a population of 228 people. Of these, 42% were aged 65 and over. Of the 174 private dwellings, 37 (or 21 %) were unoccupied at the time of the census, providing an indication of the number of holiday homes (www.censusdata.abs.gov.au).

9.6.1 Planned Retreat – Future Development

LEP Provisions

Consideration should be given in the future (say 50 years time) to mapping the entire Manning Point settlement in the LEP as an area where a time limit applies to new development consents. This should be based on inundation due to catchment flooding and flood extents under sea level rise, combined with the coastline hazard lines.

Development controls

A large proportion of land use in the settlement is for tourist accommodation (holiday parks, cabins etc.) and it is recommended that this use be expanded into the residential area over time. Accordingly, any new development or redevelopment should be relocatable and/ or of lightweight construction. In addition, no subdivision of rural land on Mitchell's Island should occur which would create additional lots at risk over the 100 year planning period.

10. HARRINGTON ENTRANCE TO CROWDY HEAD

This covers the area from the north side of Harrington Inlet to Crowdy Head. The study area is mostly within Harrington Beach State Park.

10.1 Key Features

Harrington is located along the northern bank of the Harrington inlet. Although trained along the northern shoreline, the entrance at Harrington is unstable with mobile sand shoals extending upstream from the entrance for approximately 5km. The long training wall is popular with anglers and the Harrington Lagoon, within the entrance area, provides safe swimming. Harrington Beach is not patrolled. There are three 4WD access tracks to the beach. Pedestrian access is available through the Harrington Beach Holiday Park.

10.2 Beach Characteristics

Harrington Beach faces south-east and is 5.6km long. The beach generally has a double bar system, cut by rips every 200-300m on the inner bar, and more widely spaced rips on the outer bar. A strong permanent rip runs out against Crowdy Head (Short 2007).

The dune system at the northern end of Harrington Beach was mined in the past and by the 1950s the dunes were badly destabilised. However, rehabilitation works began in the 1980s, resulting in the present stable, vegetated system. Along Harrington Beach the incipient dune is covered by spinifex, with the hind dune vegetation being typical of the coast (e.g. coastal wattle, banksia and tea tree). However, infestations of the introduced Bitou Bush occur along the beach.

Looking north to Crowdy Head

4WD access at northern end of beach

10.3 Land Use Zoning and Tenure

Under the Greater Taree LEP 2010, the foreshore along Harrington Beach is zoned E2 Environmental Conservation. Adjacent to this is land zoned E1 National Park and Nature Reserve (Crowdy Bay National Park) which includes an area to be acquired for inclusion in the National Park (as shown on acquisition map – sheet LRA-017A).

10.4 Summary of Coastline Hazards

Harrington Beach has historically shown stability, with net accretion occurring between 1965 and 2006. Harrington Beach is supplied with sand from the south within the net northerly littoral transport regime of the northern portion of Manning Point Beach/ Harrington Beach area. Sediment transported northward from Manning Point Beach infills the Harrington Inlet entrance and bypasses to Harrington Beach, particularly during high flow events.

Historically, the planform of the beach has responded to the introduction of the Harrington Inlet training wall. As is typical of a beach downdrift (north) of trained river entrances on the Mid and North Coasts of NSW, wave refraction/ diffraction effects causing lateral expansion currents prograde the southern portion of the beach, with a corresponding recession of the northern portion (rotating the beach). This planform is in equilibrium with the long term altered wave climate and little change has been evident. Progradation of the entire beach compartment occurs relative to the net bypassing of the Harrington Inlet entrance.

10.5 Areas and Structures at Risk

The following storm demand and recession rates were estimated in the Hazard Definition Study:

Storm demand:	220 m^3/m run of beach
Recession due to sediment loss:	0m /year from Harrington Inlet to about the mid point of the beach embayment. 0.6 m/year from about the mid point of the beach embayment for a distance of 1km to the north then transitioning to 0 m/yr at Crowdy Head.
Recession due to sea level rise:	45 m by 2108, for a sea level rise of 0.9 m.

Appendix A 8.1 and **A 9.1** show the hazard lines for Harrington Beach (north of Harrington Inlet to Crowdy Head). No development, facilities or infrastructure are at immediate risk at Harrington Beach or over the longer term (50 and 100 year planning periods). Some areas may be subject to overwash from wave runup under a 0.9m sea level rise coupled with a 1 in 100 year ARI storm event, as shown in **Appendix A 8.2** and **A 9.2**, i.e. the southern 1.5km of Harrington Beach with low-lying dunes (approximately 5m AHD).

