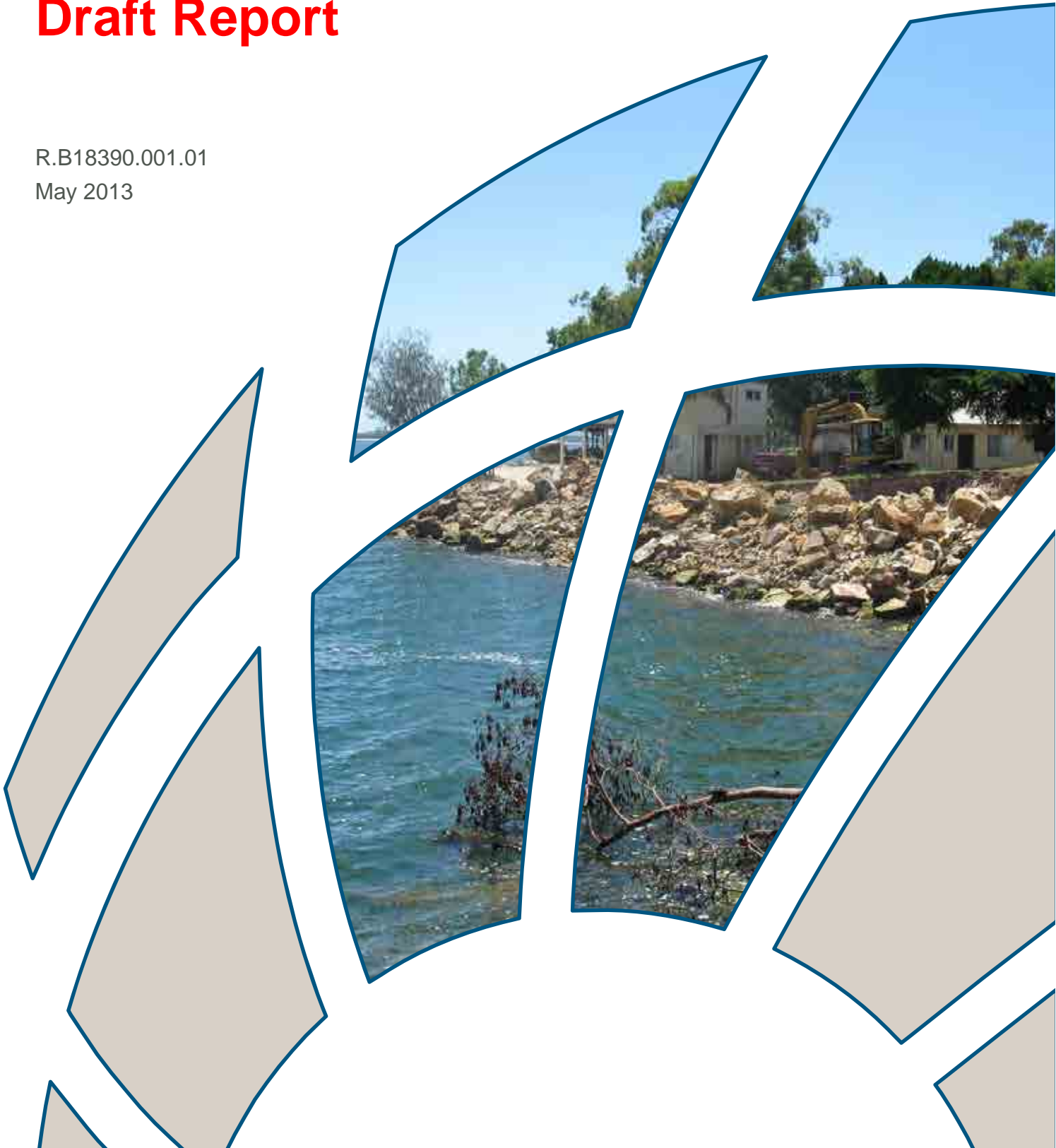


Amity Point Shoreline Erosion Management Plan **Draft Report**

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Amity Point Shoreline Erosion Management Plan Draft Report

DRAFT

Prepared For: Redland City Council

Prepared By: BMT WBM Pty Ltd (Member of the BMT group of companies)

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| Title : | Amity Shoreline Erosion Management Plan – Draft Report |
| Author : | Malcolm Andrews, Matt Barnes, Lyn Léger |
| Synopsis : | This report is a Shoreline Erosion Management Plan for the Amity shoreline and outlines the principal coastal processes, legislative framework and recommended erosion management strategies for this shoreline. |

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EXECUTIVE SUMMARY

Background

The Amity community is situated on the north western side of North Stradbroke Island with the commercial centre located at Amity Township immediately south of Amity Point (refer Figure 1-1). A significant part of the study area fronts onto the Moreton Bay Marine Park, a national park with significant environmental values.

The Amity shoreline has a history of active shoreline management as shoreline erosion has threatened development and assets in the past and various protection and rehabilitation works have been carried out in response to the erosion threat. Historical protection measures mostly include the construction of seawalls and groynes.

Redland City Council has recognised the threat of persistent erosion to the cultural and socio-economic welfare of its community and in particular the safety issue related to dramatic bank slumping into Rainbow Channel. The Council has therefore embarked on the process of developing a Shoreline Erosion Management Plan (SEMP) for the Amity shoreline.

This report is prepared as part of the development of a SEMP for the Amity shoreline with the aim being to provide a plan for the management of persistent shoreline erosion around Amity Township and more stable conditions in the outlying communities. It is Redland City Council's objective to maintain and increase where possible the amenity of the foreshore.

Planning and Legislative Framework

Proposed management options recommended within this SEMP must be consistent with the local government planning scheme, and comply with all relevant legislation (Commonwealth, State and local) and coastal and environmental policies.

The basis and control of management of the coast of Queensland is governed by the *Coastal Protection and Management Act 1995* (Qld). The Queensland Coastal Plan (QCP), including the State Policy for Coastal Management (SPCM), and the Coastal Protection State Regulatory Planning Provision (Coastal SPRP) set out more detailed provisions for the management of the coastal zone and recommendations in this SEMP. The SCMP seeks to manage all coastal land and coastal resources and the Coastal SPRP provides a framework for decision-making regarding assessable development in the coastal zone.

At a local level, the Redland City Council Planning Scheme zones the seaward side of the urban residential area of Amity Point as sub-area UR3 (areas west of Ballow Street). Within this area all future buildings and structures are to be demountable and capable of removal. In addition buildings, structures or infrastructure associated with the use of other development are not to extend any further seaward than existing uses and development on the site. This is part of a strategic plan of retreat proposed by RCC whereby the line of development will retreat as shoreline erosion continues, rather than redeveloping within the erosion prone area (RCC 2011a).

Coastal Processes

It has long been known that the coastline at Amity is largely influenced by the ongoing meandering of Rainbow Channel, and to a lesser extent the Rous Channel and South Passage, which all carry the tidal flow between Moreton Bay and the Pacific Ocean. The previous data collection campaigns and numerical modelling undertaken for this study indicate that the ebb tide flow and associated sand transport tends to force the Rainbow Channel current hard against the Amity shoreline from Amity Point to the Amity boat ramp with tidal velocities up to 1.8m/s occurring. Aerial photography shows that the channel in front of Amity Township is deepest with a broadening and shallowing of the channel adjacent to the Amity Caravan Park. Historical aerial photography indicates the channel width at Amity has reduced from over 900m in 1958 to around 750m today.

On the north east coastline ocean swell is significantly attenuated by the time it reaches the western end of Flinders Beach but still transports sand along Flinders Beach towards Rainbow Channel near Amity Point. A small proportion of this sand is caught in the Rainbow Channel flows and progresses along the shoreline of Amity as shoals but does not provide any long term benefit to the shoreline.

The more significant of the local wind waves approaches the shore from the southwest and can reach a height of 0.7m. These waves will tend to cause limited beach erosion at or near high tide level and small scarps in the unrevetted sandy areas will occur as sand is moved offshore. In particular this is of concern in the recessed beaches between the groynes in front of the Amity Caravan Park and to the immediate north of the end of the rock revetment at Amity Point.

The Flinders Beach shoreline continues to receive a supply of sand from the east driven by ocean swell. The continuing rotation of the Rainbow Channel is allowing the South Bank area to the east of Amity Point to grow northwards resulting in accretion on Flinders Beach and foreshore stability in recent times. However, this may reverse at any time in the future dependent on channel movements, offshore shoal configurations and the continued supply of sand around Pt Lookout.

Both mean sea level rise and intensification of the storm occurrences are likely to increase the erosive pressure on the Amity shoreline and may change the historical accretion on Flinders Beach. With mean sea level rise likely to accelerate due to climate change, the tidal compartment of Moreton Bay will increase substantially resulting in greater flows in Rainbow Channel and increased pressure on the Amity shoreline.

In addition to shoreline erosion due to channel alignment and beach profile alterations, increased sea level rise has also the potential to affect the longshore sediment supply to Flinders Beach as the headland at Pt Lookout may tend to interrupt the longshore sand transport. This may decrease the amount of sand current entering the system from the east resulting in changes both at Flinders Beach and Amity Point.

Options Assessment

A full range of management options have been considered for each beach unit including:

- Do nothing;
- Beach nourishment;
- Channel relocation;

- Structures; and
- Retreat.

SEMP Recommendations

Amity Township

It is considered that there are only two options which are likely to be successful at Amity Township.

Firstly, the design and construction of a full rock revetment at an estimated cost of \$15M with the expectation that this will need to be extended in the future as Rainbow Channel continues to realign.

Secondly, planned retreat where the danger zone related to unforeseen slumping of the foreshore into Rainbow Channel is assessed by a Geotechnical Consultant and affected buildings and infrastructure is moved out of the nominated danger zone. To allow a comparison of costs in this report a nominal value of \$3M in relation to building relocation has been allocated to this option. The seaward side (west of Ballow Street) of this area is zoned UR3 in the Council's Town Planning Scheme 1998 which requires future buildings or infrastructure to be demountable and capable of being removed.

Of these it is recommended that the planned retreat strategy be implemented as it has the highest likelihood of success, lower cost and will leave the foreshore in a natural state.

Amity Caravan Park

After assessment of the management options, it is recommended that the beach nourishment option be implemented at this beach. The beach nourishment will provide added protection to the assets and minimise the need for other structural protection measures in the future. It will retain natural processes and provide an improvement to the beach amenity.

The likely minimum quantity of sand required to provide appropriate protection would be in the order of 335 cubic metres. The estimated capital cost of the recommended initial beach nourishment works is estimated to be \$10,000, based on a beach nourishment requirement of 335m³ of sand sourced locally and delivered by truck then spread by backhoe.

For ongoing maintenance beach nourishment, there should be a provision of \$1,000 per annum, which may need to increase in the future if mean sea level rise accelerates due to climate change. In addition, there should be some provision for costs associated with routine dune vegetation and management at this beach.

Flinders Beach

The recommended shoreline erosion management strategy for the communities of Geera Street and Providence Street is to "do nothing" at this time and monitor the location of the shoreline.

After a review of the coastal processes, risks and values at each of section of the shoreline, potential management options for each beach were assessed. A detailed discussion on the possible management options and the recommended strategies for each individual beach is provided above.

Summary

After review of the coastal processes, risks and values for the Amity shoreline and an assessment of the available management options, the following actions have been recommended:

1. Immediate education campaign regarding danger of dramatic slumping into Rainbow Channel;
2. Geotechnical Consultant assessment of slump danger zone;
3. Retreat of assets within danger zone;
4. Nourishment of beaches between the groynes at the Amity Caravan Park; and
5. Ongoing monitoring of beach condition and success of management strategies.

Program of Works and Cost Estimate

Implementation of the recommended Amity Geotechnical Assessment and beach nourishment at the Amity Caravan Park would cost in the order of \$110,000 over 12 months based on present understanding of the required works and sand sourced locally.

Any future costs at Amity will be determined by the method in which the retreat option is implemented. Nourishment maintenance at the Amity Caravan Park would require expenditure of about \$1,000 annually. The monitoring survey costs should be able to be incorporated into routine Council surveying costs. The implementation plan is summarised in the table below.

Note that non-action, or works inconsistent with the recommended SEMP strategy, may result in greater risks and increased rehabilitation costs in the longer term.

| <i>Beach/Shoreline Location</i> | <i>Recommended Erosion Management Strategy</i> | <i>Activity and Cost</i> | <i>Timing</i> |
|--|---|--|----------------------|
| Amity Township | Retreat out of assessed danger zone | \$100,000 Geotechnical Consultant definition of danger zone. | Year 1 |
| | Retreat out of assessed danger zone | Remove buildings and infrastructure. Planning Scheme indicates building relocation by owner. | Year 2 |
| Amity Caravan Park | Minor beach nourishment | \$10,000 initial + \$1,000 annual maintenance | Year 1 |
| Flinders Beach Communities | Do nothing and monitor | Routine Council expenditure | Ongoing |

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1 INTRODUCTION

1.1 Background

The Amity community is situated on the north western side of North Stradbroke Island with the commercial centre located at Amity Township immediately south of Amity Point (refer Figure 1-1). A significant part of the study area fronts onto the Moreton Bay Marine Park, a national park with significant environmental values.

The coastal zone at Amity is an important recreational and aesthetic asset for both the residents of Amity and the wider community of North Stradbroke Island. The shoreline is diverse and comprises sandy beaches with headlands, groynes and further afield areas where mangroves front the shoreline. Nearby Point Lookout provides rocky outcrops and cliffs. The Amity shoreline has a history of active shoreline management as shoreline erosion has threatened development and assets in the past and various protection and rehabilitation works have been carried out in response to the erosion threat. Historical protection measures mostly include the construction of seawalls and groynes.

Redland City Council has recognised the threat of persistent erosion to the cultural and socio-economic welfare of its community and in particular the safety issue related to dramatic bank slumping into Rainbow Channel. The Council has therefore embarked on the process of developing a Shoreline Erosion Management Plan (SEMP) for the Amity shoreline.

This report is prepared as part of the development of a SEMP for the Amity shoreline with the aim being to provide a plan for the management of persistent shoreline erosion around Amity Township and more stable conditions in the outlying communities. It is Redland City Council's objective to maintain and increase where possible the amenity of the foreshore.

1.2 Description of the Amity SEMP Study Area

The coastline at Amity is largely influenced by Rainbow Channel and to a lesser extent the Rous Channel and South Passage, which all carry the tidal flow between Moreton Bay and the Pacific Ocean. In particular, Rainbow Channel has been realigning from a southwest-northeast alignment to a more south-north alignment over the last century. A positive aspect of this has been to slow accretion of Flinders Beach on the northeast side of Amity Point.

Because of the asymmetry of the tidal wave a large volume of sand has migrated through the entrance and exists as shoals adjacent to, and many kilometres to the south and west of, Rainbow Channel and Rous Channel but these do not provide any protection to the Amity shoreline. Similarly ocean swell transports a low volume of sand along Flinders Beaches towards Rainbow Channel near Amity Point. A small proportion of this flow enters Rainbow Channel but does not provide any long term benefit to the shoreline at Amity.

The study area of this SEMP includes the shoreline which stretches from southern end of Basin Drive to Millers Lane at the northern end of the Amity Township and also includes the small communities at Geera Street and Providence Street facing Flinders Beach.

There are numerous shoreline protection structures along the shoreline at Amity, including several groynes and a range of revetment walls. Furthermore, there is a significant area of land which has been lost to the sea including whole lots and parts of many other lots. This has been despite mitigation measures including groynes and rock revetments since the 1950's.

1.3 Coastal Management Requirements

The coastline at and near Amity is subject to a range of natural and man-made threats and various erosion protection and rehabilitation projects have been carried out in the past. In general the following points can be made regarding the shoreline:

- The shoreline movements at Amity appear to be slowly but persistently erosive and are influenced by the ongoing meandering of Rainbow Channel and to a lesser extent Rous Channel and South Passage;
- The foreshore has substantial development, comprising mostly private residential property and some public infrastructure. Coastal structures in the form of rock revetments have been constructed to protect private property and infrastructure against erosion threats; and
- The depth of the adjacent channel (up to 20m) makes the building of a robust revetment very difficult and the existing rock revetments are perched on the top of the bank which is subject to undercutting and dramatic failure.

The present study is aimed at reviewing the dominant coastal processes, which shape the shoreline, the legislative conditions and values which may restrict the implementation of viable shoreline erosion management options and the existing management options which are currently in use.

An understanding of the coastal processes and legislative conditions is essential for the development of engineering and management options for dealing with risk associated with shoreline erosion. Ongoing policy guidance for identifying and assessing issues, specific objectives and suitable options will be provided through liaison with the Council and other stakeholders.



Figure 1-1 Locality Map (Source: Google Earth)

2 PLANNING AND LEGISLATIVE FRAMEWORK

This chapter outlines legislation, regulation and policies that require consideration in the development of the Amity Point SEMP. It has been compiled based on legislation, regulation and policies current at the time of writing. Further consideration should be given to the requirements current at the time of implementing erosion management recommendations. The legislation, regulation and policies mentioned in this chapter are not meant to be a comprehensive list but should be used as a starting point and guide for determination of considerations at the time of approval and construction.

Proposed management options recommended within the SEMP must be consistent with the local government planning scheme of the Redland City Council (RCC) and comply with all relevant legislation (Commonwealth, State and local) and coastal and environmental planning instruments and policies.

The basis and control of management of the coast of Queensland is governed by the *Coastal Protection and Management Act 1995 (Coastal Act)*. Under this Act, the Queensland Coastal Plan (QCP) is the primary statutory planning instrument giving effect to the objects of the Act. The following planning and legislative framework relates to the provisions of the QCP as they apply to Amity Point. Legislation and policies considered in this SEMP will require consideration of issues including, but not limited to:

- The use of coastal structures for property protection;
- Protection of species listed under State and Commonwealth legislation and conservation of their habitat;
- Management of shoreline erosion in a manner that is not detrimental to the adjacent Moreton Bay Marine Park and Ramsar site; and
- The maintenance of local biodiversity.

These legislative and policy considerations are described in more detail in the following chapters.

2.1 Coastal Act

The Queensland *Coastal Act* provides for management of the coastal zone.¹ The *Coastal Act* recognises the diverse range of resources and values of the coastal zone, and has the following objectives:²

- Provide for the protection, conservation, rehabilitation and management of the coastal zone, including its resources and biological diversity;
- Have regard to the goal of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone;
- Ensure decisions about land use and development safeguard life and property from the threat of coastal hazards; and

¹ Coastal waters and land up to a point 5km landward of the high-water mark or the point nearest the high-water mark where land reaches 10m AHD, whichever is more landward: ss15 and 18A *Coastal Act*

² s3

- Encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.

The main means of achieving this management under the *Coastal Act* is the regulation of development and allocations, and the preparation of management plans.

The QCP has been developed as a State Planning Instrument (SPI) under the requirements of the *Coastal Act*.³ The plan consists of the State Policy for Coastal Management (SPCM).

2.1.1 State Planning Instruments

The Queensland Government currently manages development in the coastal zone using two State Planning Instruments: the QCP, consisting of the SPCM, and the Coastal Protection State Planning Regulatory Provision (Coastal SPRP). Both of these instruments have application to the coastal zone as defined by the *Coastal Act*. The SCMP seeks to manage all coastal land and coastal resources within this zone and applies to all management planning, activities, decisions and works that are not assessable development under the *SP Act*, including the development of a SEMP. The Coastal SPRP provides a framework for decision-making regarding assessable development in the coastal zone. In addition, the Draft State Planning Policy (SPP) has been recently released and is intended to replace all other SPPs in the State. While not yet a binding instrument, it should be considered in planning for development.

For the purposes of developing the Amity Point SEMP, the SPCM will be applied. At the time of implementation of recommendations within the SEMP (e.g. submission of development applications for construction of coastal protection works), the Coastal SPRP and Draft SPP will be applied. In this context, all three instruments are considered below.

2.1.1.1 State Policy for Coastal Management

The SPCM provides for the decision-making of managers of State and local coastal land and coastal resources, and for the owners of private coastal land. The policy is based on five (5) overall outcomes for management.⁴ Application of the SPCM is to ensure that management of coastal land:

- Protects, conserves and enhances coastal resources;
- Maintains natural physical coastal processes through appropriate design of works and structures or by setting them back from vulnerable areas;
- Ensures infrastructure and services facilitate managed public use of the coast without having significant adverse impacts on ecological values or physical coastal processes;
- Ensures that management actions on State or local government coastal land is consistent with the policy outcomes of the QCP; and
- Encourages public participation in the management of public coastal land, collaborative actions, knowledge sharing, community awareness and the monitoring, review and reporting of the effectiveness of management.

These overall policy outcomes are further divided into 13 specific policy outcomes:⁵

³ Chapter 2 Part 1

⁴ Part 2

1. *Protection Coastal Processes in Erosion Prone Areas* – natural coastal processes including erosion and accretion are able to occur without interruption;
2. *Buildings and Structures in Erosion Prone Areas* – structures (including all infrastructure) in erosion prone areas are designed, located and managed to ensure the impacts on coastal processes are avoided or minimised;
3. *Dune Management* – dunes are to be protected and dune vegetation is maintained and enhanced;
4. *Management of Areas of Ecological Significance* – protect areas of high ecological significance and conserve other ecological values;
5. *Indigenous Cultural Heritage* – the living culture of Indigenous Traditional Owners and their connection with cultural resources and in marine areas is maintained and enhanced;
6. *Public Access and Use of the Coast* – public access and use of the coast is maintained and enhanced for current and future generations;
7. *Buildings and Structures on State Coastal Land* – buildings and structures (including all infrastructure) are established on State coastal land only where they are essential, provide a public service, and cannot be feasibly located elsewhere;
8. *Driving on Beaches* – driving on beaches is not supported unless required for access and is actively managed to prevent significant impacts on ecological values and ensure a safe environment for other beach users;
9. *Management Planning* – management and use of coastal land is guided by plans of management;
10. *Monitoring and Review* – coastal land managers achieve effective coastal management through regular monitoring, reviewing and reporting mechanisms;
11. *Knowledge Sharing and Information* – knowledge and awareness of coastal resources and their management is shared with the community;
12. *Community Engagement* – the community is engaged in coastal management decision-making processes; and
13. *Review of the State Policy for Coastal Management.*

Each of these specific policy outcomes is given effect by the application of relevant policies. As SEMP's are developed for priority areas for shoreline erosion management, the most relevant policy outcomes and related policies to the preparation of the Amity Point SEMP are those regarding buildings and structures and protecting coastal processes in erosion prone areas.

Protecting Coastal Processes in Erosion Prone Areas

Specific policy outcome (SPO) 1, *Protecting Coastal Processes in Erosion Prone Areas*, establishes a framework for the protection of naturally occurring processes of erosion and accretion in the coastal zone. Specifically, the policy prevents the modification of natural coastal processes in the erosion prone area subject to some exceptions. Erosion prone areas are defined as the area included in an erosion prone area plan developed by the Minister under the *Coastal Act*. For Amity Point, the

⁵ Part 3

erosion prone area is marked by a line 145m inland from the seaward toe of the frontal dune. See 2.1.1.2 and Appendix A for details on mapping erosion prone areas. See also Figure 2-3 for the erosion prone area for Amity Point.

Works in the erosion prone area are not to impact upon coastal processes. The means of achieving this outcome required by Policies 1.1, 1.2, 1.4 and 1.5 of SPO1 is the use of native vegetation management to stabilise land and promote dune building processes, the creation of buffer zones free of buildings and structures (see SPO2 below), the preservation of longshore transport processes, the retention of dune and beach system sand volume, and the maintenance of dune crest heights (*Policy 1.1, Policy 1.2, Policy 1.4 and Policy 1.5*). This promotes a system of coastal management relying upon maintenance of coastal features. Where erosion occurs along the coast, soft protection measures involving the relocation and augmentation of natural coastal sediments, such as beach nourishment, beach scraping and beach reprofiling, are preferred.

There are exceptions, however, to these requirements. Buildings and structures are permitted in the erosion prone area where they are temporary and relocatable and for recreation or safety purposes (*Policy 1.2*). Longshore transport processes can also be disrupted where there is no significant impact or any impact can be compensated by nourishment of sand bypassing (*Policy 1.3*). Most importantly, however, total sand volume in the dune and active beach system may be reduced by development where there is no significant impact, adequate beach nourishment, or there is a need to protect property from coastal processes (*Policy 1.4*). Shoreline erosion management works impacting upon the dune and beach system, therefore, are justifiable on grounds of property protection or where there is sufficient beach nourishment. Table 2-1 summarises the requirements and exemptions of SPO1.

Table 2-1 Summary of Requirements and Exemptions of Specify Policy Outcome

| Policy | Requirement | Exemptions |
|--------|---|---|
| 1.1 | Stabilisation of land/maintenance of foreshore processes by management of native vegetation | N/A |
| 1.2 | Natural fluctuations of the coast preserved by coastal buffer free of structures | Temporary and relocatable structures for recreational/safety purposes |
| 1.3 | No disruption of longshore transport (e.g. by groynes, dredging) | Activities causing no significant impact or compensated by bypassing or nourishment |
| 1.4 | Sand volume in dunes/active beach system preserved | Activities causing no significant impact, compensated by nourishment from outside active system, or necessary to protect property |
| 1.5 | Dune crest heights maintained for protection | N/A |

Buildings and Structures in Erosion Prone Areas

SPO2, *Building and Structures in Erosion Prone Areas*, aims to ensure that all structures within the erosion prone area are designed, located and managed to ensure a minimal impact on the coastal zone and coastal processes.

To avoid impacts to buildings and structures, new development should be located outside the erosion prone area or as landward as possible in manner minimising the need for future protection works (*Policy 2.1*). Development may still occur in the erosion prone area where it is any of the following: (1) for State reserved coastal land, consistent with the public purpose of the reserve; (2) coastal-dependent access facilities; (3) temporary or relocatable; (4) essential community infrastructure that cannot feasibly be located elsewhere; or (5) redevelopment not increasing the risk of a structure for erosion (*Policy 2.2*).

Where there is a potential threat to structures, beaches or infrastructure on State or local government coastal land, a SEMP must be prepared by the local government (*Policy 2.5*). Appendix 1 Item 1 of the SPCM identifies the Redland City, especially Amity Point, as a priority area for the preparation of a SEMP. These management plans are required to set out an agreed list of options and recommendations to manage response to existing and future potential erosion threats to buildings and structures.

In determining options for shoreline erosion management beach nourishment of foreshores and retreat in the face of coastal erosion is favoured over engineered erosion control structures (*Policy 2.3*). Where beach nourishment or landward retreat is not a practical or cost effective option for permanent buildings and structures at risk, engineered erosion control structures may be considered (*Policy 2.4*). These structures must be located as close as possible to the development under threat to minimise any impact on coastal processes. This creates a hierarchy of management options, shown in Figure 2-1.

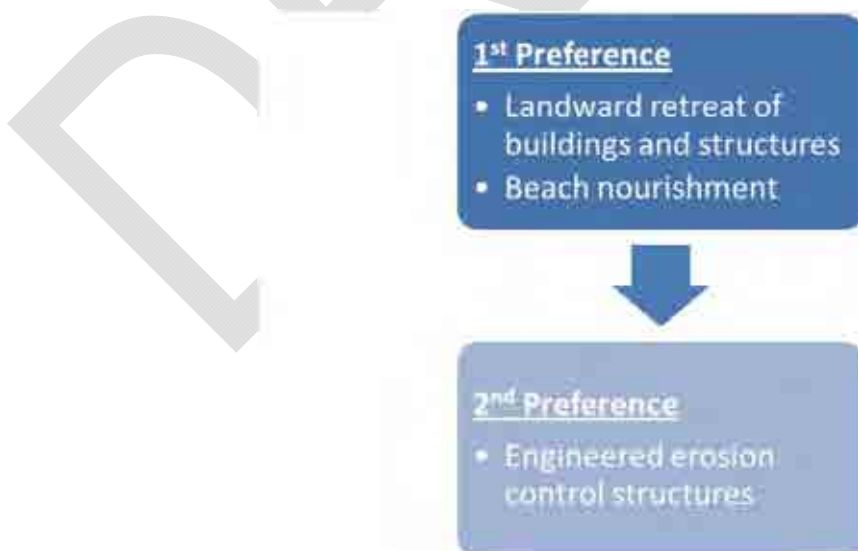


Figure 2-1 Hierarchy of Recommended Erosion Management Strategies for Buildings and Structures in the Erosion Prone Area

Annex 5 of the QCP requires final options to be determined only once there has been a thorough analysis of the social, environment and economic aspects of each option.

Management Planning

SPO9, *Management Planning*, establishes a framework for the development of plans and strategies for the management of coastal areas. The framework requires all work on State coastal land to be consistent with the relevant management plan for the local area, the QCP and (where relevant) the purpose for which the land was reserved (*Policy 9.4*). Management plans are those prepared by State coastal land managers in consultation with DEHP, Indigenous Traditional Owners and other relevant interest groups, and approved by DEHP (*Policy 9.1* and *Policy 9.3*) and include SEMP's.

Coastal management plans, including SEMP's, should preferably contain the following:

- Description of physical coastal processes and resources and statement of management practices and actions to maintain processes and conserving or rehabilitating resources;
- Description of the recreational, public access and scenic values of the area and a statement of the management practices and actions to be employed to manage these values;
- Statement of performance indicators; and
- Program of annual works and maintenance.

Issues covered by management plans include resource allocation, tenure decisions, covenants, and development and implementation of management arrangements. Management plans guide the management of coastal land to reflect the requirements of the QCP at a local level. Appendix 1 Item 8 of the SPCM identifies Amity Point as a priority area for local area coastal management planning.

Other Applicable Policies

Other policies under the SPCM applicable to the Amity Point SEMP are:

- *Policy 3.1* – the long-term stability of dune systems and the capacity of the dunes to rebuild after erosion is to be maintained through retaining and enhancing the extent, species composition and natural zonation of coastal dune vegetation;
- *Policy 3.4* – for high-use recreational areas where vegetation retention is not practicable, physical management methods such as beach reprofiling are to be implemented to maintain an erosion buffer zone and the sand volume of the beach and dune;
- *Policy 5.1* – traditional Owners are to be encouraged to participate in planning for the management of the coast; and
- *Policy 6.1* – use of coastal land ensures public access to the coast is maintained or enhanced.

The coastal zone and CMD for Amity Point is shown in Figure 2-2 together with areas of significance under the QCP. The coastal zone covers the entire study area while the CMD includes areas within the Amity Township and the settlements along the north-eastern coast. All lands outside the Townships are areas of ecological significance (AES).



PhotoMap by nearmap.com



LEGEND

- Fish Habitat Areas
- Coastal Management District
- Areas of High Ecological Significance
- Areas of General Ecological Significance
- Strategic Rehabilitation Areas
- Cadastral Boundary

Queensland Coastal Plan

- Coastal Management District
- Areas of High Ecological Significance
- Areas of General Ecological Significance
- Strategic Rehabilitation Areas

Note:
The Coastal Zone covers the entire area of this map.

Title:
Coastal Zone, Coastal Management District and Areas of Planning Interest under Queensland Coastal Plan for Amity Point

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Filepath : I:\B18390_I_GML Shoreline Erosion Study MJA\DRG\COA_003_120620_QCP Coastal Zone CMD and Planning Interest Areas .wor

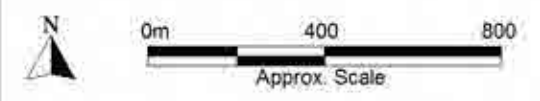


Figure:
2-2

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2.1.1.2 Coastal Protection State Planning Regulatory Provision

The Coastal SPRP applies to development in a coastal management district (CMD) that is impact assessable or requires referral to DEHP, or that is assessed by DEHP as the assessment manager.

The SPRP provides assessment criteria for coastal hazards, development in an erosion prone area, nature conservation, areas of High Ecological Significance (HES), public access, and coastal-dependent development. The following constraints and requirements are relevant to works under the SEMP:

- Retreat is the default option in areas threatened by erosion in the erosion prone area. The presence of development to a scale and intensity that makes retreat not achievable will justify property protection works. Structural engineering and stabilisation works are a last resort where there is an immediate threat to public safety, property or infrastructure. These works must not cause adverse impacts on coastal resources or natural cycles of erosion and accretion of beaches.
- All tidal works require (a) proof of demonstrated need in the public interest, and (b) a comprehensive investigation that determines no significant adverse impacts on longshore transport of sediments or an increase in coastal hazards (including erosion) to neighbouring foreshore.
- Beach and related areas that contain significant wildlife habitat are to be protected and managed. This includes:
 - Key shorebird roosting and feeding habitat. Where works require the loss of shorebird habitat, offsets are to be provided before the works commence;
 - Fish habitat and movement passages, including those in Myora-Amity Banks Fish Habitat Area (FHA) (see Section 2.2.2.3);
 - Benthic habitat, including seagrass beds as well as benthic communities and tidal flats (see Section 2.2.2.3); and
 - Stands of native vegetation, especially riparian vegetation. Riparian zones are to be maintained as wildlife corridors.
- No development in areas of HES.
- No net loss of public access to the foreshore unless it compromises the protection of coastal resources.
- Dredging must be beneficial to the State in terms of navigation and economics and be proven to maintain the existing physical environment of the area. An application for dredging will only be approved where supported by studies into the nature of dredging spoils and impacts on physical processes, and maintenance dredging requires a dredge management plan.
- Reclamation will only be allowed where clearly justified and where there are no or minimal adverse impacts on coastal resources. Reclamation is justified where it is necessary for erosion control/nourishment purposes, protects the physical environment, or is necessary to reinstate land that has been eroded where the reclamation is coordinated with neighbouring properties.

2.1.1.3 Draft State Planning Policy

The Draft SPP is a preliminary step of the State Government towards a single, centralised development assessment system. The SPP outlines assessment requirements for all State Interests and is intended to replace all other SPPs. There are three State Interests under the Draft SPP of relevance to the SEMP:

- Coastal environment;
- Natural hazards (including coastal erosion); and
- Biodiversity.

The assessment requirements of these State Interests are summarised in Table 2-3. The erosion prone area for the study area, as defined by DEHP, is shown in Figure 2-3.

Table 2-2 State Interests and Assessment Criteria under Draft SPP

| State Interest | Assessment criteria |
|---------------------|---|
| Coastal environment | <ul style="list-style-type: none"> • Avoid or minimise adverse impacts on coastal resources and their values • Maximise opportunities to maintain or enhance natural scenic amenity values of the coast • Maintain or enhance general public access to, or along, the foreshore unless this is contrary to the protection of coastal resources or public safety • Avoid the disposal of material dredged from land into coastal waters unless for reclamation or coastal protection works • Compliance with a dredge management plan that demonstrates how environmental impacts will be managed and mitigated, and complies with requirements of the National Assessment Guidelines for Dredging 2009 • Reclaim tidal land only where it is for coastal protection work or work necessary to protect coastal resources or coastal process |
| Biodiversity | <ul style="list-style-type: none"> • Any potential adverse environmental impacts are identified and considered • Avoid adverse environmental impacts, or where this is not reasonably possible, minimise impacts and offset residual impacts |
| Natural hazards | <ul style="list-style-type: none"> • Address the natural hazard and associated risks to people, property, economic activity, social wellbeing and the environment by achieving the following performance outcomes: <ol style="list-style-type: none"> a) the development is compatible with the risk associated with the natural hazard b) the development siting, layout and access responds to a potential natural hazard and minimises risk to personal safety; c) the development is resilient to natural hazard events by ensuring siting and design accounts for the potential risks of natural hazards to property; d) the development directly, indirectly and cumulatively avoids and unacceptable increase in the severity of the natural hazard and does not significantly increase the potential for damage on the site or to other properties; and e) natural processes and the protective function of landforms and/or |

| State Interest | Assessment criteria |
|----------------|---|
| | <p>vegetation are maintained in natural hazard areas</p> <ul style="list-style-type: none"> • Development in a coastal hazard area ensures that: <ul style="list-style-type: none"> a) erosion prone areas in a coastal management district are maintained as development-free buffers or where permanent buildings or structures exist, coastal erosion risks are avoided or mitigated; and b) coastal protection work is undertaken only as a last resort where erosion presents an imminent threat to public safety or property, and (i) the property cannot reasonable be relocated or abandoned, (ii) the coastal protection work is located on private land to the maximum extent reasonable, and (iii) the coastal protection work does not increase coastal hazard risk for adjacent areas • Have regard to SPP mandatory requirements: coastal hazard |

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LEGEND

- Cadastral Boundary
- Indicative Erosion Prone Area 2100 ***
(including projected climate change impacts to 2100)
- Erosion due to storm impact and long term trends of sediment loss and channel migration
- Erosion and permanent tidal inundation due to sea level rises

Based on cadastral data provided by the State of Queensland (Department of Environment and Resource Management) 2012, in consideration of the State permitting use of the data, you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or cost (including consequential damage) resulting from any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

* The erosion prone areas shown on this map are indicative of the erosion and inundation extent that may occur with climate change impacts up to 2100.

Title:
Defined Erosion Prone Area Plan for Amity Point

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Figure: 2-3
Rev: A



Filepath : I:\B18390_I_GML Shoreline Erosion Study MJA\DRG\COA_004_120621_QCP Erosion Prone Area.wor

2.2 Other Legislation and Approvals

The following legislation provides a planning background and framework for the preparation of the SEMP and application of recommended management options for shoreline erosion management at Amity Point.

2.2.1 Commonwealth

2.2.1.1 *Environment Protection and Biodiversity Conservation Act 2009*

Any actions that have or are likely to have a significant impact on a matter of national environmental significance (NES) are to be referred to the Minister administering the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. Matters of NES that *may* be significantly impacted by coastal protection works at Amity Point include (see further Appendix B):

- Wetlands of international importance (Moreton Bay Ramsar Site);
- Listed threatened species and ecological communities; and
- Migratory species.

If coastal protection works are declared a 'controlled action', approval will be required from Minister before the works can commence.

Directory of Important Wetlands in Australia

The Australian, State and Territory governments have jointly compiled a Directory of Important Wetlands in Australia which identifies and recognises Australia's nationally important wetlands. Although not directly protected under Commonwealth legislation, these wetlands are still of planning significance at a Commonwealth level.

The only wetlands within the vicinity of Amity Point listed on the directory are the Moreton Bay Aggregation (QLD134) and NSI itself (QLD191). These wetlands are protected at a State level under marine parks legislation as the Moreton Bay Marine Park (see Section 2.2.2.6).

2.2.1.2 *Native Title Act 1993*

The *Native Title Act 1993* provides for the recognition of Native Title rights of Indigenous Traditional Owners over non-freehold areas in Australia. In 2011, the Federal Court of Australia ruled in favour of a Native Title determination for the Quandamooka people of Minjerribah (NSI). This determination covers all non-freehold land on the island, including areas of unallocated State land and reserve at Amity Point. This grants rights to the Quandamooka people in accordance with their traditional rights over the land, including rights of occupancy and management.

Acts undertaken subsequent to 1 January 1994 that would affect Native Title are termed *future acts*. Future acts are invalid unless allowed under an Indigenous Land Use Agreement (ILUA) or through some other negotiated process with the local Traditional Owners. Two ILUAs have been entered into by the Quandamooka; one with the State government and one with RCC.

In planning and preparing a SEMP it is necessary to consider that any recommendations made over USL and coastal reserves managed by the local government will be subject to the management

consent of the Quandamooka Traditional Owners and the Quandamooka ILUAs. Any development proposed under the SEMP that occurs on private land will be exempt from this requirement as Native Title does not apply to freehold land.

2.2.2 Queensland

2.2.2.1 Sustainable Planning Act 2009

Coastal erosion management works will require development approval under the Integrated Development Assessment System (IDAS) of the *SP Act*. Assessment under the *SP Act* for potential shoreline erosion management recommendations will be required according to triggers including but not limited to:

- Tidal works;
- Fisheries matters (including removal, destruction or damage to marine plants and work in fish habitat areas);
- Dredging;
- Vegetation clearing; and
- Disturbance of acid sulfate soils (ASS).

Approvals triggered under the IDAS process require assessment by both local government and State agencies against relevant statutory instruments and policies. Table 2-3 summarises the main approvals associated with coastal protection works and the relevant administering legislation and agency at the State level. The effects of this legislation are discussed below. Local area requirements are discussed in Section 2.2.2.9.

Table 2-3 Summary of IDAS Form and Administering Legislation and Agency for Common Forms of Coastal Protection Development

| Development | IDAS Form | Relevant Legislation | Relevant Agency |
|-----------------------------|-----------|---|---|
| Tidal Works | 23 or 28 | <i>Coastal Protection and Management Act 1995</i> | Department of Environment and Heritage Protection |
| Dredging | 8 | <i>Environmental Protection Act 1994</i> | Department of Environment and Heritage Protection |
| Clearing Native Vegetation | 11 | <i>Vegetation Management Act 1999</i> | Department of Natural Resources and Mines |
| Works in Fish Habitat Areas | 26 | <i>Fisheries Act 1994</i> | Department of Agriculture, Fisheries and Forestry |
| Clearing Marine Plants | | | |

Development under IDAS may be impact or code assessable, self-assessable, compliance assessable, or exempt. The necessary level of development is identified under the *Sustainable Planning Regulation 2009 (SP Regulation)* and the Redland City Planning Scheme. The instruments required for assessment depend upon the level of assessment required. Necessary instruments for development assessment may include those listed Table 2-3 above as well as other State and local planning instruments discussed below.

In addition to development approval, works in the coastal zone may also require resource allocation authority (RAA). This includes allocation of quarry material taken from tidal waters (i.e. dredged material) and fisheries resources (i.e. marine plants and fish habitats). Whether or not RAAs are required for development depends upon the type of development being undertaken.

Prohibited development is a category of development that cannot occur where certain activities are triggered. Schedule 1 of the *SP Act* lists all prohibited development activities. This includes clearing native vegetation without a relevant purpose (see Section 2.2.2.4 below).

2.2.2.2 *Environmental Protection Act 1994*

The *Environmental Protection Act 1994 (EP Act)* and the *Environmental Protection Regulation 2008 (EP Regulation)* provide the main framework in Queensland for controlling environmental harm and pollution resulting from development.

The *EP Act* sets out a general environmental duty (s319) requiring persons not to cause environmental harm unless all reasonable and practicable measures are taken to prevent or minimise the harm. Compliance with the duty is a defence to causing environmental harm without appropriate authorisation.⁶ In the context of the SEMP, Council must not carry out any activities that cause, or are likely to cause, environmental harm unless they take reasonable and practicable measures to prevent or minimise the harm.

Environmentally relevant activities (ERAs) are a particular type of action causing environmental harm. These activities can only be undertaken with the appropriate approval. Under the *EP Regulation*, ERAs include dredging (ERA 16). Authorisation to undertake ERA 16 may be required where dredging of sand of beach nourishment purposes is recommended under the SEMP.

Environmental protection policies (EPPs) are also prepared under the *EP Act* to protect Queensland's environment. These EPPs seek to protect environmental values (EVs) and objectives identified for various aspects of the environment including water, noise, air quality and waste management. EVs and objectives have been identified under the following policies and instruments for the Amity Point area:

- Environmental Protection (Water) Policy 2009;
 - Moreton Bay environmental values and water quality objectives (Basin No. 144 (part) and adjacent basins 141, 142, 143, 145 and 146, including Moreton Bay, North Stradbroke, South Stradbroke, Moreton and Moreton Bay Islands); and
 - Queensland Water Quality Guidelines 2009;
- Environmental Protection (Air) Policy 2008 (EPP (Air));
- Environmental Protection (Noise) Policy 2008 (EPP (Noise)); and
- Environmental Protection (Waste Management) Policy 2000 (EPP (Waste)).

