

2 OVERVIEW OF HAZARDS AND THREATS

A number of coastline hazards have been identified in the Ballina Coastline Hazard Definition Study. Specific hazards identified as requiring consideration with respect to emergency response and interim planning relate primarily to:

- beach erosion;
- seawall stability; and
- coastal inundation.

These are discussed below.

2.1 Beach Erosion

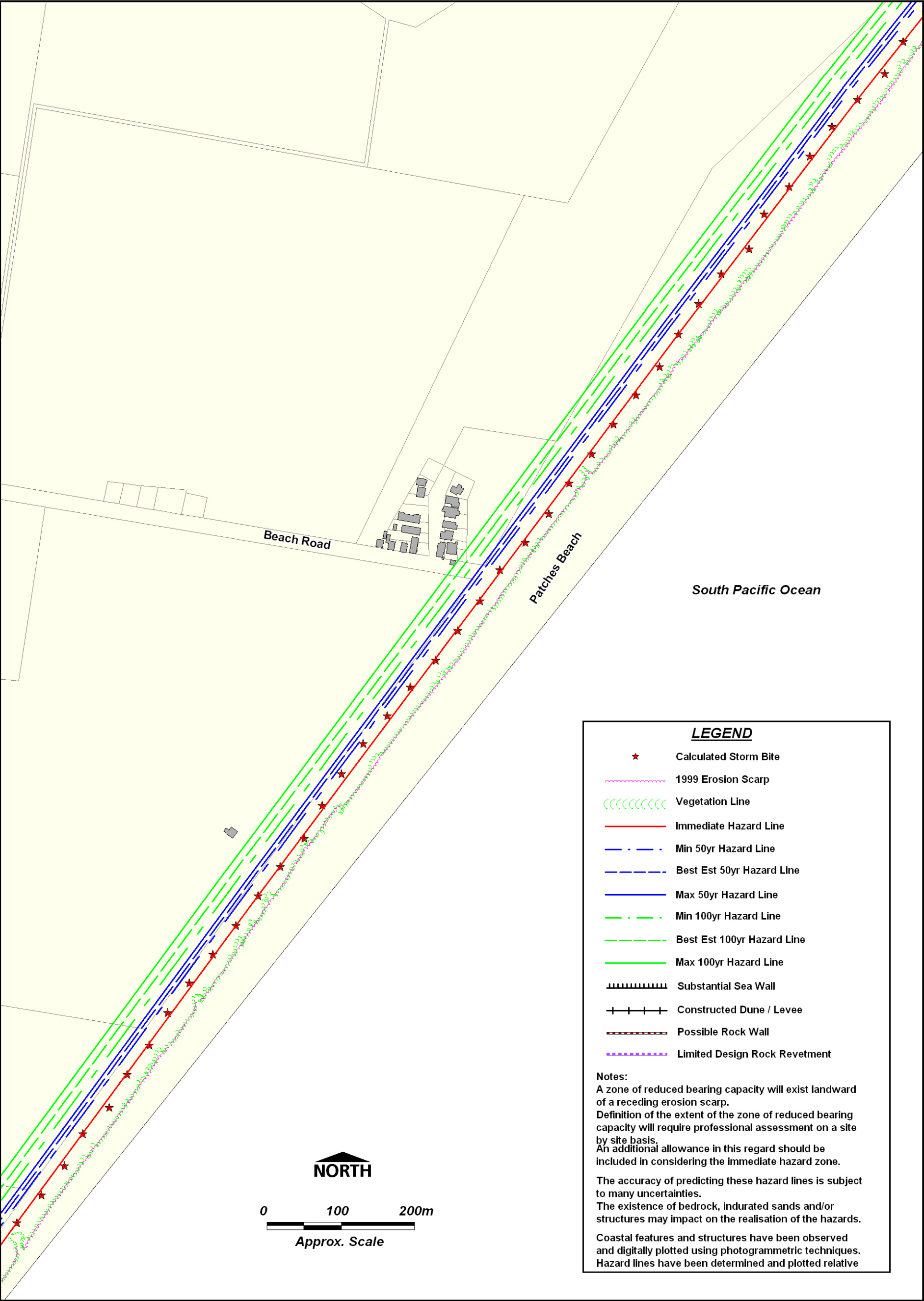
Erosion of the foreshore can occur as result of short term storm demand and/or longer term shoreline recession. Often these influences occur together and are difficult to separate. During major storm events, high waves and elevated water levels lead to rapid erosion of the upper beach and dune.