As no assets are at risk from coastline hazards within the 100 year planning period, no management options have been proposed apart from ongoing dune management and maintaining the Harrington Inlet training wall. Maintaining the training wall will:

- continue to train and control the route of the Manning River entrance thereby preventing migration of the river mouth to the north and impacting on Harrington;
- provide some protection to Harrington from the effects of coastal inundation due to elevated water levels resulting from astronomical tides, storm surge and wave setup (caused by breaking waves);

- provide future protection to Harrington from the increased threat of coastal inundation due to sea level rise – training wall crest levels may need to be modified and increased in the future;
- afford protection from aeolian sand drift; and
- prevent recession of the Harrington frontage as a result of scour due to increased flow rates during extreme flood events.

11. ASSESSMENT OF MANAGEMENT OPTIONS

11.1 Background

Physical/ structural and planned retreat management options were considered for existing assets at risk in areas generally affected by the 50 year hazard line, i.e. options for management of the coastline hazard at Diamond Beach and Old Bar over the next 50 years, taken to be the design life of dwellings and protection works. Note that some areas of the GTCC coast affected by the 50 year hazard line are subject to potentially stabilising influences (such as rocky headlands). Accordingly, site specific assessments are likely to identify that risks are mitigated by these influences and hence alterations/ additions and redevelopment may be possible over the next 100 years without placing assets at risk. Accordingly, no structural options were considered in these locations.

In the case of Holiday Parks (where 'at risk' structures are moveable) and future development, environmental planning/ development control options are applicable.

11.1.1 Property Values

Use of Land Value vs Market Value

Information from the Land and Property Management Authority (LPMA) notes that although land valuations do not include the value of dwellings or other improvements, they are based on inspections and analysis of a large number of sales in a locality to gain an in-depth understanding of what is happening in the real estate market. During the valuation process, the valuer examines both vacant land and improved property sales. When comparing property sales to the land being valued, the valuer may take a number of factors into consideration. These include:

- the location of the land;
- soil type and land surface (such as slope);
- town planning controls and constraints on use;
- land size and shape; and
- nearby development and amenities (such as views) (www.lpma.nsw.gov.au).

Accordingly, beachfront land values would be expected to decline over time in light of experienced coastal erosion and recession.

From a review of the available data for single dwellings at Diamond Beach and Old Bar, it appears that current market value is generally around $200,000 more than the land value, making dwellings a relatively small component (approximately 20%) of market value (see **Appendix B** for more information).

Maintaining land improvements over the next 50 years involves a cost, because the market value for a dwelling in 50 years time would approach land value if it was not maintained, renovated or replaced. For this reason, and to avoid relying on limited data on sale prices, land value has been adopted in the evaluation of options for property protection.

Income from general rates has not been taken into account, as part of this income relates to specific property services (e.g. garbage collection) and, over time, there would be an increasing cost in maintaining safe access along the beach (clean up after storms, fencing off steep escarpments). Eventually there would also be demolition costs, while it is anticipated that land value, and hence rates income, would reduce over time due to a reduction in the usable building footprint. In the case of protection works, although proposed legislative changes would allow Councils to levy benefitting landowners, there would still be a cost to Council associated with maintaining public access and beach amenity.

Land value has also been adopted for the cost associated with property purchase because if purchased now, dwellings could be leased or rented until such time as shoreline recession made it necessary to vacate and demolish the building, and if property purchase was delayed until the building was at structural risk from coastal erosion, the property price would approximate the land value.

Information on the LPMA website advises that the permitted use of the land is taken into account in determining land values and where development of the land exceeds current zoning and planning restrictions, the higher existing use is taken into consideration when determining the land value (www.lpma.nsw.gov.au).

On a review of land values along Lewis Street, it does not appear that the value of the existing higher density land use is reflected in the overall valuation for the Meridian Resort. Also, the land value of individual apartments is essentially the total land value divided by the number of lots (41), i.e. generally does not take into account the size of the apartment and whether or not it has ocean views.

The land value of a beachfront lot along Lewis Street appears to be around 70% higher than an equivalent lot on the eastern side of Lewis Street with only road frontage (e.g. land value of No. 30 Lewis Street, located landward of the Meridian Resort, is $370,000 while a similar sized lot with beach frontage, No.4 Lewis Street, is $636,000).