These guidelines and EPPs set the baseline of water, air and noise quality and waste management to be achieved to ensure ecologically sustainable development in Queensland.

⁶ *EP Act* s493A

2.2.2.3 Fisheries Act 1994

The *Fisheries Act 1994* protects fisheries resources and fish habitats in Queensland. All coastal protection works requiring the clearing of marine plants (including any removal, damage or destruction) or fish habitat areas (FHA) require assessment under the *SP Act* subject to concurrence assessment under the *Fisheries Act*. Figure 2-4 shows the extent of the Myora-Amity Banks FHA which covers the coastal waters offshore and to the south of Amity, Figure 2-5 shows seagrass (i.e. benthic marine plant) mapping for these same waters. The fisheries values of these waters is summarised in Table 2-4 below.

Table 2-4 Summary of Fisheries Values Present in SEMP Area

| Area | Fisheries Values |
|----------|--|
| Onshore | <ul style="list-style-type: none"> • <i>Avicennia</i> and <i>Rhizophora</i> spp. mangrove communities dominating fringing shoreline; • Foreshore flats; • Freshwater inputs from Capembah Creek into mangrove communities; and • Wetland habitat. |
| Offshore | <ul style="list-style-type: none"> • Myora-Amity Banks FHA; • Extensive <i>Zostera</i>, <i>Halophila</i> and <i>Syringodium</i> spp. seagrass beds; • Intertidal shoals; • Minor coral areas; • Fisheries: bream, flathead, cobia, snapper, garfish, spotted and school mackerel, sea mullet, tailor, whiting, banana prawns, eastern king prawns, bay prawns, mud crabs, sand crabs, and oysters; • Dugong and turtle habitat; and • Penaeid nursery area. |



PhotoMaps by nearmap.com

LEGEND

- Myora - Amity Banks Fish Habitat Areas
- Other Fish Habitat Areas
- Cadastral Boundary



Based on or contains data provided by the State of Queensland (Department of Environment and Resource Management), 2012, in consideration of the State permitting use of the data, you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or cost (including consequential damage) resulting in any way of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

Title:
Myora - Amity Banks Fish Habitat Area within SEMP Area

Figure:
2-4

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Filepath : I:\B18390_I_GML Shoreline Erosion Study MJA\DRG\COA_005_120621_Myora Amity Banks Fish Habitat Area.wor



PhotoMap by osm.com



LEGEND

- Seagrass 2004/2005 (DERM/UQ)
- Wetlands
- Directory of Important Wetlands in Australia - Moreton Bay
- Ramsar Site - Moreton Bay
- Cadastral Boundary

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Title:
Seagrass Beds and Coastal Wetlands of the SEMP Area

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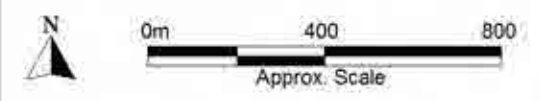


Figure: **2-5** Rev: **A**



Relevant policies necessary to consider when recommending works involving fisheries matters are summarised in Table 2-5 below.

Table 2-5 Summary of Applicable Fish Habitat Management Operational Policies and Policy Requirements for Erosion Protection Works in the SEMP Area

| Policy | Applicable Policy Requirements |
|---|---|
| <p>FHMOP 001 <i>Management of protection of marine plants and other tidal fish habitats</i></p> | <ul style="list-style-type: none"> • Coastal development proposals should avoid impacts to marine plants and other tidal fish habitats; • All private development works must be set back from tidal lands and fish habitats; • Tenure over tidal fish habitats for private development is not supported; • Erosion protection and dredging activities must be in accordance with FHMOP 010 and FHMOP 040, respectively; and • Revetment works supported only where there is substantiated accelerated bank erosion or slumping threatening buildings or infrastructure. |
| <p>FHMOP 002 <i>Management of declared Fish Habitat Areas</i></p> | <ul style="list-style-type: none"> • RAA only to be issued in a declared FHA for 'prescribed development purposes' includes maintaining: <ul style="list-style-type: none"> ○ A structure that was constructed before the area was declared to be a FHA under the Fisheries Act; and ○ A lawfully constructed structure; and • Constructing a permanent structure on tidal land or depositing material for beach replenishment is not supported in a FHA. |
| <p>FHMOP 004 <i>Dredging, extraction and spoil disposal activities: Departmental procedures for provision of fisheries comments</i></p> | <ul style="list-style-type: none"> • Dredging for waterway management (i.e. beach nourishment) is determined on a case-by-case basis but requires community/habitat benefits to outweigh potential losses; • Dredging within FHA prohibited unless in an existing navigation channel; • Spoil disposal on non-tidal land is preferred; • Proposals for dredging for waterway management, dredging for navigational purposes, or spoil disposal will not be opposed where there are: <ul style="list-style-type: none"> ○ No, or very minimal, immediate or foreseeable, permanent, adverse impacts on fisheries resources; or ○ Demonstrated fisheries related benefits; or ○ Essential community benefits (e.g. beach nourishment); and • Dredging or spoil disposal proposal will be opposed where dredging occurs within a FHA and/or feasible alternative exist. |
| <p>FHMOP 010 <i>Tidal fish habitats, erosion control and beach replenishment</i></p> | <ul style="list-style-type: none"> • Natural shoreline processes and existing tidal fish habitat values are to be maintained by: <ul style="list-style-type: none"> ○ Using erosion buffer zones and managed retreat where there is no significant erosion; ○ Treating the cause of erosion, rather than only |

| Policy | Applicable Policy Requirements |
|--------|--|
| | <p>attempting to manage the erosion through the use of erosion control structures and beach replenishment, where the erosion is the result of human activities;</p> <ul style="list-style-type: none"> ○ Designating buffer zones; • Erosion control measures are supported where there is significant erosion, inadequate erosion buffer zone and impossibility of managed retreat; • Erosion control structures are to be constructed by parties with as-of-right or approved use of land (for private property) or by local government on behalf of the community; • Erosion control structures not permitted in declared FHA, unless temporary; • Seawalls, revetments and other structures parallel to the shoreline are to be located as far landward as possible; • Depositing material for beach nourishment not permitted in FHA; • Beach nourishment supported only where there is significant erosion or requirement for the protection or effective functioning of erosion control structures; • Nourishment material must be sourced outside the FHA with a buffer zone of at least 100m between extraction site and the FHA boundary; • Nourishment material must be sourced away from locations where there are marine plants and fishing grounds; • Filling of tidal land for creation of a dune or beach at a level above HAT must be an integral part of the erosion control design and minimise renourishment frequency/impact of renourishment of tidal fish habitats, or remove the need for other erosion control works; and • Dredging to comply with FHMOP 004. |

2.2.2.4 *Vegetation Management Act 1999*

The *Vegetation Management Act 1999 (VM Act)* prohibits the clearing of native vegetation unless for a relevant purpose. Alternatively, clearing may be exempt from the approval process where listed under Schedule 24 of the *SP Regulation*. Relevant purposes and exemptions relevant to shoreline erosion management for particular land are summarised in Table 2-6 below.

**Table 2-6 Relevant Purpose and Exemptions under the Vegetation Management Act 1999
Applicable to Clearing Vegetation for Shoreline Management Works**

| Type of Vegetation on Regional Ecosystem Map | Colour on RE Map | Relevant Purpose/Exemptions Available for Clearing |
|---|------------------------------|---|
| <i>Freehold land</i> | | |
| Non-remnant | White | <ul style="list-style-type: none"> For any purpose |
| Remnant | Green, orange or pink | <ul style="list-style-type: none"> Under a development approval for a material change of use or to reconfigure a lot where the Department administering the VM Act is a concurrence agency to the development application |
| <i>Leasehold land (other than a lease used for agriculture and grazing)</i> | | |
| Non-remnant | White | <ul style="list-style-type: none"> For any purpose |
| <i>Road</i> | | |
| Non-remnant or remnant least concern | White or green | <ul style="list-style-type: none"> Any purpose carried out by a local government in an urban area |
| <i>Trust land</i> | | |
| Non-remnant | White | <ul style="list-style-type: none"> Carried out by the trustee for any purpose |
| <i>All land types</i> | | |
| All types | White, green, orange or pink | <ul style="list-style-type: none"> Where approval has been obtained for works which are: <ul style="list-style-type: none"> A project declared to be a significant project under the <i>State Development and Public Works Organisation Act 1971</i>, section 26; and For an extractive industry (including dredging and ancillary deposition). |

Regional ecosystem (RE) and remnant vegetation mapping for the Amity Point area are shown in Figure 2-6 below. Almost all freehold land at Amity Point is cleared or non-remnant vegetation while State land further inland and to the north is marked as least concern remnant vegetation. Most of this vegetation is also marked as essential habitat for protected species which will restrain the clearing of this vegetation under a development approval. Table 2-7 summarises the REs in the SEMP area.

Table 2-7 Description of Regional Ecosystems and Essential Habitat at Amity Point

| RE Number | RE Description | Status | Essential Habitat |
|-----------|---|---------------|--|
| 12.1.3 | Mangrove shrubland to low closed forest on marine clay plains and estuaries | Least concern | - |
| 12.2.5 | <i>Corymbia</i> spp., <i>Banksia integrifolia</i> , <i>Callitris columellaris</i> , <i>Acacia</i> spp. open forest to low closed forest on beach ridges | Least concern | Wallum sedgefrog (<i>Litoria olongburensis</i>) Wallum froglet (<i>Crinia tinnula</i>) Wallum rocketfrog (<i>Litoria freycineti</i>) |
| 12.2.6 | <i>Eucalyptus racemosa</i> woodland on dunes and sand plains. Usually deeply leached soils | Least concern | - |
| 12.2.7 | <i>Melaleuca quinquenervia</i> or <i>M. viridiflora</i> open forest to woodland on sand plains | Least concern | Wallum froglet Wallum rocketfrog |
| 12.2.14 | Foredune complex | Least concern | - |
| 12.2.15 | Swamps with <i>Baumea</i> spp., <i>Juncus</i> spp. and <i>Lepironia articulata</i> | Least concern | Cooloola sedgefrog (<i>Litoria cooloolensis</i>) Wallum sedgefrog Wallum froglet Wallum rocketfrog |



PhotoMap by nearmap.com



LEGEND

- Regional Ecosystem
- Remnant vegetation that is a least concern regional ecosystem
- Vegetation Management Act Essential Habitat
- Vegetation Management Act Essential Regrowth Habitat - Threatened Fauna
- Cadastral Boundary

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Title:
Regional Ecosystems and Remnant Vegetation Mapping for Amity Point

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2.2.2.5 Nature Conservation Act 1992

The object of the *Nature Conservation Act 1992 (NC Act)* is the conservation of nature. This includes the protection of native flora and fauna and the declaration of protected areas. While no protected areas are designated under the *Nature Conservation (Protected Areas) Regulation 1994* for the SEMP area, least concern (LC) and endangered, vulnerable or near threatened (EVNT) species under the *Nature Conservation (Wildlife) Regulation 2006* have been identified as occurring in the area (see Appendix C).

Any action that involves the taking or native flora or fauna is unlawful unless authorised by a permit. Wherever clearing is required for the purposes of coastal protection works, therefore (including clearing to gain access to sand extraction areas) the proponent must obtain the appropriate permit under the *NC Act*. This does not apply, however, to flora covered under the provisions of other Acts (e.g. marine plants). All clearing of koala habitat trees must be in accordance with the *Nature Conservation (Koala) Conservation Plan 2006*.

2.2.2.6 Marine Parks Act 2004

The *Marine Parks Act 2004 (MP Act)* establishes a framework for protecting the marine environment through declaration of marine parks. Under the *MP Act* the Moreton Bay Marine Park (MBMP) has been declared over the tidal waters and tidal land (up to HAT)⁷ of Amity Point (see Figure 2-7). This marine park is managed under the *Marine Parks (Moreton Bay) Zoning Plan 2008*. The tidal land and waters of Amity are marked as 'Yellow' conservation park zone and 'Light Blue' habitat protection zone. Persons may use these zones for carrying out works consistent with the objects of the conservation park zone and habitat protection zone, respectively.

Objects for conservation zones include the provision for the conservation of the areas of the marine park within the zone and to provide opportunities for reasonable use and enjoyment, including limited extractive use.⁸ This includes the use of these areas for nourishment purposes and, arguably, the development of limited coastal protection works so long as the conservation values of the area are not affected.

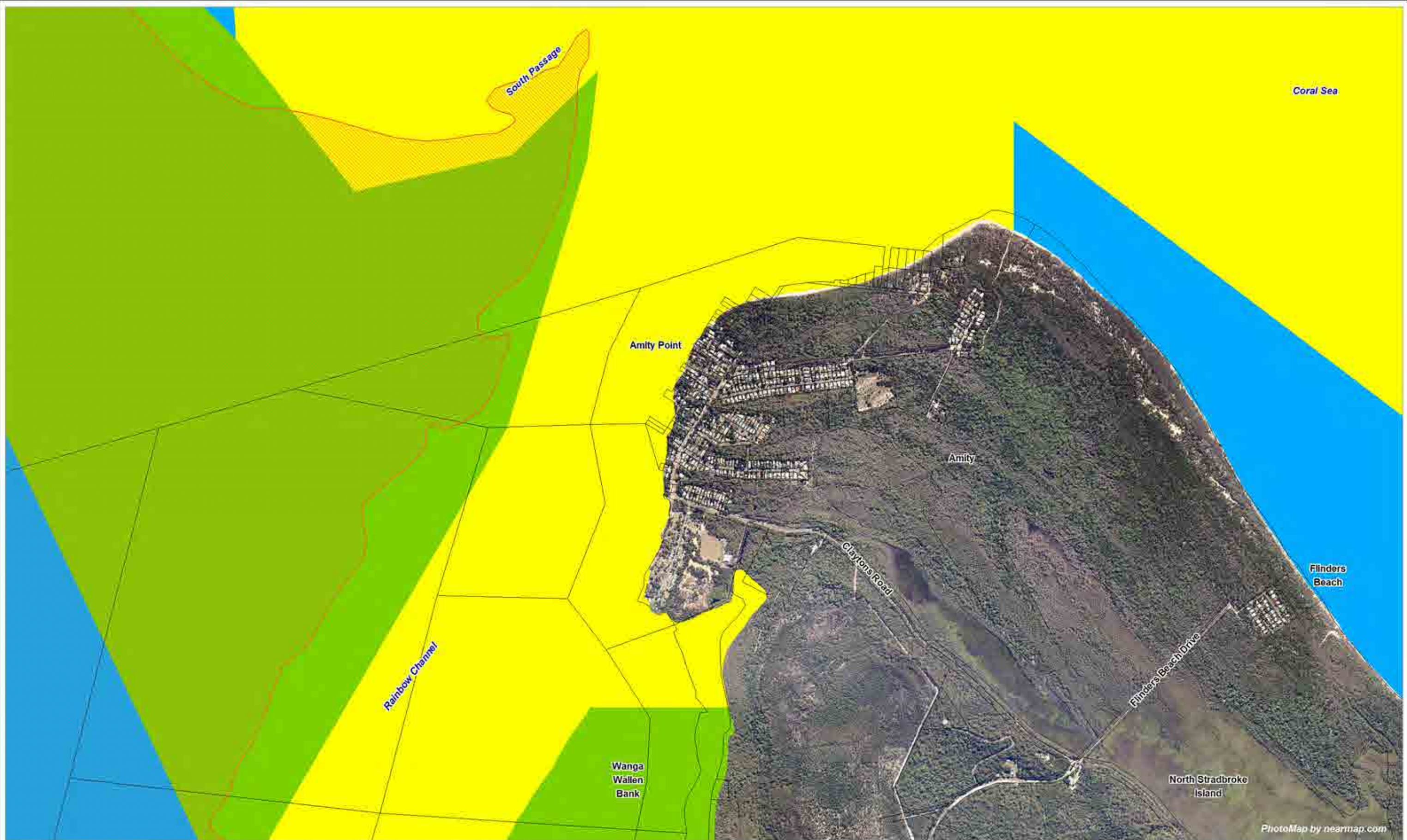
The objects for the habitat protection zone are to provide for the conservation of the areas of the marine park within the zone through the protection and management of sensitive habitats that are generally free from potentially damaging activities, and to providing opportunities for reasonable use of the areas.⁹ Coastal protection works in this area will only be supported where they do not impact upon sensitive habitat, including shorebird roosting locations and offshore benthic habitat.

Before any works can be undertaken below HAT, a permit must be obtained from the Department of National Parks, Recreation, Sport and Racing (DNPRSR).

⁷ Highest astronomical tide

⁸ *Marine Parks Regulation 2006* Schedule 1 Item 4

⁹ *Marine Parks Regulation 2006* Schedule 1 Item 2



PhotoMap by nearmap.com



LEGEND

Moreton Bay Marine Park Zones

- Habitat Protection
- Conservation Park
- Marine National Park

- Go Slow Area for Turtles, Dugong and Natural Values
- Cadastral Boundary

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Title:

Moreton Bay Marine Park Waters and Zoning within SEMP Area

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2.2.2.7 *Native Title (Queensland) Act 1993*

The *Native Title (Queensland) Act 1993* reflects the provisions of the Commonwealth *Native Title Act 1993* at a State level. Native Title determinations and ILUAs made under the Commonwealth Act are valid under the State Act and apply to the SEMP as described in Section 2.2.1.2.

2.2.2.8 *South East Queensland Regional Plan 2009-2031*

The *South East Queensland Regional Plan 2009-2031 (SEQ Regional Plan)* needs to be considered in the SEMP in the context of recommending appropriate shoreline erosion management measures for the SEQ region. The *SEQ Regional Plan* aims to manage growth and associated change in SEQ in the most sustainable way and to protect and enhance the quality of life in the region. Relevant policies and requirements of the *SEQ Regional Plan* in relation to shoreline erosion management at Amity, considered in the development of recommendations are summarised in Table 2-8 below.

Table 2-8 Summary of Relevant Policies and Requirements of the South East Queensland Regional Plan for Shoreline Erosion Management at Amity

| Policy | Principle | Relevant Requirements |
|---|--|--|
| 1.4 Natural Hazards and Climate Change Adaptation | Increase the resilience of communities, development, essential infrastructure, natural environments and economic sectors to natural hazards including the projected effects of climate change | <ul style="list-style-type: none"> Establish adaptation strategies to minimise vulnerability to inundation and coastal erosion; and Development decisions to be in accordance with QCP. |
| 2.1 Biodiversity | Protect, manage and enhance the region's biodiversity values and associated ecosystem services and maximise the resilience of ecosystems to the impact of climate change | <ul style="list-style-type: none"> Avoid impacts on areas with significant biodiversity values (i.e. most of the SEMP terrestrial area) or offset impacts where unavoidable. |
| 2.2 Koala Conservation | Koala populations in the region are enhance through the protection, management and the achievement of a net gain in bushland koala habitat and through managing conflict with urban development | <ul style="list-style-type: none"> Ensure development impacts on koala habitat throughout SEQ (e.g. clearing to source beach nourishment material) are offset through the delivery of a net benefit to koalas. |
| 2.4 Managing the Coast | Maintain, protect and enhance the values of the region's coast, including the foreshore, coastal wetlands, dunes, coastal processes, marine ecosystems, significant coastal values and marine waters | <ul style="list-style-type: none"> Ensure that development on the coast or in tidal waters maintains natural physical coastal processes or ensures that there is no increased risk of shoreline erosion to adjacent areas of coastline; Maintain and enhance safe public access to the foreshore and coastal waters; and Ensure plans are consistent with the Moreton Bay Marine Park zones |

| Policy | Principle | Relevant Requirements |
|--|--|--|
| | | and fish habitat zones and management plans for the region. |
| 3.5 Scenic Amenity | Identify and protect important scenic amenity areas, view corridors and viewpoints | <ul style="list-style-type: none"> Identify regionally significant and locally important areas of scenic amenity, view corridors and popular and significant viewpoints, and protect them from intrusive development; and Retain and enhance public access to significant and popular viewpoints. |
| 4.2 Land, Extractive Resources, Minerals, Forestry and Fisheries | Manage the region's natural economic resources to sustainably and efficiently meet the needs of existing and future communities | <ul style="list-style-type: none"> Protect, manage and enhance marine, estuarine and freshwater habitats to sustain fish stock levels and maximise fisheries production for the ongoing benefit of the community. |
| 7.1 Traditional Owner Engagement | Recognise Aboriginal Traditional Owners as stakeholders, involve them in planning, and understand and respect their relationship with the land, sea and natural resources | <ul style="list-style-type: none"> Consult with Traditional Owners in the development of planning schemes and, particularly regarding the inclusion of processes for identifying and conserving Aboriginal cultural heritage sites and landscapes; and Recognise Traditional Owners' procedural rights to be consulted at the outset in relation to matters that may affect their Native Title rights, the alienation of unallocated State land or traditional cultural heritage values. |
| 7.2 Community Engagement | Provide Aboriginal and Torres Strait Islander peoples who have traditional, historical and contemporary connections to SEQ with the opportunity for active involvement in planning processes | <ul style="list-style-type: none"> Recognise the cultural need for Aboriginal representatives to obtain group endorsement of consultation responses, and provide periodic forums for the provision of information to the broader community of Aboriginal peoples. |

2.2.2.9 State Planning Policy 2/20 Koala Conservation in South East Queensland

SPP 2/10 *Koala Conservation in South East Queensland* is a SPI designed to protect koala habitat in the SEQ region, including the local government area of RCC. The SPP has application to master plans and planning schemes applied in areas by the local government. While the SEMP is not a planning scheme for Amity Point, recommendations made under the SEMP may have consequences

for existing koala habitat in the SEMP area. For this reason, the requirements of the SPP 2/10 have been taken into account when preparing the SEMP.

The SPP 2/10 requires planning instruments to minimise the impacts of development upon koalas and koala habitat. This can be achieved where the instrument identifies and protects significant areas of koala habitat value and habitat connectivity, in addition to apply other planning based ends (e.g. levels of assessment, offset requirements). As can be seen in Figure 2-8 much of the SEMP area is mapped as having one of the following koala habitat values:

- Medium value bushland habitat;
- Medium rehabilitation suitability value;
- Medium other area value; and
- Generally not suitable for habitat.

It is important for the purposes of the SEMP, therefore, to avoid clearing of areas marked as having bushland or rehabilitation habitat value for koalas. This is applicable in regards to any development requiring clearing in these areas, such as for sourcing sand or for installing development works.



PhotoMap by nearmap.com

LEGEND

Koala Habitat Value Category

- Bushland Habitat - Medium Value
- Suitable for Rehabilitation - Medium Value
- Other Areas of Value - Generally Not Suitable

Cadastral Boundary



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Title:

**South East Queensland Koala Protection Area
Koala Habitat Value**

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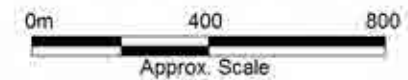


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2.2.2.10 Other Considerations

It may be necessary to liaise with, and obtain permission from, the following agencies regarding the legislation and issues mentioned above:

- DEHP for matters concerning dredging, nourishment, conservation values, tidal quarry material allocations, and management under the QCP;
- DNPRSR for marine park and *NC Act* permits;
- Department of Natural Resources and Mines (DNRM) for matters concerning the allocation of State and use of State land, vegetation management, Indigenous cultural issues, and land title;
- Department of Agriculture, Fisheries and Forestry (DAFF) for matters concerning fisheries resources, marine plants and FHAs; and
- Department of Transport and Main Roads (DTMR) / Regional Harbour Master in relation to navigation and navigation channels for potential dredging within/adjacent to channels and watercourses.

2.2.3 Redland City

Amity occurs within the local government jurisdiction of RCC. This jurisdiction extends seaward to the high water mark under the *Local Government Act 2009 (LG Act)*. The *LG Act* also enables local government to obtain specific jurisdiction from the State over the foreshore, between high and low water mark for special purposes, such as coastal protection works.

RCC controls land use and activity under the local planning scheme (under the *SP Act*) and Local Laws (under the *LG Act*). RCC also has legislative responsibilities under the *EP Act*. Local government generally has responsibilities relevant to coastal management for, *inter alia*:

- Land use control;'
- Recreational planning;
- Management of local reserves;
- Environmental protection and rehabilitation; and
- Monitoring.

2.2.3.1 Redlands Planning Scheme

The *Redlands Planning Scheme – Version 4* (the Planning Scheme) is the leading local planning instrument (LPI) governing all planning and development within Redland City. Shoreline erosion management recommendations and planning under the Amity SEMP reflect the requirements of the Planning Scheme outcomes, zones, overlays and codes.

Outcomes

The outcomes sought to be achieved by the Planning Scheme are as follows:

- Desired Environmental Outcomes (DEOs);
- Overall Outcomes that are the purpose of a code;

- Specific Outcomes that contribute to achieving the Overall Outcomes and are the outcomes by which code or impact assessable development are assessed;
- Probable Solutions that are prescriptive requirements and provide a guide to achieving Specific Outcomes; and
- Acceptable Solutions that are prescriptive requirements for self-assessable development.

There are six (6) DEOs identified under the Planning Scheme. These DEOs establish the overarching outcomes that the Planning Scheme seeks to achieve. Relevant aspects of these DEOs to shoreline erosion management are summarised in Table 2-9 below.

Table 2-9 Summary of Relevant Requirements of Redlands Planning Scheme Desired Environmental Outcomes in Relation to Shoreline Erosion Management

| DEO | Relevant requirements |
|--------------------------|---|
| 1 Natural Environment | Shoreline erosion management works are to: <ul style="list-style-type: none"> • Protect and enhance remnant ecosystems on North Stradbroke Island, koala habitats and species of native fauna and flora that range from internationally to locally significant and threatened to common species; • Maintain the health of drainage systems, water catchments and Moreton Bay minimising the disturbance of ASS; and • Minimise the adverse impacts of natural hazards on environmental values and the Redland Community. |
| 2 Character and Identify | Character and identity is protected and strengthened by: <ul style="list-style-type: none"> • Ensuring significant landform and landscape features of Redland City (e.g. green backdrop provided by NSI) are protected and retained from incompatible development. |

Other outcomes identified under the Planning Scheme are achieved through the application of codes, zones and overlays.

Zones and Overlays

Zones and overlays under the Planning Scheme establish the required level of assessment and relevant assessment codes for particular development and uses depending upon their location.

Table 2-10 summarises the applicable zones and overlays and related codes for basic shoreline erosion management activities recommended under the SEMP. See Appendix D for Planning Scheme Maps related to the SEMP area.

It should be noted that part of the urban residential area of Amity Point (west of Ballow Street) has been zoned as sub-area UR3. In this sub-area all future buildings and structures are to be demountable and capable of removal. In addition buildings, structures or infrastructure associated with the use of other development are not to extend any further seaward than existing uses and development on the site. This is part of a strategic plan of retreat proposed by RCC whereby the line of development will retreat as shoreline erosion continues, rather than redeveloping within the erosion prone area (RCC 2011a).

Table 2-10 Level of Assessment and Applicable Assessment Codes for Common Shoreline Erosion Management Activities Based on Zones and Overlays of the SEMP Area

| Activity | Zones | | | Overlays | |
|--|--|--------------------------|--|---|--|
| | <i>Low Density Residential</i> | <i>Conservation</i> | <i>Open Space</i> | <i>Acid Sulfate Soils</i> | <i>Flood Prone, Storm Tide and Drainage Constrained Land</i> |
| Uses | | | | | |
| Extractive Industry ¹⁰ (on-shore sourcing of nourishment material) | Impact assessable | Impact assessable | Impact assessable | Self-assessable If complying with AS of Acid Sulfate Soils Overlay Code. Code assessable <ul style="list-style-type: none"> Acid Sulfate Soils Overlay Code. | Exempt |
| Works | | | | | |
| Excavation and fill (on-shore sourcing of nourishment material and actual nourishment works) | Exempt If disturbing less than 50m ³ or at a depth less than 300mm. | Impact assessable | Exempt If disturbing less than 50m ³ or at a depth less than 300mm. | Exempt If disturbing less than 50m ³ or at a depth less than 300mm. | Exempt If disturbing less than 50m ³ of soil or at a depth less than 300mm. |
| | Self-assessable if complying with AS ¹¹ of Erosion Prevention and Sediment Control Code and Excavation and Fill Code. | | Self-assessable If complying with AS of Erosion Prevention and Sediment Control Code and Excavation and Fill Code. | Self-assessable If complying with AS of Acid Sulfate Soils Overlay Code. | |

¹⁰ Use of premises for dredging, excavating, quarrying, sluicing or otherwise mining materials including sand, gravel, soil, rock, stone and similar substances from the earth and the removal of these materials from the premises

¹¹ Acceptable Solutions

| Activity | Zones | | | Overlays | |
|-------------|--|---------------------|--|--|---|
| | <i>Low Density Residential</i> | <i>Conservation</i> | <i>Open Space</i> | <i>Acid Sulfate Soils</i> | <i>Flood Prone, Storm Tide and Drainage Constrained Land</i> |
| | <p>Code assessable</p> <ul style="list-style-type: none"> Erosion Prevention and Sediment Control Code; and Excavation and Fill Code. | | <p>Code assessable</p> <ul style="list-style-type: none"> Erosion Prevention and Sediment Control Code; and Excavation and Fill Code. | <p>Code assessable</p> <ul style="list-style-type: none"> Acid Sulfate Soils Overlay Code. | <p>Code assessable</p> <ul style="list-style-type: none"> Flood Prone, Storm Tide and Drainage Constrained Land Overlay Code. |
| Other works | Exempt | Exempt | Exempt | Exempt | Exempt |

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While certain works are exempt from assessment under the Planning Scheme they may still be prescribed as assessable development under the *SP Regulation* and subject to assessment as part of the IDAS process.

Code or self-assessable development is required only to comply with the codes identified under the zones and overlays of the Planning Scheme (see Table 2-10 above). Impact assessable development is required to be assessed against the entire Planning Scheme to achieve DEOs and Overall Outcomes of codes. This is discussed in the context of Planning Scheme codes below.

Codes

The following codes are relevant when assessing development related to shoreline erosion management activities:

- Erosion Prevention and Sediment Control Code (acceptable solutions only if self-assessable);
- Excavation and Fill Code (acceptable solutions A1.(1)(b), (c), (d) only if self-assessable);
- Acid Sulfate Soils Overlay Code;
- Flood Prone, Storm Tide and Drainage Constrained Land Overlay Code; and
- Extractive Industry Use Code.

Assessment against these codes is undertaken on a case-by-case basis at the development application and assessment stage or recommendations made under this SEMP. Assessment codes may also trigger the need to undertake works in accordance with planning scheme policies (PSPs) such as PSP 7 (Flood Prone, Storm Tide and Drainage Constrained Land) or PSP 14 (Waterways, Wetlands and Moreton Bay).

2.2.3.2 Other local Instruments

Recommendations of the Amity SEMP have been made taking into account the relevant requirements of the following LPIs and local laws:

- *Corporate Plan 2010-2015* – provides particular objectives and goals of RCC, including 3. Embracing the Bay:
 - *Outcome: The benefits of the unique ecosystems, visual beauty, spiritual nourishment and coastal lifestyle provided by the islands, beaches, foreshores and water catchments of Moreton Bay will be valued, protected and celebrated; and*
 - *Strategy 3.2: Better manage our foreshore through coordinated planning with a special focus on resilience to the impacts of flooding and storm tides;*
- *Flinders Beach Land Management Plan 2005-2009* (Flinders Beach LMP) – a strategy for managing Flinders Beach in order to reduce the impacts of vehicles and campers, enhance the wildlife habitats, ensure safety and amenity for all beach users, administer existing legislation, and monitor management actions into the future;
- *Biodiversity Strategy 2008-2012* – identifies key biodiversity values and threats in Redland City and identifies planning and management framework by which to protect and enhance biodiversity;

- *Confronting Our Climate Future. A strategy to 2030 for Redland City to: Reduce Greenhouse Gas Emissions, Respond to Climate Change, and Achieve Energy Transition* – establishes a framework for mitigating and adapting to climate change, including undertaking coastal studies and identifying key areas and infrastructure for coastal erosion protection;
- *Confronting Our Climate Change – Redland City Council Response to Climate Change* – lists the background and context of various climate change mitigation and adaptation strategies, including coastal erosion and storm-tide inundation;
- *Redland City Disaster Management Plan 2010* – management plan designed at responding to emergency events, including coastal hazards;
- *Redlands Koala Policy and Implementation Strategy 2008* – prioritises the need to protect, enhance and increase koala habitat; and
- *Local Law No. 6 Protection of Vegetation* – where development involves the clearing of ‘protected vegetation’ a permit for clearing is required.

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3 VALUES

In making recommendations for shoreline erosion management measures in the study area, it is necessary to consider the existing ecological, conservation, cultural, heritage, recreational, economic, amenity and access values. The following value descriptions provide the framework for conducting a triple-bottom line assessment for preparation of the SEMP as required by the Coastal Hazards Guideline. See also the results of the Wildlife Online species database search in Appendix C.

3.1 Amity Township

3.1.1 Environmental Values

The Amity Township is an area of residential development along the coastline of Amity Point. While most of the residential lots have been cleared (but for individual trees) most of the inland ecosystems remain intact, at some points reaching to within 150m of the coastline. Vegetation in close proximity to the coastline is RE 12.2.5: open to low closed *Corymbia* spp., *Bankisa inegrifolia*, *Callitris columellaris* and *Acacia* spp. forest, located on beach ridges (DEHP 2012a). This RE may also contain palustrine wetland (vegetated swamp) in dune swales. Essential habitat associated with the ecosystem includes habitat values for wallum frog species Table 2-7. Potential koala habitat has also been identified in these ecosystems (Figure 2-8).

These wetlands are also part of the NSI nationally listed wetlands (QLD191) and Moreton Bay Aggregation (QLD134). The Moreton Bay Aggregation and parts of the NSI wetlands are protected as a wetland of international importance (Moreton Bay Ramsar site). These wetlands provide habitat for international migratory shorebirds which are protected under international conventions and domestically under the *EPBC Act*.

Offshore of the Township is Rainbow Channel. From the coastline, the channel drops immediately to deep water (approx 20m). No seagrass beds or other fishery values occur in this area. These waters have been mapped as an area of conservation significance under the Moreton Bay Marine Park Management Plan (Figure 2-7).

3.1.2 Socio-Economic Values.

Amity is one of three main urban areas on North Stradbroke Island (Amity Point, Dunwich and Point Lookout). Amity Township is the main settlement of Amity Point and thus represents the centre of social and economic activities for the north-west area of the island. In the 2006 census Amity had a population of 405 persons, 1.5% of which was Indigenous (RCC 2007). Amity is mainly a small residential area, noted for having the atmosphere of a fishing village (RCC 2010a).

Community areas in Amity include the Amity Point Beach along Old Ballow Street, the Old Schoolhouse Park along Ballow Street, and the beginning of Flinders Beach to the north (RCC 2011b). These areas provide local residents with the opportunity to access the beach for fishing and swimming activities and to undertake other recreational activities. As most of the coastline at Amity is private property, access to the water at Amity Point Beach is of high value to the community. Amity benefits economically from the tourist values of the local area and Flinders Beach, with day visitors, locals and tourists contributing to the value of local businesses.

Amity Point Public Hall, located at 16 Ballow Street, is also an area of local heritage value. This site was the former Benevolent Asylum, later converted by community labour in the early 1950s into a hall for public use. This site is protected under the RCC Planning Scheme. Other than this site, no heritage features have been identified at Amity Township. As a small coastal village, however, the houses of Amity along the foreshore are likely of high socio-cultural significance to local residents, especially due to the age of many of these structures.

All of Stradbroke Island, including Amity Township, is subject to the Quandamooka ILUA and Native Title claim (see Section 2.2.1.2). This includes all non-freehold (i.e. State and community) land in the area. The Quandamooka people have a cultural and spiritual connection with this land, as well as over coastal waters.

3.2 Amity Park

3.2.1 Environmental Values

Most of Amity Park has been cleared for development, with the closest vegetation ecosystems and available terrestrial habitat located inland (~300m) or to the south of the site. The vegetation immediately inland of Amity Park is mapped as RE 12.2.15: coastal sedgeland and palustrine swamp dominated by *Baumea* spp., *Juncus* spp. and *Lepironia articulate* (DEHP 2012e). Much of this ecosystem is noted as essential habitat for wallum frogs and the Cooloola sedgefrog (Table 2-7) and also provides habitat for the ground parrot (*Pezoporus wallicus wallicus*) all of which are EVNT species under the NC Act (see Section 2.2.2.5). This vegetation is connected to *Eucalyptus racemosa* and *Melaleuca* spp. woodlands on sandy plains to the east and west (REs 12.2.6 and 12.2.7, respectively) (DEHP 2012b; DEHP 2012c). RE 12.2.7 is also palustrine wetland and provides essential habitat for EVNT frogs. These forested areas also provide medium bushland habitat or medium value sites for rehabilitation in relation to SEQ koala habitat values (Figure 2-8).

To the south of Amity Park are palustrine wetlands mapped by DAFF on the Coastal Habitat Resources Information System (CHRIS) (Fisheries Queensland 2001). These wetlands are composed of closed *Avicennia* spp. and closed *Ceriops* spp. assemblages located along the coast, connected to the Myora-Amity Banks FHA (see Figure 2-4 and Figure 2-5). These coastal tree and mangrove swamps provide important ecosystem functions to the local area, and affect hydrology, microclimate and flooding regimes (Joyce 2006; Joyce 2010). Mangrove wetlands are also extremely important to local fisheries and provide habitat for a range of fish species (see Section 2.2.2.3). These wetlands are also part of the NSI and Moreton Bay Aggregation wetlands and listed internationally as part of the Moreton Bay Ramsar site.

Seagrass meadows have been mapped offshore of Amity Park between 1984 and 1988 by DAFF and benthic assemblages still occur in these marine areas (Fisheries Queensland 2001). These ecosystems, together with mangrove and swampland vegetation, provide feeding and breeding habitat for local fish species. The Myora-Amity Banks FHA does not actually cover these seagrass beds, however, as it is located to the south and west of Rainbow Channel running alongside NSI.

There are also some limited environmental values associated with Amity Park. This area has not been entirely cleared and so offers fragmented and partial feeding and roosting values for avifauna and small terrestrial fauna species. The groyne field located along the coastline has also had the affected of trapping sand, creating an artificial sand deposit, providing some habitat to infauna and

other invertebrate species. It is also likely that the groyne themselves may also provide hard-structure habitat values to species such as barnacles.

3.2.2 Socio-Economic Values

Amity Park is a large area of community land located at Amity which has not been highly developed. This area is the site of the Amity Point Picnic Park and Cabarita Park (RCC 2011) which are popular local parks. This is also the site of the Amity Point camping ground, providing cabins and tent and camper van sites for visitors (RCC nd.a). This park has direct access to the local beach and a range of facilities, including shower and toilet blocks, picnic areas, boat ramps, play grounds and a nearby skate park (RCC nd.a). Recreational activities in this area would include camping, fishing, swimming, skating, and day visits. This camping site provides commercial values to the Amity Park area and also complements the commercial value of local businesses, such as fishing shops and food retailers.

Anecdotal evidence (2012) suggests that the row of trees along the Amity Park foreshore, behind the existing groyne field, represent some of the first trees identified at the location upon first settlement. While not formally protected or recognised under heritage listings, these trees are potentially of cultural significance to the resident Amity community. No other local or cultural heritage sites have been identified at Amity Park but all non-freehold land has recently been recognised as subject to the Native Title rights of the Quandamooka people of NSI, with their rights set forth under the Quandamooka ILUA (see Section 2.2.1.2).

3.3 Flinders Beach

3.3.1 Environmental Values

Flinders Beach is an 8km long beach located along the northern shore of NSI between Amity Point and Rocky Point (Surf Lifesaving Australia (SLA) 2009). The extensive beach foreshore is backed by extensive vegetated areas consisting of RE 12.2.14 and RE 12.2.7. These represent common foredune assemblages (*Spinifex sericeus* grasslands with *Casuarina equisetifolia* subsp. *incana* woodland open/forest) and *Melaleuca quinqueneriva*/*M. viridiflora* woodlands on sandy plains (DEHP 2012c; DEHP 2012d; Redland Shire Council (RSC) 2005). Behind the foredunes, vegetation consists of RE 12.2.5: *Corymbia* spp., *Banksia integrifolia*, *Callitris columellaris* and *Acacia* spp. open to low closed forest (DEHP 2012a). This vegetation is associated with palustrine swampland, drained east of the settlement (SLA 2009).

Rear dune and inland vegetation has been mapped as essential habitat for wallum frog species (Table 2-7) and has also been noted as potential habitat for the ground parrot. Other habitat values provided on site include the beach area itself, providing foraging and other habitat values to invertebrates and shorebird species (RSC 2005). An EPBC Act protected matters search (undertaken May 9th 2012) showed over 30 migratory avifauna species occurring within the SEMP area and it is likely many of these species feed and roost along Flinders Beach. This area has also been mapped as of habitat significance for the Moreton Bay Marine Park (Figure 2-7), suggesting the occurrence of various important habitat values to terrestrial, marine and avifauna species in the Moreton Bay region (including sea turtles). Loggerhead turtles occasionally nest on the beach (RSC 2005) while dolphins and other cetaceans are noted to occupy waters near Point Lookout (RCC 2010b), with all these marine species occasionally occupying waters offshore of Flinders Beach. Under the Koala SPP,

dune and inland vegetation is medium koala bushland or rehabilitation habitat and so provides additional values to the SEQ population of koalas.

Wetland values through this area are recognised at a national and international scale as part of the NSI and Moreton Bay Aggregation wetlands and the Moreton Bay wetland site of international importance (see discussion above).

3.3.2 Socio-Economic Values

Flinders Beach provides opportunities for locals, day-trippers and longer staying visitors to undertake nature-based activities in a reasonably undeveloped area (RSC 2005). The area provides camping and four wheel drive (4WD) opportunities along an ocean beach (RCC nd.b). There are 16 beach access points between Amity and Rocky Point as well as a number of defined beach driving tracks (RSC 2005). The beach is a common tourist and recreational user destination for persons from across SEQ and further afield (RSC 2005).

The main recreational values at Flinders Beach are (RCC nd.b; RSC 2005):

1. Camping and 4WD driving;
2. Day visits;
3. Fishing; and
4. Swimming and Surfing.

The site also features a number of commercial values. These include commercial fishing based on NSI targeting mullet and other fish species. Tourism is also a key economic activity in the Flinders Beach area and a significant part of the RCC *Sustainable Tourism Development Strategy*. Other commercial values are associated with local businesses at Amity and Point Lookout benefiting from the tourist numbers at Flinders Beach, such as surf shops, food vendors and souvenir shops (RSC 2005).

All of Flinders Beach (with the exception of freehold land) has been successfully claimed by the Quandamooka people of NSI as part of a claim for Native Title. This is also recognised under the Quandamooka ILUA (see Section 2.2.1.2). Other than this cultural connection with the land, no specific cultural heritage sites have been identified by RCC in relation to the area. There are also no known local heritage sites along Flinders Beach.

The settlements along Flinders Beach are also part of Amity, representing the extension of the Township into more isolated areas. Anecdotal evidence suggests the original settlement of these areas represented planning for westward expansion/retreat of Amity. These areas, therefore, hold significant social value for the future of Amity in addition to their current values as more isolated residential areas surrounded by native bushland.