The short term storm demand for a single storm or a series of closely spaced storms has been assessed as typically around 200m³/m in terms of the beach/dune erosion quantity above mean sea level(MSL). The actual recession distance is dependent on the height of the dune and the status of the beach /nearshore profile with respect to recent erosion or accretion in the form of a beach berm. For a beach with a dune crest height of 6m above MSL and little or no berm, this equates to a recession distance of about 35m.

The beaches of Ballina Shire are also subject to potential longer term trends of recession to varying degrees as a result of differentials in the rate of longshore transport and the predicted impacts of climate change including sea level rise. The highest rates of long term recession of between 0.3 and 0.7m/yr have been assessed for the southern and central sections of Lennox Head. Recession due to sea level rise ranges from 10m for the year 2050 to 25m for the year 2100.

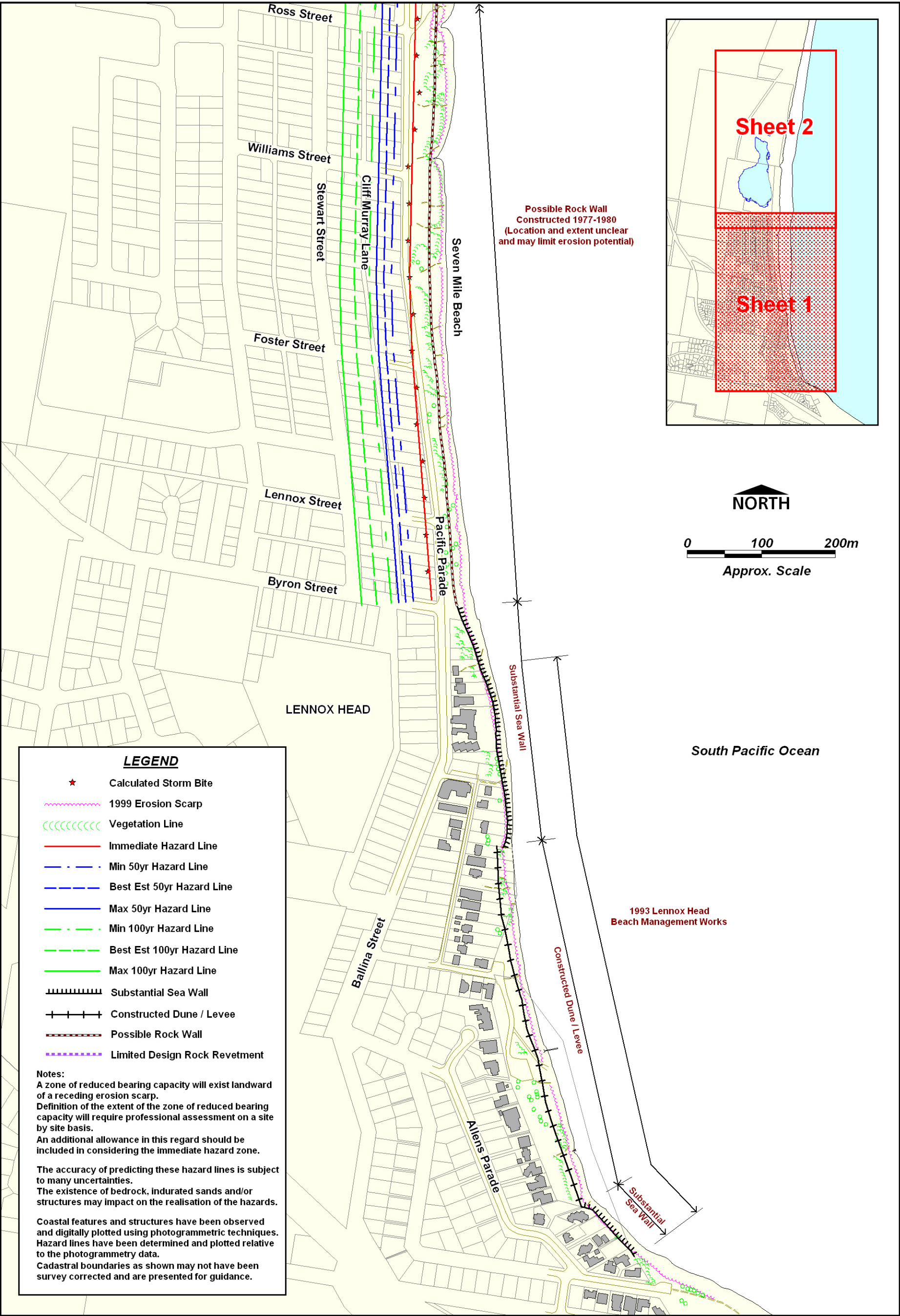
As part of the Coastline Hazard Definition Study, erosion hazard zone maps combining the above components were prepared for two priority areas of Patches Beach and Lennox Head-Seven Mile Beach. These Hazard Zone Maps are reproduced here as Figure 2-1 to Figure 2-3. While the individual erosion hazard components were assessed for the other beaches as well, the hazard zones did not extend into developed areas and maps were not produced.