Assuming that this difference is attributable to ocean views and beach access, it is estimated that the total land value of the Meridian beachfront apartments (taken to be 20 lots) is approximately $1,900,000 (if they were on a separate title), with the total value of the remaining lots being approximately $1,090,000 (total land value of $2,990,000). This equates to a beachfront land value of $95,000 per apartment, in contrast to an estimated market value of approximately $500,000 (i.e. approximately $400,000 above land value) and an estimated land value of $51,900 for the remaining lots compared to a market value in the low $200,000s (say approximately $150,000 above market value). Refer to **Appendix B** for more information.

To give some consideration to the existing use value, while maintaining some consistency with land valuations, the total land value of the Meridian Resort has been used in the assessment of options, even though essentially only the beachfront apartments are located seaward of the 50 year hazard line. This approach (approximately $350,000, between land value and estimated market value) was considered reasonable, as it is not possible to relocate or make substantial improvements to individual apartments in the way that relocation, improvements and additions etc. can be made to individual Torrens title dwellings.

Planned Retreat Options

In determining costs associated with planned retreat, reference was made to the *Land Acquisition (Just Terms Compensation) Act 1991* which lists a number of matters to be considered in determining the amount of compensation to which a person is entitled.

Reference was also made to Council's DCP 2010 with regard to building setbacks (generally 5m from the street for one and two storey residential development) and minimum lot sizes (450m^2 for residential lots). The building setback from the seaward side of lots along Jubilee Parade, Diamond Beach is 15m.

11.1.2 Beach Value

Attributing a Value to Beach Amenity

A review of published data on the value of a beach visit (mainly based on travel cost methods) is presented in **Appendix B**. This ranged from around $15 to $100 per visit. As a comparison, other studies on 'willingness to pay' to maintain beach amenity (e.g. to prevent beach erosion or for beach nourishment) ranged from about $30 to $70 per annum per person.

Most of the data on the value of a beach visit related to high profile tourist destinations, such as the Gold Coast. In determining the value of a beach visit to the Greater Taree Coast, a comparison was made of visitor numbers and trip spend for the Gold Coast and other LGAs north of Sydney, with these expressed as percentages. A corresponding value for a beach visit was determined for each LGA, assuming the Gold Coast had the highest trip spend per visit, per annum ($100) and the LGA with the lowest visitation had the lowest trip spend (i.e. $15). This was considered reasonable as travel costs (e.g. accommodation, food and drink, transport fares, fuel etc.) associated with visiting a beach where visitation is high would be expected to be higher.

In addition, although tourism data was used to provide an estimate of the number of visitors to Greater Taree's beaches per annum (i.e. visitors indicating a trip to the beach during their visit), the average trip spend of a visitor visiting the beach ($238.96) was not used as it is recognised that visiting the beach may only be one of a number of activities participated in by visitors. In addition, the trip spend quoted includes money spent on items, such as entertainment, that are not directly related to a trip to the beach.

Through the method described above, the value of a beach visit to the Greater Taree coast was estimated at $19 per visit (see **Appendix B** for further information).

To convert the value of a beach visit to a value per km of beach, $19 was multiplied by the number of visitors to the beach per annum (estimated at 122,000), divided by the length of the Greater Taree coast (excluding most of the coastline with frontage to Crowdy Bay National Park), i.e. 31.5km. This provided a valuation of $73,587 per km of beach, per annum.

11.1.3 Design Assumptions for Structural Options

Of all the engineered options considered, only the construction of a properly engineered seawall (referred to as a vertical structure in this report) or revetment (sloped structure) provides certifiable protection from erosion events. All others rely in some way on modifying coastal processes such that the risk is reduced (usually by maintaining a sand buffer to assets at risk). The other engineered options do not guarantee full or continual protection of the coastline from storm erosion, or continued landward recession. Accordingly these options are considered in combination with nourishment to initially provide the required protective sand buffer due to the limited supply of sediment. The benefit of structures (other than seawalls/ revetments) is that they are likely to reduce the rate at which sand needs to be replenished on a receding beach.

Furthermore, the following generic disadvantages need to be considered in relation to all engineered options:

- relatively high capital cost;
- ongoing maintenance costs; and
- inconsistencies with Ecological Sustainable Development (ESD) principles embodied in the *NSW Coastal Policy 1997*.

It is noted that the NSW Government intends to amend legislation so that councils can require benefitting landowners to contribute to the costs associated with the design, construction, maintenance and operation of protection works, as well as permitting landowners to fund long term protection works.

Conceptual structural options have been developed taking into account the following considerations:

- designs to withstand the 100 year ARI ocean storm design event (water level, wave height and period, scour level, wave runup and other design parameters);
- acceptable damage levels during storm events;
- available construction materials;
- probable construction methodology (which can be a determining criteria in some cases, e.g. groyne crest widths sufficient for construction vehicles);
- scour and settlement; and
- intent of structure (complete or partial mitigation of coastal hazards).