4 COASTAL PROCESSES & CAUSES OF EROSION

4.1 General Considerations

An appropriate understanding of the fundamental coastal processes affecting the Amity shoreline is needed in order to make an informed decision on the most reliable management strategy to be adopted. The Amity shoreline has an extensive history of active shoreline management as persistent shoreline erosion has threatened development and assets in the past and various protection works have been carried out in response to these threats. Historical protection measures primarily include the construction of revetments and groynes.

A number of studies into the coastal processes and options to mitigate erosion along the Amity shoreline have been undertaken and these have been reviewed at part of this study. The coastal processes studies that have been considered in this SEMP include:

- Early Beach Protection Authority Advice Circa 1970;
- Erosion at Amity Point (Eberhardt, 1978);
- Storm Tide Hazard Study – Redland and Logan Shires (Cardno LT, 2009); and
- Redland Shire Council – Rainbow Channel Cross Section Surveys (ongoing).

In addition, previous field measurements have been interpreted, numerical modelling of waves and currents has been carried out, and aerial imagery has been inspected to assess the sand transport processes at the Amity shoreline and the impacts of previous mitigation works. Furthermore, a site inspection was carried out soon after the significant erosion event in early 2011 and discussions were held with Redland City Council staff to collect information in relation to recent shoreline protection works.

On the basis of the above information, it was possible to gain reasonable knowledge of the active coastal processes. A brief outline of this knowledge is presented in this Section.

The key issues affecting these processes and hence the most appropriate management actions are those of:

- The ongoing meandering of Rainbow Channel;
- The depth of the channel and the apparent sudden collapse of banks at Amity;
- Review of the success or otherwise of previous mitigation works;
- The implications of the existence of the Moreton Bay Marine Park and Myora-Amity Fish Habitat Area; and
- The feasibility of different management options.

The nature and rate of the progressive long-term erosion remains uncertain. The uncertainty lies in the complex interaction of coastal and estuarine processes that drive the meanderings of the Rainbow Channel. These processes are a response to the large volume of water exchanged between Moreton Bay and the Ocean with each tide and the considerable momentum contained in these flows.

Also relevant is the existing coastal structures that are present on the shoreline and the impact of these on local processes. A comprehensive investigation over some years and involving substantial cost would be needed to gain a full understanding of those processes and still may not be able to predict the impacts of storms and cyclones.

However, the review of existing coastal studies has provided a level of understanding sufficient to identify the primary cause of the erosion over the last 100 years and the most reliable engineering and/or management options for mitigating the erosion. Within that context, relevant uncertainties and their significance are also identified and discussed.

4.2 Previous Reports and Studies

The Eberhardt study of 1978 was the result of several investigations carried out by the University of Queensland with assistance from the then Beach Protection Authority. The study gathered information from historical surveys and Navigation Charts and other studies being undertaken at UQ to give an indication of the substantial changes to South Passage, Rainbow Channel, Rous Channel and Amity over the period 1892 to 1971 as shown in Figure 4-1 and Figure 4-2 below. Also presented was the shoreline movement of Amity from 1886 to 1971 and it is of note that the original sub-division followed the shoreline of 1886. This study also noted that erosion at Amity was first reported as early as 1922. The first groynes were built in the area in 1955 and surveyed bank profiles of 1976 and 1977 showed continuing erosion. The study also reported southward movement of sand in the channel after a tracer study.

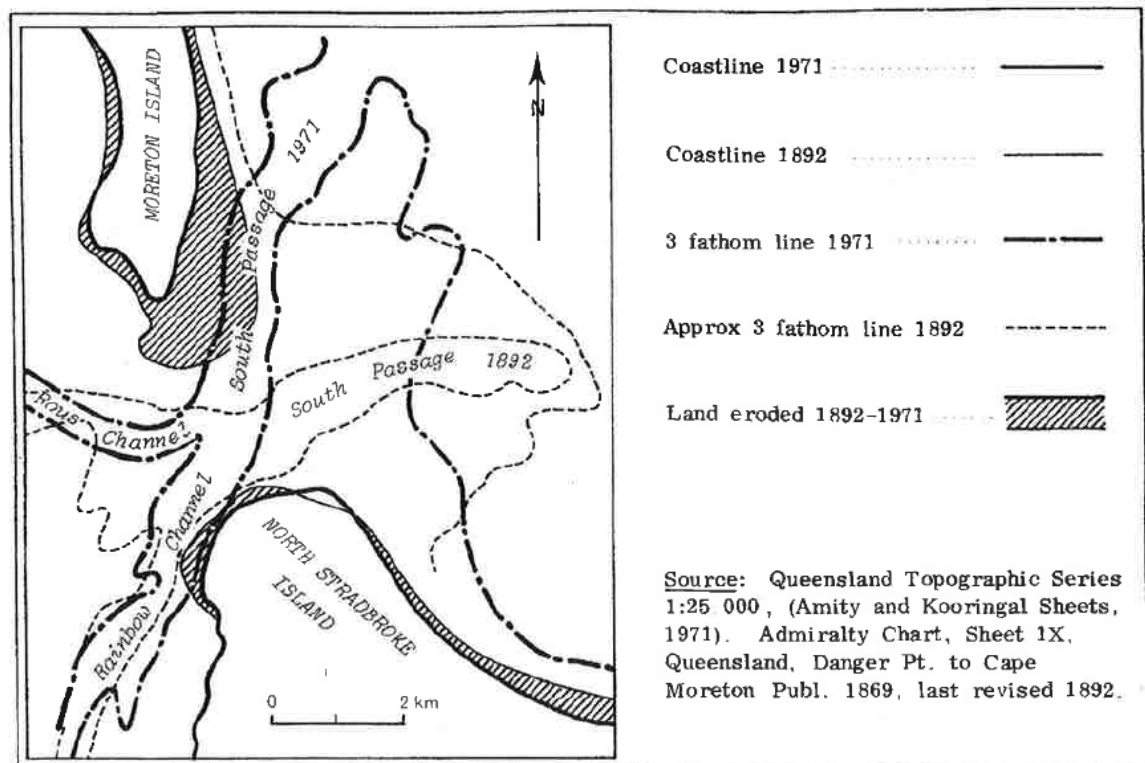


Figure 4-1 Historical Channel Changes in Channels

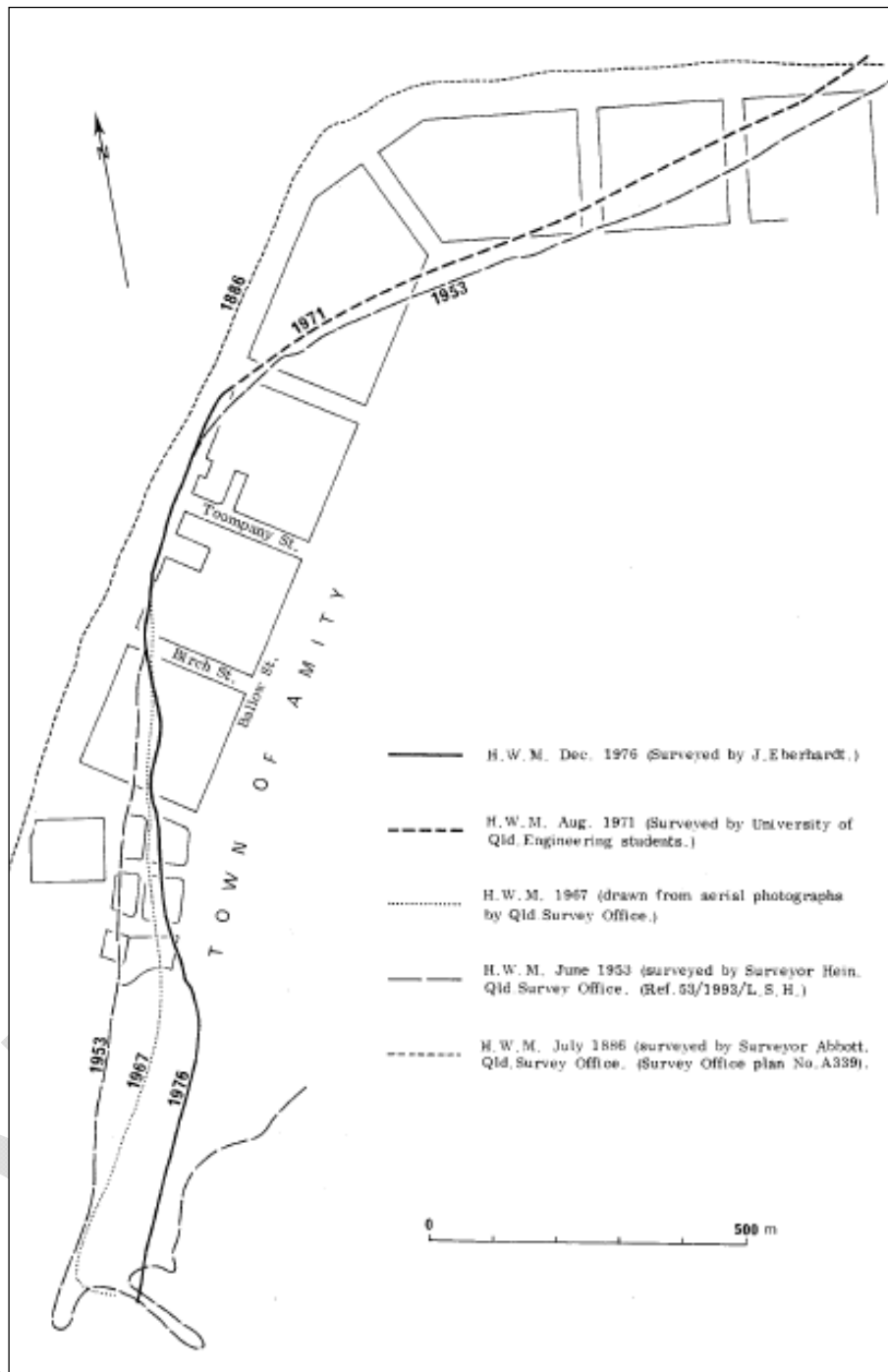


Figure 4-2 Historical Channel Changes near Amity

Another report of note is the Brisbane River and Moreton Bay Wastewater Management Study of 1998 where channel velocities were measured in Rainbow Channel at Amity and Rous Channel in January 1998.

Of note in these studies were the flood and ebb tide velocities with the ebb tide velocity being up to 1.5m/s adjacent to the shore at Amity. Typical plots from the study are shown in Figure 4-3 and Figure 4-4 below. Components from the above reports are included throughout this report when discussing coastal processes.

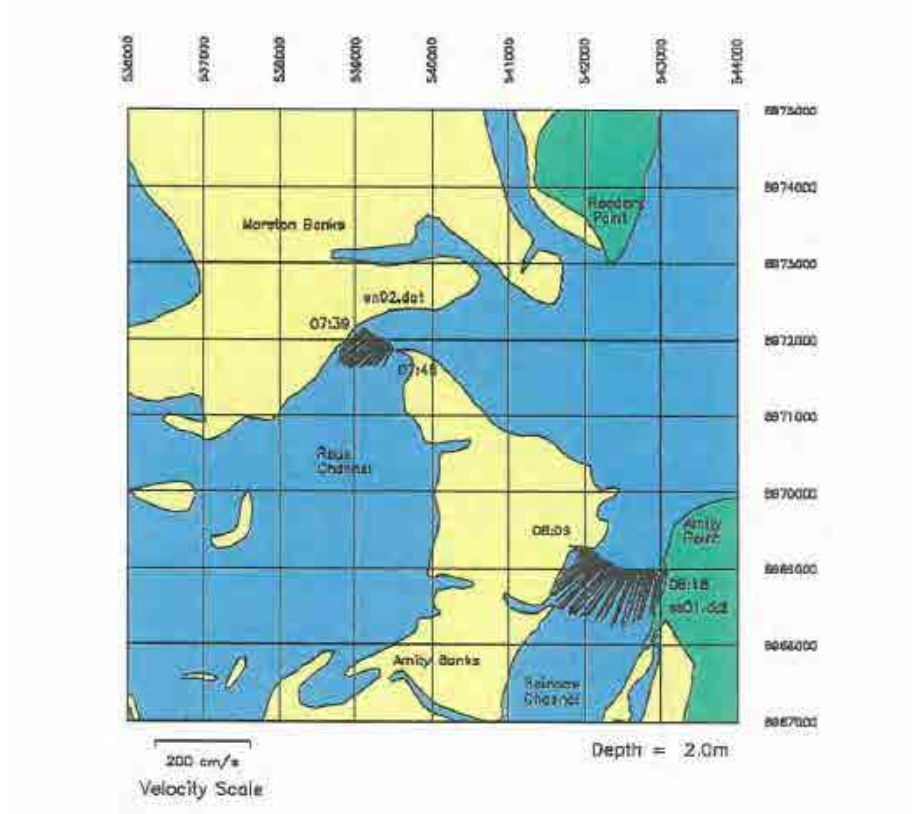


Figure 4-3 Typical Spring Flood Tide Velocities near Amity

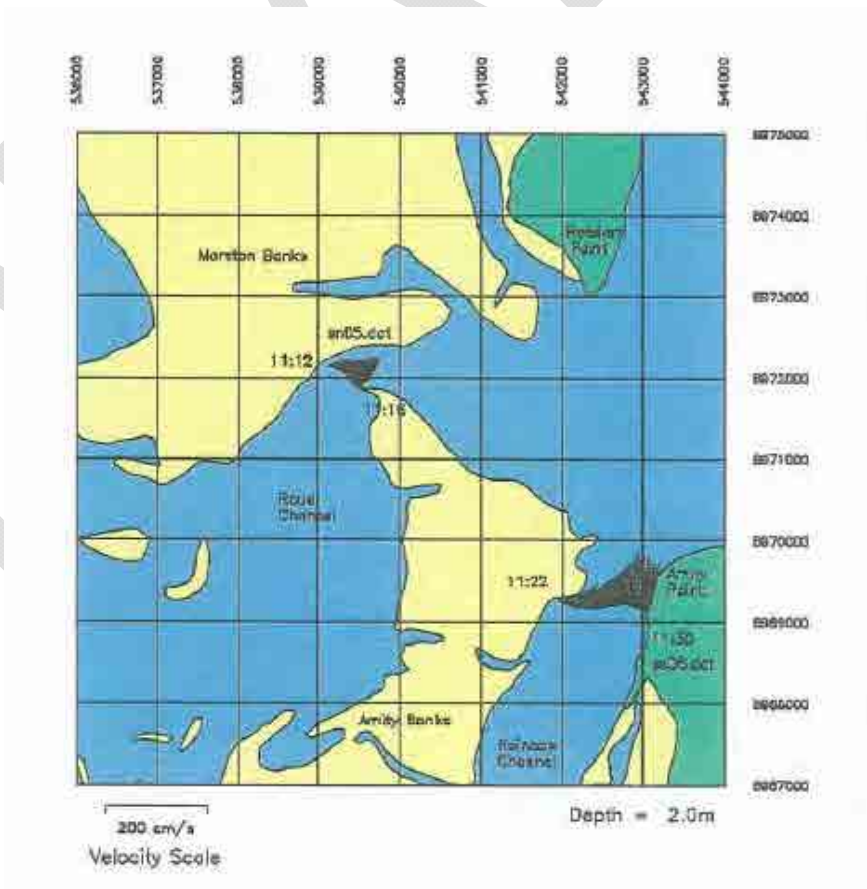


Figure 4-4 Typical Spring Ebb Tide Velocities near Amity

4.3 Coastal and Estuarine Processes

It has been established that the coastline at Amity is heavily influenced by the ongoing meandering of Rainbow Channel, and to a lesser extent the Rous Channel and South Passage, which carry the tidal flow between Moreton Bay and the Pacific Ocean. Also, a large volume of sand has migrated through the entrance and exists as shoals adjacent to and many kilometres to the south and west of Rainbow Channel, Rous Channel and South Passage (refer Figure 4-5). However, these do not provide any protection to the Amity shoreline because of the high velocities in Rainbow Channel which scour the sand out of the channel adjacent to Amity. Similarly ocean swell transports a low volume of sand along Flinders Beach towards Rainbow Channel near Amity Point. A small proportion of this flow progresses along the shoreline of Amity as shoals but does not provide any long term benefit to the shoreline. The following section will look at the individual process contributing to these complex phenomena so that a better understanding of the potential to influence the erosion at Amity is understood.



Figure 4-5 Channels and Shoals near Amity (from Google Maps)

4.3.1 Water Level Variations

Variations in sea level significantly influence coastal behaviour by altering the volume of water entering and leaving Moreton Bay each tide and influencing the level and direction at which waves attack the shoreline. This not only relates to day-to-day tidal influences, but also to storm events that can be experienced along the shoreline. Water levels are likely to be elevated above normal conditions during storm events due the interaction of tide and storm surge.

4.3.1.1 *Astronomical Tide*

The astronomical tide at Amity is semi-diurnal, typically with significant variation in subsequent high and low tides. The ocean tide propagates to the site predominantly via the South Passage, nearby shoals and Rainbow Channel.

The tidal planes at Amity Point relative to Lowest Astronomical Tide (LAT) and Australian Height Datum (AHD) are as listed in Table 4-1 (From the Tide Tables and Boating Safety Guide (MSQ, 2012)).

Table 4-1 Tidal Planes at Amity Point

| | Level at Amity Point (For datum shown) | |
|---------------------------|---|-------|
| | mLAT | mAHD |
| Highest Astronomical Tide | 2.24 | 1.12 |
| Mean High Water Springs | 1.78 | 0.76 |
| Mean High Water Neaps | 1.46 | 0.44 |
| Mean Sea Level | 1.09 | 0.07 |
| Mean Low Water Neaps | 0.62 | -0.40 |
| Mean Low Water Springs | 0.30 | -0.72 |
| Lowest Astronomical Tide | 0.00 | -1.02 |

4.3.1.2 Storm Tide Levels

The tidal planes are predictions based on the movements of celestial bodies. Local meteorological conditions, which differ from the average, will cause corresponding differences between the predicted and the actual tide. Variations in tidal heights are mainly caused by strong or prolonged winds and by unusually high or low barometric pressure. The increase in sea level resulting from these effects during severe storms and cyclones is called the storm surge. The resulting water level combining the surge with the astronomical tide is referred to as the storm tide.

Within Moreton Bay, a storm surge consists of the following components:-

- Oceanographic processes (including coastal trapped waves);
- Regional wave set-up generated by wave breaking along shoals;
- Inverse barometer (atmospheric pressure);
- Local wind set-up within Moreton Bay; and
- Local wave set-up generated near the shoreline.

Potential storm tide levels for design purposes have been assessed by a review of existing studies including a recent storm tide study for the Redland Shire (Redland and Logan Shires Storm Tide Hazard Study – Cardno LT, 2009). A plot from this study of the land inundated by the 100 year ARI storm tide at Amity is presented in Figure 4-6.



Figure 4-6 Storm Tide Inundation Risk near Amity

4.3.2 Sand Transport Mechanisms

Sand is transported along the western shoreline of North Stradbroke Island by the combined action of currents and waves. Currents generated by the tide flowing in and out of Moreton Bay are the dominant transport mechanism with some assistance from waves both locally generated and as swell from the ocean.

The prevailing waves are locally wind-generated “sea” waves from the westerly directions and as such are of relatively low height and period and limited sand transport capacity compared to tidal currents. The shoals directly north of Amity Point on the eastern side of South Passage will reduce the energy of swell waves penetrating the entrance except in periods of elevated water levels (cyclones and easterly trough lows). However, these swell waves transport sand along Flinders beach providing a small input of sand to South Passage/Rainbow Channel at Amity Point.

The locally generated sea waves are present on a day-to-day basis whereas the swell and storm waves are present irregularly. The wave induced sand re-suspension and currents will interact with tidal currents to provide a complex sand transport regime.

Numerical models of the wave conditions and current conditions at Amity are described in Sections 3.3.4 and 3.3.5 below.

4.3.3 Legislated Erosion Prone Areas

For the Amity area, the DEHP has adopted the CMD shown below in Figure 4-7 which is primarily based on erosion prone areas as defined by the then Beach Protection Authority (BPA) in 1984 (Plan SC3365F). The original Erosion Prone Areas (EPAs) at Amity were defined as a zone measured 145m landward of the mean high water springs line except where approved revetments exist, in which case the zone is 10m landward of the upper edge of the revetment alignment. Further east at Flinders Beach the EPA is defined as 190m. BPA's Erosion Prone Areas width includes allowances for the erosion likely to be experienced by erosion in the event of a major storm or series of storms (short-term erosion), long-term progressive recession if long-term erosion was allowed to occur and shoreline retreat associated with climate change impacts (i.e. mean sea level rise).



Figure 4-7 Coastal Management District (CMD) near Amity (from DEHP)

4.3.4 Numerical Modelling

To better understand the individual processes contributing to the complex coastal processes driving channel current velocities and sand transport around Amity numerical modelling of waves and tidal currents has been undertaken. This is described in the following sections.

4.3.4.1 Waves

The long term average wind wave climate at Amity Point has been predicted using SWAN, a third-generation wave model developed at Delft University of Technology, Netherlands (Booij, 1999). Wave parameters within the study area were predicted on a grid with a 50m x 50m resolution. The islands and shoals in the vicinity of the study area influence the wave climate at Amity Point. These features significantly reduce the fetch area (that is, the area of the sea surface where the wind can generate

waves). Under normal, prevailing conditions the wave energy reaching the study area from outside Moreton Bay is assumed to be negligible.

The wave assessment is based on the local wind climate obtained from the Bureau of Meteorology (BoM). The wind input data for the wave model was obtained from the BoM weather station at Cape Moreton Lighthouse (site number 040043) recorded between 1996 and 2010. Half-hourly wind recordings are available for this period. The recorded wind magnitude was scaled to 10m above sea level following the Coastal Engineering Manual (US Army Corps., 1996). The wind record was analysed in order to obtain the frequency occurrence of specific wind magnitude and direction scenarios with a total of 137 unique wind scenarios defined. As a conservative approach, each wind scenario was modelled with a water level equivalent to MHWS at Amity Point (0.76m AHD). The influence of currents on the wave height was not considered in the assessment.

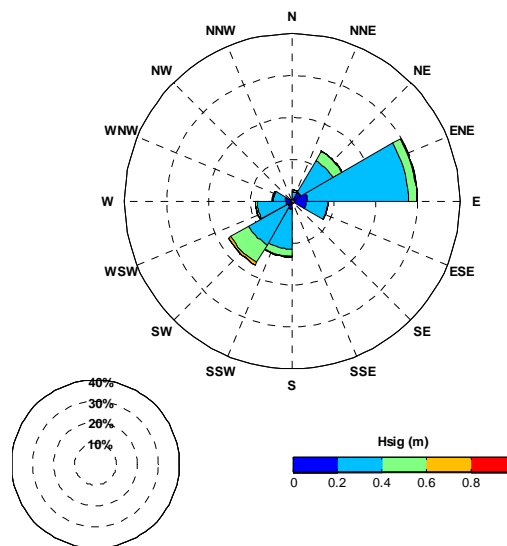


Figure 4-8 Long Term Annual Average Wave Climate Offshore from Amity Point

The wave climate modelling results are summarised as an average annual rose plot in Figure 4-8. The summary is based on results at a location offshore from Amity Point where the water depth is approximately 16m below AHD. Wave height and direction recurrence frequency percentages are presented in Table 4-2.

The wave modelling results indicate the following:

- For approximately 87% of the year the significant wave height is predicted to be less than 0.5m. For these smaller waves, the dominant wave direction is from the east-north-east to easterly sector and will have little impact at Amity.
- The highest percentage of waves with heights above 0.5m is predicted to be from the southwest. These waves generated within Moreton Bay occur less than 1% of the time and will be associated with high wind speeds during episodic storm events. These waves will cause minor erosion on exposed beaches facing west at Amity.

- The model results indicate significant wave energy dissipation across Amity and Moreton Banks. Much of these areas are exposed at low tide and during this time wave breaking occurs offshore with minimal wave energy reaching the Amity Point shoreline.

Table 4-2 Long Term Annual Average Wave Height and Direction Recurrence Frequency (%)

| Hs (m) | Wave Direction (Degrees from North) | | | | | | | | | Total | |
|--------------|-------------------------------------|--------------|--------------|-------------|-------------|-------------|--------------|--------------|-------------|-------------|--------------|
| | 0 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | | 270 |
| 0.1 - 0.3 | 1.9% | 8.8% | 24.0% | 5.1% | | | 9.5% | 10.7% | 6.9% | 2.8% | 69.8% |
| 0.3 - 0.5 | 0.5% | 2.5% | 2.1% | | | | 1.7% | 4.9% | 0.3% | 0.2% | 12.2% |
| 0.5 - 0.7 | 0.0% | 0.1% | 0.1% | | | | 0.2% | 0.6% | 0.1% | 0.0% | 1.1% |
| >0.7 | | 0.0% | 0.0% | | | | 0.0% | 0.0% | | | 0.0% |
| Total | 2.4% | 11.4% | 26.2% | 5.1% | 0.0% | 0.0% | 11.4% | 16.2% | 7.3% | 3.0% | 83.2% |

Calms (Hs < 0.1m): 16.8%

4.3.4.2 Currents

The tidal currents were assessed using an existing TUFLOW FV model of Moreton Bay with increased resolution in the vicinity of the study area. Figure 4-9 shows a current speed time series at a location offshore from Amity Point and for a typical spring tide. The peak flood current speed is predicted to reach approximately 1.4m/s. A higher peak current speed that exceeds 1.8m/s is predicted during the ebb phase.

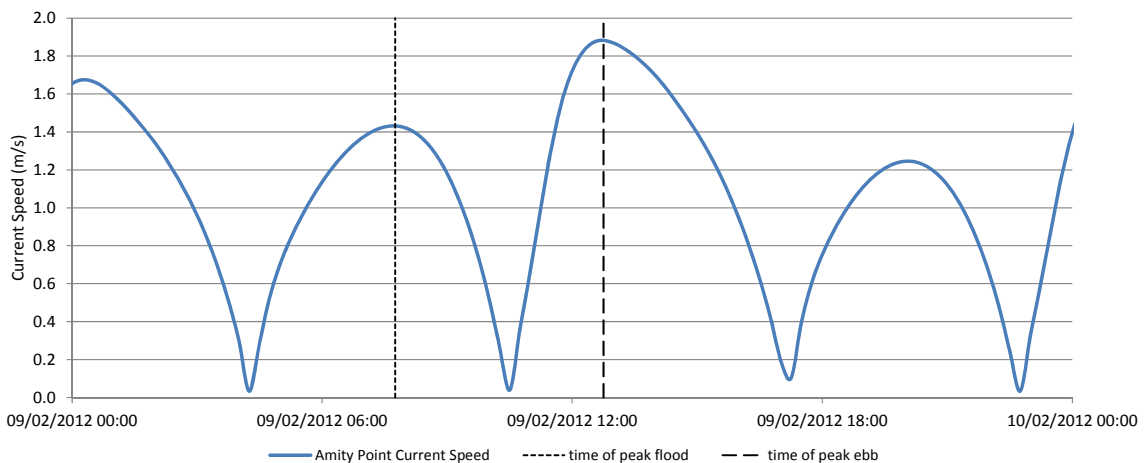


Figure 4-9 Typical Spring Tide Current Speed Time Series at Amity Point

Figure 4-10 and Figure 4-11 provide spatial plots at the time of peak flood and peak ebb current speed (times indicated in Figure 4-9).

Figure 4-10 suggests that during the flood tide phase maximum currents occur opposite Amity Point on the western edge of Rainbow Channel. The flood currents are expected to transport sand in a southern direction and along Rainbow Channel which has led to the formation of shoals to the south of Amity Point.

Figure 4-11 suggests that during the ebb tide phase the current speed progressively increases across Rainbow Channel and reaches a maximum at Amity Point. The distribution of currents also indicates a significant flow from the east which is transporting sand into shoals adjacent to Rainbow Channel resulting in a decrease in the channel width and increased erosive pressure at Amity.

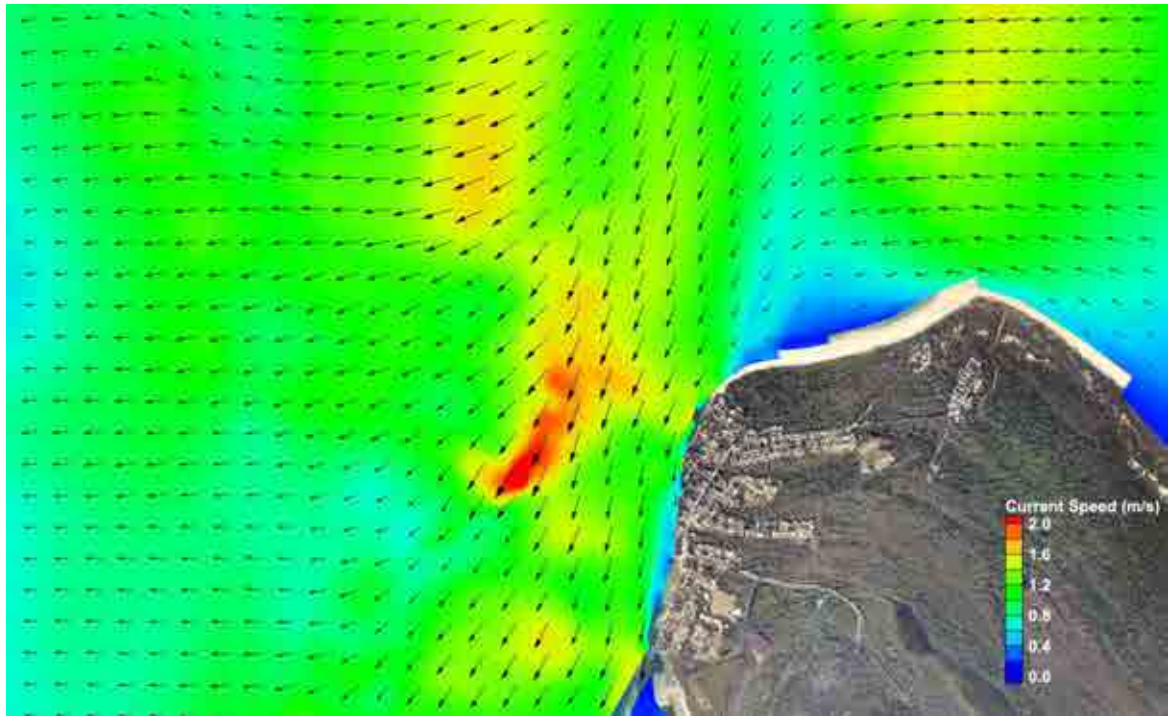


Figure 4-10 Typical Spring Tide Current Speed Contour and Vector Plot – Peak Flood

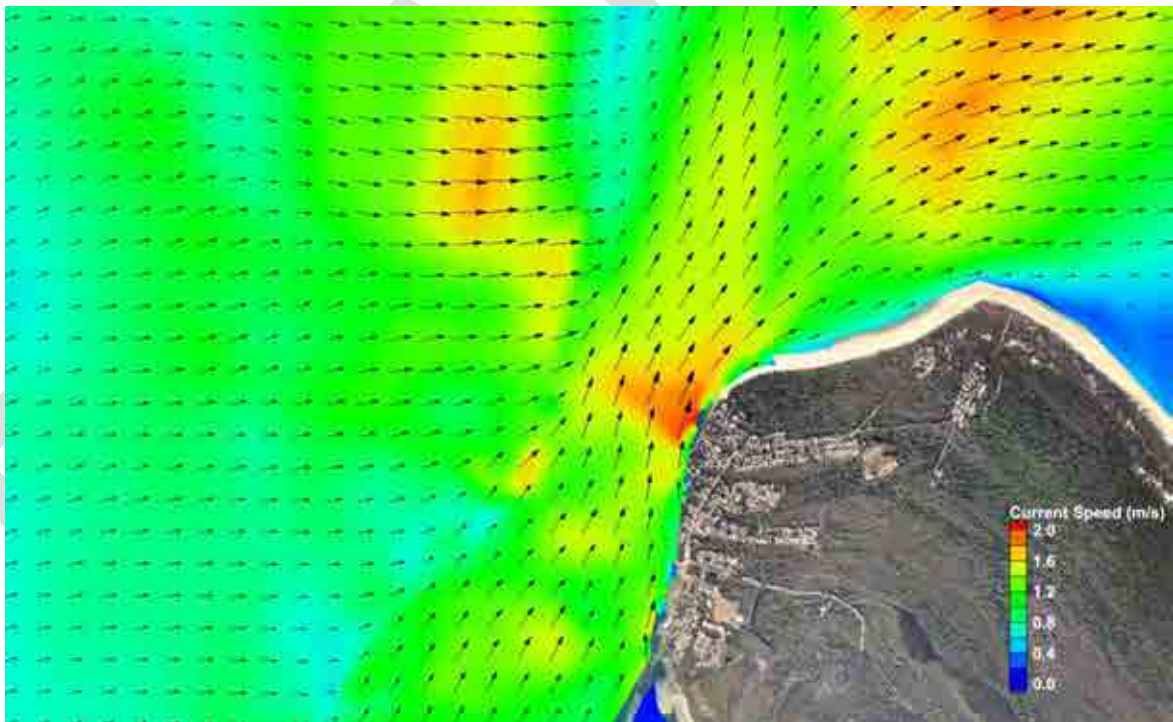


Figure 4-11 Typical Spring Tide Current Speed Contour and Vector Plot – Peak Ebb

4.4 Present and Future Shoreline Erosion

4.4.1 Assessment of Current Erosion

It has long been known that the coastline at Amity is largely influenced by the ongoing meandering of Rainbow Channel, and to a lesser extent the Rous Channel and South Passage, which all carry the

tidal flow between Moreton Bay and the Pacific Ocean. The previous data collection campaigns and numerical modelling undertaken for this study indicate that the ebb tide flow and associated sand transport tends to force the Rainbow Channel current hard against the Amity shoreline from Amity Point to the Amity boat ramp with tidal velocities up to 1.8m/s occurring. It should be noted that velocities above 0.3m/s will initiate sand transport. The aerial photography in Figure 4-12 shows that the channel in front of Amity Township is deepest with a broadening and shallowing of the channel adjacent to the Amity Caravan Park. Historical aerial photography indicates the the channel width at Amity has reduced from over 900m in 1958 to around 750m today. Hydraulically this dictates that either higher velocities or a deeper channel is required to maintain flow volumes.

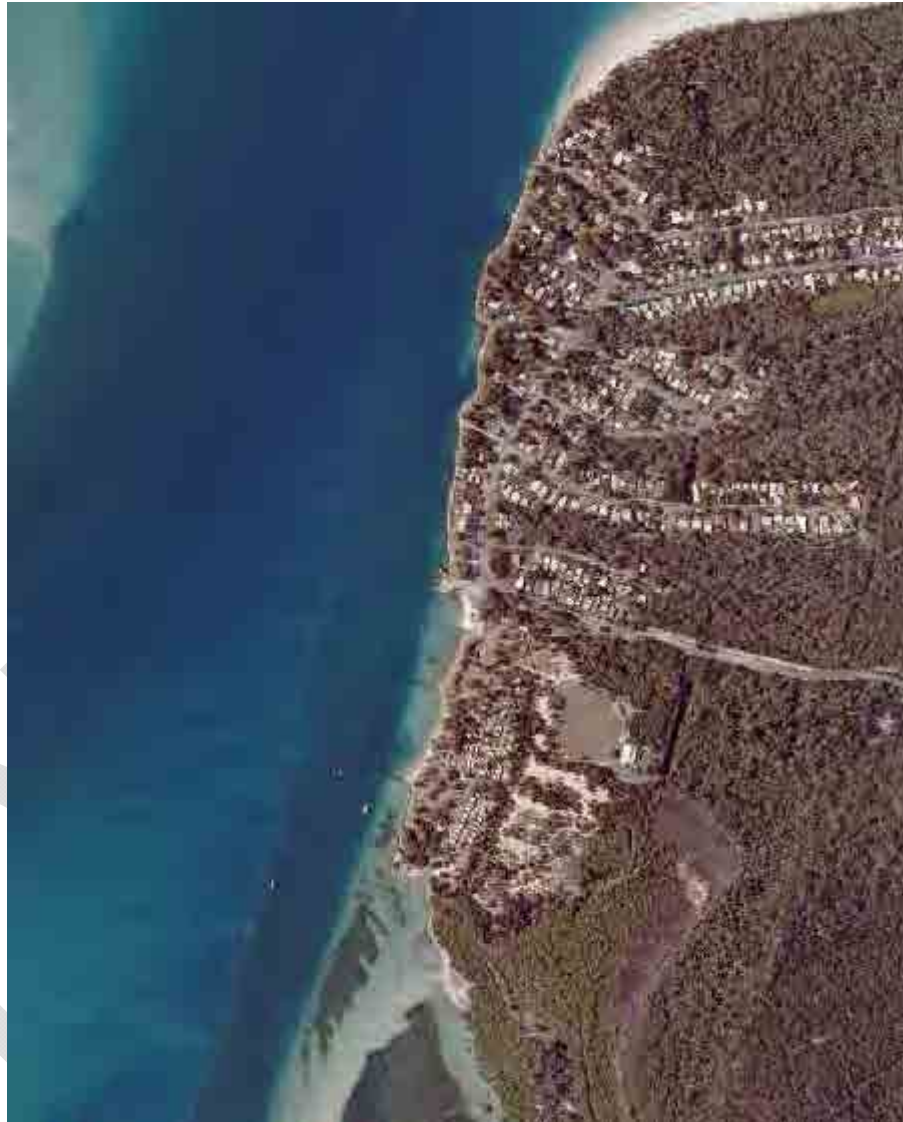


Figure 4-12 Main Rainbow Channel Location near Amity (Source: DEHP)

On the north east coastline ocean swell is significantly attenuated by the time it reaches the western end of Flinders Beach but still transports sand along Flinders Beach towards Rainbow Channel near Amity Point. A small proportion of this sand is caught in the Rainbow Channel flows and progresses along the shoreline of Amity as shoals but does not provide any long term benefit to the shoreline.

The more significant of the local wind waves approaches the shore from the southwest and can reach a height of 0.7m. These waves will tend to cause limited beach erosion at or near high tide level and

small scarps in the unrevetted sandy areas will occur as sand is moved offshore. In particular this is of concern in the recessed beaches between the groynes in front of the Amity Caravan Park and to the immediate north of the end of the rock revetment at Amity Point.

The Flinders Beach shoreline continues to receive a supply of sand from the east driven by ocean swell. The continuing rotation of the Rainbow Channel is allowing the South Bank area to the east of Amity Point to grow northwards resulting in accretion on Flinders Beach and foreshore stability in recent times. However, this may reverse at any time in the future dependent on channel movements, offshore shoal configurations and the continued supply of sand around Pt Lookout.

4.4.2 Climate Change Impacts

Since 1900, global-average temperatures have increased by about 0.7°C and the global-average sea-level has risen at a rate of 1.7mm/year (Church and White, 2006). Due to anthropogenic greenhouse gas emissions the rates of both temperature increase and Sea Level Rise (SLR) are likely to be presently increasing and are expected to further accelerate in the future (IPCC, 2001; IPCC, 2007).

There are uncertainties as to the actual magnitude and rate of future sea level rise. This has led to various scenarios being adopted by the Intergovernmental Panel on Climate Change (IPCC), based on the range of model results available and dependent upon the amount of future emissions assumed.

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) reports that global sea level rise is projected to be 18–59 cm by year 2100 relative to 1990 levels. These projections do not include a contribution from ice flow rates, however if these were to continue to grow linearly with global warming, then the upper ranges of sea level rise would increase by a further 10 to 20 cm (by year 2100 relative to 1990) (IPCC, 2007). There is an acknowledged risk that the contribution of ice sheets to sea level rise this century may be substantially higher than this.

The climate models predict that there will be a not-insignificant regional variation in future sea level rise, predominantly due to spatial variations in the contribution made by ocean thermal expansion. Predictions reported by the CSIRO (2007) indicate that future sea level rise along the eastern Australian coastline may be up to 7 cm greater than the global average due to the greater efficiency in South Pacific Ocean currents (such as the East Australian Current) to disperse thermal energy.

In summary the total mean sea level rise along the eastern Australian coastline is estimated to be in the range 28–86 cm to the year 2100. This will occur gradually at first as we continue to accelerate from the historic rate of 1.7 mm per year and then more rapidly as the year 2100 is approached.

For land use planning purposes, Redland City Council has followed the Queensland Coastal Plan (2011) which has adopted a sea level rise projection of 0.8m by 2100 (relative to the 1990 mean sea level). This value is based on the upper range of projections published by the IPCC (2007) and may be revised following the release of future IPCC report.

Little is known about likely changes to prevailing winds or extreme storm behaviour, although it is likely that cyclones would extend further south under warmer sea temperatures. The effect of changed storm occurrences on storm surges has been investigated by James Cook University as part of the Oceans Hazard Assessment Stage 3 Report (JCU, 2004).

The JCU study assessed the likely impact of a 10% increase in cyclone intensity and frequency including a poleward shift in cyclone track by 1.3 degrees. The predictions by JCU indicate that these potential changes to cyclone intensity, frequency and path may increase the 1% AEP storm tide levels in the study area by 0.30m. This would be in addition to mean sea level rise

Changes in storm conditions and sea level rise may impact on the severity of storm erosion due to more intense or more frequent storms or long term changes in wind directions may cause a re-alignment of the shoreline resulting in accretion at one end of the beach and erosion at the other. A recent report summarising existing theory and high-resolution dynamical climate model output indicates that greenhouse warming will cause the globally averaged intensity of tropical cyclones to increase by 2-11% by 2100. These studies also project decreases in the globally averaged frequency of tropical cyclones by 6-34% (Knutson et al., 2010).

With regard to beach erosion at Amity it is expected that future sea level rise and any change in wind climate (speed and direction) or storminess will exacerbate the existing problem.

4.4.3 Likely Change Due To Climate Change

Both mean sea level rise and intensification of the storm occurrences are likely to increase the erosive pressure on the Amity shoreline and may change the historical accretion on Flinders Beach. With mean sea level rise likely to accelerate due to climate change, the tidal compartment of Moreton Bay will increase substantially resulting in greater flows in Rainbow Channel and increased pressure on the Amity shoreline.

In addition to shoreline erosion due to channel alignment and beach profile alterations, increased sea level rise has also the potential to affect the longshore sediment supply to Flinders Beach as the headland at Pt Lookout may tend to interrupt the longshore sand transport. This may decrease the amount of sand current entering the system from the east resulting in changes both at Flinders Beach and Amity Point.

5 COASTLINE MANAGEMENT CONSIDERATIONS

5.1 Beach Erosion Problem

The Amity shoreline is subject to a threat of erosion associated with:

- The ongoing meandering of Rainbow Channel;
- The depth of the channel and the apparent sudden collapse of banks at Amity;
- The impact of existing mitigation works on shorelines to the south;
- The feasibility of management options in the light of the existing mitigation works;
- Future erosion pressure due to sea level rise; and
- The implications of the existence of the Moreton Bay Marine Park and Myora-Amity Fish Habitat area.

5.1.1 General Considerations

The nature of solution options needed to deal with the coastal erosion problem depends on the nature and level of the threat and consequences if it is left unchecked. The erosion problem to be addressed is jointly one of threat to property and loss of the beach, to varying degrees along the beach. The most appropriate management options may vary along the beaches of the study area.

It must be recognised that some options aimed primarily at protection of property located within the erosion prone area (e.g. rock revetment construction) may be detrimental to the beach. Considerations are set out below in the context of the nature of the erosion threat and the priority objective to be achieved.