The hazard zone maps include an immediate hazard line which depicts the potential position of the top of the erosion scarp following a severe storm or a series of closely spaced storms. It should be recognised that a zone of reduced bearing capacity will exist landward of a receding erosion scarp. The stability of foundations located within a zone of reduced bearing capacity will be compromised if adequate measures have not been considered in their design to withstand such conditions.



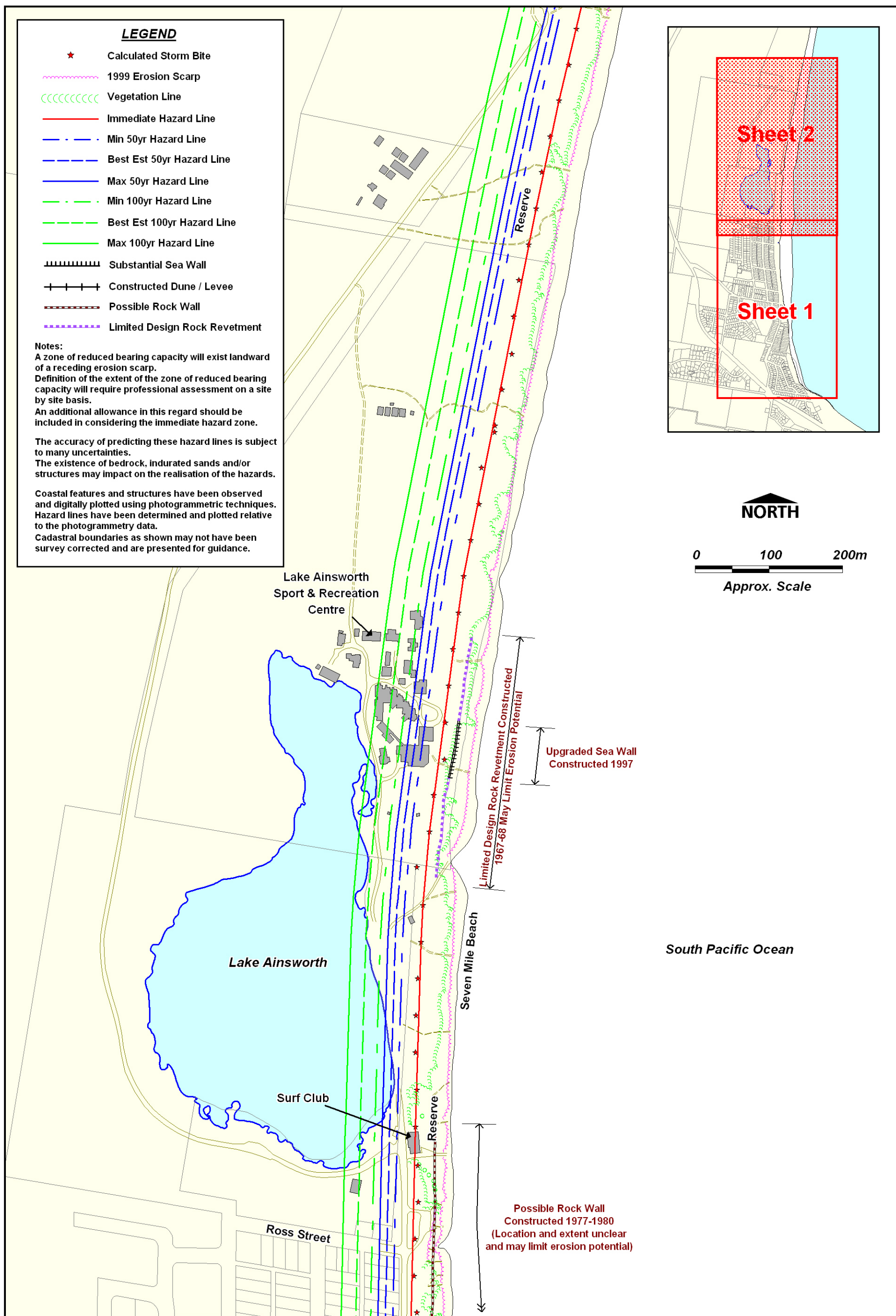
Patches Beach Erosion Hazard Zones

Figure 2-1



Lennox Head Erosion Hazard Zones - Sheet 1

Figure 2-2



Lennox Head Erosion Hazard Zones - Sheet 2

Figure 2-3

Figure 2-4 illustrates the principle dune instability zones. Stability factors relating to these zones have been defined by extensive studies (Nielsen et al 1992). Amongst other factors, the width of the zone of reduced bearing capacity is dependent on a range of factors including the natural angle of repose of the sand and the height of the dune. Definition of this width will require professional assessment on a site by site basis but could typically be in the range of 10m to 15m, for dunes up to 8m in height. An additional allowance in this regard should be made when considering the immediate hazard threat.

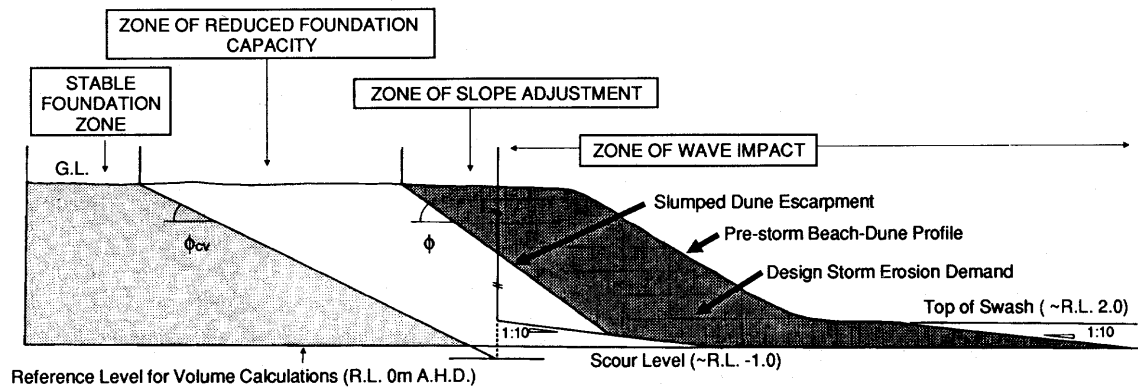


Figure 2-4 Dune Instability Zones

The hazard zone maps also include hazard lines for 50 year and 100 year planning periods taking into account predicted shoreline recession due to regional sediment budget deficits as well as predicted sea level rise recession. They have been shown as bands with minimum, maximum and best estimate lines due to uncertainties and natural variability with respect to ongoing recession. The lines also reflect the potential position of the shoreline following severe storm erosion at the end of the planning period. That is, they include the storm bite component as well.

It should be recognised that if extensive bedrock, indurated sand and/or protective structures are encountered in the beach face within these predicted zones, then this may reduce the shoreline recession. Furthermore, future recession rates may be influenced by the nature of coastline management options adopted. In particular, whether existing coastal structures are upgraded and retained or removed will have a bearing on the location and extent of erosion.

At Lennox Head, hazard lines have only been drawn north of Byron Street. South of this point, works have been implemented as part of the Lennox Head Beach Management Plan to manage coastal erosion. These works include a substantial seawall at the northern and southern ends with a constructed dune in the central section where development is set back slightly. It is understood that these works have been designed to withstand storm wave attack.