Conceptual designs (plan and sections) are presented for each management option in **Appendix C**. **Appendix C** also includes information on the calculation of beach nourishment volumes to maintain the immediate hazard line seaward of existing dwellings. The design of seawalls/ revetments would allow for the future raising of crest levels to address sea level rise.

11.1.4 Costings

Preliminary cost estimates for each engineered management option are detailed in **Appendix C**. Note that the highly conceptual nature of the designs inhibits accurate costing and estimates should be considered as indicative of the relative order of magnitude only. Consistency in costing assumptions has been maintained across the different options such that a comparative assessment is possible.

The preliminary cost estimates outlined are based on WorleyParsons' experience and judgement as a firm of practising professional engineers, familiar with the construction industry. The cost estimates can NOT be guaranteed as we have no control over Contractor's prices, market forces and competitive tender bids. The cost estimates may exclude items which should be considered in a cost plan. Examples of such items are design fees, project management fees, authority approval fees, contractors risk and other project contingencies (e.g. to account for construction and site conditions, weather conditions, ground conditions and unknown services). The cost estimates by WorleyParsons are not to be relied upon in any way. If a reliable cost estimate is required, then an appropriately

qualified Quantity Surveyor should be engaged following selection of the preferred concepts and detailed design of the works.

11.2 Background to Assessment Matrix

The assessment matrix, **Table 11.1** (Diamond Beach) and **Table 11.2** (Old Bar), relates to management options for areas affected by the 50 year hazard line. It includes:

- current capital and maintenance costs for each option and the value of associated benefits;
- an indication and comment on whether the option is certain to protect assets at risk over the 50 year planning period;
- an indication and comment on whether the option will maintain environmental values and is consistent with ESD principles;
- an indication of the confidence in predicting impacts associated with the option; and
- the benefit-cost in terms of Net Present Value (NPV), benefit-cost ratio and net benefit cost ratio (see **Section 11.2.1** for further explanation).

The benefit-cost analysis does not take into account intangibles such as ecological impacts and impacts such as emotional stress resulting from storm damage to private property or relocation. The value of services at risk, (water mains, power lines, roads etc.) associated with properties at risk has not been included in **Table 11.1** because, although these assets may be lost due to shoreline recession they would no longer be required to service private residences and conversely, if works were undertaken to protect property, services and roads would also be protected.

In addition to options identified by WorleyParsons to address the specific coastal processes operating within the Old Bar Beach and Diamond Beach compartments, **Tables 11.1** and **11.2** address options put forward for examination by the community (i.e. offshore breakwater and groynes). Most options have been costed on the basis of maintaining the value of beach amenity by maintaining beach width.

11.2.1 Benefit-Cost Methodologies

For the analysis of options, it is assumed physical works have a design life of 50 years (i.e. would need to be replaced/ redone in 50 years) and that to maintain beach amenity (beach value), beach nourishment would need to be undertaken periodically in association with physical works (for the purposes of the analysis, taken to be at regular intervals over the 50 year timeframe). As money is worth more now than it will be in the future, a discount rate of 7% has been applied to bring costs and benefits back to present day values. Accordingly, the overall option costs and benefits are calculated in terms of Net Present Value (NPV) (see **Appendix C** which provides the NPV of costs, including maintenance costs and costs associated with loss of beach amenity and benefits including maintenance of beach amenity). Comparison of options has been undertaken using a variety of methods which are discussed below.

- **Benefit-Cost** is the NPV of the costs of the option minus the NPV of the benefits of the option. The disadvantage of the Benefit-Cost method is that the scale of the project is not taken into account (i.e. magnitude of option costs).

- **Benefit-Cost Ratio** which is the benefit of the option in NPV divided by the cost of the option in NPV terms. If the value of the benefit is greater than the cost, i.e. ratio is one or greater, a project is generally taken to be financially feasible. However, this can be misleading when choosing between more than one option, as it is only a measure of relative benefit. In addition, it tends to favour capital intensive projects because capital costs are treated in the same way as recurring costs.
- **Net Benefit-Cost Ratio** which, to some extent, addresses the disadvantages of using the Benefit-Cost Ratio and equals benefits minus recurring costs, divided by the initial investment cost. A negative value in **Table 11.1** or **11.2** indicates that maintenance costs are higher than capital costs.
- **Cost-effectiveness ratio** is where benefits are measured in physical quantities rather than monetary units (units of benefit over costs). This can be useful in evaluating public sector projects, although the units of benefit assigned are subjective (e.g. benefit of option that does not impact on conservation values is 10, while an option that has a major impact on conservation values might be assigned a value of 2). Due to the subjective nature of this method an overall ranking system for options has not been provided. Instead, an indication (tick or cross) and comment on intangibles has been provided in **Table 11.1** and **11.2**.