5.1.1.1 Undeveloped Areas

In presently undeveloped areas, the key objective is to prevent an erosion problem from occurring in the future. That is, allowing the natural beach processes of erosion and accretion, including any progressive long term trend of shoreline retreat to occur without threat to property.

The most appropriate coastal management strategy is to prevent development within the erosion prone area. The natural processes, including shoreline fluctuations, will thus be allowed to continue unimpeded and the natural amenity and character of the beach will be retained.

This may require a set-back control on any future development. To achieve this, the following coastline management strategies would need to be adopted:

- Ensure appropriate planning controls are in place to prevent infrastructure and residential development occurring in erosion prone areas which are presently undeveloped (preferably over a 100 year planning timeframe);
- Allow natural processes to occur with ongoing monitoring of coastline behaviour; and
- Continue dune management and protection works and controlled access to the shoreline as necessary to maintain the integrity of the dune system and prevent wind erosion.

5.1.1.2 Areas with Existing Development under Erosion Threat

Where present development is not under immediate erosion threat, but may potentially come under threat over time, forward planning is needed to prevent future problems. The degree of natural variability in the coastal processes and the level of uncertainty in predicting future coastline behaviour over long timeframes are such that the need for and nature of any future action will be dependent on factors that are unknown at present such as:

- Realisation of the erosion threat and the likelihood of ongoing recession;
- Effects of potential climate change impacts (e.g. sea level rise); and
- Future opportunities and attitudes towards coastline management and options for dealing with such threat.

The potential future threat from erosion should, however, be recognised in present planning and appropriate strategies put in place that will not compromise future management decisions.

There are two basic strategic approaches for dealing with the problems of erosion threat to the development and loss of the beach, namely:

- Undertaken works to hold or improve the present coastal alignment, thereby preventing future recession of the beach; or
- Allow the shoreline to recede in such a way that the natural processes would maintain the beach characteristics and amenity, but at the expense of existing land and infrastructure.

There are alternative approaches within these two categories, as discussed below.

5.1.2 Channel Relocation Option

The shoreline erosion at Amity Township is related to channel movements with the Rainbow Channel adopting a more north-south alignment over recent times. Consideration at a high level can be given to the option of relocating Rainbow Channel to the west with the possibility of placing the dredged sand in front of Amity Township. Previous studies in other areas have shown that this option involves a large volume of dredging with the likelihood that the system will return to the initial condition over time as this is the natural balance of forces at the time. It is often the case that natural changes can be slow and persistent such as the channel changes over the last 100 years but they can also be dramatic in storm events and cyclones.

It must be noted that experience has shown that the modification of tidal flows in lower estuaries is a major undertaking and would involve substantial costs in studies for approvals, design studies and construction.

Relocating the channel to the west would not be expected to cause any impacts that would not naturally occur to ecological and fisheries values within the Fish Habitat Area and the Marine Park in general. It is expected that relocating the channel to the west would lead to minimal impacts to the natural environment because:

- Fauna communities within the Rainbow Channel are adapted to a dynamic environment;
- No aquatic flora would directly be disturbed during relocation works;

- Turbidity plumes would be limited in extent and duration due to the marine source and hence “cleanliness” of the sand;
- Sediments to be disturbed are unlikely to contain significant contaminant loads; and
- Works would be timed so as to have minimal impact to fish populations and commercial/recreational fisheries. The works would likely be carried out in September/October to prevent impacts to fish spawning and fishing activities.

However, it is recognised that migratory and resident shorebirds may use the area and studies would need to be undertaken to address any impacts to these.

5.1.3 Protection Options

Options to hold the present coastal alignment fall into two sub categories:

- Beach nourishment to rebuild the beach with sand imported from outside the active beach system to make up the deficit, either alone or with other control structures to improve the longevity and give added protection; and
- Structural measures such as rock revetments, groynes to either directly protect the property or trap sand to rebuild the beach in front.

These protection options are discussed in detail below.

5.1.4 Beach Nourishment Options

The primary intent of beach nourishment is to ensure existence of the recreational beach and provide protection to the development by rebuilding the beach with sand imported from outside the active beach system. This effectively replaces the deficit of sand that is causing the erosion. In this way a natural beach and its associated values will be returned and maintained while providing a buffer of sand to accommodate natural beach fluctuations and protect the property and facilities behind.

The quantity of sand required will be dependent on the design philosophy with respect to the level of initial and ongoing protection, the grain size of the material and the use of structures to enhance the longevity of the works.

One of the inherent advantages of beach nourishment is that it maintains the natural character and recreational amenity of the beach while also providing property protection. As such, where the beach is severely depleted, it provides many intangible benefits to the general community, as well as a direct economic benefit to those businesses that rely on tourism and the presence of a usable beach.

However, identification and access to sources of suitable nourishment sand is usually a key issue, as is the ongoing cost to maintain this protection and amenity. Transport of the sand to the beach is most cost-effectively achieved by dredging procedures. Sufficient sand deposits would need to be identified before beach nourishment can be considered a practical shoreline protection option.

5.1.4.1 Sand Recycling

Sand recycling or relocation refers to moving sand within the beach system. Sand recycling differs from beach nourishment as no additional sand is added to system, rather the sand is simply

redistributed to help maintain beach amenity or protect a section of shoreline susceptible to storm erosion.

Sand relocation systems are in place at the Mooloolah River entrance and Noosa Main Beach. The systems trap sand at the downdrift end of the beach and pump it back to the eroded updrift areas. While this system will not prevent erosion it does assist in maintaining the recreational/tourism value of a beach and reduces the threat of erosion for the adjacent development.

5.1.5 Structural Protection Options

Structural options provide protection of property against ongoing erosion either directly through the construction of a seawall or by rebuilding of the beach through the construction of groynes. They are options that could be considered in the event that retreat options are not viable and that conditions are such that beach nourishment is not possible (e.g. high currents) or sand is not available in sufficient quantities. However, there are always some adverse impacts of such an approach where no additional sand is provided, as outlined below.

Such structures would typically be of flexible rubble mound design with rock being sourced and trucked to the site from quarries in the region. While they may be effective in protecting property or providing a localised wider beach, they are generally accompanied by associated costs related to adverse impacts on the adjacent beaches. This cost is typically made up of direct costs associated with lost income from the tourist industry and other intangible costs associated with the natural coastal amenity, beach access, loss of recreational beach area and degradation of ecological values.

5.1.5.1 Seawalls or Rock Revetments

Seawalls or rock revetments are commonly built with the intent of providing terminal protection against shoreline retreat. Seawalls or rock revetments are robust structures constructed along the shoreline which provide a physical barrier separating the erodible material immediately behind the structure from wave and current forces acting on the shoreline. They are typically constructed of loosely placed rock to allow for some flexible movement and need to be designed to withstand severe wave attack.

Where possible, seawalls or rock revetments should be continuous to prevent end effects and/or discontinuities that could threaten the overall integrity of the wall. They also have to be suitably founded for stability against scour at the toe of the structure, particularly on a receding shoreline. This is a major constraint at Amity where the Rainbow Channel is up to 20m deep and tidal currents are high.

While a properly designed and constructed seawalls or rock revetments can protect the landward property from erosion, it effectively isolates the sand located behind the wall from the active beach system and may lead to other adverse consequences.

On a receding shoreline, the seawall or rock revetment becomes progressively further seaward on the beach profile over time. This is the case at Amity where the revetments and protected Township now protrude significantly into Rainbow Channel. Scour of the lower section of the bank below the perched revetment ultimately leads to bank slumping and the need for ongoing maintenance. This slumping can be dramatic with no notice and could cause loss of life.

Seawalls or rock revetments in isolation can thus be effective in protecting the property behind, but at a cost of the loss of the beach in front and exacerbated erosion on the downdrift side.



Figure 5-1 Rock Revetment near Amity Point (Source: NearMap Pty Ltd, 2011)

5.1.5.2 Groynes and Artificial Headlands

Groynes and artificial headlands are impermeable structures constructed at right angles to the shoreline and extend across the beach and the nearshore surf zone. Their function is to trap sand moving along the shoreline under longshore transport processes to build up and stabilise the alignment of the beach on the updrift side. By necessity they require littoral sand transport to be effective and starve the beach of sand supply on the downdrift side causing erosion. The sand trapped on the updrift side provides a buffer of sand to accommodate short term storm erosion. The shoreline alignment will also change providing greater stability and reduced long term erosion immediately updrift of the structure. The extent of accretion and length of shoreline affected is dependent on the length of the structure as well as the characteristics of the longshore transport processes. Generally, the longer the groyne, the more sand it will trap over a longer distance with decreasing influence away from the structure.

Groynes have been used without success to prevent shoreline erosion at Amity since the 1950's (refer Figure 5-2). Over the years the groyne field at Amity has been replaced by rock revetments and the groyne field moved south to protect the caravan park with the result that the area to the south has eroded.



Figure 5-2 Amity Point in 1958 showing Groynes (Source: DEHP)

Often a series of groynes are required to maintain a section of beach as shown in Figure 5-3 and Figure 5-4 at Amity Park. This figure clearly shows that the lack of sand transport has caused the shoreline to retreat even though the groynes are in place. It also indicates that if groynes were to be considered further to the north in front of the Township then a retreat of about 50-60m of urban development would need to accompany the proposal to maintain a consistent channel alignment.

However, there is a physical limit to the length of shoreline affected by each groyne and therefore a number of groynes are needed if protection is required over a long stretch of shoreline. In such a case, there is a balance between the length and spacing of groynes that needs to be optimised as part of a detailed design process.

An artificial headland is a substantial groyne type structure that has a physical width at its head in comparison to a conventional narrow groyne. It is believed that this width alters the mechanisms of sand transport past the end of the structure and may allow a wider/longer beach to be retained on the updrift side for the same protrusion offshore. This could have the benefit of minimising the need for, or maximising the spacing of, additional structures to provide protection for a long stretch of coastline. However, such headland type structures would be larger and more expensive to construct.



Figure 5-3 A Series of Groynes near Amity Park (Source: NearMap Pty Ltd, 2011)



Figure 5-4 Shoreline Recession near Amity Caravan Park (Source: NearMap Pty Ltd, 2011)

Groynes or artificial headlands can thus be used to rebuild a beach and stabilise the shoreline against ongoing recession on the updrift side. However, in the absence of other works such as beach nourishment, this comes at the cost of exacerbated erosion on the downdrift side to where the erosion trend is transferred.

Another significant consideration associated with groynes is their potential visual intrusion to the vista of a long sweeping beach and interruption to direct access along the beach. There are various design options with respect to the style and crest height of the structures that could be considered to minimise such adverse effects.

5.1.6 Retreat Options

The intent of retreat options is to remove the development under threat and allow the shoreline to behave in a natural manner, thus restoring and retaining the natural character and amenity of the shoreline as it recedes. The planned retreat option acknowledges that erosion is an ongoing phenomenon and seeks to address the issue by removal of threatened facilities rather than trying to protect them. This may release a quantity of sand into the active beach from the receding shoreline and provide some additional space for the natural beach movements to occur.

At some locations there may be scope for setting back building lines (retreating within the lot) to give some longer term surety to the assets.

For consideration in this SEMP, there are two different approaches to planned retreat, which essentially relate to the ownership of the land and the responsibility for removal of structures. There are substantial differences between these options in terms of cost, who pays, likelihood of success and ultimate ownership of the beach as discussed below.

5.1.6.1 Retreat under Public Ownership

This option involves the upfront transfer of ownership of all land with an erosion risk to the Crown so that it is under public ownership as recession occurs. Key factors for consideration of planned retreat under public ownership are as follows:

- Transfer of ownership to the Crown should be controlled and implemented via a voluntary acquisition process by government;
- 100% of the affected properties must be obtained in any one beach location for this option to be effective;
- Coastal land values have increased over recent times and could increase further, which may result in high acquisition cost;
- Once implemented, a need will subsequently arise to address the erosion threat of the “new erosion prone area” (the new shoreline after 50 to 100 years will be landward of its current position), and this would entail further significant expenditure to purchase. Unless this land was also purchased, all previous money spent on acquisition could be wasted; and
- At some locations, this retreat option could provide opportunities to establish or enhance public access to and along the beach as land ownership is transferred to the Crown.

5.1.6.2 Retreat under Private Ownership

This option involves the land remaining in private ownership as recession occurs. Key factors for consideration of planned retreat under private ownership are as follows:

- The affected land (currently privately owned) will remain in private ownership when it is lost to erosion and private individuals will be responsible for their own planning in terms of loss of buildings, infrastructure and relocation;
- This option would require regulations to prevent implementation of erosion protection structures by private property owners that comprise coastal principles set out in the State Coastal Plan;
- Ad-hoc loss of private property to erosion typically causes significant adverse visual impacts;

- As the shoreline progressively erodes, the beach could become private property, which could privatise access to and along the beach;
- In terms of equity, it is relevant that the beachfront allotments were historically created by the community (i.e. their representative being the government of the time) for residential use, prior to recognition of the erosion hazard. Accordingly, some responsibility should be shared by the community and the loss of the land for no compensation would be inequitable; and
- It is noted that experience at other coastal Townships where this retreat option has been implemented (e.g. Byron Shire) has been that residents are reluctant to leave their beachfront locations and will utilise legal and practical means to protect their properties.

5.2 Material Sources and Costing Considerations

The implementation of coastal protection works is dependent on suitable material being able to be obtained and placed in a practical, economical and environmentally acceptable manner. General considerations associated with sourcing, cost and applicability of different material types are discussed below, including preliminary estimates in terms of unit costs for capital and ongoing maintenance works provided on the basis of available information.

Cost estimates for the various options are based on these unit rates for comparison purposes. Specific recommended works would be subject to detailed design, impact assessment and tendering processes that may influence the final cost. There will also be on-costs associated with the design, impact assessment and approval processes for the recommended options.

5.2.1 Beach Nourishment

The feasibility of beach nourishment is dependent on the practicality of sand remaining on the beach and cost-effective availability of a suitable source of sand. Sand should be of suitable quality (grain size and colour) and would ideally match the existing beach sand. When nourishment sand is imported from outside the beach system, sufficient quantities of sand should be available for both initial and ongoing nourishment.

Sand for beach nourishments should be able to be obtained and placed without adverse environmental impacts. In environment sensitive areas, this may be challenging. Potential nourishment sand sources have been considered in terms of their location as discussed below.

5.2.1.1 Offshore Marine Sand Sources

Possible offshore sources of sand for nourishment of Amity beaches have not been investigated in detail. Potential sources in nearby areas include Middle Banks south of Caloundra and/or the offshore continental shelf east of South passage.

If viable sand deposits are located in nearby offshore areas, there is still the considerable issue of getting the sand to site. Weather conditions and the delivery distance are likely to ensure the delivered cost is high perhaps as high as \$50-100/m³.

General considerations with respect to use of offshore sand sourcing sites include:

- Identification of sand source(s);

- Suitability of the sand;
- Transport of the sand to the site;
- Rezoning and approval for sand extraction; and
- Potential environmental impacts.

This cost estimate does not consider the associated project costs such as environmental studies, beach profiling, pre and post construction surveys and ongoing monitoring.

5.2.1.2 Land-based Sand Sources

Possible onshore sources of sand for beach nourishment purposes have not been investigated to date but potential locations for consideration are within the lower estuaries of the study area. These areas include the adjacent shoals. Access to sand in these areas is presently constrained by Fish Habitat Areas and other legislation. The use of this sand would require approval from DEHP following detailed assessments that indicate no significant impact on physical or ecological processes.

Considerations with respect to use of such sites include:

- Identification of sand source(s);
- Suitability of the sand;
- Transport of the sand to the site;
- Possible need to purchase the property involved;
- Rezoning and approval for sand extraction;
- Potential environmental impacts including acid sulfate soil considerations; and
- Site rehabilitation.

Transportation of the sand may be an issue, particularly if large quantities are involved. Trucks would cause disruption and damage along access roads. Small suction dredges are only used if the transport distance is less than about 1.0 -1.5 km. Costs of such sources, if viable, are typically around \$10-15/m³ but the transportation costs would raise the price to \$25-30/m³.

Other land sources may include existing quarries. Sand from such sources would be transported to site by conventional equipment and trucks. Costs of such sources, if viable, are typically around \$30-\$50/m³, depending on the distance and method of transport.

5.2.2 Coastal Structures

Coastal protection structures are typically of a flexible mound construction type to allow for some movement and to absorb some of the wave energy. Rock is the dominant material used in such structures and is dependent on suitable local sources being available. Alternative construction materials such as concrete armour units and sand filled geotextile bags could also be considered for such structures but have limitations such as high cost and poor visual amenity of concrete units and short practical life due to decay, failure and vandalism of geotextile units.

Rock armour units would need to be obtained from local hard rock quarries. While the specific extent and limitations of the available resource is not known, it is evident that sufficient rock would be

available but would need to be sourced by truck from quarries at substantial distance and cost. A significant constraint associated with rock armour is the need to truck the material to the site over local roads. For large projects, this can mean frequent truck movements over an extended time frame.

The channel depth at Amity is a significant consideration in the consideration of a rock revetment. A sound design requires a rock revetment to be founded at such a depth that scour cannot undermine the foundation and cause instability. For Amity this will require a foundation depth of at least 18-20m below AHD and a crest height of around 3m above AHD giving a wall height of around 21-23m. For this height the section depth will also need to be significant (approximately 2m) requiring a large volume of rock. Also, to avoid accelerated erosion at the ends of the seawall the structure would need to be in a straight alignment and extend through the entire area at risk.

Groyne structures would not be considered at this site due to the presence of the deep channel with little available sand and high currents.

Indicative cost estimates for the supply and transport to site of rock based on typical experience are as follows:

- Armour rock supply to site: \$40 - \$50/tonne; and
- Quarry run rock supply to site: \$25 - \$35/tonne.

On this basis, typical rock revetment structure costs including design costs and on-site placement are estimated at \$20,000/m with an initial structure length of about 750m. It is expected that this revetment will need to be extended in the future as the Rainbow Channel continues to realign.

For the assessment of the erosion management options, a nominal contingency allowance of 25% has been applied to the above coastal structure cost estimates.

Rock structures by their nature are subject to movement and settlement over time. They are also subject to damage during storm events although they are designed to withstand major wave attack. A typical design criterion is for less than 5% damage during a 50 year storm. As such, ongoing maintenance will be required to ensure the structural stability is not compromised.

This will necessitate maintaining access to the top of any seawall to allow 'top up' works to be carried out. An ongoing maintenance cost of 1% per year is typically adopted for rock structures.

5.2.3 Comparison Summary

A brief comparison of the various alternative means of combating erosion problems is shown in Table 5-1.

In many practical cases, a combination of methods may be more applicable than relying on any single approach. For example, a commonly used combination is beach nourishment and seawall or groyne construction. From the viewpoint of beach protection only, those approaches which do not involve direct interference with the beach system, namely "do nothing" and "planned retreat", are the most desirable. In most cases, however, these options are not viable because of low public acceptance (for lack of long-term property protection) and/or prohibitive long-term costs.

Structural solutions such as rock revetments and groynes are effective in some cases but all cause adverse impacts unless used in conjunction with beach nourishment. Beach nourishment is not possible on a receding shoreline such as Amity.

Table 5-1 Comparison of Erosion Control Measures

| Erosion Control Measures | Advantages | Disadvantages | Comments |
|---------------------------------|--|---|--|
| 1.Do Nothing | (a) Shoreline continues to behave naturally (b) No direct expenditure required on protective measures – removal of debris may be required | (a) Property and improvements are lost by continued erosion (b) Limited application in developed areas | This approach is only practical where threatened property is of limited value, and its loss can be accepted |
| 2.Planned Retreat | (a) Effectively solves the beach erosion problem (b) Shoreline continues to behave naturally | (a) Public reaction against relocation is usually strong (b) Compensation payments may be prohibitive | In spite of its apparent drawbacks it may be cheaper in the long run in some areas |
| 3.Seawalls | (a) Well suited to emergency erosion control (b) Provides direct property protection | (a) Only effective if properly designed and constructed (b) Adversely affects the beach; decreased amenity | Should only be used in emergency situations; protects property but not the beach |
| 4.Groynes | (a) May be effective in building beach on updrift side (b) Effective channel training structures | (a) Does not prevent erosion – merely transfers it (b) High level of maintenance | Only useful in conjunction with beach nourishment or if erosion on downdrift side is acceptable; can be used to train tidal channels |
| | | | |
| 5.Beach Nourishment | (a) Increase buffer zone width and therefore increases property protection (b) Enhances natural beach | (a) Sources of nourishment sand not always close to nourishment site (b) Not suitable for receding shoreline | Appears to be the best approach to local erosion problems on beaches |
| 6.Channel Relocation | (a) Removes erosion threat in medium-term | (a) Will need to be repeated High Cost | Will require impact study |

5.3 Environmental Considerations

As well as the cost and effectiveness of each management option, environmental impact issues also need to be considered. Applicable legislation (see Section 2) may require detailed environmental assessments (e.g. Environmental Impact Assessments). Other approvals processes and government authorities may require additional studies. Note that a comprehensive list of environmental issues for each site and recommended shoreline erosion management measures cannot be determined until the final details of proposed works are known. However, an indication of likely environmental issues is provided below as a guide.

5.3.1 Beach Nourishment Considerations

Beach nourishment is dependent on being able to source and place suitable sand in an environmentally acceptable, practical and economic manner. Sand can either be obtained from land or marine-based sources with specific considerations as outlined below.

5.3.1.1 Marine-based Sand Extraction

The following is a summary of the potential environmental impacts of marine sand extraction in the study area. This assessment does not include noise, traffic and transport associated impacts, and social and cultural aspects.

Water Quality

The disturbance of the substrata by sand extraction activities generally results in the remobilisation of sediments. The creation of turbid plumes can have indirect effects on aquatic biota and their habitats (e.g. smothering of benthic communities, reduced light in the water column and altered sediment-water dynamics). The extent and magnitude of such increases in turbidity depends on the type of equipment used, the volume and nature of any overflow from the dredge, the material being excavated and the currents present at the excavation site.

The material that would be excavated in marine-based sand supply is typically clean sand from highly active shoal areas with negligible fines content. Hence, turbidity plumes are expected to be of limited spatial and temporal extent.

In areas where there are other materials underlying the clean sands, extraction may result in elevated turbidity, and may potentially release contaminants or elevated oxygen demand into the water column. Wherever possible, disturbance of fine material should be avoided. This requires knowledge of the depths, quantities and characteristics of sand to be dredged.

Ecological Factors

The ecological impacts of sand extraction will vary according to the spatial/temporal scale being considered and the intensity of the disturbance, as well as the resilience of the populations and assemblages to disturbance. Generally, ecological impacts of sand extraction may include:

- Changes to biotope (habitat) structure associated with changes to the morphology of the dredged area. In this regard, shallow banks may be replaced by deep holes/channels;
- Direct effects on seagrass and mangroves due to removal and/or smothering, or indirect effects due to increases in turbidity;
- Disturbance of megafauna and marine turtles. Marine turtles and various cetaceans (dolphins and whales) occur within the study area. Humpback Whales migrate through the broader area. The slow speed of vessels used in sand extraction activities is not anticipated to cause mortality of cetaceans from boat strike. Environment management actions are required to ensure turtles are not harmed by the dredge.
- Changes to the diversity, abundance, and structure of macrobenthic assemblages in and adjacent to the dredged area. Depending on the sand source site, some species of benthic macroinvertebrates may be of commercial importance or may be collected by recreational harvesters for use as bait;

- Changes to the fish assemblages in and adjacent to the dredged area, with potential impacts to commercial and recreational fisheries;
- Changes to the population structure of species;
- Changes to the migration patterns of animals (e.g. crustaceans such as prawns and crabs), with potential impacts to commercial and recreational fisheries;
- Changes to the recruitment dynamics of fish and macrobenthic species. Impacts to recruitment dynamics potentially may have flow-on effects to recreational and commercial fisheries; and
- Mobilisation of contaminants and nutrients following disturbance of sediments.

5.3.1.2 Land-based Sand Extraction

There are a wide range of potential environmental issues associated with land-based extraction, from the natural, social and economic perspectives. Potential impacts to natural environment are considered below.

Groundwater and Surface Water

Sand extraction operations on land have the potential to influence both groundwater and surface water through the release of toxicants and turbidity. The potential for disturbance of acid sulfate soils and the mobilisation of heavy metals is of concern. These contaminants may impact on either the underlying groundwater or surface water adjacent to the operations. Often land based sand extraction results in the creation of an artificial lake at the completion of the works with associated water quality considerations.

Potentially, land-based extraction may also occur in conjunction with development of building sites pursuant to the *Building Act 1975*.

Ecological Impacts

Land-based extraction has the potential to have effects on fauna and flora communities and supporting ecological processes through a variety of means including:

- Loss of species as a direct consequence of habitat removal, reduction in habitat area (e.g. decreased habitat suitability for species requiring large home ranges) and habitat isolation (e.g. reduced opportunity to escape the effect of environmental perturbations and recolonise after such events). This may include impacts to species, habitats or ecological communities listed under the *EPBC Act*, *Native Conservation Act 1992*, *Vegetation Management Act 1999 (VMA)* and *Land Act 1994*;
- Alterations to ecosystem processes due to the development of edge environments, especially areas adjacent to small remnants. This usually involves changes in abiotic and biotic conditions such as microclimate changes (wind, radiation, soil moisture regimes) and increased presence of introduced flora and predatory fauna and disturbance-tolerant aggressive native species);
- Disturbance of acid sulfate soils, which when exposed to air produce sulfuric acid and may release toxic quantities of associated metals into the surrounding environment. Disturbance of other contaminated sediments may also be an issue;

- Negative pressures accompanying development and operations, including disturbance through increased human activity, traffic, noise and light pollution, etc.;
- Potentially, large scale disturbances such as:
 - Reduction of population viability and genetic diversity resulting from disruption of ecological connectivity and population isolation. This results from decreases in, and/or cessation of regular successful dispersal between populations; and
 - Alterations to ground water levels (e.g. rising water table and increased salinity) and surface water hydrology (e.g. changes to runoff patterns and increased erosion). These effects may result in waterway degradation through increased salinity, turbidity and nutrient pollution.

5.3.1.3 Placement of Sand for Beach Nourishment

Change in Benthic Communities and Habitat Loss

The placement of sand on the shoreline has the potential for immediate impacts associated with burial of existing surface sediments and biota (macroinvertebrates and seagrasses). Sandy material that is placed onshore is unlikely to cause significant changes in the composition of surface sediments and habitat type, but would result in the burial of organisms that have colonised the area. Some buried organisms may be able to migrate through appreciable depths of placed material, but other organisms are likely to be lost. Assuming the surface sediments are similar to those prior to nourishment, recolonisation of the placement area would occur within a short time. Opportunistic and/or mobile species would recolonise the nourishment area within a relatively short period of time.

Further Ecological Considerations

Any loss of benthic macroinvertebrates and/or seagrass associated with burial from nourishment would represent a short-term reduction in available food/habitat resources for fish. Most fish species that inhabit the area would be capable to move from the placement area to forage in other parts of the study area.

Further, placement of sand for beach nourishment may temporarily disturb roosting, breeding or feeding activities of wading birds. In the greater South-East Queensland region, the highest number of waders has been recorded in October, during the southern migration when population densities of migratory birds reach an annual peak. The lowest counts are typically recorded during August, a time when mainly resident and juvenile migratory birds (<one year old) stay in the region rather than migrate to breeding grounds in the Northern Hemisphere.

Where nourishment is recommended, studies would need to be conducted to determine species using the impacted areas, and periods when roosting and breeding periods for these species can be avoided.

5.3.2 Considerations of Rocky Shores and Constructed Features

The rocky shores of the study area include limited an existing revetment and groynes. No known studies have been carried out on the flora and fauna assemblages of artificial rocky shores within the study area. This is probably due to the fact that constructed features are not regarded as high priority conservation areas. However, in general, rocky shores are considered important in the maintenance of aquatic ecosystems, and the local richness of habitats and species in the region.

The erosion management options involving constructed features is limited to replacement of existing rock revetments at Amity Township.

Environmental considerations associated with these works are outlined below.

5.3.2.1 Terrestrial Vegetation

Replacement of rock revetments would require access to the foreshore. Where removal of vegetation is required for access to the foreshore, this may result in the loss of habitat and/or habitat change. Rebuilding of rock revetments is likely to require a corridor of about 10 metres along the foreshore. As this work would occur in previously disturbed and cleared areas, this would have a minimal impact.

5.3.2.2 Disturbance of Marine Habitat

Replacement of rock revetments would impact on marine communities. The initial removal of rock required for the replacement of the wall would cause disturbance to benthic communities at the base of the wall and in nearby areas from physical removal and elevated levels of turbidity when works are conducted at high tide. Any areas of seagrass in the broader may also be affected. The effects would depend on the characteristics of the community and the nature of the disturbance. It is likely however, that natural coastal processes such as waves and currents disturb these areas on a regular basis, and as such, are likely to support opportunistic (early successional) communities comprised of species that are capable of rapid recolonisation.

Although benthic communities used as food resources by fish and crustaceans may be removed (temporarily/permanently), it is expected that the high mobility exhibited by most common species in the area may result in fish temporarily moving elsewhere if food is in short supply to forage in other parts of the study region.

5.3.3 Considerations for Channel Relocation

When assessing the ecological impacts/considerations of the impacts of an actual channel relocation at Amity, it needs to be recognised that although relocation/realignment of the channel is artificial, this could occur naturally (i.e. since the 1970's) and lead to similar consequences. However, if these options are considered as an erosion management option, it is likely significant studies will be required.

5.3.3.1 Terrestrial Vegetation

Channel relocation could cause a major impact to terrestrial vegetation communities due to the complete physical removal of an area depending on the alignment. Further assessment of the degree of the impacts would be based on the area of vegetation to be removed and the conservation status of the vegetation. Additionally, fauna species using the terrestrial area as habitat may be disturbed through physical removal of the vegetation. There is likely to be less of an impact in areas where fauna can relocate to alternative habitat nearby.

5.3.3.2 Disturbance of Marine Habitat

Fauna communities in channels are dynamic and are adapted to a mobile environment. They are generally opportunistic and are able to adapt to a wide variety of conditions. Should conditions

become sub-optimal, some particularly mobile species such as fish, crabs and prawns generally relocate from the area of disturbance for a short period and re-establish when conditions become more suitable. The timing of works would need to be considered with respect to fish spawning and fishing activities.

Channel relocation may also result in the loss of marine plants such as mangroves, seagrass and saltmarsh. This may be directly through diversion of waters away from areas supporting these plants, or indirectly through significant changes to the tidal regime.

5.3.4 Considerations for Planned Retreat and the “Do Nothing” Option

Planned retreat or the “do nothing” approach would affect terrestrial communities through the physical loss of vegetation due to erosion. While intact vegetation communities occur in close proximity to the shoreline (approx 150m), residential areas within minimal vegetation would be the initial areas required to retreat. As retreat is a natural process, fauna species using the vegetation as habitat would be likely to move elsewhere as this gradual natural process occurs.

Retreat would also be likely to result in the disturbance of marine fauna species associated with intertidal areas and dune areas. It is probable that these areas would be recolonised by similar fauna as presently occurs. Such a process would occur in association with natural movement of the shoreline. In this regard, impacts resulting from retreat would be short-term and localised.

6 OPTIONS AND RECOMMENDED STRATEGIES FOR AMITY

The existence and nature of shoreline management considerations at Amity can be divided into three basic coastal segments being:

1. Amity Township (existing rock revetments);
2. Amity Park (existing groynes); and
3. Flinders Beach (existing natural beach).

The existing condition for each coastal segment as well as the prevailing coastal processes has been described in Section 3. The dominant coastal processes and the level of risk at the various locations will mean that some management options (Section 4) will be more suitable than others for each coastal segment. In the following sections, potential management options are discussed and the recommended strategy is presented for each coastal segment.

6.1 Amity Township

6.1.1 Introduction

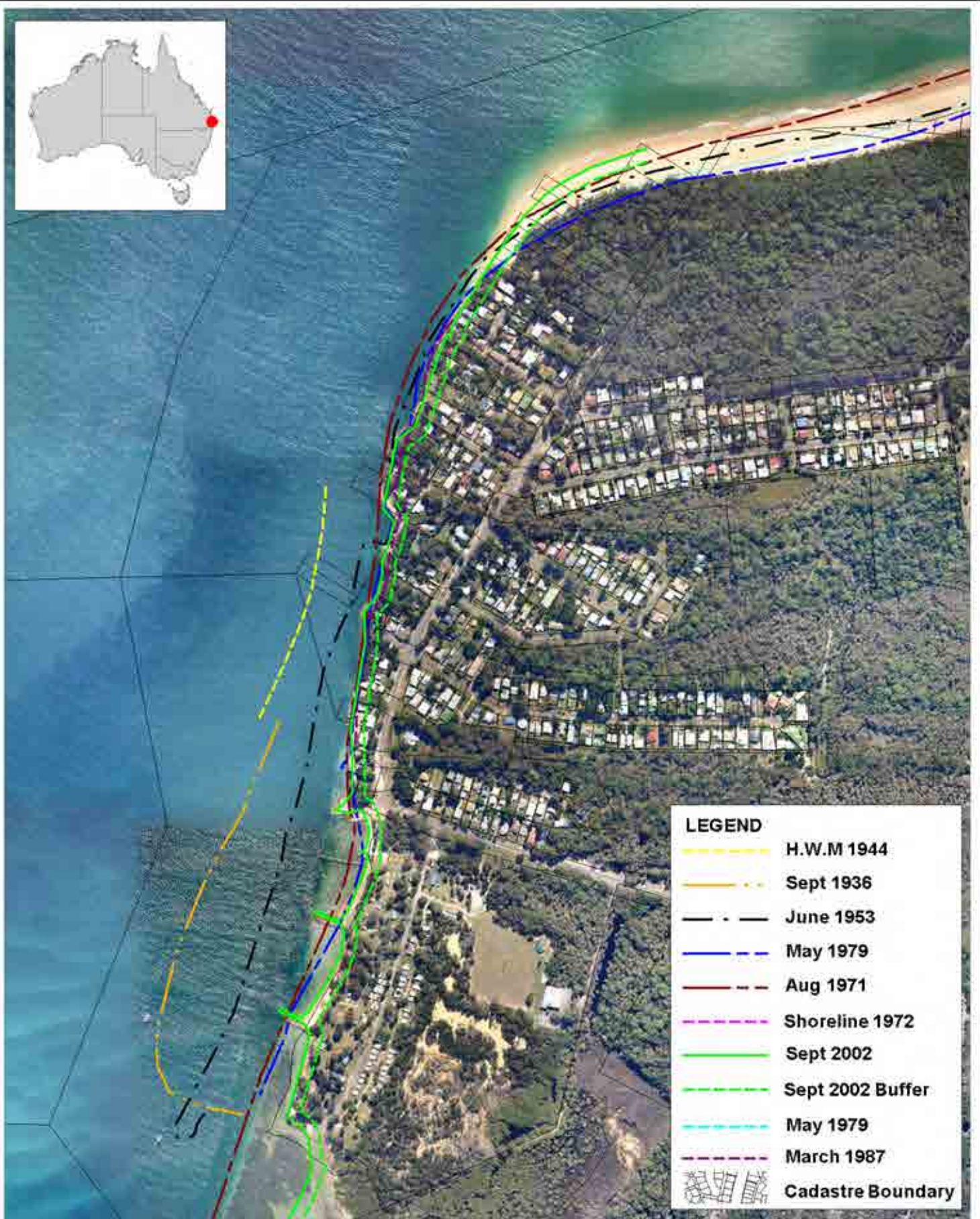
The coastline at Amity is largely influenced by the ongoing meandering of Rainbow Channel, and to a lesser extent the Rous Channel and South Passage, which carry the tidal flow between Moreton Bay and the Pacific Ocean (refer Figure 6-1). The previous data collection campaigns and numerical modelling undertaken for this study indicate that the ebb tide flow and associated sand transport tends to force the Rainbow Channel current hard against the Amity area from Amity Point to the Amity boat ramp with velocities up to 1.8m/s occurring. Aerial photography also shows that the channel in front of Amity Township is deepest with a broadening and shallowing of the channel adjacent to the Amity Caravan Park. Inspection of Historical aerial photography indicates that the channel width at Amity has reduced from over 900m in 1958 to around 750m today. The most recent channel survey in 2002 indicates that the channel adjacent to the Amity shoreline has a depth of about 16m below LWD (about 17m below AHD).

The mitigation practice at Amity involves providing rock free of cost to residents after slips in the shoreline adjacent to Rainbow Channel. The residents then arrange for the rocks to be tipped from the foreshore into the channel until it can support itself on the underlying material.

However, there is an issue of public safety relating to the slippages as the eroded shoreline moves closer to existing buildings.

6.1.2 Shoreline Management Options Considered

Shoreline erosion management strategies for the shoreline between the boat ramp and Ballow Street will need to consider the risks associated with the presence of Rainbow Channel and the effectiveness of current remedial works. Consideration will also be given to the past failure of mitigation strategies including groyne fields and rock revetments since the 1950's and the continued advice from authorities including the then Beach Protection Authority to adopt a policy of retreat.



LEGEND

- - - H.W.M 1944
- . - . Sept 1936
- - - June 1953
- - - May 1979
- - - Aug 1971
- - - Shoreline 1972
- Sept 2002
- - - Sept 2002 Buffer
- - - May 1979
- - - March 1987
- Cadastre Boundary

Title:
Historic Erosion Lines

Figure:
6-1

Rev:
A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



0 150 300m
Approx. Scale



Therefore management options considered for this beach are:

- Do nothing;
- Beach nourishment;
- Channel relocation;
- Structures; and
- Retreat.

General considerations of these management options were presented in Section 4.

Do Nothing

The current mitigation practice at Amity involves providing rock free of cost to residents after slips in the shoreline adjacent to Rainbow Channel. This rock is typically in the upper area of the channel bank which in some cases has a depth of over 20m. This rock provides short term protection against wave attack but is ineffective in mitigating long term recession of lower areas of the bank due to tidal currents.

However, there is an issue of public safety relating to the slippages as the eroded shoreline moves closer to existing buildings. Continuation of the current mitigation strategy cannot be contemplated after consideration of the increasing danger as the shoreline recedes towards exiting occupied buildings.

Beach Nourishment

Beach nourishment alone cannot be supported on a receding shoreline where there is no indication that the processes causing shoreline recession will not diminish or stop in the future. On the contrary predicted sea level rise is likely to exacerbate the problem. Also, the presence on the Moreton Bay Marine Park and Myora-Amity Fish Habitat Area may limit the availability of a cheap marine based sand resource close to the site.

Channel Relocation

The relocation of Rainbow Channel a hundred metres or so would require extensive studies in current movements and sediment morphology over a wide area. This may not be completed with any certainty unless the recent movement of Rainbow Channel was able to be predicted. Also, the impact of predicted sea level rise would add a further level of uncertainty. Therefore, it is considered unlikely that a guaranteed solution could be found.

Also, the presence of Moreton Bay Marine Park and Myora-Amity Fish Habitat Area may require further extensive ecological studies to gain approval.

Based on the above the likelihood of relocation the Rainbow Channel away from Amity is not considered feasible.

Structures

Groyne fields and rock revetments have been used unsuccessfully at Amity for over 60 years. Groyne fields have been abandoned over that time and protection is now provided by ad-hoc perched rock revetments. During that time the pressure of Rainbow Channel erosion has increased and the current depth of the channel adjacent to the shoreline is such that rock revetments need to be significant structures to be successful.

A sound revetment design would require it to be founded at such a depth that scour cannot undermine the foundation and cause instability. For Amity this will require a foundation depth of at least 18-20m below AHD and a crest height of around 3m above AHD giving a wall height of around 21-23m. For this height the section depth will also need to be significant (approximately 2m) requiring a large volume of rock. Also, to avoid accelerated erosion at the ends of the seawall the structure would need to be in a straight alignment and extend through the entire area at risk.

Indicative cost estimates for the supply and transport to site of local rock based on typical experience are as follows:

- Armour rock supply to site: \$40 - \$50/tonne; and
- Quarry run rock supply to site: \$25 - \$35/tonne.

On this basis, typical rock revetment structure costs including design costs and on-site placement are estimated at \$20,000/m with a structure length of about 750m initially (refer Figure 6-2) giving an estimated cost of \$15M. It is expected that this revetment will need to be extended in the future as the Rainbow Channel continues to realign. It is also expected that any future extension of the revetment will interrupt sand supply to the Amity Caravan Park groynes exacerbating the erosion problems there.



Title:
Coastline Mitigation Options

Figure:
6-2

Rev.:
A

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0 150 300m
Approx. Scale



Planned Retreat

One of the major concerns of the current conditions at Amity is the unforeseen and dramatic slumping of sections of the foreshore into Rainbow Channel.

The intent of a retreat option is to remove the public danger and development under threat and allow the shoreline to behave in a natural manner, thus restoring and retaining the natural character and amenity of the shoreline as it recedes. Erosion is acknowledged as an ongoing phenomenon which has not been able to be stopped and planned retreat seeks to address the issue by removal of the danger and threatened facilities rather than trying to protect them. At some locations there may be scope for setting back building lines (retreating within the lot) to give some longer term surety to the development.

At this stage it is considered that the following steps need to be undertaken:

1. Provide adequate warning and education to the public regarding the slumping shoreline danger to reduce the risk of loss of life;
2. Engage a geotechnical consultant to assess the danger zone of the slumping foreshore;
3. Determine within Council how the retreat will be handled (under public or private ownership);
4. Prepare a retreat strategy which includes an assessment of risk (i.e. geotechnical risk, social disruption risk), assessment of options (i.e. triggers to retreat, relocation options), legal advice and policy advice on required changes to RCC planning scheme; and
5. Engage with the affected landholders to facilitate retreat from the danger zone including the removal of buildings and other assets.

It is estimated that a Geotechnical Consultant definition of the danger zoned may cost \$100,000. However, to progress this study a width of 20m has been assumed. Reference to Council plan ES101-1-1 last amended in 2002 and assuming a 20m danger zone it is estimated that about 10 properties will be affected (refer Figure 6-1) . It is expected that the average cost of the assets may be in the order of \$200,000 (buildings only) giving a nominal value for comparison for this option of around \$3M including relevant ancillary costs such as studies, removal and landscaping. The seaward side of this area is zoned UR3 in the Council's Planning Scheme which requires future buildings to be demountable and capable of removal and prevents infrastructure, structures or buildings associated with development extending seaward of the development and existing uses on the site.

6.1.3 Recommended Strategy

It is considered that there are only two options which may possibly be successful at Amity Township.

Firstly, the design and construction of a robust rock revetment at an initial estimated cost of \$15M with the expectation that this will need to be extended in the future as Rainbow Channel continues to realign. However, while technically possible, albeit expensive, there are many implications of constructing a revetment wall such as:

- impact to visual amenity;

- impact to recreational amenity;
- high uncertainty regarding walls effectiveness over medium term;
- legislative constraints in that it disrupts natural coastal processes; and
- Significant State Government advice over decades which recognise protection works are unlikely to be viable long term solution for Amity.

The culmination of these points is that this option cannot be recommended.

Secondly, planned retreat where the danger zone related to unforeseen slumping of the foreshore into Rainbow Channel is assessed by a Geotechnical Consultant and affected buildings and infrastructure is moved out of the nominated danger zone. This option was given a nominal cost of \$3M for comparison with other options in this study. Much of the seaward side of this area (land west of Ballow Street) is zoned UR3 in the Council's Town Planning Scheme 1998 which requires future buildings to be demountable and capable of being removed. All future infrastructure, structures and buildings supporting the development cannot be located further seaward than the existing development of uses on the site.