Information on how values and costs were derived for the assessment matrix are presented in **Appendices B** and **C**.

Table 11.1 Options Assessment Matrix - Diamond Beach

Option	Current Cost	$Cost (current)	Benefit	$Benefit (current)	Certainty in protecting assets at risk over the 50 year planning period		Maintenance of environmental values and consistency with ESD principles		Confidence in predicting impacts	B-C (NPV)	B-C Ratio	Net B-C Ratio
Emergency Protection Works-	capital cost (in 10 yrs) loss of beach	656,500 14,717/yr (years 10-50)	land value Jubilee Pde	21,241,000	✓	- emergency response (geobag seawall) in line with EAP may ensure protection (level of protection would be compromised if structure was damaged during storm event)	✓	- allows for natural coastal processes until assets at immediate threat	moderate – relying on emergency placement of coastal protection compromises decision making, structural integrity/quality, HSE issues, impact mitigation and liability	$18,674,000	16.9	31.4
Property Purchase	land value Jubilee Pde	21,241,000	beach amenity	36,794/yr	✓	- removes assets at risk from storm erosion and coastline recession	✓	- allows for natural coastal processes	high	-$18,166,000	0.1	0.1
Buried Seawall - sand from creek to maintain beach amenity	capital cost maintenance costs	10,127,000 2,834,000/25yrs	land value Jubilee Pde beach amenity	21,241,000 36,794/yr	✓	- provides terminal protection for assets at risk from storm erosion and coastline recession	✓ X	Seawall component: - allows for natural coastal processes until assets at immediate threat Nourishment component: - proposed borrow site in National Park (high conservation value)	high	$6,775,000	1.5	1.7
Buried Seawall - sand trucked in to maintain beach amenity	capital cost maintenance costs	10,127,000 6,604,000/25yrs	land value Jubilee Pde beach amenity	21,241,000 36,794/yr	✓	- provides terminal protection for assets at risk from storm erosion and coastline recession	✓ X	Seawall component: - allows for natural coastal processes until assets at immediate threat Nourishment component: - external borrow site impacts	high	$92,000	1.0	1.1
Nourishment - sand from creek	capital cost maintenance costs	1,352,000 721,500/10yrs	land value Jubilee Pde beach amenity	21,241,000 73,587/yr	X	- does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and alongshore + additional sand to account for sea level rise over 50 years	X	Proposed borrow site in National Park (high conservation value)	high	$18,586,000	5.0	15.7
Nourishment - sand trucked in	capital cost maintenance costs	5,642,000 2,671,500/10yrs	land value Jubilee Pde beach amenity	21,241,000 73,587/yr	X	- does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and alongshore + additional sand to account for sea level rise over 50 years	X	- external borrow site impacts	high	$5,465,000	1.3	2.0

Table 11.1 Options Assessment Matrix - Diamond Beach

Option	Current Cost	$Cost (current)	Benefit	$Benefit (current)	Certainty in protecting assets at risk over the 50 year planning period		Maintenance of environmental values and consistency with ESD principles		Confidence in predicting impacts	B-C (NPV)	B-C Ratio	Net B-C Ratio
Groynes - sand from creek for beach amenity	capital cost maintenance costs	12,129,000 1,241,500/10 yrs	land value Jubilee Pde net beach amenity (erosion nth of groyne field)	21,241,000 95,663/yr	X	- does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and alongshore + additional sand to account for sea level rise over 50 years - limited effectiveness of groyne field in reducing storm erosion and sea level rise recession (offshore losses) - possible exacerbation of storm erosion (offshore losses)	X	Groyne field component: - compartmentalisation of beach - significantly altered beach state and surf character, downdrift sacrificial erosion along undeveloped portion of Diamond Beach - visual amenity impacts Nourishment component: - proposed borrow site in National Park (high conservation value)	high	$7,095,000	1.4	1.6
Groynes - sand trucked in for beach amenity	capital cost maintenance costs	16,419,000 2,671,500/10yrs	land value Jubilee Pde net beach amenity (erosion nth of groyne field)	21,241,000 95,663/yr	X	- does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and alongshore + additional sand to account for sea level rise over 50 years - limited effectiveness of groyne field in reducing storm erosion and sea level rise recession (offshore losses) - possible exacerbation of storm erosion (offshore losses)	X	Groynes field component: - compartmentalisation of beach - significantly altered beach state and surf character, downdrift sacrificial erosion along undeveloped portion of Diamond Beach - visual amenity impacts Nourishment component: - external borrow site impacts	high	-$3,596,000	0.9	0.8