Of these two options it is recommended that the planned retreat strategy be implemented as it has the highest likelihood of success, lower cost and will leave the foreshore in a natural state. To be successful this strategy will require a well-developed plan which will need to include an assessment of risk (i.e. geotechnical risk, social disruption risk), assessment of options (i.e. triggers to retreat, relocation options), legal advice and policy advice on required changes to RCC planning scheme.

6.2 Amity Caravan Park

6.2.1 Introduction

The existing groyne field appears to have begun in the late 1970's and continued as erosion problems exacerbated. The lack of sand supply to the area, due to the protection measures further north at Amity, have meant that the residual beaches have become recessed at about 50m behind the heads of the groynes. These recessed beaches still suffer minor erosion from wave action from the west in the winter months.

6.2.2 Shoreline Management Options Considered

Shoreline erosion management strategies for the Amity Caravan Park area will need to consider the historical shoreline erosion of the area and the current mitigation provided by the existing groyne field. As discussed in Section 4 the result of a groyne field is to transfer the erosion to the downdrift end of the groyne field. This has been experienced as erosion has occurred in the area to the south resulting in rock revetments being constructed in that area.

The management options considered for the beaches between the groynes are:

- Do nothing;
- Minor beach nourishment; and
- Minor rock revetments.

General considerations of these management options were presented in Section 4.

Do Nothing

Currently the beaches suffer minor erosion in winter months when the dominant westerly wind cause wave action which erodes the beach. The beaches are recessed between the groynes and are not able to recover in the summer months when winds are from the east. Therefore, a slow but persistent recession of the shoreline occurs resulting in loss of high amenity value land and threat to cultural heritage value trees which exist in the caravan park area. If no action is taken then the shoreline will continue to recede resulting in continued loss of an asset.

Beach Nourishment

Beach nourishment as an option will reduce or remove the immediate threat of erosion to public assets as well as providing a means of enhancing the recreational value of the beach. This option would require the importation of beach sand of a grain size and quality similar to the existing beach.

The quantity of nourishment would be subject to detailed design and consideration of the level of protection required, but as a first assessment, the likely minimum quantity of sand required to would be in the order of one (1) cubic metres per metre of beach. The quantity per location would be:

- 75 m³ between the boat ramp and groyne 1;
- 100 m³ between groyne 1 and 2; and
- 160 m³ between groyne 2 and 3.

It must be recognised that the sand placed on the beach will be integrated into the natural processes of erosion from the beach. Ongoing maintenance nourishment of sand will remain necessary to maintain the beach at its current level.

One issue relating to beach nourishment would be the source of sand. Although, it is likely that the quantity of sand required for nourishment can be sourced from the existing quarries, this source is distant and delivery by truck may require a specific management plan to avoid environmental and traffic concerns.

6.2.3 Recommended Strategy

After assessment of the shoreline management options, it is recommended that the beach nourishment option be implemented at this beach. The beach nourishment will provide added protection to the assets and minimise the need for other structural protection measures in the future. It will retain natural processes and provide an improvement to the beach amenity.

The likely minimum quantity of sand required to provide appropriate protection would be in the order of 335 cubic metres.

The cost of implementing the recommended nourishment program will be dependent on the adopted final design, negotiations with suppliers and timing of the works. However, the capital cost that would be involved in the implementation of recommended initial beach nourishment works are estimated to be about \$10,000, based on a beach nourishment requirement of about 335m³ and sand sourced locally and delivered by truck then spread by backhoe.

For ongoing maintenance beach nourishment, there should be a provision of \$1,000 per annum, which may need to increase in the future if mean sea level rise accelerates due to climate change. In addition, there should be some provision for costs associated with dune vegetation and management at this beach.

6.3 Flinders Beach

6.3.1 Introduction

In recent historical time Flinders Beach has slow accretion with some seasonal and storm response changes. The alignment of the beach is strongly related to the position of South Bank which has moved to the north largely in response to the rotation of Rainbow Channel.

6.3.2 Shoreline Management Options Considered

Shoreline erosion management strategies for the communities of Geera Street and Providence Street will need to consider the long term alignment of Flinders Beach. For the last 30 years the beach has shown persistent accretion. However, this cannot be guaranteed into the future.

As this beach has shown persistent accretion in recent time it is appropriate to “do nothing” at this time and monitor the location of the shoreline. If the shoreline begins to recede then consideration will need to be given to the rate of recession and the timeframe for action by Council or the community.

6.3.3 Recommended Strategy

The recommended shoreline erosion management strategy for the communities of Geera Street and Providence Street is to “do nothing” at this time and monitor (refer Section 6.5) the location of the shoreline.

6.4 Summary

After a review of the coastal processes, risks and values at each of section of the shoreline, potential management options for each beach were assessed. A detailed discussion on the possible management options and the recommended strategies for each individual beach is provided above.

A summary of the recommended erosion management strategies for each beach is presented in Table 6-1.

Table 6-1 Recommended Erosion Management Strategy

| <i>Beach/Shoreline Location</i> | <i>Recommended Erosion Management Strategy</i> | <i>Cost</i> |
|-----------------------------------|--|---|
| Amity Township | Retreat out of assessed danger zone | \$100,000 Geotechnical Consultant definition of danger zone. Town Planning Scheme indicates building relocation by owner. |
| Amity Caravan Park | Minor beach nourishment | \$10,000 initial + \$1,000 annual maintenance |
| Flinders Beach Communities | Do nothing and monitor | Routine Council expenditure |

6.5 Monitoring and Review Program

There is a need for monitoring in order to:

- Gain an increasing level of basic knowledge of the beach processes and channel movements at the Amity shoreline, particularly the magnitude of shoreline fluctuations and processes that influence change;
- Monitor the response to the proposed works to assess their performance and guide future action; and
- Document long term changes in the shoreline behaviour.

A program of ongoing monitoring as discussed below should be implemented by Council to provide data on channel and beach behaviour and response to works as a basis for future action planning. Some of the beach monitoring work will add to the available knowledge of how the beach behaves can be implemented immediately at low cost, while more comprehensive monitoring surveys require allocation of Council funds.

The proposed investigation and monitoring components are listed below:

Low Cost Beach Monitoring

It is feasible to undertake simple but effective beach monitoring without significant expense. This would be beneficial at Flinders Beach and may involve input from Council staff or volunteer residents, with minimal technical knowledge or expertise. Typically, it could include:

- Volunteer daily observations of waves, currents and sand transport at open beach shorelines using established observation techniques (Patterson and Blair 1983); and
- Regular (say monthly) survey of selected beach cross-sections using simple techniques.

Comprehensive Monitoring Surveys

Comprehensive monitoring needs to be undertaken by appropriately qualified and experienced specialists, with a view to quantifying the processes taking place in the beach system, providing accurate and defensible data for consideration and assessment in any future action. This would

involve detailed channel surveys on an annual basis along the Amity Township area and beach profile surveys at a few nominated locations on Flinders Beach.

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7 PROGRAM OF WORKS AND COST ESTIMATE

After review of the coastal processes, risks and values for the Amity shoreline and an assessment of the available management options, the following actions have been recommended:

1. Immediate education campaign regarding dramatic slumping into Rainbow Channel;
2. Geotechnical Consultant assessment of slump danger zone;
3. Retreat of assets in danger zone;
4. Nourishment of beaches between the groynes at the Amity Caravan Park; and
5. Ongoing monitoring of beach condition and success of management strategies.

Implementation of the recommended Amity Geotechnical Assessment and beach nourishment at the Amity Caravan Park would cost in the order of \$110,000 over 12 months based on present understanding of the required works and sand sourced locally. The actual costs of implementing the works will vary, depending on the adopted scope, circumstances and timing of the works and activities undertaken. Nevertheless, they provide a basis for planning and budgeting purposes.

Any future costs at Amity will be determined by the method in which the retreat option is implemented. Nourishment maintenance at the Amity Caravan Park would require expenditure of about \$1,000 annually. The monitoring survey costs should be able to be incorporated into routine Council surveying costs.

The recommended Implementation plan is summarised in Table 7-1 below. Note that non-action, or works inconsistent with the recommended SEMP strategy, may result in greater risks and increased rehabilitation costs in the longer term.

Table 7-1 Recommended Implementation Plan

| <i>Beach/Shoreline Location</i> | <i>Recommended Erosion Management Strategy</i> | <i>Activity and Cost</i> | <i>Timing</i> |
|--|---|--|----------------------|
| Amity Township | Retreat out of assessed danger zone | \$100,000 Geotechnical Consultant definition of danger zone. | Year 1 |
| | Retreat out of assessed danger zone | Remove buildings and infrastructure. Planning Scheme indicates building relocation by owner. | Year 2 |
| Amity Caravan Park | Minor beach nourishment | \$10,000 initial + \$1,000 annual maintenance | Year 1 |
| Flinders Beach Communities | Do nothing and monitor | Routine Council expenditure | Ongoing |

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APPENDIX A: EROSION PRONE AREA CALCULATIONS FOR AMITY POINT

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Erosion Prone Area

Redland City Local Government Area

Erosion Prone Area Definition

1. Erosion prone areas are deemed to exist over all tidal water to the extent of Queensland Coastal Waters and on all land adjacent to tidal water.
2. Erosion prone areas include areas subject to inundation by the highest astronomical tides (HAT) by the year 2100 or at risk from sea erosion.
3. On land adjacent to tidal water the landward boundary of the erosion prone area shall be defined by whichever of the following methods gives the greater erosion prone area width:
 - a. a line measured 40 metres landward of the plan position of the present day HAT level except where approved revetments exist in which case the line is measured 10 metres landward of the upper seaward edge of the revetment, irrespective of the presence of outcropping bedrock;
 - b. a line located by the linear distance shown on Table 1 and measured, unless specified otherwise, inland from:
 - i. the seaward toe of the frontal dune (the seaward toe of the frontal dune is normally approximated by the seaward limit of terrestrial vegetation or, where this cannot be determined, the level of present day HAT); or
 - ii. a straight line drawn across the mouth of a waterway between the alignment of the seaward toe of the frontal dune on either side of the mouth
 - c. the plan position of the level of HAT plus 0.8 m vertical elevation.

Except:

- i. where the linear distance specified in 3b is less than 40 metres, in which case section 3a. does not apply and the erosion prone area width will be the greater of 3b and 3c; or
 - ii. where outcropping bedrock is present and no approved revetments exist, in which case the line is defined as being coincident with the most seaward bedrock outcrop at the plan position of present day HAT plus 0.8m; or
 - iii. in approved canals in which case the line of present day HAT applies, irrespective of the presence of approved revetments or outcropping bedrock.
4. Erosion prone areas defined in accordance with the above are deemed to exist throughout all the local government areas, irrespective of whether the entire local government area is depicted on erosion prone area plans for the area.

Notes to clarify the definition

1. The specific location along the coast to which each erosion prone area linear distance applies (a segment) is shown in Table 1.
2. A map indicating the approximate location along the coast of each linear distance segment is shown on Maps 1 to 3.
3. Each erosion prone area segment is located on the coastline between 2 points defined by latitude and longitude. A projection of each point to the nearest actual coastline and continuing inland perpendicular to the coast defines the erosion prone area segment.
4. "Present day HAT" in the definition is always taken to be the present day level of HAT for the coastline as defined in the Queensland Tide Tables for that year or as defined by empirical methodology at the site.
5. The extent of the erosion prone area where it is defined by "HAT plus 0.8m" is the HAT coastline at the year 2100 and includes sea level rise to that time. It is determined by the area of land inundated to the level HAT of the nearest adjacent open coast or river tide gauge plus 0.8m vertical elevation. Site based HAT is not to be used as present day attenuation of inland HAT level due to flow constraints may not persist to 2100 with coastline response to sea level rise. For further explanation see the Coastal Hazard Guideline.
6. Where noted on Table 1 (and the map) the specified linear distance applies except where a revetment has been constructed and maintained to the approved design in which case the landward boundary of the erosion prone area is at the upper seaward edge of the revetment (A-line).
7. The approximate erosion prone area footprint is shown on Coastal Hazard Area Maps available on the Department of Environment and Resource Management's website at www.derm.qld.gov.au. These footprints are indicative only and the definition in this plan prevails for any inconsistency between the two.
8. This erosion prone area plan may be updated from time to time and a new revision created. Please check with the Department of Environment and Resource Management or the local government that this copy is the current version prior to using the contained information in any way.

Date of Erosion Prone Area Declaration: 26 January 2012 CTS18073/11

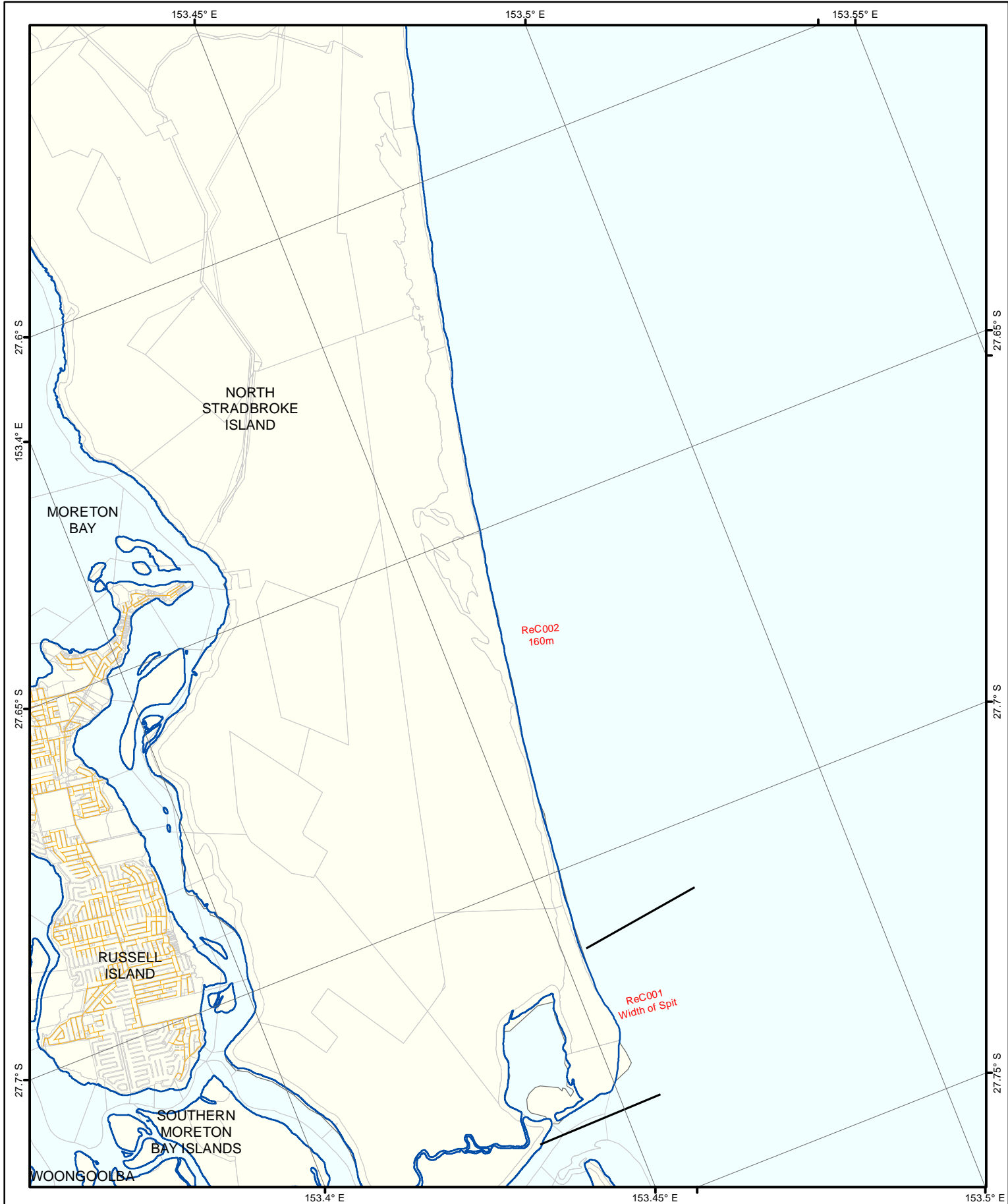
Date of Erosion Prone Area Amendment:

Plan No:

REC 1A

REC1A Table 1: Linear distances for the erosion prone area and the specific location of each segment

| Erosion prone area segment number | Segment start latitude (degrees) | Segment start longitude (degrees) | Segment end latitude (degrees) | Segment end longitude (degrees) | Erosion prone area linear distance (Width in metres) |
|--|---|--|---------------------------------------|--|---|
| ReC001 | -27.72766 | 153.43672 | -27.71197 | 153.45385 | Width of Spit |
| ReC002 | -27.71197 | 153.45385 | -27.43691 | 153.54241 | 160m |
| ReC003 | -27.43691 | 153.54241 | -27.43246 | 153.54420 | 0m |
| ReC004 | -27.43246 | 153.54420 | -27.42668 | 153.54339 | 160m (Possible Bedrock) |
| ReC005 | -27.42668 | 153.54339 | -27.42503 | 153.54035 | 0m |
| ReC006 | -27.42503 | 153.54035 | -27.42435 | 153.53629 | 160m (Possible Bedrock) |
| ReC007 | -27.42435 | 153.53629 | -27.42488 | 153.53466 | 0m |
| ReC008 | -27.42488 | 153.53466 | -27.42121 | 153.51422 | 160m |
| ReC009 | -27.42121 | 153.51422 | -27.38868 | 153.45328 | 190m |
| ReC010 | -27.38868 | 153.45328 | -27.40581 | 153.43728 | 145m |



Erosion Prone Area Linear Distances and their Locations for Redland City Local Government Area

Note:

This map is a representation of the erosion prone area segment locations provided in Table 1 and should be used as a guide only.

Disclaimer:
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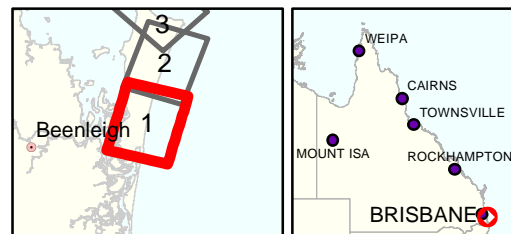
REC1A Map 1

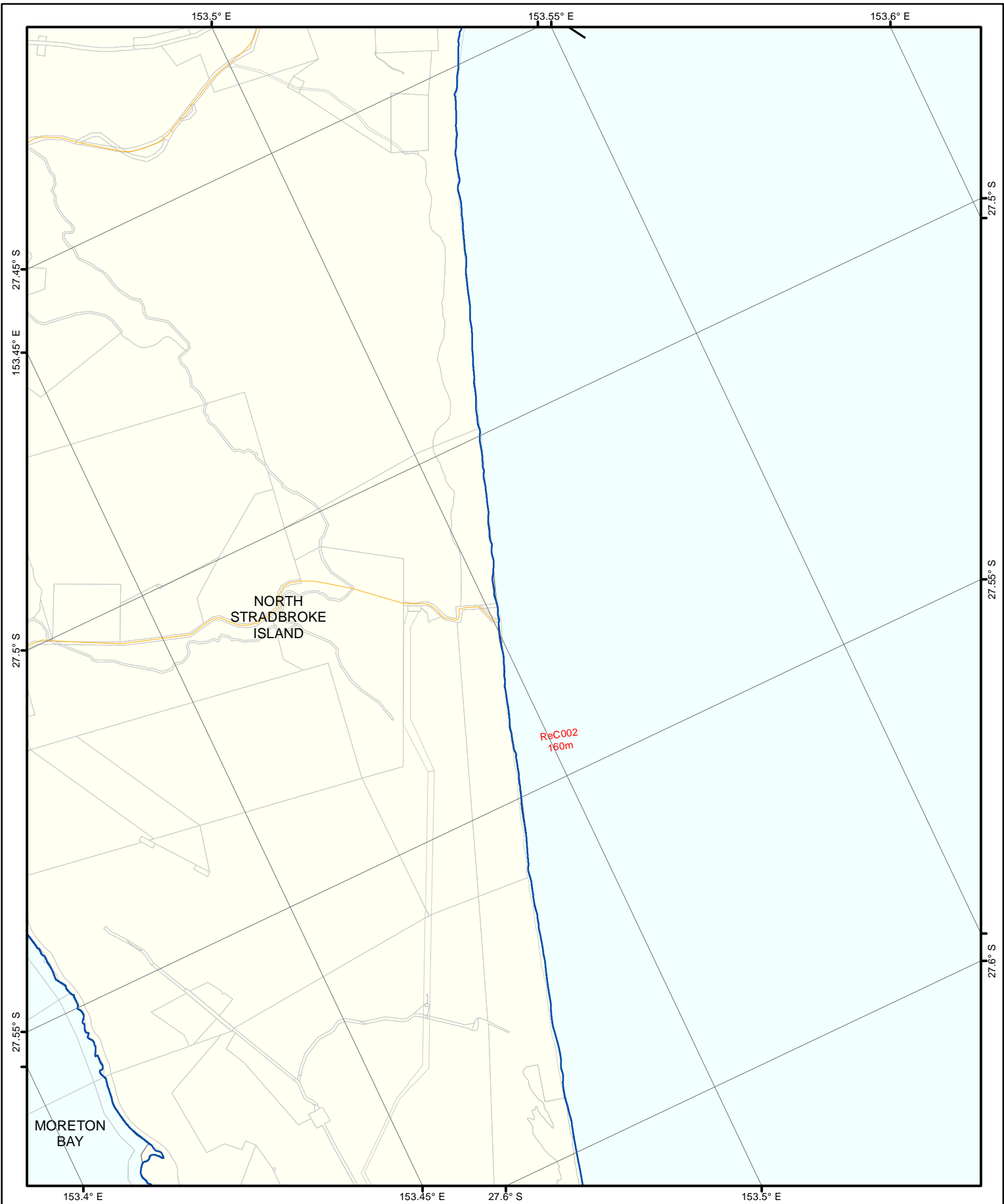


- ReC006** Segment number and linear 100m distance for erosion prone area
- EPA segment start/stop location
- ↗ Freeways / highways
- ↘ Streets
- ⋯ Cadastral boundaries
- ⋯ Queensland coast



Projection: Albers. Datum: GDA 1994.








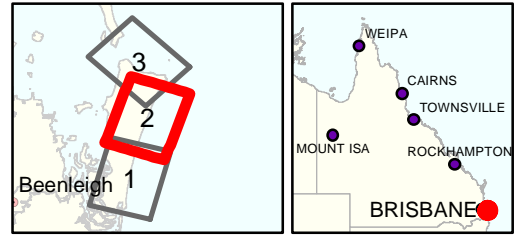
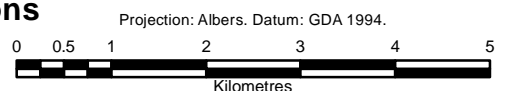


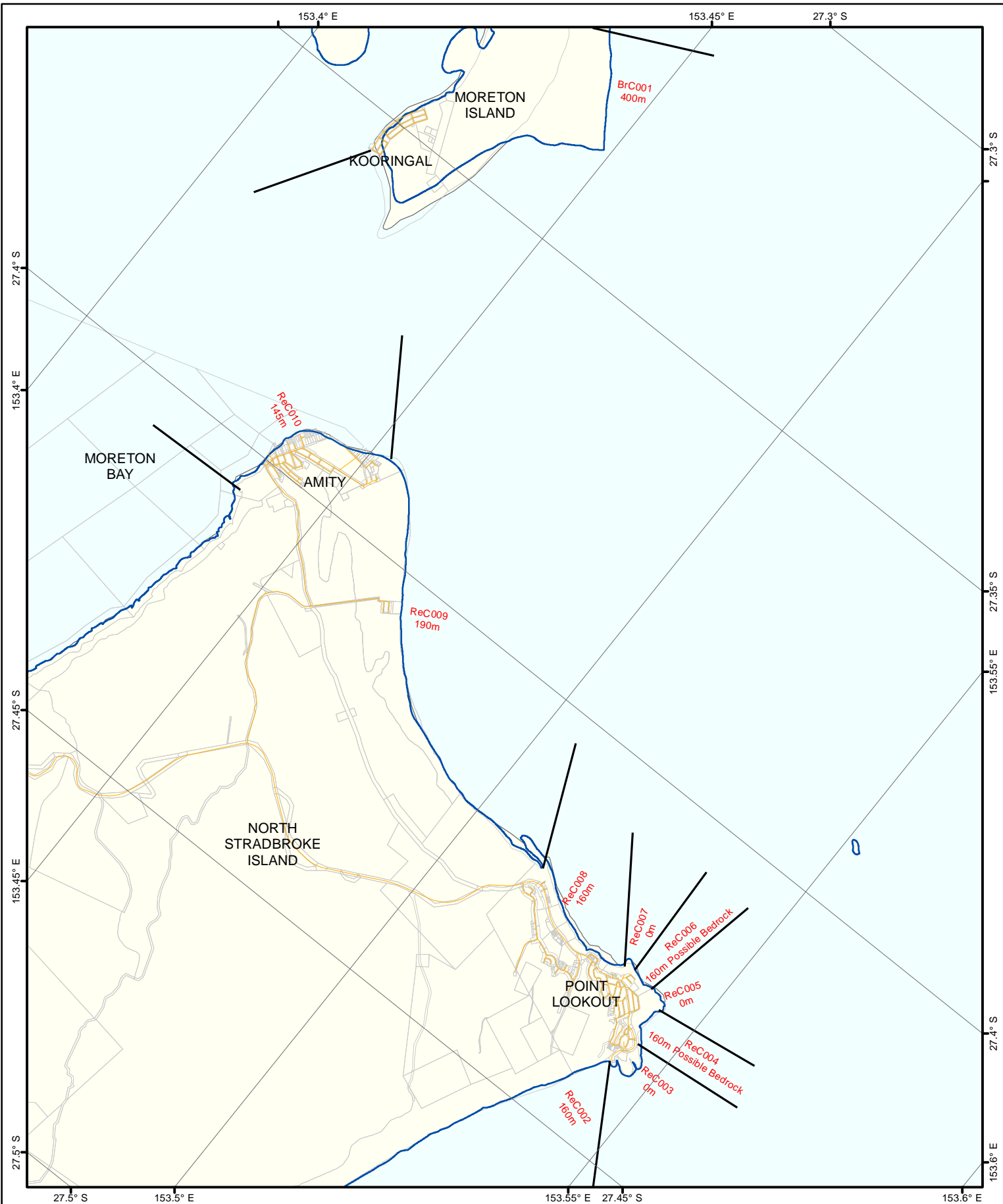
Erosion Prone Area Linear Distances and their Locations for Redland City Local Government Area

Note:
This map is a representation of the erosion prone area segment locations provided in Table 1 and should be used as a guide only.

Disclaimer:
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- REC1A Map 2** 
- ReC006** Segment number and linear 100m distance for erosion prone area
 - EPA segment start/stop location
 -  Freeways / highways
 -  Streets
 -  Cadastral boundaries
 -  Queensland coast










Erosion Prone Area Linear Distances and their Locations for Redland City Local Government Area

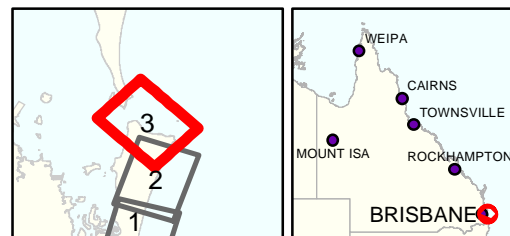
Note:

This map is a representation of the erosion prone area segment locations provided in Table 1 and should be used as a guide only.

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- REC1A Map 3** 
- ReC006** Segment number and linear 100m distance for erosion prone area
 - EPA segment start/stop location
 -  Freeways / highways
 -  Streets
 -  Cadastral boundaries
 -  Queensland coast

Projection: Albers. Datum: GDA 1994.



APPENDIX B: EPBC ACT PROTECTED MATTERS REPORT FOR SEMP AREA

DRAFT



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

Report created: 09/05/12 14:04:05

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

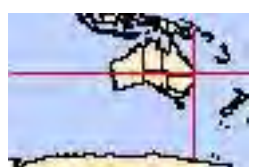
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 1.0Km](#)



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>

| | |
|--|------|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International | 1 |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Areas: | None |
| Threatened Ecological Communities: | None |
| Threatened Species: | 33 |
| Migratory Species: | 55 |

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov>.

| | |
|---|------|
| Commonwealth Lands: | None |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 87 |
| Whales and Other Cetaceans: | 13 |
| Critical Habitats: | None |
| Commonwealth Reserves: | None |

Extra Information

This part of the report provides information that may also be relevant to the area you have

| | |
|--|------|
| Place on the RNE: | 3 |
| State and Territory Reserves: | 2 |
| Regional Forest Agreements: | None |
| Invasive Species: | 6 |
| Nationally Important Wetlands: | 2 |

Details

Matters of National Environmental Significance

| | | |
|---|------------|--|
| Wetlands of International Significance (RAMSAR) | | [Resource Information] |
| Name | | Proximity |
| Moreton bay | | Within Ramsar site |
| Threatened Species | | [Resource Information] |
| Name | Status | Type of Presence |
| BIRDS | | |
| Anthochaera phrygia | | |
| Regent Honeyeater [82338] | Endangered | Species or species |

| Name | Status | Type of Presence |
|---|------------|---|
| Botaurus poiciloptilus Australasian Bittern [1001] | Endangered | habitat may occur within area Species or species habitat may occur within area |
| Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438] | Vulnerable | Species or species habitat likely to occur within area |
| Lathamus discolor Swift Parrot [744] | Endangered | Species or species habitat may occur within area |
| Macronectes giganteus Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within area |
| Macronectes halli Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Pterodroma neglecta neglecta Kermadec Petrel (western) [64450] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche melanophris impavida Campbell Albatross [82449] | Vulnerable | Species or species habitat may occur within area |
| Turnix melanogaster Black-breasted Button-quail [923] | Vulnerable | Species or species habitat likely to occur within area |
| FISH | | |
| Epinephelus daemeli Black Rockcod, Black Cod, Saddled Rockcod [68449] | Vulnerable | Species or species habitat may occur within area |
| FROGS | | |
| Litoria olongburensis Wallum Sedge Frog [1821] | Vulnerable | Species or species habitat known to occur within area |
| MAMMALS | | |
| Eubalaena australis Southern Right Whale [40] | Endangered | Species or species habitat likely to occur within area |
| Megaptera novaeangliae Humpback Whale [38] | Vulnerable | Congregation or aggregation known to occur within area |
| Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104] | Vulnerable | Species or species habitat known to occur within area |
| Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645] | Vulnerable | Species or species habitat may occur within area |
| Pteropus poliocephalus Grey-headed Flying-fox [186] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Xeromys myoides Water Mouse, False Water Rat [66] | Vulnerable | Species or species habitat known to occur within area |
| PLANTS | | |
| Allocasuarina defungens Dwarf Heath Casuarina [21924] | Endangered | Species or species habitat may occur within |

| Name | Status | Type of Presence area |
|--|------------|--|
| Arthraxon hispidus Hairy-joint Grass [9338] | Vulnerable | Species or species habitat may occur within area |
| Cryptocarya foetida Stinking Cryptocarya, Stinking Laurel [11976] | Vulnerable | Species or species habitat likely to occur within area |
| Olearia hygrophila Swamp Daisy, Water Daisy [5631] | Endangered | Species or species habitat likely to occur within area |
| Phaius australis Lesser Swamp-orchid [5872] | Endangered | Species or species habitat likely to occur within area |
| Taeniophyllum muelleri Minute Orchid, Ribbon-root Orchid [10771] | Vulnerable | Species or species habitat may occur within area |

REPTILES

| | | |
|--|------------|---|
| Caretta caretta Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas Green Turtle [1765] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat likely to occur within area |
| Eretmochelys imbricata Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |
| Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Species or species habitat likely to occur within area |
| Natator depressus Flatback Turtle [59257] | Vulnerable | Species or species habitat likely to occur within area |

SHARKS

| | | |
|---|-----------------------|--|
| Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751] | Critically Endangered | Species or species habitat may occur within area |
| Carcharodon carcharias Great White Shark [64470] | Vulnerable | Species or species habitat may occur within area |
| Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442] | Vulnerable | Species or species habitat may occur within area |
| Rhincodon typus Whale Shark [66680] | Vulnerable | Species or species habitat may occur within area |

Migratory Species

[[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|------------|--|
| Migratory Marine Birds | | |
| Apus pacificus Fork-tailed Swift [678] | | Species or species habitat may occur within area |

| Name | Threatened | Type of Presence |
|--|-------------|---|
| Calonectris leucomelas Streaked Shearwater [1077] | | Species or species habitat may occur within area |
| Macronectes giganteus Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within area |
| Macronectes halli Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Puffinus leucomelas Streaked Shearwater [66541] | | Species or species habitat may occur within area |
| Thalassarche impavida Campbell Albatross [64459] | Vulnerable* | Species or species habitat may occur within area |
| Migratory Marine Species | | |
| Balaenoptera edeni Bryde's Whale [35] | | Species or species habitat may occur within area |
| Carcharodon carcharias Great White Shark [64470] | Vulnerable | Species or species habitat may occur within area |
| Caretta caretta Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas Green Turtle [1765] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat likely to occur within area |
| Dugong dugon Dugong [28] | | Species or species habitat known to occur within area |
| Eretmochelys imbricata Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |
| Eubalaena australis Southern Right Whale [40] | Endangered | Species or species habitat likely to occur within area |
| Lagenorhynchus obscurus Dusky Dolphin [43] | | Species or species habitat may occur within area |
| Lamna nasus Porbeagle, Mackerel Shark [83288] | | Species or species habitat may occur within area |
| Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Species or species habitat likely to occur within area |
| Megaptera novaeangliae Humpback Whale [38] | Vulnerable | Congregation or aggregation known to occur within area |
| Natator depressus Flatback Turtle [59257] | Vulnerable | Species or species habitat likely to occur within area |

| Name | Threatened | Type of Presence |
|--|-------------|--|
| Orcaella brevirostris Irrawaddy Dolphin [45] | | Species or species habitat may occur within area |
| Orcinus orca Killer Whale, Orca [46] | | Species or species habitat may occur within area |
| Rhincodon typus Whale Shark [66680] | Vulnerable | Species or species habitat may occur within area |
| Sousa chinensis Indo-Pacific Humpback Dolphin [50] | | Species or species habitat may occur within area |
| Migratory Terrestrial Species | | |
| Haliaeetus leucogaster White-bellied Sea-Eagle [943] | | Species or species habitat likely to occur within area |
| Hirundapus caudacutus White-throated Needletail [682] | | Species or species habitat may occur within area |
| Merops ornatus Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Monarcha melanopsis Black-faced Monarch [609] | | Species or species habitat known to occur within area |
| Monarcha trivirgatus Spectacled Monarch [610] | | Breeding likely to occur within area |
| Myiagra cyanoleuca Satin Flycatcher [612] | | Breeding likely to occur within area |
| Xanthomyza phrygia Regent Honeyeater [430] | Endangered* | Species or species habitat may occur within area |
| Migratory Wetlands Species | | |
| Actitis hypoleucos Common Sandpiper [59309] | | Species or species habitat known to occur within area |
| Arenaria interpres Ruddy Turnstone [872] | | Species or species habitat known to occur within area |
| Calidris acuminata Sharp-tailed Sandpiper [874] | | Species or species habitat known to occur within area |
| Calidris alba Sanderling [875] | | Species or species habitat known to occur within area |
| Calidris canutus Red Knot, Knot [855] | | Species or species habitat known to occur within area |
| Calidris ferruginea Curlew Sandpiper [856] | | Species or species habitat known to occur within area |
| Calidris ruficollis Red-necked Stint [860] | | Species or species habitat known to occur within area |

| Name | Threatened | Type of Presence |
|--|------------|---|
| Calidris tenuirostris Great Knot [862] | | Species or species habitat known to occur within area |
| Charadrius bicinctus Double-banded Plover [895] | | Species or species habitat known to occur within area |
| Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877] | | Species or species habitat known to occur within area |
| Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879] | | Species or species habitat known to occur within area |
| Charadrius veredus Oriental Plover, Oriental Dotterel [882] | | Species or species habitat known to occur within area |
| Gallinago hardwickii Latham's Snipe, Japanese Snipe [863] | | Species or species habitat known to occur within area |
| Heteroscelus brevipes Grey-tailed Tattler [59311] | | Species or species habitat known to occur within area |
| Limicola falcinellus Broad-billed Sandpiper [842] | | Species or species habitat known to occur within area |
| Limosa lapponica Bar-tailed Godwit [844] | | Species or species habitat known to occur within area |
| Limosa limosa Black-tailed Godwit [845] | | Species or species habitat known to occur within area |
| Numenius madagascariensis Eastern Curlew [847] | | Species or species habitat known to occur within area |
| Numenius minutus Little Curlew, Little Whimbrel [848] | | Species or species habitat known to occur within area |
| Numenius phaeopus Whimbrel [849] | | Species or species habitat known to occur within area |
| Pluvialis fulva Pacific Golden Plover [25545] | | Species or species habitat known to occur within area |
| Pluvialis squatarola Grey Plover [865] | | Species or species habitat known to occur within area |
| Tringa glareola Wood Sandpiper [829] | | Species or species habitat known to occur within area |
| Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833] | | Species or species habitat known to occur within area |
| Xenus cinereus Terek Sandpiper [59300] | | Species or species habitat known to occur within area |

Other Matters Protected by the EPBC Act

Listed Marine Species [[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|--|------------|---|
| Birds | | |
| Actitis hypoleucos | | |
| Common Sandpiper [59309] | | Species or species habitat known to occur within area |
| Apus pacificus | | |
| Fork-tailed Swift [678] | | Species or species habitat may occur within area |
| Arenaria interpres | | |
| Ruddy Turnstone [872] | | Species or species habitat known to occur within area |
| Calidris acuminata | | |
| Sharp-tailed Sandpiper [874] | | Species or species habitat known to occur within area |
| Calidris alba | | |
| Sanderling [875] | | Species or species habitat known to occur within area |
| Calidris canutus | | |
| Red Knot, Knot [855] | | Species or species habitat known to occur within area |
| Calidris ferruginea | | |
| Curlew Sandpiper [856] | | Species or species habitat known to occur within area |
| Calidris melanotos | | |
| Pectoral Sandpiper [858] | | Species or species habitat known to occur within area |
| Calidris ruficollis | | |
| Red-necked Stint [860] | | Species or species habitat known to occur within area |
| Calidris tenuirostris | | |
| Great Knot [862] | | Species or species habitat known to occur within area |
| Calonectris leucomelas | | |
| Streaked Shearwater [1077] | | Species or species habitat may occur within area |
| Charadrius bicinctus | | |
| Double-banded Plover [895] | | Species or species habitat known to occur within area |
| Charadrius leschenaultii | | |
| Greater Sand Plover, Large Sand Plover [877] | | Species or species habitat known to occur within area |
| Charadrius mongolus | | |
| Lesser Sand Plover, Mongolian Plover [879] | | Species or species habitat known to occur within area |
| Charadrius ruficapillus | | |
| Red-capped Plover [881] | | Species or species habitat known to occur within area |
| Charadrius veredus | | |
| Oriental Plover, Oriental Dotterel [882] | | Species or species habitat known to occur within area |

| Name | Threatened | Type of Presence |
|--|------------|--|
| Gallinago hardwickii Latham's Snipe, Japanese Snipe [863] | | within area Species or species habitat known to occur within area |
| Haliaeetus leucogaster White-bellied Sea-Eagle [943] | | Species or species habitat likely to occur within area |
| Heteroscelus brevipes Grey-tailed Tattler [59311] | | Species or species habitat known to occur within area |
| Heteroscelus incanus Wandering Tattler [59547] | | Species or species habitat known to occur within area |
| Himantopus himantopus Black-winged Stilt [870] | | Species or species habitat known to occur within area |
| Hirundapus caudacutus White-throated Needletail [682] | | Species or species habitat may occur within area |
| Lathamus discolor Swift Parrot [744] | Endangered | Species or species habitat may occur within area |
| Limicola falcinellus Broad-billed Sandpiper [842] | | Species or species habitat known to occur within area |
| Limnodromus semipalmatus Asian Dowitcher [843] | | Species or species habitat known to occur within area |
| Limosa lapponica Bar-tailed Godwit [844] | | Species or species habitat known to occur within area |
| Limosa limosa Black-tailed Godwit [845] | | Species or species habitat known to occur within area |
| Macronectes giganteus Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within area |
| Macronectes halli Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Merops ornatus Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Monarcha melanopsis Black-faced Monarch [609] | | Species or species habitat known to occur within area |
| Monarcha trivirgatus Spectacled Monarch [610] | | Breeding likely to occur within area |
| Myiagra cyanoleuca Satin Flycatcher [612] | | Breeding likely to occur within area |
| Numenius madagascariensis Eastern Curlew [847] | | Species or species habitat known to occur within area |
| Numenius minutus Little Curlew, Little Whimbrel [848] | | Species or species |

| Name | Threatened | Type of Presence |
|--|-------------|---|
| Numenius phaeopus Whimbrel [849] | | habitat known to occur within area Species or species habitat known to occur within area |
| Philomachus pugnax Ruff (Reeve) [850] | | Species or species habitat known to occur within area |
| Pluvialis fulva Pacific Golden Plover [25545] | | Species or species habitat known to occur within area |
| Pluvialis squatarola Grey Plover [865] | | Species or species habitat known to occur within area |
| Recurvirostra novaehollandiae Red-necked Avocet [871] | | Species or species habitat known to occur within area |
| Thalassarche impavida Campbell Albatross [64459] | Vulnerable* | Species or species habitat may occur within area |
| Thinornis rubricollis Hooded Plover [59510] | | Species or species habitat known to occur within area |
| Tringa glareola Wood Sandpiper [829] | | Species or species habitat known to occur within area |
| Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833] | | Species or species habitat known to occur within area |
| Xenus cinereus Terek Sandpiper [59300] | | Species or species habitat known to occur within area |
| Fish | | |
| Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187] | | Species or species habitat may occur within area |
| Campichthys tryoni Tryon's Pipefish [66193] | | Species or species habitat may occur within area |
| Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199] | | Species or species habitat may occur within area |
| Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203] | | Species or species habitat may occur within area |
| Festucalex cinctus Girdled Pipefish [66214] | | Species or species habitat may occur within area |
| Filicampus tigris Tiger Pipefish [66217] | | Species or species habitat may occur within area |
| Halicampus grayi Mud Pipefish, Gray's Pipefish [66221] | | Species or species habitat may occur within area |
| Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish | | Species or species |

| Name | Threatened | Type of Presence |
|---|------------|--|
| [66228] | | habitat may occur within area |
| Hippichthys heptagonus | | |
| Madura Pipefish, Reticulated Freshwater Pipefish [66229] | | Species or species habitat may occur within area |
| Hippichthys penicillus | | |
| Beady Pipefish, Steep-nosed Pipefish [66231] | | Species or species habitat may occur within area |
| Hippocampus kelloggi | | |
| Kellogg's Seahorse, Great Seahorse [66723] | | Species or species habitat may occur within area |
| Hippocampus kuda | | |
| Spotted Seahorse, Yellow Seahorse [66237] | | Species or species habitat may occur within area |
| Hippocampus planifrons | | |
| Flat-face Seahorse [66238] | | Species or species habitat may occur within area |
| Hippocampus whitei | | |
| White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240] | | Species or species habitat may occur within area |
| Lissocampus runa | | |
| Javelin Pipefish [66251] | | Species or species habitat may occur within area |
| Maroubra perserrata | | |
| Sawtooth Pipefish [66252] | | Species or species habitat may occur within area |
| Micrognathus andersonii | | |
| Anderson's Pipefish, Shortnose Pipefish [66253] | | Species or species habitat may occur within area |
| Micrognathus brevirostris | | |
| thorntail Pipefish, Thorn-tailed Pipefish [66254] | | Species or species habitat may occur within area |
| Microphis manadensis | | |
| Manado Pipefish, Manado River Pipefish [66258] | | Species or species habitat may occur within area |
| Solegnathus dunckeri | | |
| Duncker's Pipehorse [66271] | | Species or species habitat may occur within area |
| Solegnathus hardwickii | | |
| Pallid Pipehorse, Hardwick's Pipehorse [66272] | | Species or species habitat may occur within area |
| Solegnathus spinosissimus | | |
| Spiny Pipehorse, Australian Spiny Pipehorse [66275] | | Species or species habitat may occur within area |
| Solenostomus cyanopterus | | |
| Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183] | | Species or species habitat may occur within area |
| Solenostomus paegnius | | |
| Rough-snout Ghost Pipefish [68425] | | Species or species habitat may occur within area |
| Solenostomus paradoxus | | |
| Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184] | | Species or species habitat may occur within area |
| Stigmatopora nigra | | |
| Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277] | | Species or species habitat may occur within |

| Name | Threatened | Type of Presence area |
|---|------------|---|
| Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279] | | Species or species habitat may occur within area |
| Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280] | | Species or species habitat may occur within area |
| Urocampus carinirostris Hairy Pipefish [66282] | | Species or species habitat may occur within area |
| Vanacampus margaritifer Mother-of-pearl Pipefish [66283] | | Species or species habitat may occur within area |
| Mammals | | |
| Dugong dugon Dugong [28] | | Species or species habitat known to occur within area |
| Reptiles | | |
| Aipysurus laevis Olive Seasnake [1120] | | Species or species habitat may occur within area |
| Astrotia stokesii Stokes' Seasnake [1122] | | Species or species habitat may occur within area |
| Caretta caretta Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas Green Turtle [1765] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat likely to occur within area |
| Eretmochelys imbricata Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |
| Hydrophis elegans Elegant Seasnake [1104] | | Species or species habitat may occur within area |
| Laticauda laticaudata a sea krait [1093] | | Species or species habitat may occur within area |
| Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Species or species habitat likely to occur within area |
| Natator depressus Flatback Turtle [59257] | Vulnerable | Species or species habitat likely to occur within area |
| Pelamis platurus Yellow-bellied Seasnake [1091] | | Species or species habitat may occur within area |
| Whales and other Cetaceans | | |
| [Resource Information] | | |
| Name | Status | Type of Presence |
| Mammals | | |

| Name | Status | Type of Presence |
|---|------------|--|
| Balaenoptera acutorostrata Minke Whale [33] | | Species or species habitat may occur within area |
| Balaenoptera edeni Bryde's Whale [35] | | Species or species habitat may occur within area |
| Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60] | | Species or species habitat may occur within area |
| Eubalaena australis Southern Right Whale [40] | Endangered | Species or species habitat likely to occur within area |
| Grampus griseus Risso's Dolphin, Grampus [64] | | Species or species habitat may occur within area |
| Lagenorhynchus obscurus Dusky Dolphin [43] | | Species or species habitat may occur within area |
| Megaptera novaeangliae Humpback Whale [38] | Vulnerable | Congregation or aggregation known to occur within area |
| Orcaella brevirostris Irrawaddy Dolphin [45] | | Species or species habitat may occur within area |
| Orcinus orca Killer Whale, Orca [46] | | Species or species habitat may occur within area |
| Sousa chinensis Indo-Pacific Humpback Dolphin [50] | | Species or species habitat may occur within area |
| Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51] | | Species or species habitat may occur within area |
| Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418] | | Species or species habitat likely to occur within area |
| Tursiops truncatus s. str. Bottlenose Dolphin [68417] | | Species or species habitat may occur within area |