Table 11.2 Options Assessment Matrix – Old Bar

Option	Current Cost	$Cost (current)	Benefit	$Benefit (current)	Certainty in protecting assets at risk over the 50 year planning period		Maintenance of environmental values and consistency with ESD principles		Confidence in predicting impacts	B-C (NPV)	B-C Ratio	Net B-C Ratio
Planned Retreat	partial acquisition: - Meridian Resort for beach access - remainder Lewis St for beach access - Pacific Pde for road access acquisition for beach access in 10 yrs: - Meridian (20 apartments) - remainder Lewis St (14 lots) - Pacific St (13 lots) relocate exfiltration ponds in 10 years	 949,380 4,983,342 571,296 549,940 591,945 429,655 2,5000,000	beach amenity at: - Lewis St/Pacific St - exfiltration ponds	40,473/yr 55,190/yr	✓	- removes assets at risk from storm erosion and coastline recession	✓	- allows for natural coastal processes	high	-$5,503,000	0.4	0.4
Property Purchase	land value Meridian land value rest of Lewis St (23 lots) land value Pacific Pde (7 lots) relocate exfiltration ponds	2,990,000 15,198,032 2,698,000 2,500,000	beach amenity at: - Lewis St/Pacific St - exfiltration ponds	40,473/yr 55,190/yr	✓	- removes assets at risk from storm erosion and coastline recession	✓	- allows for natural coastal processes	high	-$17,475,000	0.2	0.2
Revetment	capital cost maintenance costs relocate of exfiltration ponds loss of beach amenity (Lewis St/Pacific Pde)	9,503,000 325,000/5yrs 2,500,000 50,039/yr	land value Meridian land value rest of Lewis St land value Pacific Pde (7 dwellings + rd) beach amenity at exfiltration ponds	2,990,000 15,198,032 2,698,000 55,190/yr	✓	- provides terminal protection for assets at risk from storm erosion and coastline recession	X	- construction would affect SEPP 26 littoral rainforest - modification (training) of Racecourse Creek - eventual loss of beach in front of revetment - exposed revetment - end effects of revetment wall would cause increased recession at either end of structure	high	$5,552,000	1.3	1.4
Revetment + nourishment to maintain beach amenity	capital cost maintenance costs (revetment + nourishment) relocate of exfiltration ponds	13,728,000 2,476,500/5yrs 2,500,000	land value Meridian land value rest of Lewis St land value Pacific Pde (7 dwellings + rd) beach amenity: - Lewis St/Pacific St - exfiltration ponds	2,990,000 15,198,032 2,698,000 64,021/yr 55,190/yr	✓	- provides terminal protection for assets at risk from storm erosion and coastline recession	X	- construction would affect SEPP 26 littoral rainforest - periodical exposure of revetment - periodical narrowing of beach after storm events - maintenance nourishment to mitigate loss of beach and end effects	moderate - effectiveness of maintenance nourishment may be limited due to rapidly receding beach system	-$15,573,000	0.6	0.1
Nourishment	capital cost maintenance costs	26,247,000 26,234,000/10 yrs	land value Meridian land value rest of Lewis St land value Pacific Pde (7 dwellings + rd) exfiltration ponds beach amenity	2,990,000 15,198,032 2,698,000 2,500,000 309,067/yr	X	- does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and alongshore + additional sand to account for sea level rise over 50 years - requires ongoing commitment to maintenance nourishment in perpetuity	X	- possible impact on migratory water and shorebird habitat but could be mitigated through timing of works - dredging in Farquhar Inlet may affect SEPP No.14 wetlands, oyster leases - large volumes of sediment required would significantly alter the borrow site (Farquhar Inlet)	high	-$114,754,000	0.2	-3.5

Table 11.2 Options Assessment Matrix – Old Bar

Option	Current Cost	$Cost (current)	Benefit	$Benefit (current)	Certainty in protecting assets at risk over the 50 year planning period		Maintenance of environmental values and consistency with ESD principles		Confidence in predicting impacts	B-C (NPV)	B-C Ratio	Net B-C Ratio
Entrance structure + nourishment	capital cost maintenance costs (training wall) maintenance costs (nourishment)	37,908,000 4,554,420/25yrs 9,204,000/10yrs (yrs 20 to 50)	land value Meridian land value rest of Lewis St land value Pacific Pde (7 dwellings + rd) exfiltration ponds beach amenity	2,990,000 15,198,032 2,698,000 2,500,000 309,067/yr	X	- does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and alongshore + additional sand to account for sea level rise over 50 years - erosion on Manning Beach due to change to entrance and alongshore sediment transport regime	X	- would significantly alter the hydraulic regime of Farquhar Inlet and the Manning River - entrance structure would impact on surf character, visual amenity, safety issues - marinisation of the estuary entrance compartment - may have water quality benefits for oyster leases Nourishment component: - as for massive beach nourishment	low – changes in hydraulic regime of the Manning River may have significant and unpredictable consequences similarly for the impact of the entrance structures on surf character	-$49,483,000	0.5	-0.2
Groyne field + nourishment	capital cost maintenance costs (nourishment)	34,788,000 9,204,000/10yrs (yrs 20 to 50)	land value Meridian land value rest of Lewis St land value Pacific Pde (7 dwellings + rd) exfiltration ponds beach amenity	2,990,000 15,198,032 2,698,000 2,500,000 309,067/yr	X	- does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and alongshore + additional sand to account for sea level rise over 50 years - limited effectiveness of groyne field in reducing storm erosion and sea level rise recession (offshore losses) - possible exacerbation of storm erosion (offshore losses)	X	- compartmentalisation of beach - significantly altered beach state and surf character - visual amenity impacts Nourishment component: - as for massive beach nourishment	low – complexity of coastal processes ensures predicting resultant impacts and effectiveness of option would be uncertain	-$38,082,000	0.5	-0.0
Offshore reef + nourishment	capital cost maintenance costs (nourishment)	19,747,000 9,204,000/10yrs (yrs 20 to 50)	land value Meridian land value rest of Lewis St land value Pacific Pde (7 dwellings + rd) exfiltration ponds beach amenity	2,990,000 15,198,032 2,698,000 2,500,000 309,067/yr	X	- does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and alongshore + additional sand to account for sea level rise over 50 years - limited effectiveness of reef in reducing storm erosion and sea level rise recession (offshore losses) - possible exacerbation of storm erosion (offshore losses)	✓ X	Reef component: - provision of habitat values (marine ecology) - provision of amenity values (surfing reef - if design as such) - minimal change to beach state - may cause increased recession on either side of structure Nourishment component: - as for massive beach nourishment	low – complexity of coastal processes ensures predicting resultant impacts and effectiveness of option would be uncertain	-$23,997,000	0.7	0.1

12. REFERENCES AND BIBLIOGRAPHY

Anning D., Dominey-Howes D. and Withycombe G. (2009). "What Price Climate Change? – Valuing Sydney Beaches to inform coastal management decisions" in *Management of Environmental Quality, Volume 20, Issue 4,* pp408-421.

Anning D., Dominey-Howes D. and Withycombe G. "Economic Value of Sydney Beaches". Proceedings of *18th NSW Coastal Conference, 3-6 November 2009, Ballina NSW.*

Bell, F.W. and Leeworthy, V.R. (1990). "Recreational Demand by Tourists for Saltwater Beach Days". *Journal of Environmental Economics and Management, 18:189-205.*

Couriel E. Carley J. (2010). "Surfing Reefs – Dollars and Sense" in *7th International Surfing Reef Symposium, Sydney 18-19 March 2010.*

DECCW (2009). "Reforms to Coastal Erosion Management in NSW". Information sheet DECCW 2009/704, October 2009.

Department of Lands (1984). *Old Bar Park Plan of Management.* Prepared by Endean R. P., Knight W. J. and Cocchini C. A., Crown Lands Office Taree, for Greater Taree City Council.

Department of Planning (DoP, 2009). *Mid North Coast Regional Strategy 2006-31*.

DEWHA (2009). *Australian Heritage Database*. http://www.environment.gov.au/heritage/ahdb/. Department of Water Heritage and the Arts.

DLWC (2000). *Coastal Dune Management Manual*. NSW Department of Land and Water Conservation. October 2001. ISBN 0 7347 5202 4

Greater Taree City Council (GTCC, 2006). Flora and Fauna Survey Guidelines, Greater Taree Local Government Area.

GTCC (1990). *Coastline Management Plan, Racecourse Creek/ Lewis Street Old Bar.*

Houston J. R. (2008). "The economic value of beaches – A 2008 update" in *Shore & Beach, Vol. 76, No.3, Summer 2008,* pp22-25.