Extra Information

Places on the RNE [\[Resource Information \]](#)

Note that not all Indigenous sites may be listed.

| Name | State | Status |
|--|-------|--------------|
| Natural | | |
| North Stradbroke Island (Myora section) | QLD | Interim List |
| North Stradbroke Island (northern section) | QLD | Interim List |
| Southern and Eastern Moreton Bay | QLD | Registered |

State and Territory Reserves [\[Resource Information \]](#)

| Name | State |
|---------------------|-------|
| Moreton Bay | QLD |
| Myora - Amity Banks | QLD |

Invasive Species

[[Resource Information](#)]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit,

| Name | Status | Type of Presence |
|--|--------|--|
| Frogs | | |
| Bufo marinus Cane Toad [1772] | | Species or species habitat likely to occur within area |
| Mammals | | |
| Felis catus Cat, House Cat, Domestic Cat [19] | | Species or species habitat likely to occur within area |
| Vulpes vulpes Red Fox, Fox [18] | | Species or species habitat likely to occur within area |
| Plants | | |
| Chrysanthemoides monilifera Bitou Bush, Boneseed [18983] | | Species or species habitat may occur within area |
| Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] | | Species or species habitat likely to occur within area |
| Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665] | | Species or species habitat likely to occur within area |

Nationally Important Wetlands

[[Resource Information](#)]

| Name | State |
|---|-------|
| Moreton Bay | QLD |
| North Stradbroke Island | QLD |

Coordinates

-27.4121 153.443,-27.41203 153.43835,-27.40601 153.43675,-27.4118 153.43348,-27.41127 153.4318,-27.40449 153.43569,-27.40114 153.43729,-27.39573 153.43767,-27.39261 153.43896,-27.39132 153.44254,-27.39086 153.44292,-27.38964 153.44216,-27.38949 153.443,-27.38949 153.44345,-27.39101 153.44444,-27.3904 153.44597,-27.38941 153.44604,-27.38934 153.44719,-27.39025 153.44711,-27.3888 153.44977,-27.38926 153.45031,-27.38911 153.45076,-27.38751 153.45343,-27.38797 153.45594,-27.38957 153.45853,-27.39017 153.45769,-27.38842 153.4545,-27.39063 153.45,-27.39086 153.44726,-27.39292 153.44109,-27.39589 153.43919,-27.40053 153.43851,-27.40175 153.43896,-27.40495 153.43721,-27.4099 153.43942,-27.41096 153.44132,-27.41165 153.44079,-27.41066 153.43911,-27.41142 153.43965,-27.41165 153.43965,-27.41203 153.44292,-27.4121 153.443

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

[Please feel free to provide feedback via the Contact Us page.](#)

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APPENDIX C: WILDLIFE ONLINE DATABASE SEARCH RESULTS FOR SEMP AREA

DRAFT



Wildlife Online Extract

Search Criteria: Species List for a Specified Point

Species: All

Type: Native

Status: All

Records: All

Date: All

Latitude: 27.4001

Longitude: 153.4497

Distance: 2

Email: jeremy.visser@bmtwbm.com.au

Date submitted: Friday 11 May 2012 16:16:11

Date extracted: Friday 11 May 2012 16:20:02

The number of records retrieved = 355

Disclaimer

As the DERM is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

The State of Queensland does not invite reliance upon, nor accept responsibility for this information. Persons should satisfy themselves through independent means as to the accuracy and completeness of this information.

No statements, representations or warranties are made about the accuracy or completeness of this information. The State of Queensland disclaims all responsibility for this information and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|---------|------------|-----------------|--|---------------------------------|---|----|---|---------|
| animals | amphibians | Hylidae | <i>Litoria caerulea</i> | common green treefrog | | C | | 1 |
| animals | amphibians | Hylidae | <i>Litoria sp. cf. cooloolensis (North Stradbroke Is population)</i> | | | NT | | 2 |
| animals | amphibians | Hylidae | <i>Litoria olongburensis</i> | wallum sedgefrog | | V | V | 25/13 |
| animals | amphibians | Hylidae | <i>Litoria fallax</i> | eastern sedgefrog | | C | | 6 |
| animals | amphibians | Hylidae | <i>Litoria nasuta</i> | striped rocketfrog | | C | | 8 |
| animals | amphibians | Hylidae | <i>Litoria peronii</i> | emerald spotted treefrog | | C | | 4 |
| animals | amphibians | Hylidae | <i>Litoria gracilentia</i> | graceful treefrog | | C | | 3/2 |
| animals | amphibians | Hylidae | <i>Litoria cooloolensis</i> | Cooloola sedgefrog | | NT | | 21/9 |
| animals | amphibians | Limnodynastidae | <i>Limnodynastes terraereginae</i> | scarlet sided pobblebonk | | C | | 1 |
| animals | amphibians | Limnodynastidae | <i>Limnodynastes peronii</i> | striped marshfrog | | C | | 4 |
| animals | amphibians | Myobatrachidae | <i>Crinia tinnula</i> | wallum froglet | | V | | 5 |
| animals | birds | Acanthizidae | <i>Acanthiza pusilla</i> | brown thornbill | | C | | 2 |
| animals | birds | Acanthizidae | <i>Gerygone albogularis</i> | white-throated gerygone | | C | | 1 |
| animals | birds | Acanthizidae | <i>Gerygone levigaster</i> | mangrove gerygone | | C | | 10 |
| animals | birds | Accipitridae | <i>Haliastur indus</i> | brahmyny kite | | C | | 10 |
| animals | birds | Accipitridae | <i>Haliaeetus leucogaster</i> | white-bellied sea-eagle | | C | | 20 |
| animals | birds | Accipitridae | <i>Aquila audax</i> | wedge-tailed eagle | | C | | 2 |
| animals | birds | Accipitridae | <i>Pandion cristatus</i> | eastern osprey | | C | | 8 |
| animals | birds | Accipitridae | <i>Circus approximans</i> | swamp harrier | | C | | 1 |
| animals | birds | Accipitridae | <i>Haliastur sphenurus</i> | whistling kite | | C | | 26 |
| animals | birds | Aegothelidae | <i>Aegotheles cristatus</i> | Australian owl-nightjar | | C | | 1 |
| animals | birds | Alcedinidae | <i>Ceyx azureus</i> | azure kingfisher | | C | | 1 |
| animals | birds | Anatidae | <i>Anas superciliosa</i> | Pacific black duck | | C | | 2 |
| animals | birds | Anatidae | <i>Anas castanea</i> | chestnut teal | | C | | 1 |
| animals | birds | Anatidae | <i>Chenonetta jubata</i> | Australian wood duck | | C | | 1 |
| animals | birds | Anhingidae | <i>Anhinga novaehollandiae</i> | Australasian darter | | C | | 1 |
| animals | birds | Ardeidae | <i>Ardea pacifica</i> | white-necked heron | | C | | 1 |
| animals | birds | Ardeidae | <i>Egretta garzetta</i> | little egret | | C | | 10 |
| animals | birds | Ardeidae | <i>Butorides striata</i> | striated heron | | C | | 3 |
| animals | birds | Ardeidae | <i>Ixobrychus flavicollis</i> | black bittern | | C | | 1 |
| animals | birds | Ardeidae | <i>Nycticorax caledonicus</i> | Nankeen night-heron | | C | | 1 |
| animals | birds | Ardeidae | <i>Ardea modesta</i> | eastern great egret | | C | | 6 |
| animals | birds | Ardeidae | <i>Egretta novaehollandiae</i> | white-faced heron | | C | | 14 |
| animals | birds | Artamidae | <i>Strepera graculina</i> | pieb currawong | | C | | 1 |
| animals | birds | Artamidae | <i>Cracticus torquatus</i> | grey butcherbird | | C | | 8 |
| animals | birds | Artamidae | <i>Artamus leucorhynchus</i> | white-breasted woodswallow | | C | | 7 |
| animals | birds | Artamidae | <i>Cracticus nigrogularis</i> | pieb butcherbird | | C | | 2 |
| animals | birds | Artamidae | <i>Cracticus tibicen</i> | Australian magpie | | C | | 8 |
| animals | birds | Burhinidae | <i>Esacus magnirostris</i> | beach stone-curlew | | V | | 5 |
| animals | birds | Cacatuidae | <i>Calyptorhynchus lathami lathami</i> | glossy black-cockatoo (eastern) | | V | | 64 |
| animals | birds | Cacatuidae | <i>Calyptorhynchus lathami</i> | glossy black-cockatoo | | V | | 2 |
| animals | birds | Cacatuidae | <i>Eolophus roseicapillus</i> | galah | | C | | 13 |
| animals | birds | Cacatuidae | <i>Cacatua galerita</i> | sulphur-crested cockatoo | | C | | 3 |
| animals | birds | Campephagidae | <i>Coracina lineata</i> | barred cuckoo-shrike | | C | | 1 |
| animals | birds | Campephagidae | <i>Lalage leucomela</i> | varied triller | | C | | 7 |

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|---------|-------|----------------|---|---------------------------------------|---|----|---|---------|
| animals | birds | Campephagidae | <i>Coracina papuensis</i> | white-bellied cuckoo-shrike | | C | | 1 |
| animals | birds | Campephagidae | <i>Coracina novaehollandiae</i> | black-faced cuckoo-shrike | | C | | 13 |
| animals | birds | Campephagidae | <i>Coracina tenuirostris</i> | cicadabird | | C | | 1 |
| animals | birds | Charadriidae | <i>Pluvialis squatarola</i> | grey plover | | C | | 6 |
| animals | birds | Charadriidae | <i>Vanellus miles novaehollandiae</i> | masked lapwing (southern subspecies) | | C | | 15 |
| animals | birds | Charadriidae | <i>Charadrius leschenaultii</i> | greater sand plover | | C | | 2 |
| animals | birds | Charadriidae | <i>Charadrius ruficapillus</i> | red-capped plover | | C | | 38 |
| animals | birds | Charadriidae | <i>Vanellus miles miles</i> | masked lapwing (northern subspecies) | | C | | 1 |
| animals | birds | Charadriidae | <i>Charadrius bicinctus</i> | double-banded plover | | C | | 98 |
| animals | birds | Charadriidae | <i>Elseyornis melanops</i> | black-fronted dotterel | | C | | 5 |
| animals | birds | Charadriidae | <i>Charadrius mongolus</i> | lesser sand plover | | C | | 4 |
| animals | birds | Charadriidae | <i>Pluvialis fulva</i> | Pacific golden plover | | C | | 15 |
| animals | birds | Charadriidae | <i>Vanellus miles</i> | masked lapwing | | C | | 2 |
| animals | birds | Ciconiidae | <i>Ephippiorhynchus asiaticus</i> | black-necked stork | | NT | | 1 |
| animals | birds | Cisticolidae | <i>Cisticola exilis</i> | golden-headed cisticola | | C | | 1 |
| animals | birds | Climacteridae | <i>Cormobates leucophaea metastasis</i> | white-throated treecreeper (southern) | | C | | 1 |
| animals | birds | Columbidae | <i>Ptilinopus regina</i> | rose-crowned fruit-dove | | C | | 1 |
| animals | birds | Columbidae | <i>Ocyphaps lophotes</i> | crested pigeon | | C | | 7 |
| animals | birds | Columbidae | <i>Geopelia striata</i> | peaceful dove | | C | | 11 |
| animals | birds | Columbidae | <i>Geopelia humeralis</i> | bar-shouldered dove | | C | | 8 |
| animals | birds | Columbidae | <i>Phaps chalcoptera</i> | common bronzewing | | C | | 1 |
| animals | birds | Coraciidae | <i>Eurystomus orientalis</i> | dollarbird | | C | | 6 |
| animals | birds | Corvidae | <i>Corvus orru</i> | Torresian crow | | C | | 24 |
| animals | birds | Cuculidae | <i>Centropus phasianinus</i> | pheasant coucal | | C | | 9 |
| animals | birds | Cuculidae | <i>Cacomantis flabelliformis</i> | fan-tailed cuckoo | | C | | 1 |
| animals | birds | Cuculidae | <i>Cacomantis variolosus</i> | brush cuckoo | | C | | 3 |
| animals | birds | Cuculidae | <i>Cacomantis pallidus</i> | pallid cuckoo | | C | | 1 |
| animals | birds | Cuculidae | <i>Chalcites minutillus minutillus</i> | little bronze-cuckoo | | C | | 1 |
| animals | birds | Cuculidae | <i>Eudynamys orientalis</i> | eastern koel | | C | | 1 |
| animals | birds | Dicruridae | <i>Dicrurus bracteatus</i> | spangled drongo | | C | | 3 |
| animals | birds | Estrildidae | <i>Neochmia temporalis</i> | red-browed finch | | C | | 3 |
| animals | birds | Estrildidae | <i>Taeniopygia bichenovii</i> | double-barred finch | | C | | 1 |
| animals | birds | Falconidae | <i>Falco peregrinus</i> | peregrine falcon | | C | | 1 |
| animals | birds | Haematopodidae | <i>Haematopus fuliginosus</i> | sooty oystercatcher | | NT | | 4 |
| animals | birds | Haematopodidae | <i>Haematopus longirostris</i> | Australian pied oystercatcher | | C | | 103 |
| animals | birds | Halcyonidae | <i>Todiramphus macleayii</i> | forest kingfisher | | C | | 5 |
| animals | birds | Halcyonidae | <i>Todiramphus sanctus</i> | sacred kingfisher | | C | | 7 |
| animals | birds | Halcyonidae | <i>Todiramphus chloris</i> | collared kingfisher | | C | | 5 |
| animals | birds | Halcyonidae | <i>Dacelo novaeguineae</i> | laughing kookaburra | | C | | 13 |
| animals | birds | Hirundinidae | <i>Hirundo neoxena</i> | welcome swallow | | C | | 23 |
| animals | birds | Hirundinidae | <i>Petrochelidon nigricans</i> | tree martin | | C | | 11 |
| animals | birds | Laridae | <i>Thalasseus bengalensis</i> | lesser crested tern | | C | | 10 |
| animals | birds | Laridae | <i>Chroicocephalus novaehollandiae</i> | silver gull | | C | | 30 |
| animals | birds | Laridae | <i>Gelocheidon nilotica</i> | gull-billed tern | | C | | 18 |
| animals | birds | Laridae | <i>Onychoprion fuscata</i> | sooty tern | | C | | 1 |
| animals | birds | Laridae | <i>Sternula albifrons</i> | little tern | | E | | 11 |

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|---------|-------|-------------------|--|---------------------------|---|---|---|---------|
| animals | birds | Laridae | <i>Hydroprogne caspia</i> | Caspian tern | | C | | 82 |
| animals | birds | Laridae | <i>Thalasseus bergii</i> | crested tern | | C | | 54 |
| animals | birds | Laridae | <i>Chlidonias leucopterus</i> | white-winged black tern | | C | | 1 |
| animals | birds | Laridae | <i>Anous minutus</i> | black noddy | | C | | 1 |
| animals | birds | Laridae | <i>Sterna hirundo</i> | common tern | | C | | 5 |
| animals | birds | Meliphagidae | <i>Caligavis chrysops</i> | yellow-faced honeyeater | | C | | 1 |
| animals | birds | Meliphagidae | <i>Phylidonyris niger</i> | white-cheeked honeyeater | | C | | 13 |
| animals | birds | Meliphagidae | <i>Lichmera indistincta</i> | brown honeyeater | | C | | 22 |
| animals | birds | Meliphagidae | <i>Philemon corniculatus</i> | noisy friarbird | | C | | 22 |
| animals | birds | Meliphagidae | <i>Myzomela sanguinolenta</i> | scarlet honeyeater | | C | | 11 |
| animals | birds | Meliphagidae | <i>Philemon citreogularis</i> | little friarbird | | C | | 7 |
| animals | birds | Meliphagidae | <i>Anthochaera chrysoptera</i> | little wattlebird | | C | | 10 |
| animals | birds | Meliphagidae | <i>Gavicalis fasciogularis</i> | mangrove honeyeater | | C | | 15 |
| animals | birds | Meliphagidae | <i>Melithreptus albogularis</i> | white-throated honeyeater | | C | | 6 |
| animals | birds | Meropidae | <i>Merops ornatus</i> | rainbow bee-eater | | C | | 9 |
| animals | birds | Monarchidae | <i>Grallina cyanoleuca</i> | magpie-lark | | C | | 13 |
| animals | birds | Monarchidae | <i>Myiagra rubecula</i> | leaden flycatcher | | C | | 3 |
| animals | birds | Monarchidae | <i>Myiagra inquieta</i> | restless flycatcher | | C | | 1 |
| animals | birds | Motacillidae | <i>Anthus novaeseelandiae</i> | Australasian pipit | | C | | 3 |
| animals | birds | Nectariniidae | <i>Dicaeum hirundinaceum</i> | mistletoebird | | C | | 9 |
| animals | birds | Oriolidae | <i>Sphecotheres vieilloti</i> | Australasian figbird | | C | | 8 |
| animals | birds | Oriolidae | <i>Oriolus sagittatus</i> | olive-backed oriole | | C | | 4 |
| animals | birds | Pachycephalidae | <i>Colluricincla harmonica</i> | grey shrike-thrush | | C | | 4 |
| animals | birds | Pachycephalidae | <i>Colluricincla megarhyncha</i> | little shrike-thrush | | C | | 3 |
| animals | birds | Pachycephalidae | <i>Pachycephala rufiventris</i> | rufous whistler | | C | | 6 |
| animals | birds | Pachycephalidae | <i>Pachycephala pectoralis</i> | golden whistler | | C | | 6 |
| animals | birds | Pardalotidae | <i>Pardalotus striatus</i> | striated pardalote | | C | | 3 |
| animals | birds | Pardalotidae | <i>Pardalotus punctatus</i> | spotted pardalote | | C | | 1 |
| animals | birds | Pelecanidae | <i>Pelecanus conspicillatus</i> | Australian pelican | | C | | 26 |
| animals | birds | Petroicidae | <i>Petroica rosea</i> | rose robin | | C | | 1 |
| animals | birds | Phalacrocoracidae | <i>Phalacrocorax carbo</i> | great cormorant | | C | | 1 |
| animals | birds | Phalacrocoracidae | <i>Phalacrocorax sulcirostris</i> | little black cormorant | | C | | 18 |
| animals | birds | Phalacrocoracidae | <i>Microcarbo melanoleucos</i> | little pied cormorant | | C | | 13 |
| animals | birds | Phalacrocoracidae | <i>Phalacrocorax varius</i> | pied cormorant | | C | | 16 |
| animals | birds | Podargidae | <i>Podargus strigoides</i> | tawny frogmouth | | C | | 4 |
| animals | birds | Podicipedidae | <i>Tachybaptus novaehollandiae</i> | Australasian grebe | | C | | 2 |
| animals | birds | Procellariidae | <i>Ardenna tenuirostris</i> | short-tailed shearwater | | C | | 1 |
| animals | birds | Psittacidae | <i>Trichoglossus chlorolepidotus</i> | scaly-breasted lorikeet | | C | | 6 |
| animals | birds | Psittacidae | <i>Trichoglossus haematodus moluccanus</i> | rainbow lorikeet | | C | | 12 |
| animals | birds | Rallidae | <i>Amaurornis moluccana</i> | pale-vented bush-hen | | C | | 4 |
| animals | birds | Rallidae | <i>Porphyrio porphyrio</i> | purple swamphen | | C | | 1 |
| animals | birds | Recurvirostridae | <i>Himantopus himantopus</i> | black-winged stilt | | C | | 2 |
| animals | birds | Rhipiduridae | <i>Rhipidura leucophrys</i> | willie wagtail | | C | | 16 |
| animals | birds | Rhipiduridae | <i>Rhipidura rufifrons</i> | rufous fantail | | C | | 2 |
| animals | birds | Rhipiduridae | <i>Rhipidura albiscapa</i> | grey fantail | | C | | 9 |
| animals | birds | Scolopacidae | <i>Limosa limosa</i> | black-tailed godwit | | C | | 1 |

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|---------|-----------|-------------------|--|---|---|----|---|---------|
| animals | birds | Scolopacidae | <i>Calidris alba</i> | sanderling | | C | | 8 |
| animals | birds | Scolopacidae | <i>Calidris canutus</i> | red knot | | C | | 7 |
| animals | birds | Scolopacidae | <i>Limosa lapponica</i> | bar-tailed godwit | | C | | 448 |
| animals | birds | Scolopacidae | <i>Numenius minutus</i> | little curlew | | C | | 1 |
| animals | birds | Scolopacidae | <i>Tringa nebularia</i> | common greenshank | | C | | 26 |
| animals | birds | Scolopacidae | <i>Numenius phaeopus</i> | whimbrel | | C | | 66 |
| animals | birds | Scolopacidae | <i>Actitis hypoleucos</i> | common sandpiper | | C | | 1 |
| animals | birds | Scolopacidae | <i>Arenaria interpres</i> | ruddy turnstone | | C | | 12 |
| animals | birds | Scolopacidae | <i>Calidris acuminata</i> | sharp-tailed sandpiper | | C | | 3 |
| animals | birds | Scolopacidae | <i>Calidris ferruginea</i> | curlew sandpiper | | C | | 34 |
| animals | birds | Scolopacidae | <i>Calidris ruficollis</i> | red-necked stint | | C | | 22 |
| animals | birds | Scolopacidae | <i>Calidris tenuirostris</i> | great knot | | C | | 11 |
| animals | birds | Scolopacidae | <i>Numenius madagascariensis</i> | eastern curlew | | NT | | 108 |
| animals | birds | Scolopacidae | <i>Tringa brevipes</i> | grey-tailed tattler | | C | | 185 |
| animals | birds | Spheniscidae | <i>Eudyptula minor</i> | little penguin | | C | | 1 |
| animals | birds | Strigidae | <i>Ninox boobook</i> | southern boobook | | C | | 4 |
| animals | birds | Sulidae | <i>Morus serrator</i> | Australasian gannet | | C | | 7/1 |
| animals | birds | Threskiornithidae | <i>Threskiornis molucca</i> | Australian white ibis | | C | | 16 |
| animals | birds | Threskiornithidae | <i>Platalea regia</i> | royal spoonbill | | C | | 9 |
| animals | birds | Timaliidae | <i>Zosterops lateralis</i> | silveryeye | | C | | 9 |
| animals | bony fish | Eleotridae | <i>Hypseleotris klunzingeri</i> | western carp gudgeon | | | | 1 |
| animals | bony fish | Eleotridae | <i>Ophiocara porocephala</i> | spangled gudgeon | | | | 1 |
| animals | bony fish | Mugilidae | <i>Mugil cephalus</i> | sea mullet | | | | 1 |
| animals | bony fish | Sparidae | <i>Acanthopagrus australis</i> | yellowfin bream | | | | 1 |
| animals | insects | Hesperiidae | <i>Hesperilla donnysa icaria</i> | varied sedge-skipper | | | | 1 |
| animals | insects | Lycaenidae | <i>Nesolycaena albosericea</i> | satin opal | | | | 1 |
| animals | insects | Lycaenidae | <i>Candalides erinus erinus</i> | small dusky-blue | | | | 1 |
| animals | insects | Lycaenidae | <i>Candalides hyacinthina hyacinthina</i> | varied dusky-blue (southern subspecies) | | | | 1 |
| animals | insects | Lycaenidae | <i>Candalides acasta</i> | blotched dusky-blue | | | | 1 |
| animals | insects | Lycaenidae | <i>Neolucia agricola agricola</i> | fringed heath-blue | | | | 1 |
| animals | insects | Nymphalidae | <i>Hypocysta adiante adiante</i> | orange ringlet | | | | 1 |
| animals | mammals | Delphinidae | <i>Grampus griseus</i> | Risso's dolphin | | C | | 1/1 |
| animals | mammals | Delphinidae | <i>Sousa chinensis</i> | Indo-Pacific humpback dolphin | | NT | | 7 |
| animals | mammals | Delphinidae | <i>Tursiops aduncus</i> | Indo-Pacific bottlenose dolphin | | C | | 2 |
| animals | mammals | Delphinidae | <i>Stenella longirostris</i> | spinner dolphin | | C | | 1 |
| animals | mammals | Dugongidae | <i>Dugong dugon</i> | dugong | | V | | 5 |
| animals | mammals | Macropodidae | <i>Macropus giganteus</i> | eastern grey kangaroo | | C | | 3 |
| animals | mammals | Macropodidae | <i>Wallabia bicolor</i> | swamp wallaby | | C | | 8/1 |
| animals | mammals | Muridae | <i>Xeromys myoides</i> | water mouse | | V | V | 5 |
| animals | mammals | Peramelidae | <i>Isoodon macrourus</i> | northern brown bandicoot | | C | | 1 |
| animals | mammals | Petauridae | <i>Petaurus norfolcensis</i> | squirrel glider | | C | | 3 |
| animals | mammals | Petauridae | <i>Petaurus sp.</i> | | | | | 2 |
| animals | mammals | Phalangeridae | <i>Trichosurus vulpecula</i> | common brushtail possum | | C | | 2 |
| animals | mammals | Phascolarctidae | <i>Phascolarctos cinereus</i> | koala | | C | V | 2 |
| animals | mammals | Phascolarctidae | <i>Phascolarctos cinereus (southeast Queensland bioregion)</i> | koala (southeast Queensland bioregion) | | V | V | 16 |

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|---------|-----------|-----------------|------------------------------------|--------------------------|---|---|---|---------|
| animals | mammals | Pteropodidae | <i>Pteropus scapulatus</i> | little red flying-fox | | C | | 1 |
| animals | mammals | Pteropodidae | <i>Pteropus alecto</i> | black flying-fox | | C | | 1 |
| animals | mammals | Pteropodidae | <i>Pteropus poliocephalus</i> | grey-headed flying-fox | | C | V | 1 |
| animals | mammals | Tachyglossidae | <i>Tachyglossus aculeatus</i> | short-beaked echidna | | C | | 1 |
| animals | reptiles | Boidae | <i>Morelia spilota</i> | carpet python | | C | | 2 |
| animals | reptiles | Cheloniidae | <i>Eretmochelys imbricata</i> | hawksbill turtle | | V | V | 1 |
| animals | reptiles | Diplodactylidae | <i>Amolosa lesueurii</i> | Lesueur's velvet gecko | | C | | 1 |
| animals | reptiles | Elapidae | <i>Demansia psammophis</i> | yellow-faced whip snake | | C | | 1 |
| animals | reptiles | Elapidae | <i>Cryptophis nigrescens</i> | eastern small-eyed snake | | C | | 1 |
| animals | reptiles | Scincidae | <i>Bellatorias frerei</i> | major skink | | C | | 1 |
| animals | reptiles | Varanidae | <i>Varanus gouldii</i> | sand monitor | | C | | 1 |
| animals | uncertain | Indeterminate | <i>Indeterminate</i> | Unknown or Code Pending | | C | | 2 |
| fungi | sac fungi | Cladoniaceae | <i>Cladonia rigida var. rigida</i> | | | C | | 1/1 |
| fungi | sac fungi | Collemataceae | <i>Collema rugosum</i> | | | C | | 1/1 |
| fungi | sac fungi | Collemataceae | <i>Physma</i> | | | C | | 1/1 |
| fungi | sac fungi | Collemataceae | <i>Collema glaucophthalmum</i> | | | C | | 2/2 |
| fungi | sac fungi | Lecanoraceae | <i>Lecanora austrotropica</i> | | | C | | 1/1 |
| fungi | sac fungi | Lecanoraceae | <i>Lecanora helva</i> | | | C | | 1/1 |
| fungi | sac fungi | Lecanoraceae | <i>Lecanora</i> | | | C | | 1/1 |
| fungi | sac fungi | Lecanoraceae | <i>Tephromela atra</i> | | | C | | 2/2 |
| fungi | sac fungi | Lecideaceae | <i>Lecidea russula</i> | | | C | | 1/1 |
| fungi | sac fungi | Melaspileaceae | <i>Melaspilea</i> | | | C | | 1/1 |
| fungi | sac fungi | Pannariaceae | <i>Pannaria lurida</i> | | | C | | 1/1 |
| fungi | sac fungi | Parmeliaceae | <i>Hypotrachyna immaculata</i> | | | C | | 1/1 |
| fungi | sac fungi | Parmeliaceae | <i>Parmotrema reticulatum</i> | | | C | | 3/3 |
| fungi | sac fungi | Parmeliaceae | <i>Parmotrema robustum</i> | | | C | | 2/2 |
| fungi | sac fungi | Parmeliaceae | <i>Relicina sydneyensis</i> | | | C | | 1/1 |
| fungi | sac fungi | Parmeliaceae | <i>Parmotrema tinctorum</i> | | | C | | 1/1 |
| fungi | sac fungi | Parmeliaceae | <i>Bulbothrix goebellii</i> | | | C | | 1/1 |
| fungi | sac fungi | Parmeliaceae | <i>Parmotrema crinitum</i> | | | C | | 4/4 |
| fungi | sac fungi | Parmeliaceae | <i>Bulbothrix queenslandica</i> | | | C | | 1/1 |
| fungi | sac fungi | Parmeliaceae | <i>Austroparmelina conlabrosa</i> | | | C | | 1/1 |
| fungi | sac fungi | Parmeliaceae | <i>Flavoparmelia euplecta</i> | | | C | | 1/1 |
| fungi | sac fungi | Pertusariaceae | <i>Ochrolechia subpallescens</i> | | | C | | 1/1 |
| fungi | sac fungi | Pertusariaceae | <i>Pertusaria thiospoda</i> | | | C | | 1/1 |
| fungi | sac fungi | Pertusariaceae | <i>Pertusaria bispora</i> | | | C | | 2/2 |
| fungi | sac fungi | Pertusariaceae | <i>Ochrolechia</i> | | | C | | 2/2 |
| fungi | sac fungi | Pertusariaceae | <i>Pertusaria</i> | | | C | | 4/4 |
| fungi | sac fungi | Physciaceae | <i>Buellia bahiana</i> | | | C | | 1/1 |
| fungi | sac fungi | Physciaceae | <i>Heterodermia</i> | | | C | | 1/1 |
| fungi | sac fungi | Physciaceae | <i>Buellia</i> | | | C | | 2/2 |
| fungi | sac fungi | Physciaceae | <i>Dirinaria confluens</i> | | | C | | 2/2 |
| fungi | sac fungi | Physciaceae | <i>Pyxine subcinerea</i> | | | C | | 1/1 |
| fungi | sac fungi | Physciaceae | <i>Buellia demutans</i> | | | C | | 2/2 |
| fungi | sac fungi | Physciaceae | <i>Dirinaria picta</i> | | | C | | 2/2 |
| fungi | sac fungi | Physciaceae | <i>Heterodermia obscurata</i> | | | C | | 3/3 |

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|---------|---------------|------------------|--|------------------------|---|---|---|---------|
| fungi | sac fungi | Ramalinaceae | <i>Ramalina inflata</i> subsp. <i>perpusilla</i> | | | C | | 5/5 |
| fungi | sac fungi | Ramalinaceae | <i>Ramalina confirmata</i> | | | C | | 6/6 |
| fungi | sac fungi | Ramalinaceae | <i>Ramalina peruviana</i> | | | C | | 1/1 |
| fungi | sac fungi | Ramalinaceae | <i>Ramalina pacifica</i> | | | C | | 3/3 |
| fungi | sac fungi | Sphinctrinaceae | <i>Sphinctrina</i> | | | C | | 1/1 |
| plants | conifers | Cupressaceae | <i>Callitris columellaris</i> | | | C | | 3/1 |
| plants | ferns | Blechnaceae | <i>Blechnum indicum</i> | swamp water fern | | C | | 2 |
| plants | ferns | Dennstaedtiaceae | <i>Pteridium esculentum</i> | common bracken | | C | | 2 |
| plants | ferns | Gleicheniaceae | <i>Gleichenia microphylla</i> | scrambling coral fern | | C | | 1 |
| plants | ferns | Nephrolepidaceae | <i>Nephrolepis obliterated</i> | | | C | | 2/2 |
| plants | ferns | Polypodiaceae | <i>Microsorium grossum</i> | | | C | | 1/1 |
| plants | ferns | Polypodiaceae | <i>Microsorium punctatum</i> | | | C | | 1/1 |
| plants | ferns | Pteridaceae | <i>Acrostichum speciosum</i> | mangrove fern | | C | | 1/1 |
| plants | ferns | Schizaeaceae | <i>Lygodium microphyllum</i> | snake fern | | C | | 2/2 |
| plants | ferns | Thelypteridaceae | <i>Thelypteris confluens</i> | | | V | | 1/1 |
| plants | ferns | Thelypteridaceae | <i>Cyclosorus interruptus</i> | | | C | | 2/1 |
| plants | higher dicots | Acanthaceae | <i>Brunoniella australis</i> | blue trumpet | | C | | 1 |
| plants | higher dicots | Apiaceae | <i>Centella asiatica</i> | | | C | | 1/1 |
| plants | higher dicots | Apiaceae | <i>Platysace ericoides</i> | heath platysace | | C | | 1/1 |
| plants | higher dicots | Apocynaceae | <i>Cynanchum carnosum</i> | | | C | | 1/1 |
| plants | higher dicots | Apocynaceae | <i>Parsonsia straminea</i> | monkey rope | | C | | 1/1 |
| plants | higher dicots | Araliaceae | <i>Schefflera actinophylla</i> | umbrella tree | | C | | 1/1 |
| plants | higher dicots | Asteraceae | <i>Senecio pinnatifolius</i> var. <i>pinnatifolius</i> | | | C | | 1/1 |
| plants | higher dicots | Asteraceae | <i>Podolepis longipedata</i> | tall copper-wire daisy | | C | | 1/1 |
| plants | higher dicots | Casuarinaceae | <i>Allocasuarina torulosa</i> | | | C | | 1 |
| plants | higher dicots | Casuarinaceae | <i>Allocasuarina littoralis</i> | | | C | | 1 |
| plants | higher dicots | Dilleniaceae | <i>Hibbertia vestita</i> | | | C | | 1/1 |
| plants | higher dicots | Dilleniaceae | <i>Hibbertia scandens</i> | | | C | | 1 |
| plants | higher dicots | Dilleniaceae | <i>Hibbertia linearis</i> var. <i>floribunda</i> | | | C | | 1/1 |
| plants | higher dicots | Droseraceae | <i>Drosera binata</i> | forked sundew | | C | | 1/1 |
| plants | higher dicots | Ericaceae | <i>Monotoca scoparia</i> | prickly broom heath | | C | | 1 |
| plants | higher dicots | Ericaceae | <i>Leucopogon pimeleoides</i> | | | C | | 1/1 |
| plants | higher dicots | Ericaceae | <i>Leucopogon margarodes</i> | pearl beard heath | | C | | 1 |
| plants | higher dicots | Ericaceae | <i>Leucopogon ericoides</i> | | | C | | 1/1 |
| plants | higher dicots | Ericaceae | <i>Epacris microphylla</i> | | | C | | 1 |
| plants | higher dicots | Euphorbiaceae | <i>Aleurites moluccanus</i> | candlenut tree | | C | | 1/1 |
| plants | higher dicots | Euphorbiaceae | <i>Homalanthus nutans</i> | | | C | | 1/1 |
| plants | higher dicots | Fabaceae | <i>Abrus precatorius</i> subsp. <i>precatorius</i> | | | C | | 1/1 |
| plants | higher dicots | Haloragaceae | <i>Gonocarpus micranthus</i> subsp. <i>ramosissimus</i> | | | C | | 1/1 |
| plants | higher dicots | Lamiaceae | <i>Vitex trifolia</i> var. <i>trifolia</i> | | | C | | 1/1 |
| plants | higher dicots | Melastomataceae | <i>Melastoma malabathricum</i> subsp. <i>malabathricum</i> | | | C | | 1 |
| plants | higher dicots | Mimosaceae | <i>Acacia leiocalyx</i> | | | C | | 2 |
| plants | higher dicots | Molluginaceae | <i>Macarthuria neocambrica</i> | | | C | | 1/1 |
| plants | higher dicots | Moraceae | <i>Ficus benjamina</i> var. <i>benjamina</i> | weeping fig | | C | | 1/1 |
| plants | higher dicots | Myrtaceae | <i>Leptospermum liversidgei</i> | | | C | | 1 |
| plants | higher dicots | Myrtaceae | <i>Eucalyptus resinifera</i> x <i>E.tereticornis</i> | | | C | | 1/1 |

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|---------|---------------|-----------------|-------------------------------------|--------------------------------|---|---|---|---------|
| plants | higher dicots | Myrtaceae | <i>Eucalyptus robusta</i> | swamp mahogany | | C | | 2/1 |
| plants | higher dicots | Myrtaceae | <i>Austromyrtus dulcis</i> | midgen berry | | C | | 2 |
| plants | higher dicots | Myrtaceae | <i>Ochrosperma lineare</i> | | | C | | 1/1 |
| plants | higher dicots | Myrtaceae | <i>Homoranthus virgatus</i> | twiggy homoranthus | | C | | 1/1 |
| plants | higher dicots | Myrtaceae | <i>Lophostemon confertus</i> | brush box | | C | | 2 |
| plants | higher dicots | Myrtaceae | <i>Melaleuca pachyphylla</i> | | | C | | 1/1 |
| plants | higher dicots | Myrtaceae | <i>Eucalyptus tereticornis</i> | | | C | | 1 |
| plants | higher dicots | Myrtaceae | <i>Melaleuca quinquenervia</i> | swamp paperbark | | C | | 3 |
| plants | higher dicots | Oxalidaceae | <i>Oxalis rubens</i> | | | C | | 1 |
| plants | higher dicots | Phyllanthaceae | <i>Poranthera microphylla</i> | small poranthera | | C | | 2/2 |
| plants | higher dicots | Phyllanthaceae | <i>Glochidion sumatranum</i> | umbrella cheese tree | | C | | 1 |
| plants | higher dicots | Picrodendraceae | <i>Petalostigma pubescens</i> | quinine tree | | C | | 1/1 |
| plants | higher dicots | Plumbaginaceae | <i>Plumbago zeylanica</i> | native plumbago | | C | | 1/1 |
| plants | higher dicots | Polygonaceae | <i>Persicaria decipiens</i> | slender knotweed | | C | | 1 |
| plants | higher dicots | Proteaceae | <i>Conospermum taxifolium</i> | devil's rice | | C | | 1/1 |
| plants | higher dicots | Proteaceae | <i>Banksia integrifolia</i> | | | C | | 2 |
| plants | higher dicots | Proteaceae | <i>Persoonia virgata</i> | small-leaved geebung | | C | | 1/1 |
| plants | higher dicots | Rhamnaceae | <i>Alphitonia excelsa</i> | soap tree | | C | | 1 |
| plants | higher dicots | Rosaceae | <i>Rubus parvifolius</i> | pink-flowered native raspberry | | C | | 1/1 |
| plants | higher dicots | Rubiaceae | <i>Pomax umbellata</i> | | | C | | 1 |
| plants | higher dicots | Rubiaceae | <i>Timonius timon var. timon</i> | | | C | | 1/1 |
| plants | higher dicots | Rutaceae | <i>Zieria smithii</i> | | | C | | 6/5 |
| plants | higher dicots | Rutaceae | <i>Boronia rosmarinifolia</i> | forest boronia | | C | | 1/1 |
| plants | higher dicots | Sapindaceae | <i>Cupaniopsis anacardioides</i> | tuckeroo | | C | | 1 |
| plants | higher dicots | Sapindaceae | <i>Dodonaea triquetra</i> | large-leaved hop bush | | C | | 4/2 |
| plants | higher dicots | Thymelaeaceae | <i>Pimelea linifolia</i> | | | C | | 1/1 |
| plants | higher dicots | Verbenaceae | <i>Phyla nodiflora</i> | carpetweed | | C | | 2/2 |
| plants | lower dicots | Lauraceae | <i>Cassytha pubescens</i> | downy devil's twine | | C | | 1 |
| plants | monocots | Commelinaceae | <i>Callisia</i> | | | C | | 1/1 |
| plants | monocots | Commelinaceae | <i>Commelina diffusa</i> | wandering jew | | C | | 1 |
| plants | monocots | Cymodoceaceae | <i>Halodule uninervis</i> | | | C | | 1/1 |
| plants | monocots | Cymodoceaceae | <i>Syringodium isoetifolium</i> | | | C | | 2/2 |
| plants | monocots | Cymodoceaceae | <i>Cymodocea serrulata</i> | | | C | | 2/2 |
| plants | monocots | Cyperaceae | <i>Baumea rubiginosa</i> | soft twigrush | | C | | 2/2 |
| plants | monocots | Cyperaceae | <i>Cyperus eglobosus</i> | | | C | | 1/1 |
| plants | monocots | Cyperaceae | <i>Gahnia sieberiana</i> | sword grass | | C | | 2 |
| plants | monocots | Cyperaceae | <i>Carex fascicularis</i> | tassel sedge | | C | | 1/1 |
| plants | monocots | Cyperaceae | <i>Scleria sphacelata</i> | | | C | | 1 |
| plants | monocots | Cyperaceae | <i>Cyperus polystachyos</i> | | | C | | 1 |
| plants | monocots | Cyperaceae | <i>Lepironia articulata</i> | | | C | | 3/1 |
| plants | monocots | Cyperaceae | <i>Abildgaardia vaginata</i> | | | C | | 1/1 |
| plants | monocots | Cyperaceae | <i>Cyperus stradbrogensis</i> | | | C | | 3/2 |
| plants | monocots | Cyperaceae | <i>Fimbristylis ferruginea</i> | | | C | | 1/1 |
| plants | monocots | Cyperaceae | <i>Trachystylis stradbrogensis</i> | | | C | | 1/1 |
| plants | monocots | Cyperaceae | <i>Caustis blakei subsp. blakei</i> | | | C | | 1/1 |
| plants | monocots | Cyperaceae | <i>Cladium procerum</i> | leafy twigrush | | C | | 2/2 |

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|----------|------------------|-------------------|---|----------------------|---|---|---|---------|
| plants | monocots | Cyperaceae | <i>Cyperus lucidus</i> | | | C | | 2/2 |
| plants | monocots | Cyperaceae | <i>Ficinia nodosa</i> | | | C | | 1/1 |
| plants | monocots | Cyperaceae | <i>Cyperus scaber</i> | | | C | | 2/2 |
| plants | monocots | Cyperaceae | <i>Cyperus haspan</i> | | | C | | 1 |
| plants | monocots | Cyperaceae | <i>Baumea juncea</i> | bare twigrush | | C | | 3/2 |
| plants | monocots | Dracaenaceae | <i>Dracaena sanderiana</i> | | | C | | 1/1 |
| plants | monocots | Hemerocallidaceae | <i>Dianella caerulea</i> | | | C | | 1 |
| plants | monocots | Hydrocharitaceae | <i>Halophila ovalis</i> | | | C | | 2/2 |
| plants | monocots | Juncaceae | <i>Juncus continuus</i> | | | C | | 2/2 |
| plants | monocots | Laxmanniaceae | <i>Cordyline fruticosa</i> | | | C | | 1/1 |
| plants | monocots | Laxmanniaceae | <i>Lomandra filiformis subsp. filiformis</i> | | | C | | 1/1 |
| plants | monocots | Laxmanniaceae | <i>Lomandra longifolia</i> | | | C | | 1/1 |
| plants | monocots | Orchidaceae | <i>Geodorum densiflorum</i> | pink nodding orchid | | C | | 1 |
| plants | monocots | Orchidaceae | <i>Acianthus fornicatus</i> | pixie caps | | C | | 1/1 |
| plants | monocots | Poaceae | <i>Digitaria parviflora</i> | | | C | | 1/1 |
| plants | monocots | Poaceae | <i>Eragrostis pubescens</i> | | | C | | 1/1 |
| plants | monocots | Poaceae | <i>Paspalum scrobiculatum</i> | ditch millet | | C | | 1 |
| plants | monocots | Poaceae | <i>Aristida calycina var. calycina</i> | | | C | | 1/1 |
| plants | monocots | Poaceae | <i>Panicum simile</i> | | | C | | 1/1 |
| plants | monocots | Poaceae | <i>Entolasia stricta</i> | wiry panic | | C | | 1/1 |
| plants | monocots | Poaceae | <i>Eragrostis brownii</i> | Brown's lovegrass | | C | | 2/1 |
| plants | monocots | Poaceae | <i>Eriachne insularis</i> | | | C | | 1/1 |
| plants | monocots | Poaceae | <i>Ischaemum australe</i> | | | C | | 1 |
| plants | monocots | Poaceae | <i>Oplismenus aemulus</i> | creeping shade grass | | C | | 1 |
| plants | monocots | Poaceae | <i>Paspalidium gausum</i> | | | C | | 3/2 |
| plants | monocots | Poaceae | <i>Imperata cylindrica</i> | blady grass | | C | | 2 |
| plants | monocots | Poaceae | <i>Cymbopogon refractus</i> | barbed-wire grass | | C | | 1 |
| plants | monocots | Poaceae | <i>Digitaria longiflora</i> | | | C | | 1/1 |
| plants | monocots | Restionaceae | <i>Empodisma minus</i> | spreading rope rush | | C | | 1 |
| plants | monocots | Restionaceae | <i>Baloskion tetraphyllum subsp. meiostachyum</i> | | | C | | 1/1 |
| plants | monocots | Restionaceae | <i>Sporadanthus interruptus</i> | | | C | | 1/1 |
| plants | monocots | Smilacaceae | <i>Smilax australis</i> | barbed-wire vine | | C | | 2 |
| protists | blue-green algae | Cyanophyceae | <i>Lyngbya majuscula</i> | | | C | | 1/1 |
| protists | green algae | Chlorophyceae | <i>Caulerpa peltata</i> | | | C | | 1/1 |
| protists | green algae | Chlorophyceae | <i>Codium spongiosum</i> | | | C | | 2/2 |

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992*. The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ().

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*. The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).

This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.

This number is output as 999 if it equals or exceeds this value.

APPENDIX D: REDLANDS PLANNING SCHEME ZONE AND OVERLAY MAPS INCLUDING SEMP AREA

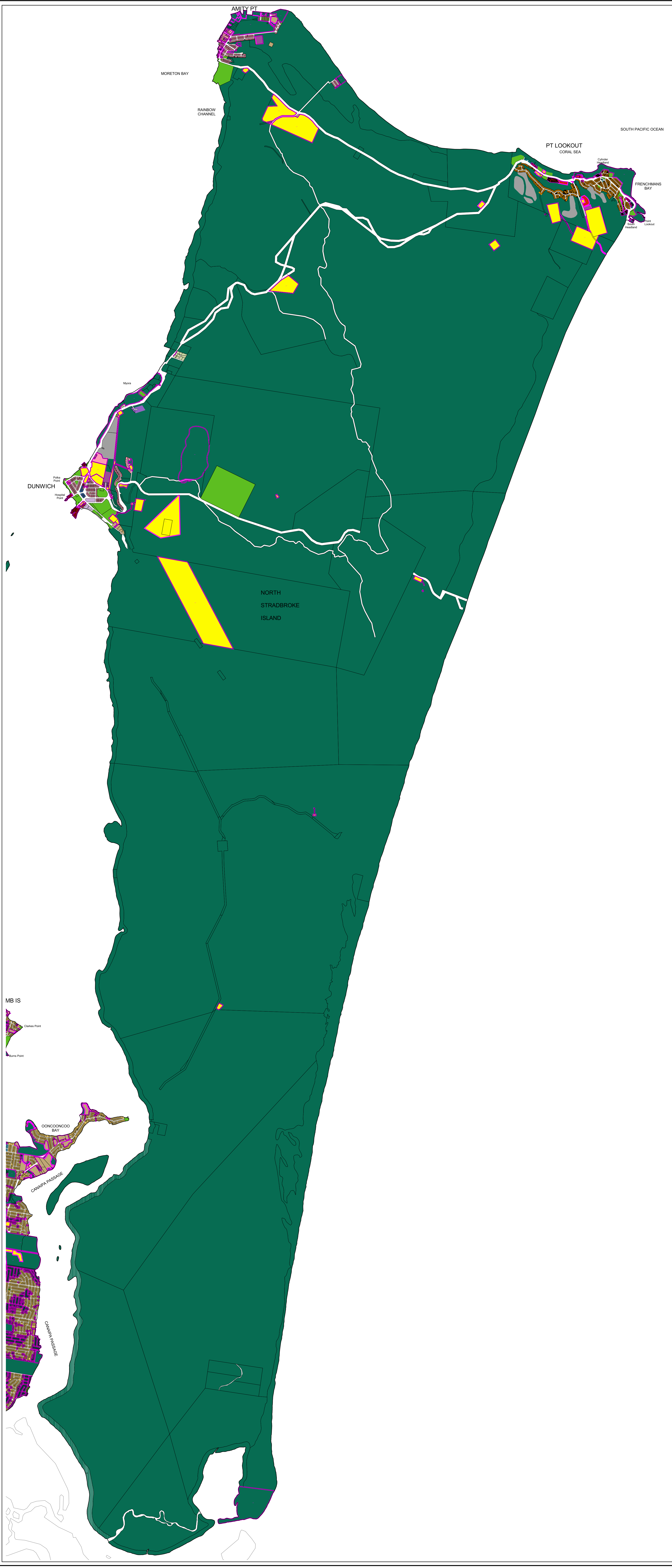
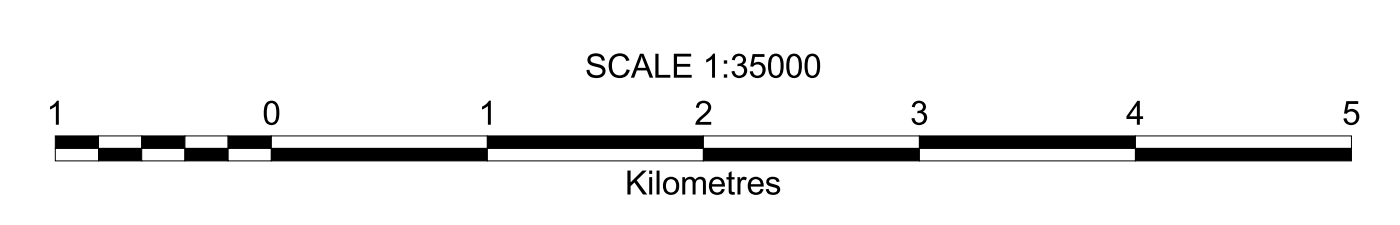
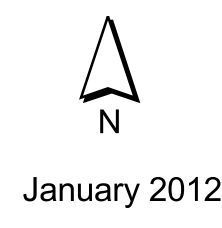
DRAFT

Redlands Planning Scheme - Version 4
NORTH STRADBROKE ISLAND

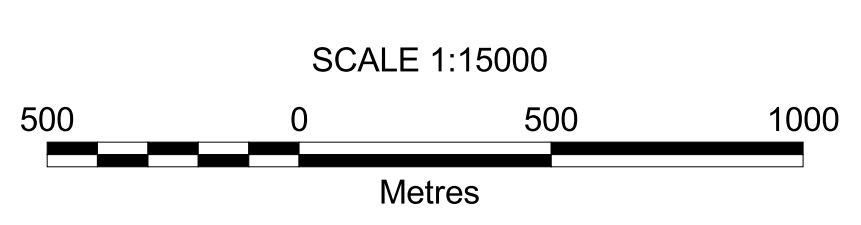
- LEGEND**
- | | | |
|----------------------------|--------------------------|--|
| RESIDENTIAL | CENTRE | CONSERVATION |
| Low Density Residential | District Centre | Park Residential |
| Medium Density Residential | Local Centre | Environmental Protection |
| Point Lookout Residential | Major Centre | Conservation |
| Point Lookout Tourist | Neighbourhood Centre | |
| SMBI Residential | Point Lookout Centre | Sub-Areas |
| Urban Residential | SMBI Centre | Suburb Boundaries |
| | | Land Designated for Community Infrastructure |
| INDUSTRY | OTHER | Outline of RCC |
| Commercial Industry | Community Purposes | Cadastral Properties |
| General Industry | Emerging Urban Community | Adjoining Shires |
| Island Industry | Open Space | |
| Marine Activity | Rural Non Urban | |
| | Investigation Zone | |



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 REDLAND CITY COUNCIL

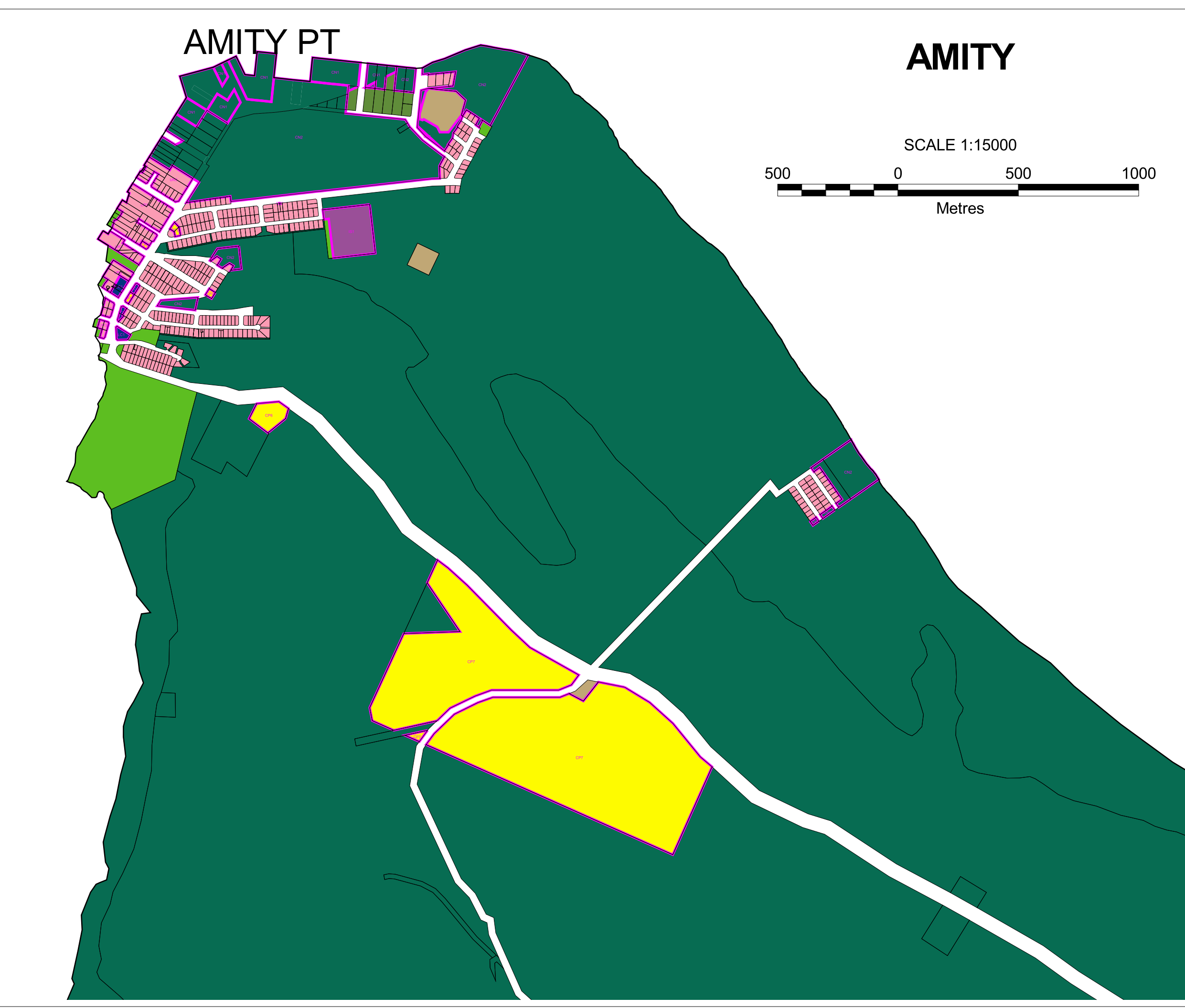
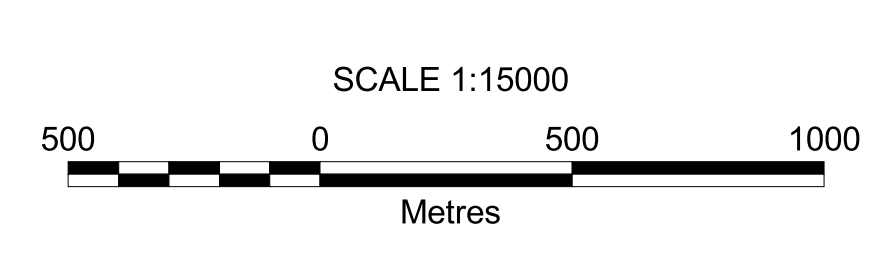


DUNWICH



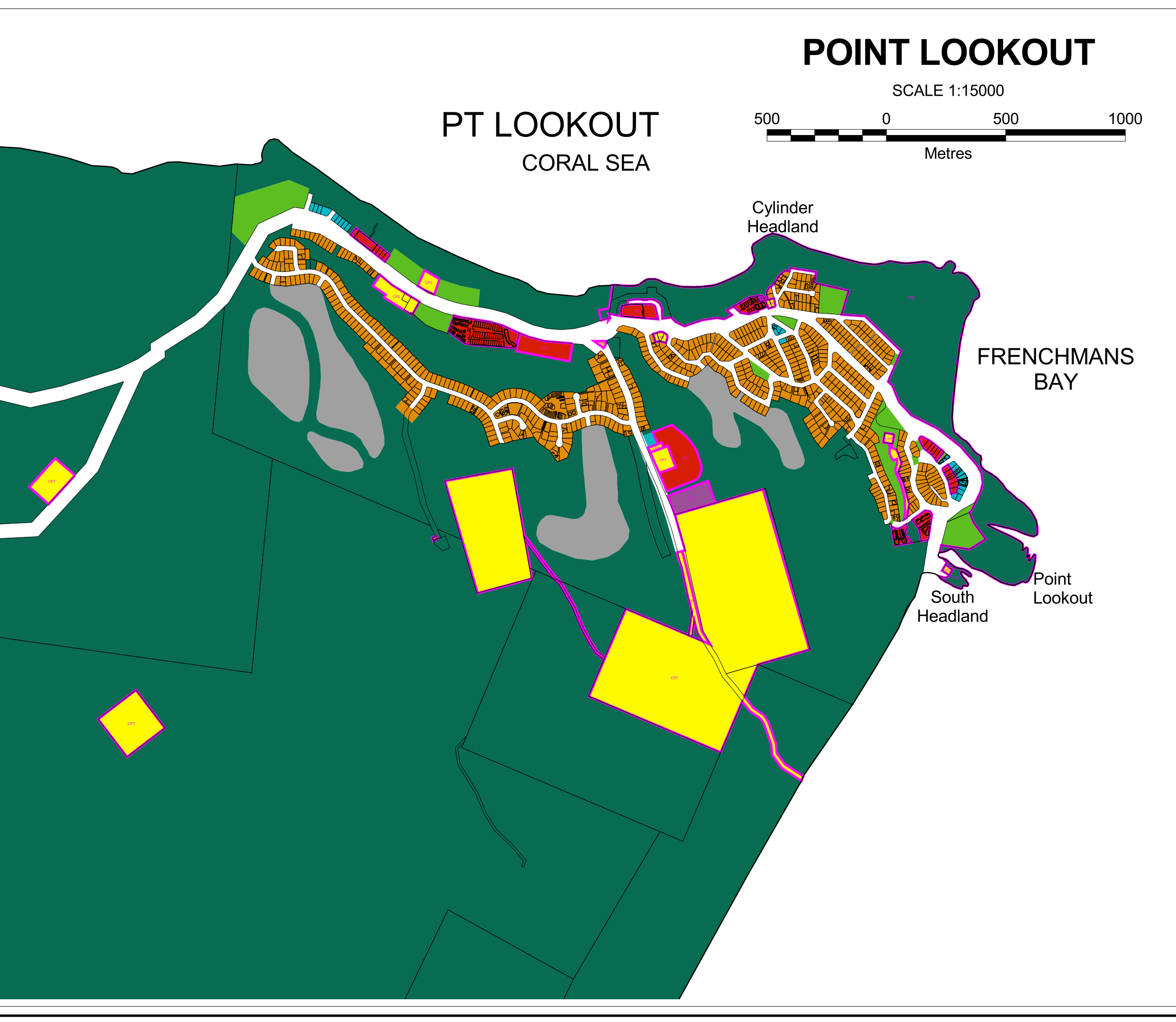
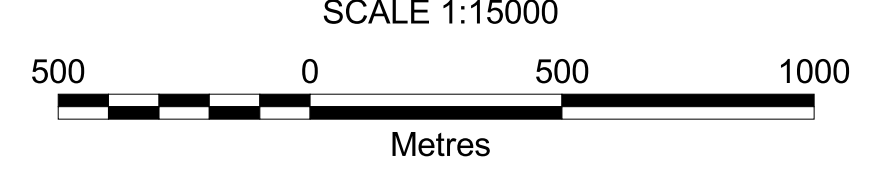
AMITY PT

AMITY



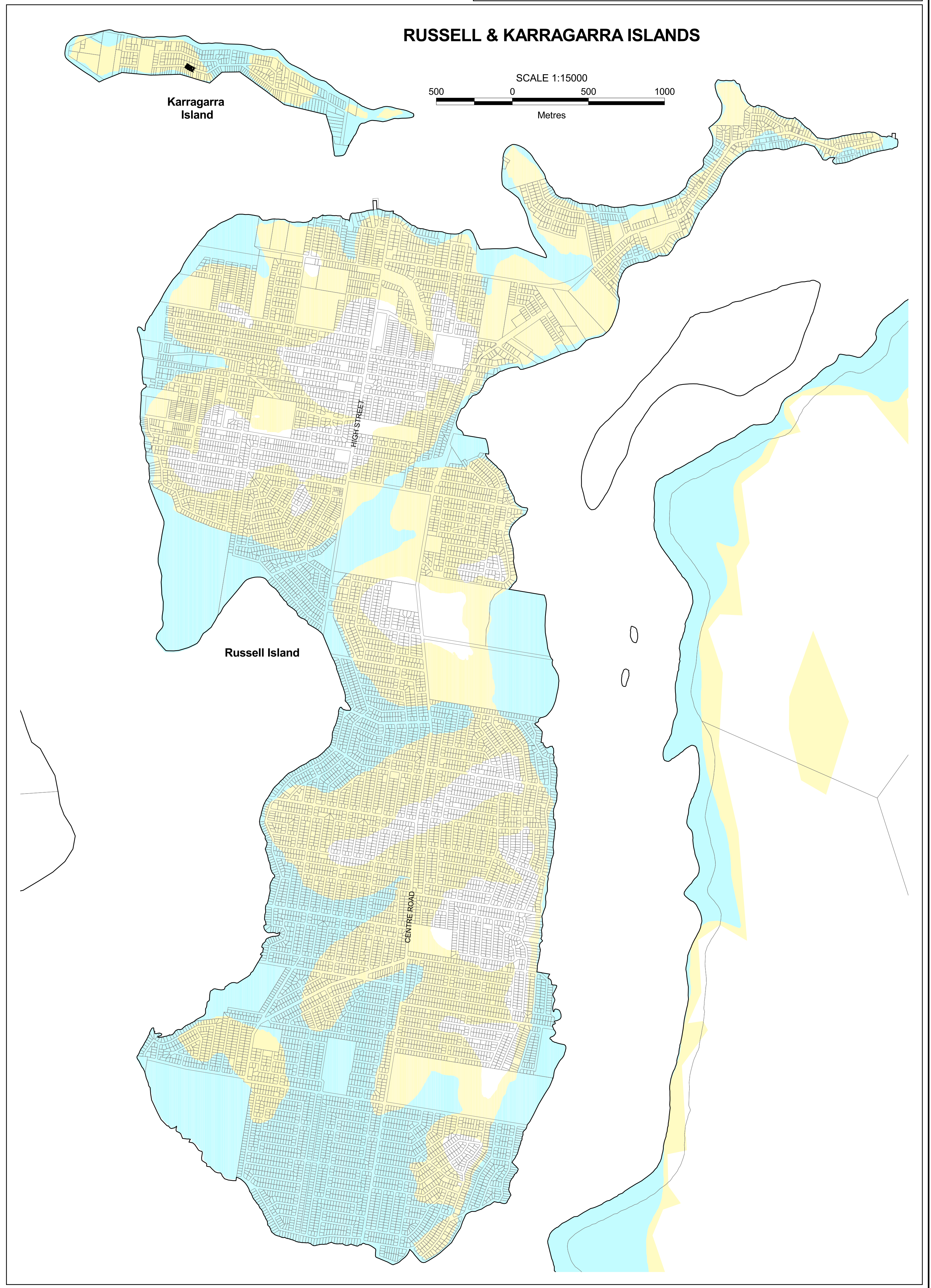
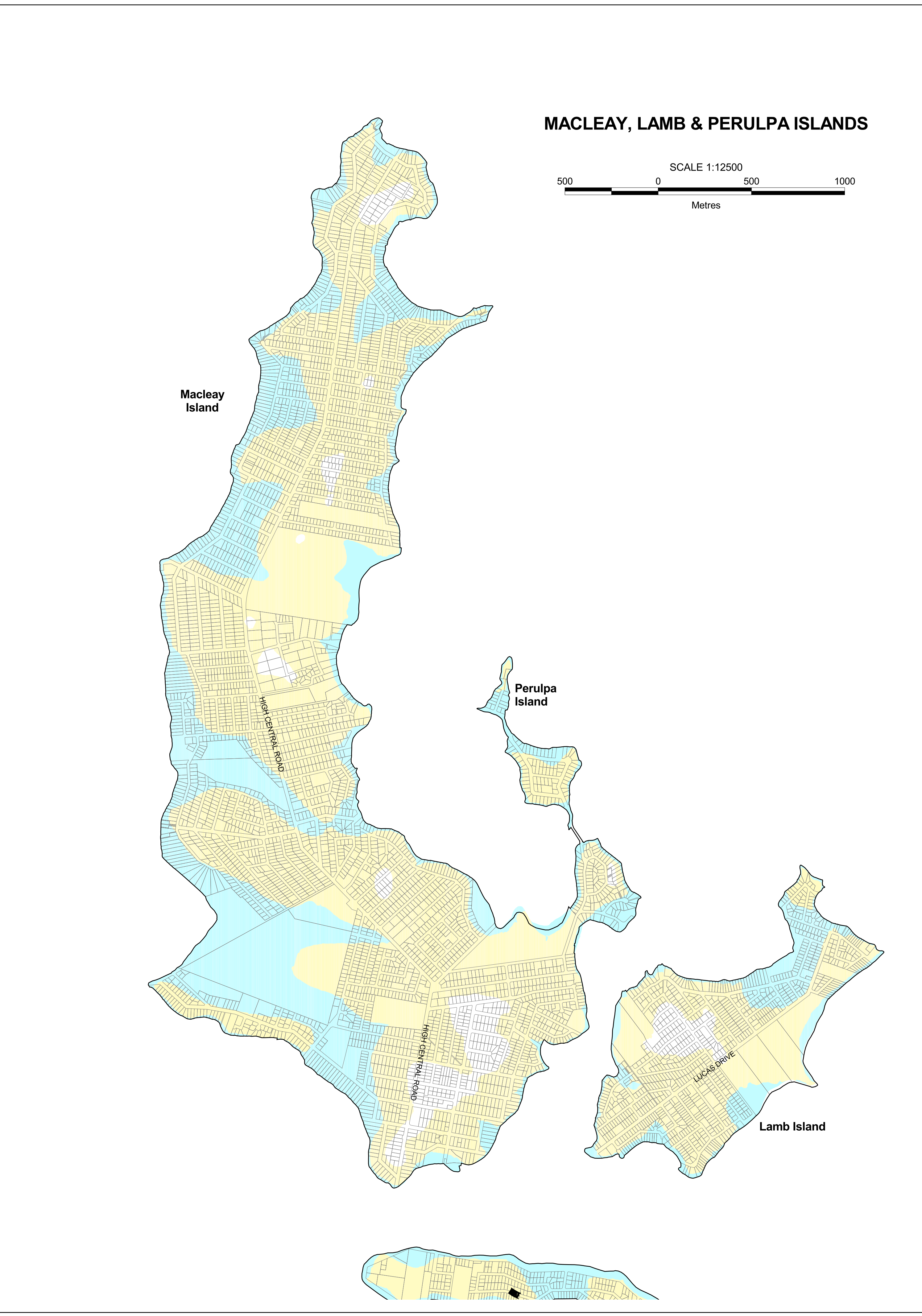
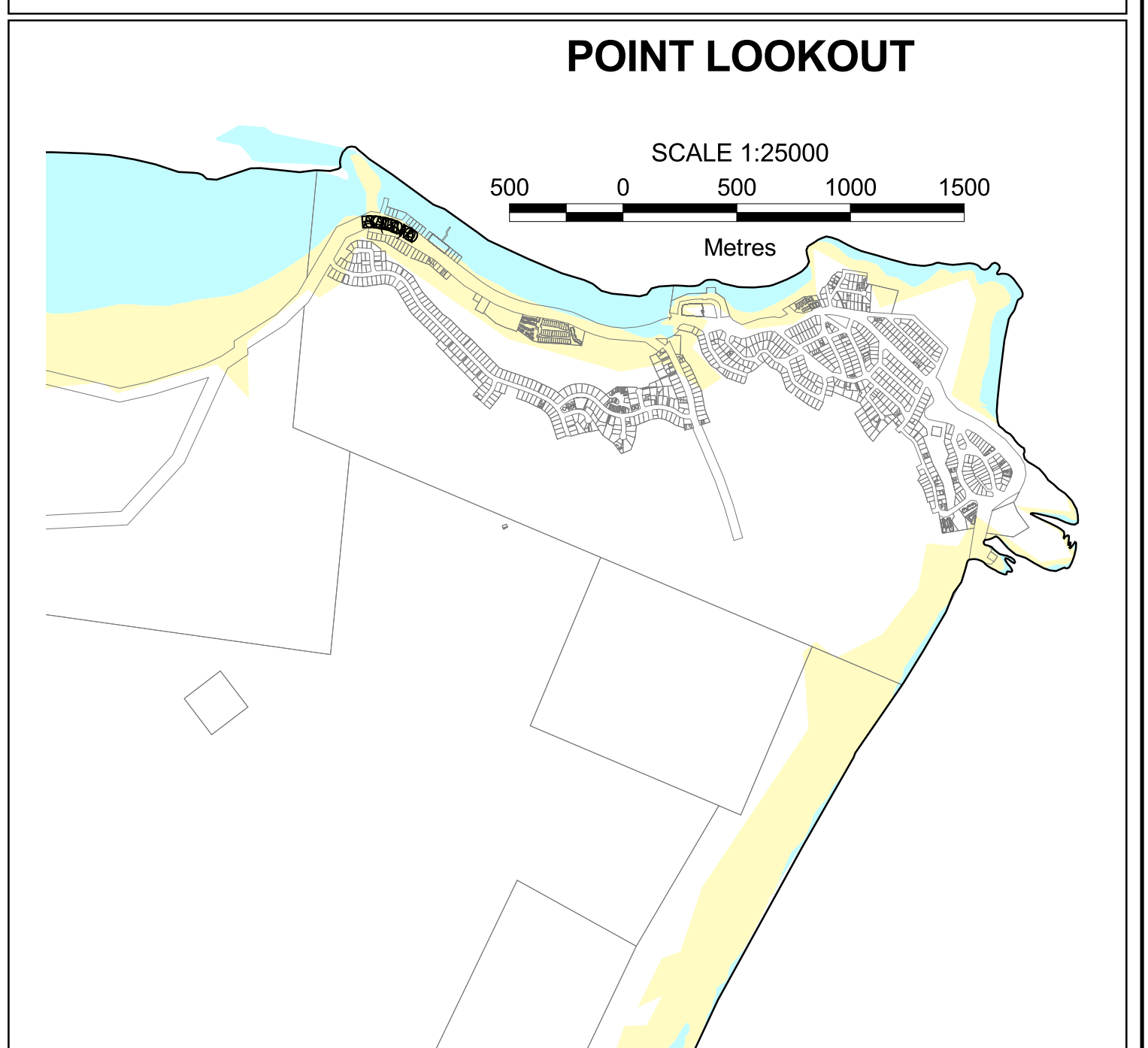
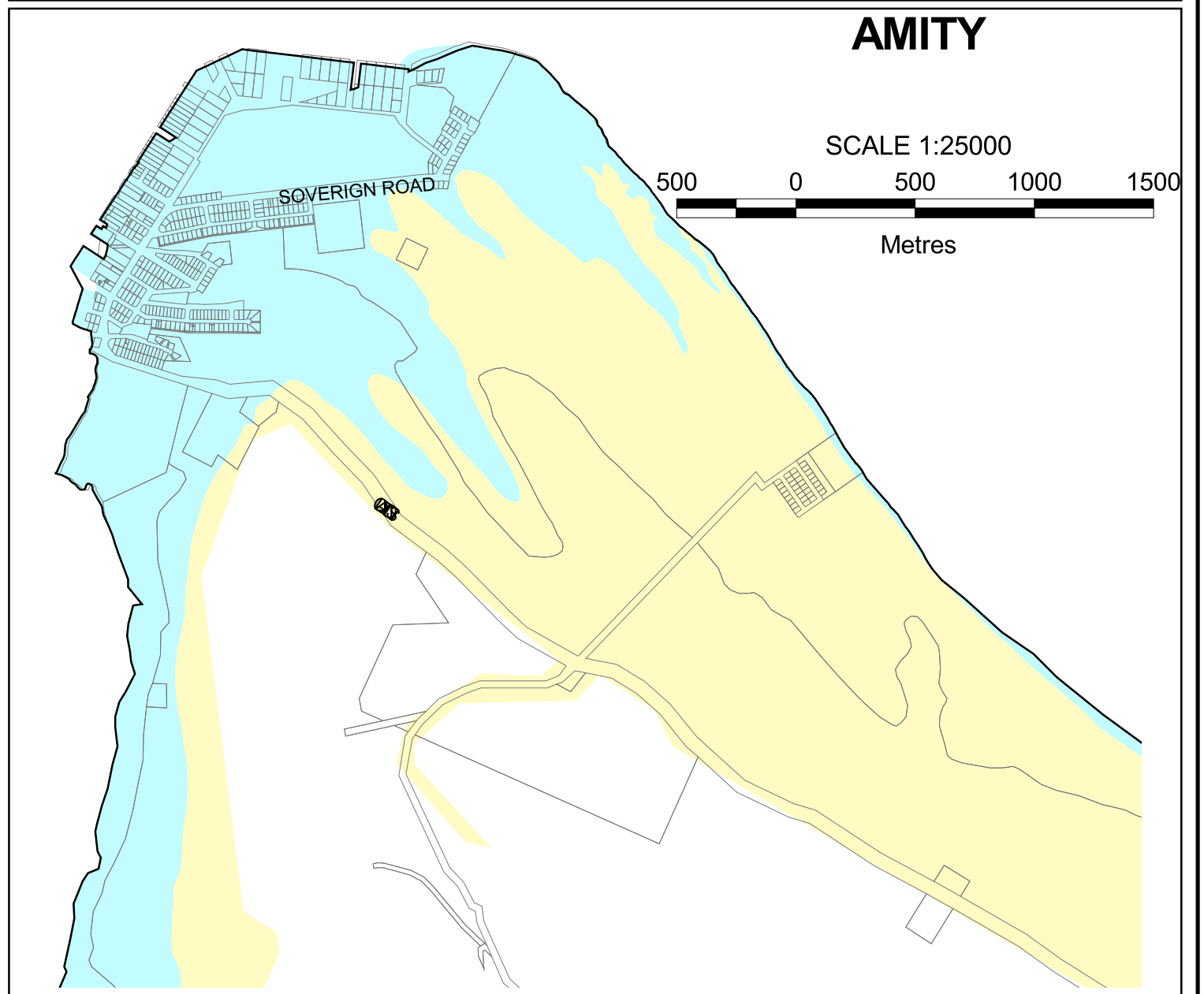
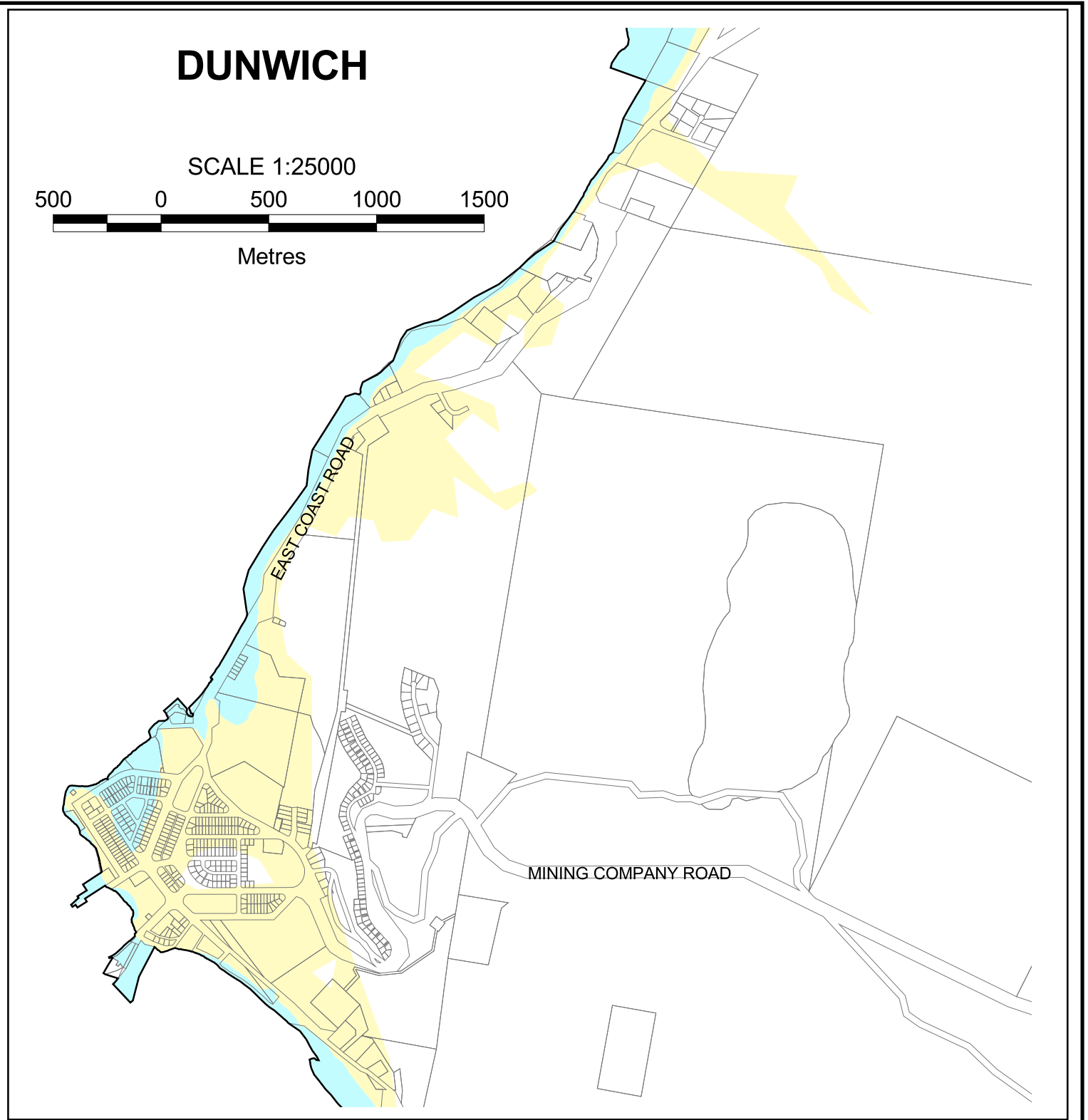
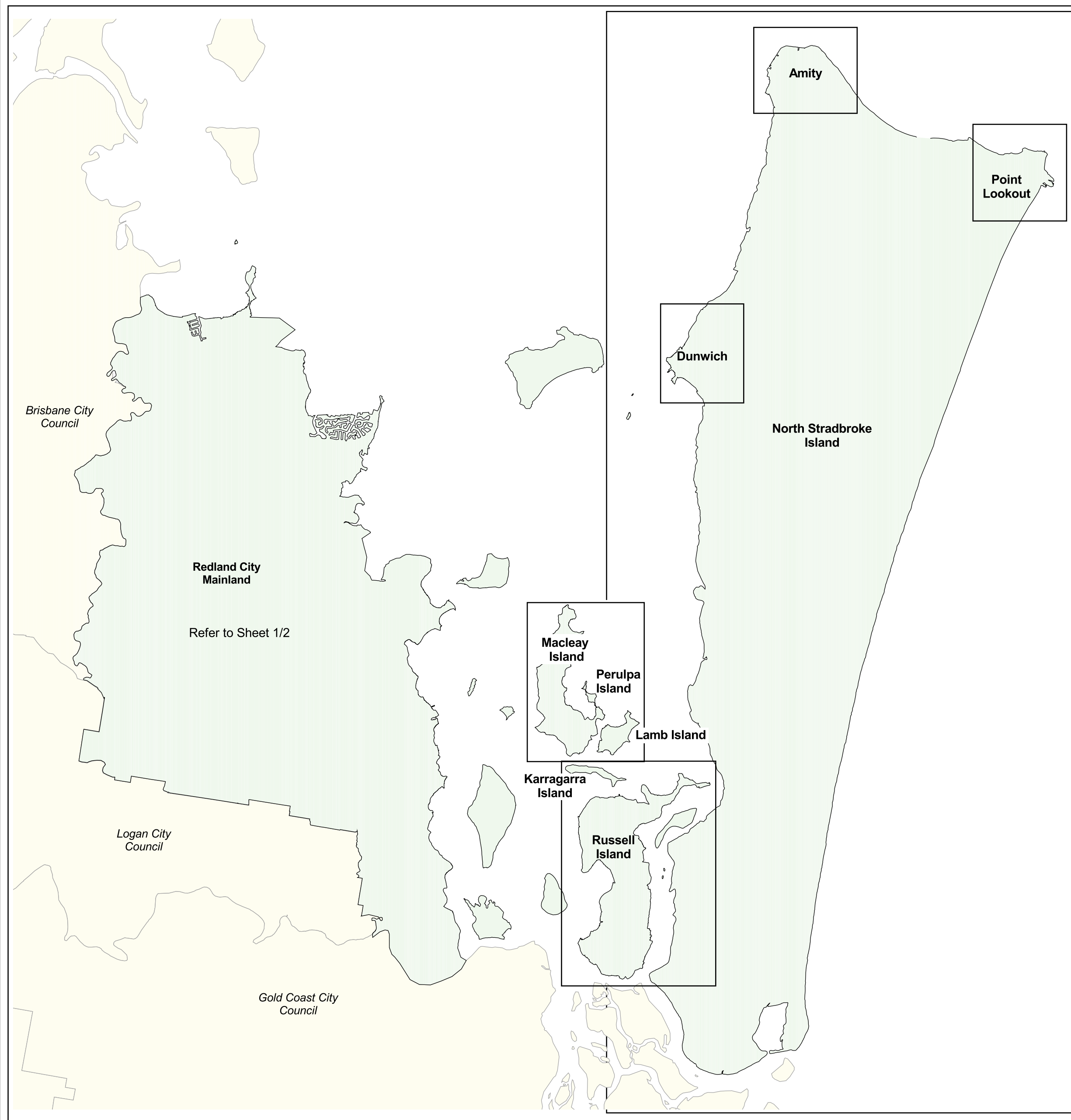
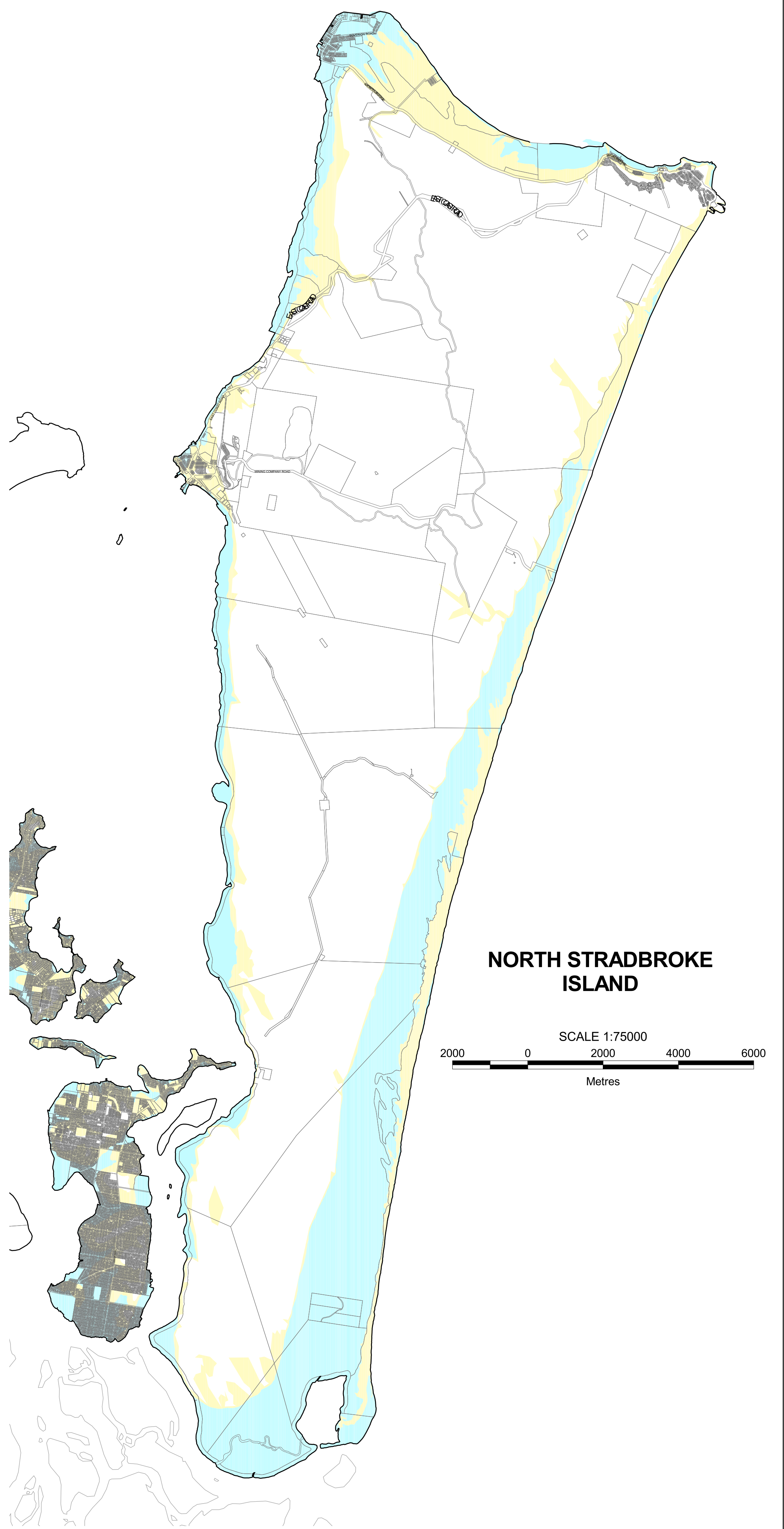
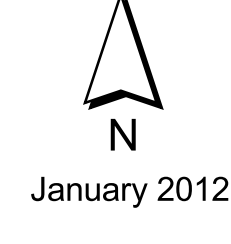
POINT LOOKOUT