Hunter Valley Research Foundation (2005). Greater Taree Economic Profile Current Structure and Future Directions.

Klaver J. and Keffernan K. J. (2009). *Greater Taree Aboriginal Heritage Study*. National Heritage Studies Pty Ltd.

Lazarow N. and Nelsen C. (2007). "The Value of Coastal Recreational Resources: A Case Study Approach to Examine the Value of Recreational Surfing to Specific Locales" in *Proceedings of Coastal Zone 07, Portland, Oregon,* July 2007.

Lazarow N. and Tomlinson R. (2009). "Using observed market expenditure to estimate the value of recreational surfing to the Gold Coast, Australia", Proceedings *Queensland Coastal Conference, 12-15 May 2009, Gold Coast.*

Love (1985). *Photographic record of the Black Head Lagoon*. In: Black Head Lagoon Entrance Plan of Management. Greater Taree City Council 2008.

NSW Government (2008). *North Coast Urban Design Guidelines*. Department of Planning. Prepared by HASSEL.

NSW Government (1990). *Coastline Management Manual*. NSW Government. September 1990. ISBN 0730575063.

NSW Treasury (2007), *Economic Appraisal Principles and Procedures, Simplified.*

Orogen (2007). *Local Environment Study Old Bar – Wallabi Point, Precinct 1*. Final Report. Prepared for Greater Taree City Council April 2007.

Penning-Rowsell, E.C., Green, C.H., Thompson, P.M., Coker, A.M., Tunstall, S.M., Richards, C. and Parker, D.J. (1992a). Chapter 8 "Case Studies in The Economics of Coastal Management". *A Manual of Benefit Assessment Techniques. Bellhaven Press London*. (Chapter 8, p. 156-192) [in Envalue].

Pitt, M. W. (1993). "The Contingent Value of Maintaining Natural Vegetation on Beach Dunes". Paper presented to the *37th Annual Conference of the Australian Agricultural Economics Society, Sydney, 9-11 February* [in Envalue].

Pitt, M. (1992a). "The Value of Coastal Land". Proceedings of the *36th Australian Agricultural Economics Society Conference, Canberra*. [in Envalue]

Pitt, M. (1992b). "Value of Beach and Dune Maintenance to Tourism". In Lockwood, M. and Delacy, T. (eds) *Valuing Natural Areas*, Johnston Centre of Parks, Recreation and Heritage, Albury. [in Envalue]

Polome, P., Marzetti, S. and van der Veen, A. (2005). "Economic and social demands for coastal protection" in *Coastal Engineering 52 (2005)* pp819-840.

Ranasinghe, R. and Turner, I. L. (2006). "Shoreline response to submerged structures: A review in *Coastal Engineering 53* (2006) 65-79.

Raybould, and Lazarow, N. (2009). *Economic and Social Values of Beach Recreation on the Gold Coast,* CRC for Sustainable Tourism.

Riedel and Byrne Consulting Engineers Pty Ltd. (1981). *Diamond Beach Coastal Erosion Study*. Public Works Department NSW. Report P.W.D. 81016. ISBN 0724064486

RP Data Ltd (2009) as quoted in www.realestate.com

Short A. (2007). *Beaches of the New South Wales coast: a guide to their nature, characteristics, surf and safety*. Sydney: Sydney University Press, 2007.

Siberman, J., Gerlowski, D. A. and Williams, N. A. (1992). "Estimating Existance Value for Users and Non Users or New Jersey Beaches" in *Land Economics, 68(2): 225-236* [in Envalue].

Sinclair Knight & Partners (SKP 1982). *Old Bar Coastal Erosion Study*.

Warren, M. (1999). *Atlas of Australian Surfing.* HarperCollins Australia.

Internet References

http://wildlifeatlas.nationalparks.nsw.gov.au/ wildlifeatlas/watlas.jsp

www.domain.com.au

www.lpma.nsw.gov.au/valuation/land_valuation_process

www.osr.nsw.gov.au

www.realestate.com - RP Data Ltd (2009)

www.tourism.nsw.gov.au – Domestic Overnight Travel to the Mid North Coast Year ended September 2009.

www.ret.gov.au/tourism/tra – caravan or camping in Australia 2008.

www.ret.gov.au/tourism/tra Tourism Profiles for Local Government Areas

Appendix A - Hazard and Inundation Lines

Appendix B - Land, Property and Beach Amenity Values

Appendix C - Options and Costs