PT LOOKOUT
 CORAL SEA



Redlands Planning Scheme - Version 4
ACID SULFATE SOILS OVERLAY
 SHEET 2/2

- LEGEND**
- Below 5 metres AHD
 - Between 5 and 20 metres AHD
 - Cadastral Properties
 - Outline of RCC
 - Local Authorities Outside RCC



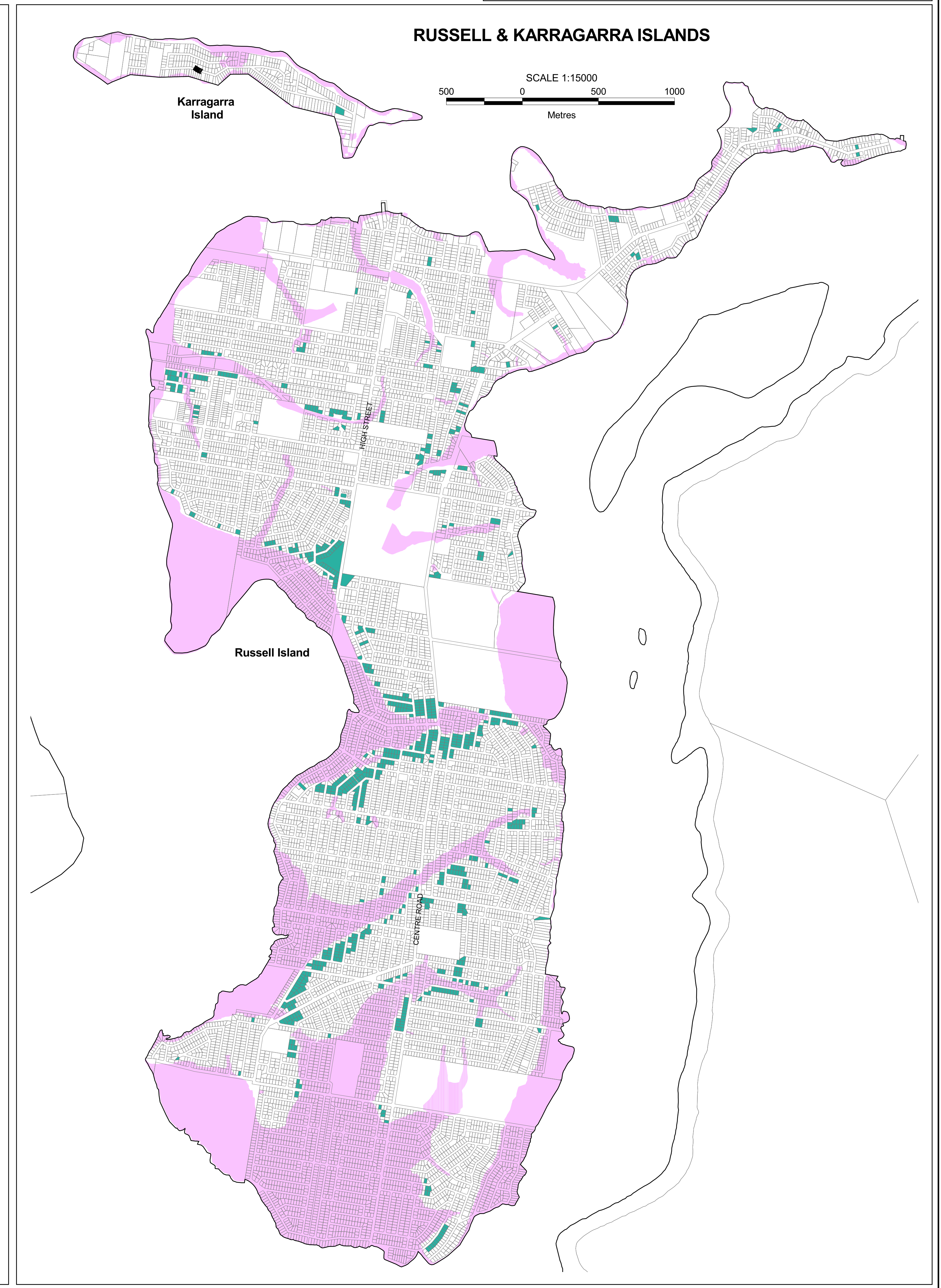
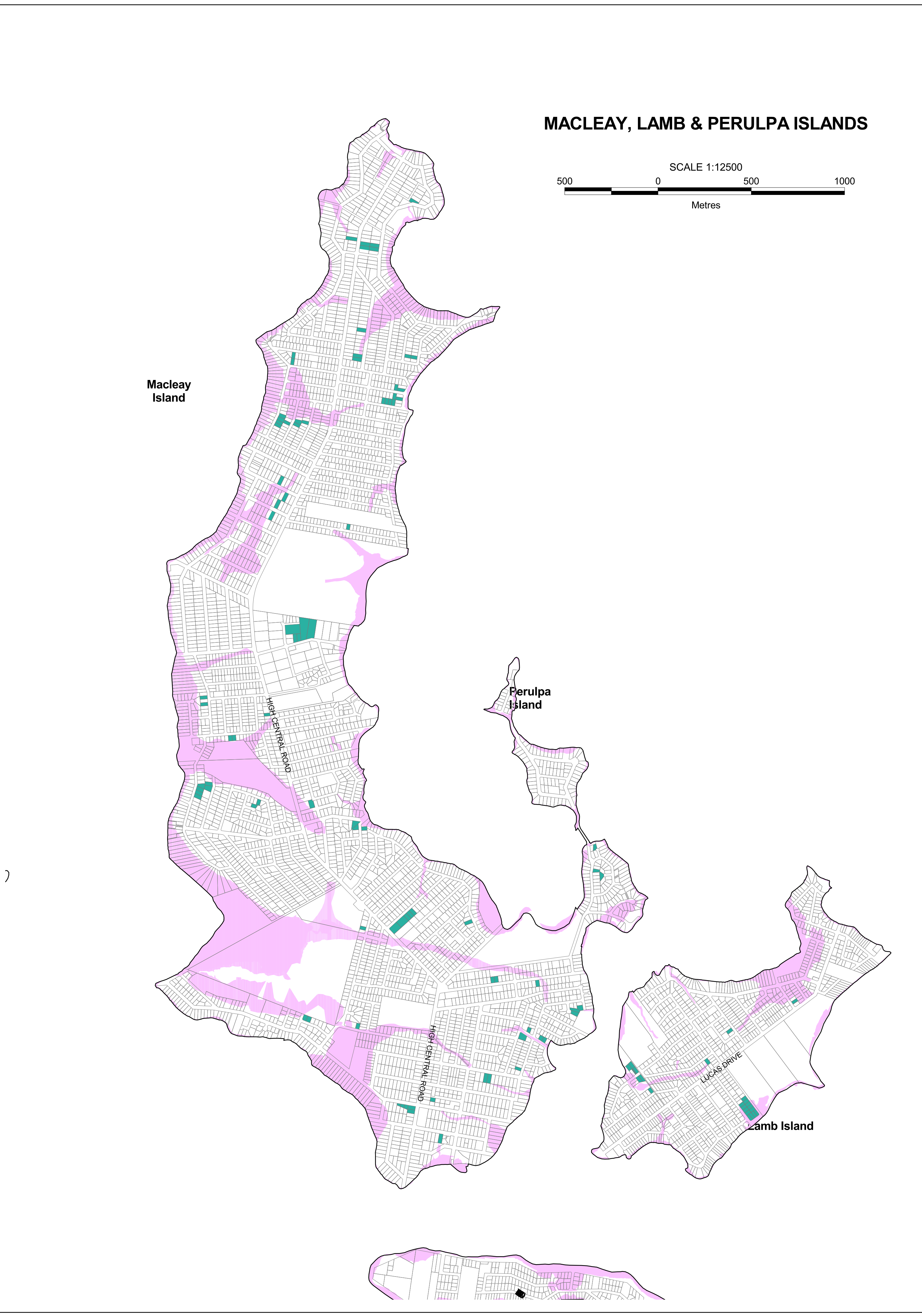
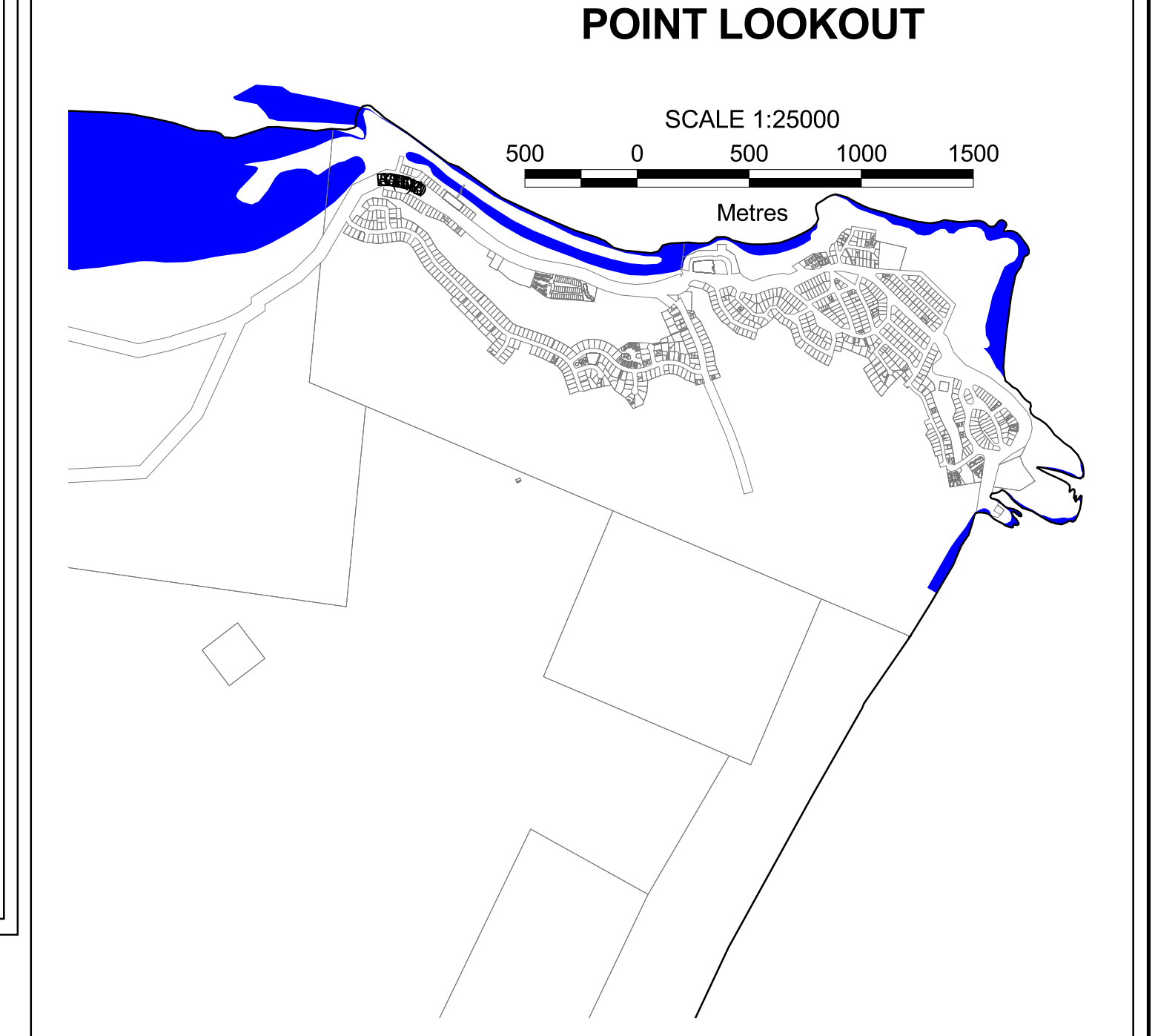
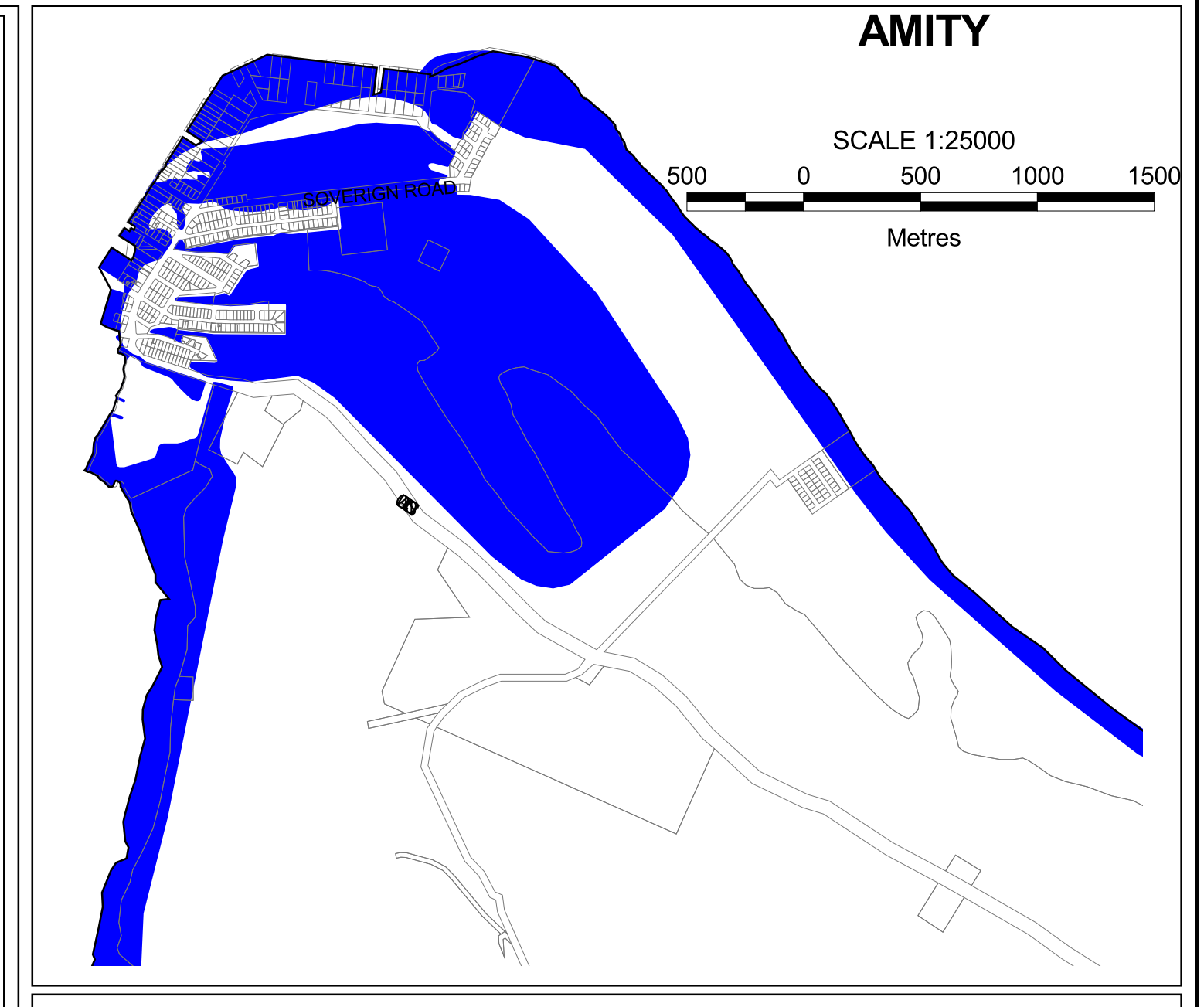
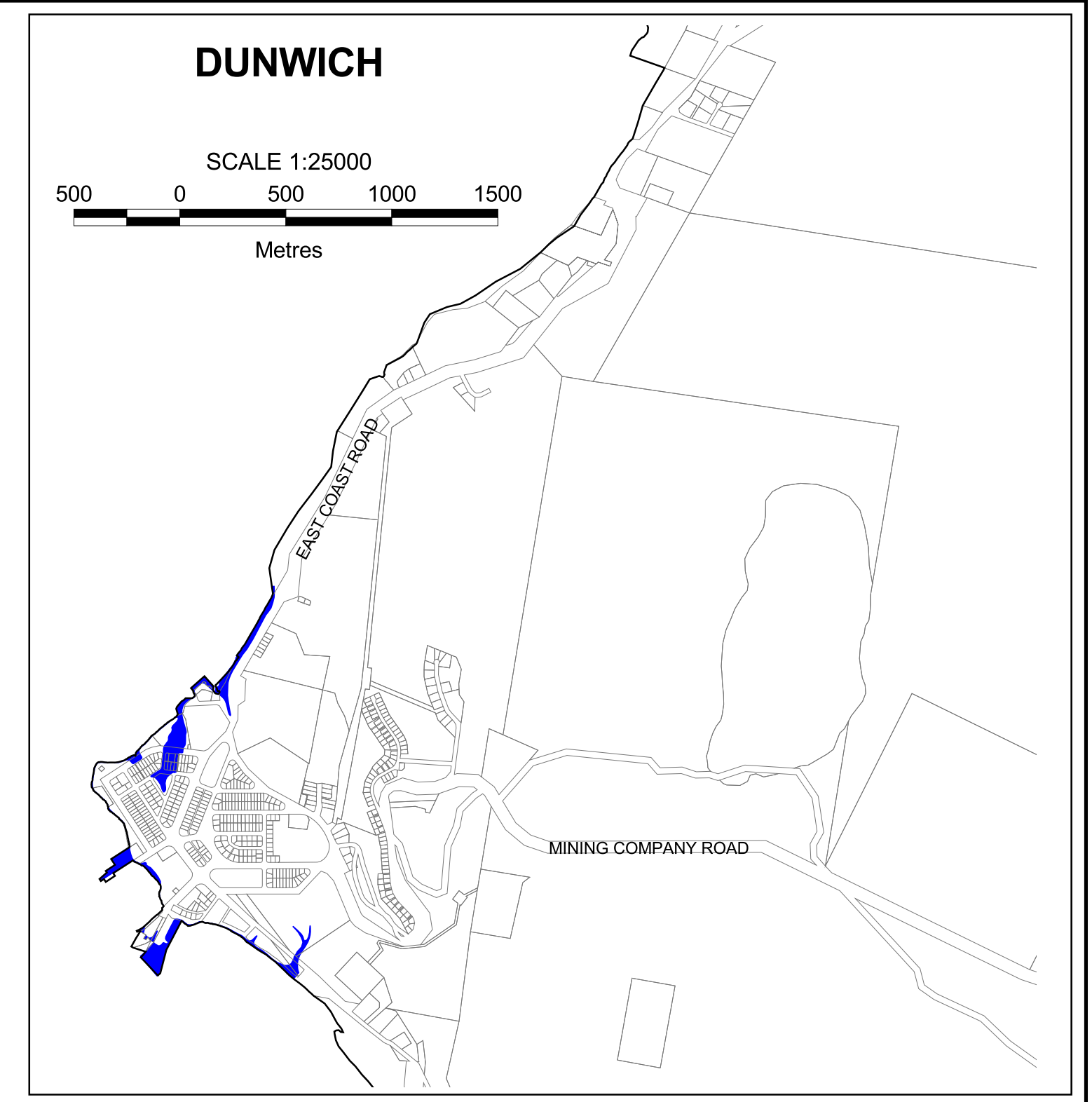
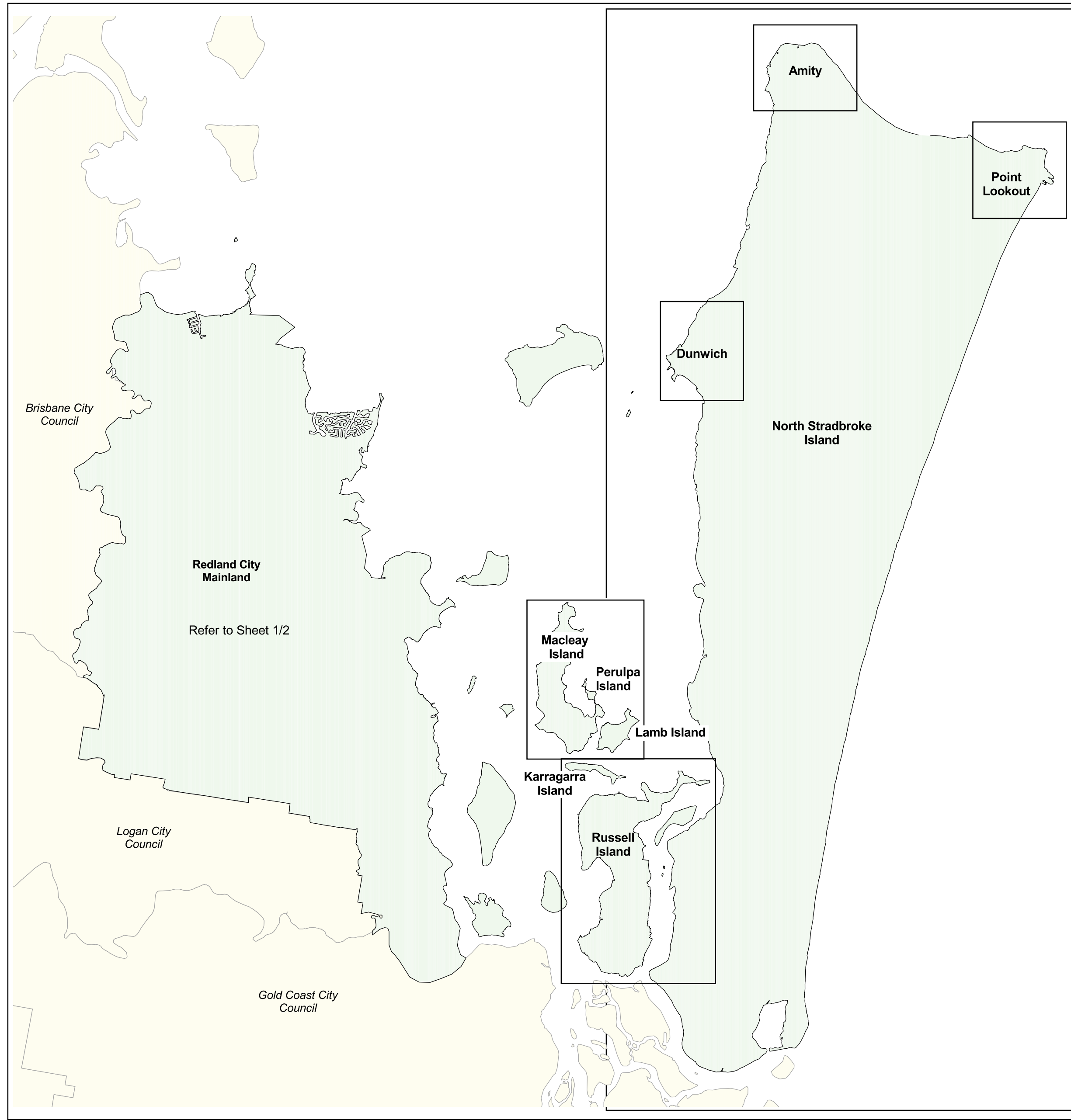
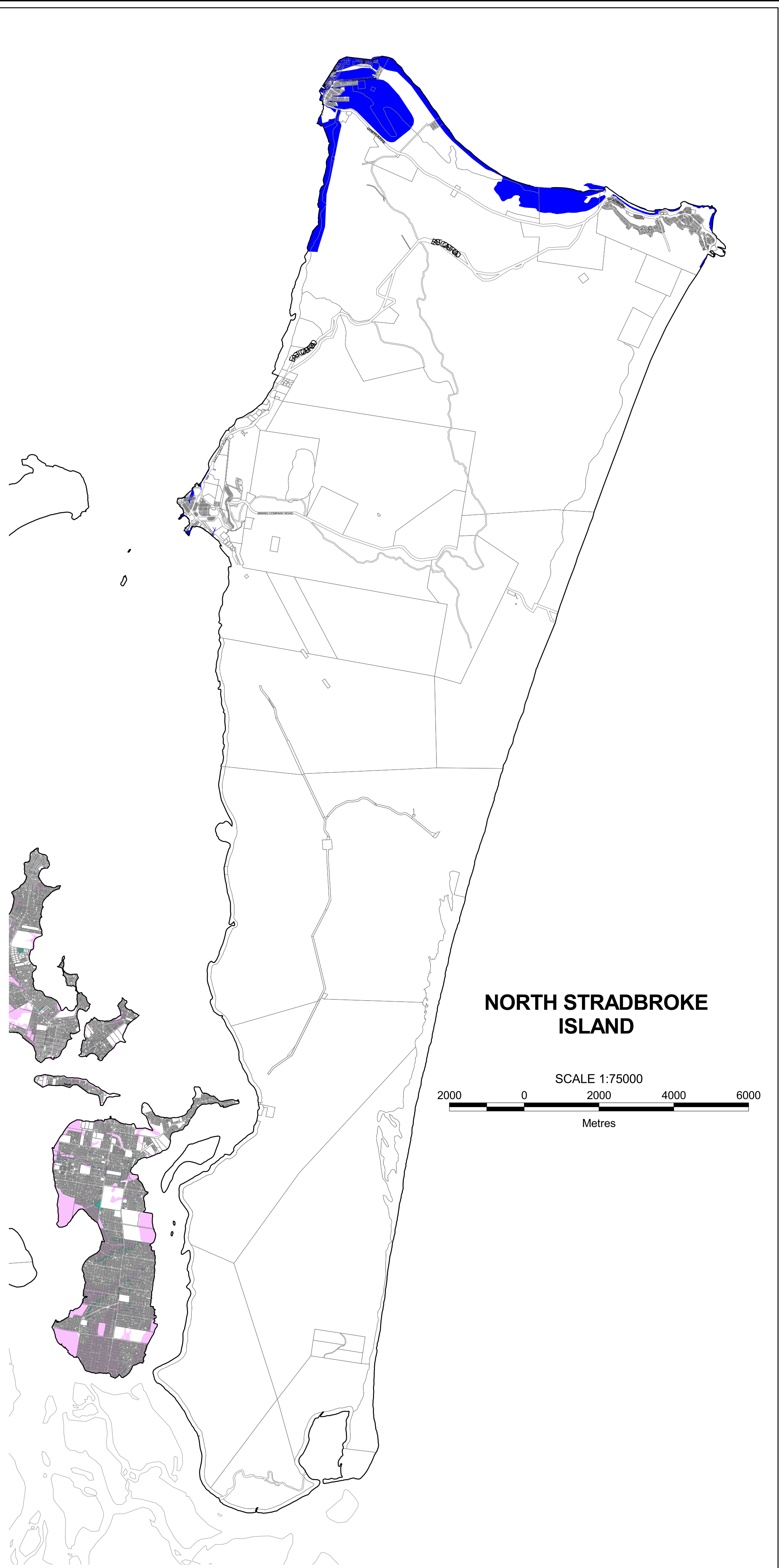
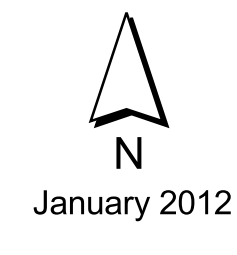
Redlands Planning Scheme - Version 4
**FLOOD PRONE, STORM TIDE AND DRAINAGE
 CONSTRAINED LAND OVERLAY**

SHEET 2/2

- LEGEND**
- Storm Tide Area
 - SMI Flood Prone and Storm Tide Area
 - Drainage Constrained Land
 - Cadastral Properties
 - Outline of RCC
 - Local Authorities Outside RCC

Notation

For the purpose of this planning scheme overlay mapping the defined flood event (DFE) for the planning scheme area is the 1 percent Annual Exceedance Probability (1 in 100 year Average Recurrence Interval) for flood and storm tide (RL2.4 metre Australian Height Datum) level.

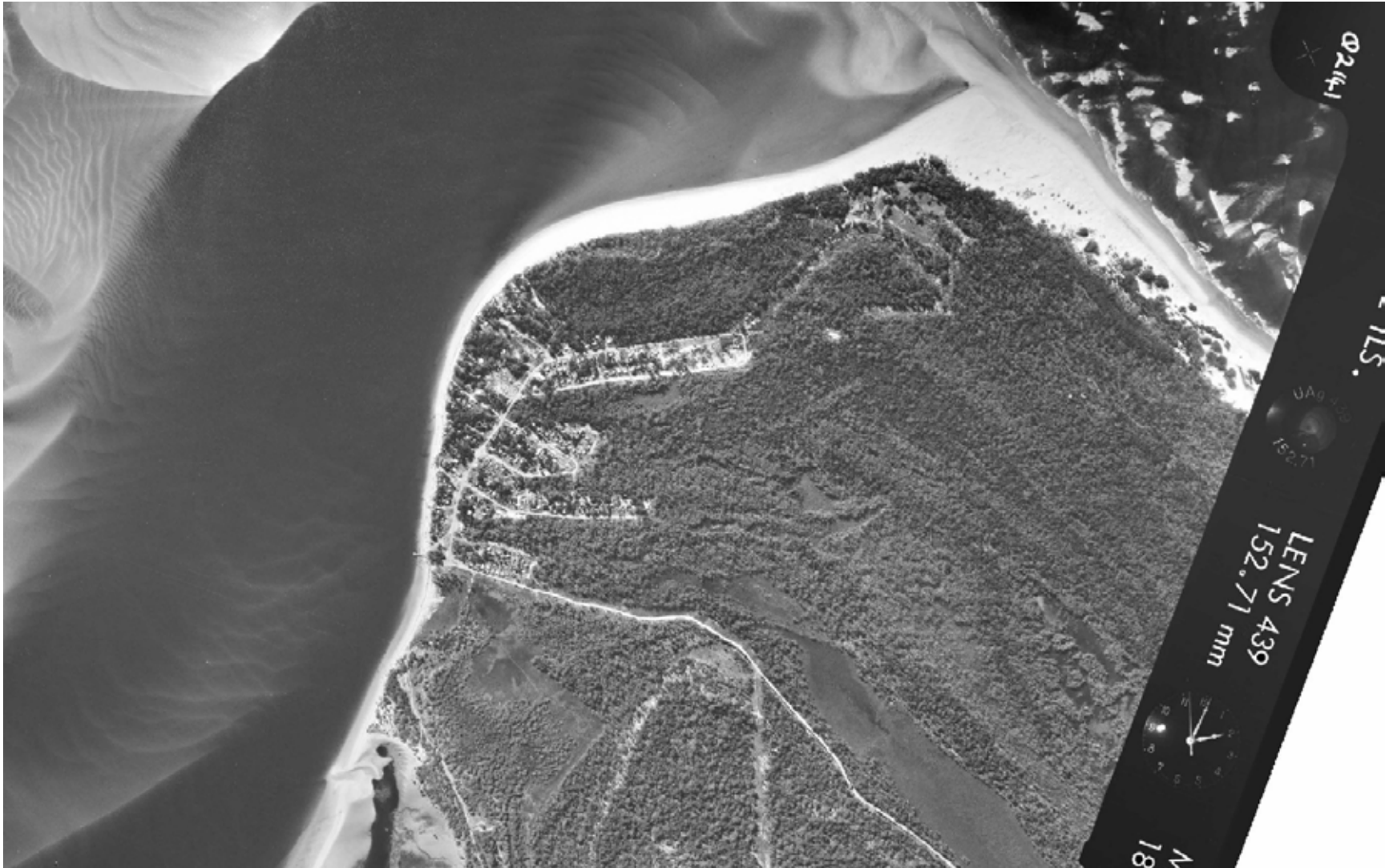


APPENDIX E: AERIAL PHOTOGRAPHY

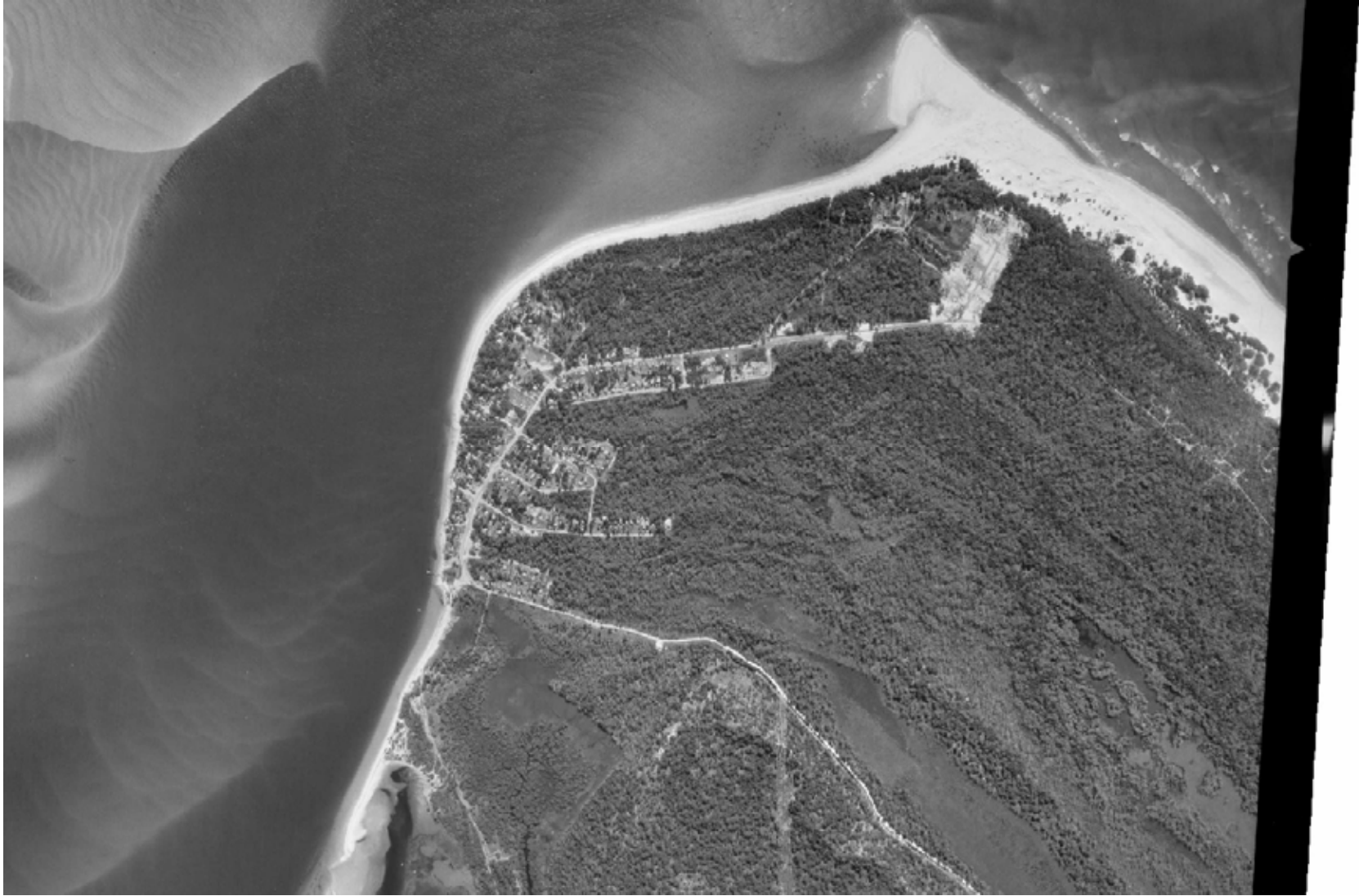
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1958



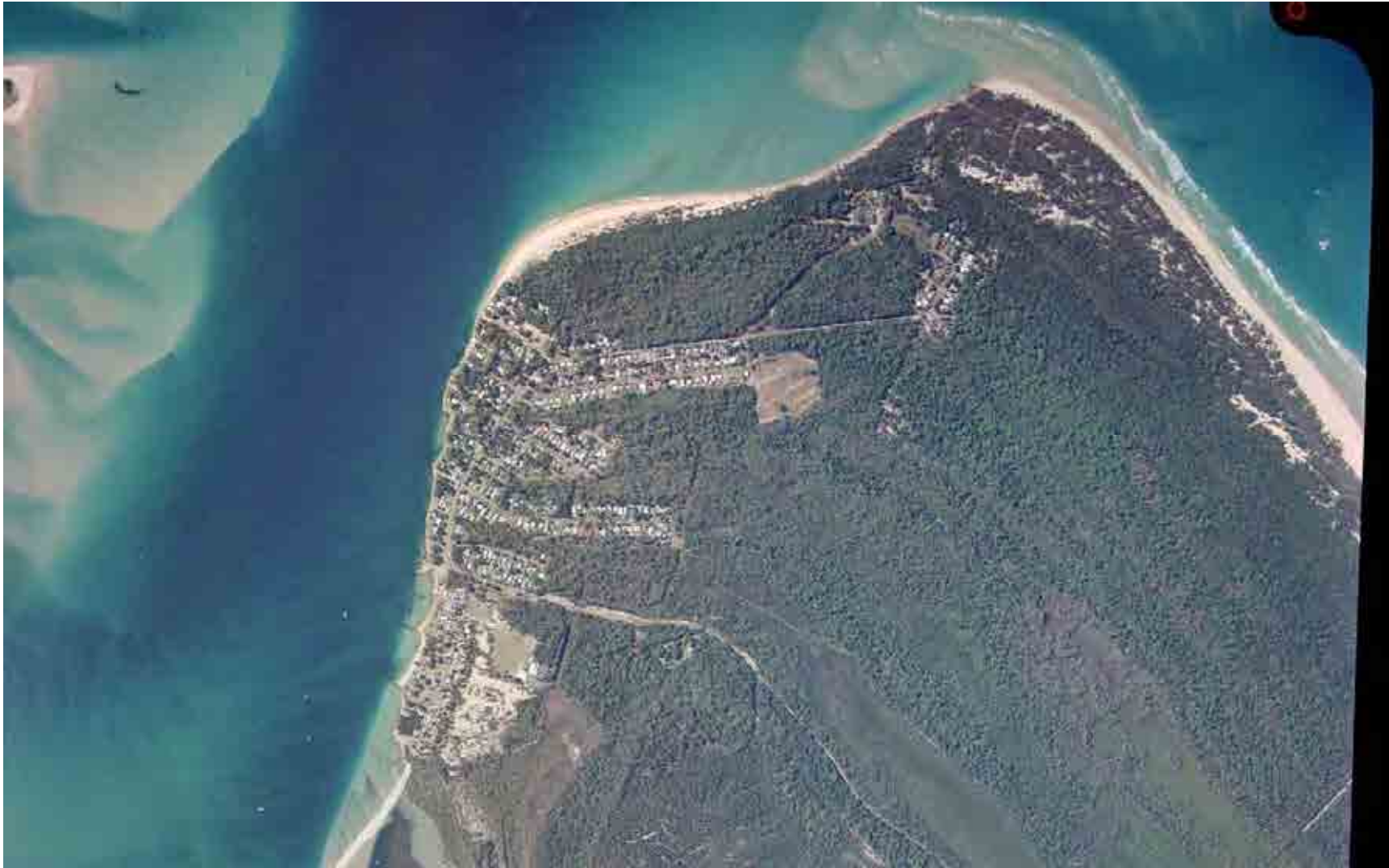
1970



1972



1978



2002



2008



2011

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