The hazard lines north of Byron Street have been drawn on the basis of no outcropping bedrock or seawalls, which are known to exist but are presently buried beneath the sand. It is likely that these walls will be exposed during a major storm event and it is recognised that such features may limit the potential for erosion. However, as their capacity in this regard is unclear, and whether they will be upgraded or maintained in the long term is unknown, the hazard lines were drawn on the basis that they do not provide any protection (i.e. worst case scenario).

2.2 Seawall Stability

At Lennox Head, a number of rubble mound seawalls have been built in response to previous erosion threats. These include substantial seawalls in the 1993 Lennox Head Beach Management Works area and in the central section of the Lake Ainsworth Sport and Recreation Centre (refer Figure 2-2 and Figure 2-3). Walls of limited design remain buried elsewhere seaward of the above Centre and Pacific Parade.

The effectiveness of those walls to withstand severe storm wave attack and hence protect property and development behind from erosion is dependent on:

- the initial design and construction; and
- maintenance following exposure to storm wave conditions.

Such walls are typically designed to have some damage in major storms, and by their nature and exposure, are subject to some slumping. Accordingly maintenance is required to ensure they retain their integrity.

It is understood that the substantial seawalls discussed above have been designed to withstand severe storm wave attack. Furthermore, they have not been exposed to severe wave attack since construction. Accordingly their integrity should be in tact at present with a limited threat of failure and exposure of the land behind to erosion.

The remaining buried seawalls are understood to be of limited design. Discussion with Council engineers at the time the walls were built, indicate that the walls should be sufficient to provide protection against modest storm conditions (eg 1 in 5 year to 1 in 10 year average recurrence interval (ARI) type events). However, available information suggests that they may not withstand severe design storm conditions. As such, there is some erosion threat to property landward of these walls. It is difficult to quantify the extent of that threat. However, the immediate hazard line as discussed above, which has been assessed on the basis of no walls, is the upper limit.

If the seawalls are damaged during a storm event and not repaired, the risk of future failure and erosion threat are enhanced.

2.3 Coastal Inundation

Coastal inundation is the flooding of coastal lands by oceanic waters. Low lying coastal lands behind barriers such as dune systems and seawalls tend to remain completely protected until a certain critical combination of waves, elevated water level (storm surge) and possibly beach erosion occurs during major storm events. This is often a gradual process with limited overland flow immediately behind. However, if the barrier is completely overtopped or breached by erosion, inundation of low lying back areas can be rapid.

Severe coastal inundation is an infrequent event and is normally of short duration (peak flooding usually persists for several hours around high tide). The extent is dependant on the height of the barrier and the land behind. If back beach areas are poorly drained, flooding behind a breached or overtopped barrier may persist for some time after coastal water levels fall.

It is generally accepted that wave runup on exposed NSW open coast beaches will exceed RL 5.0m AHD under extreme conditions. Runup levels will be potentially higher on seawalls. During these extreme events, the highly random wave energy dissipation at the shoreline could result in episodic or infrequent overtopping of barriers crested above that level for limited time.

2.4 Specific Issues and Threats

The final Coastline Management Plan will put in place strategies and/or works to address coastal hazards in the longer term. Specific issues and threats to be considered as part of this interim Plan and prior the final Plan being implemented relate primarily to:

- The risk of coastal erosion and/or inundation threatening existing development or facilities in the short term and how to manage that threat during emergency situations; and
- The presence of private and public land within designated short and longer term erosion hazard zones and how to manage applications for future development or use of that land in the interim period.

Specific areas of the Shire affected in this regard are outlined below.

2.4.1 Short Term Erosion Threat

During severe storm events, development in close proximity, to the coastline may be threatened by direct erosion of the dune system and/or failure of seawalls. The Coastline Hazard Definition Study has identified that such threat exists only at Lennox Head.

At the southern end of the township, the 1993 Lennox Head Beach Management Plan has been implemented to provide protection to property and development in this area. This Plan included:

- construction of rock revetment walls at Lennox Head Village and at the southern corner of Seven Mile Beach;
- construction of a dune levee linking the rock revetment walls; and
- planning controls for new building and redevelopment of properties (setback distances, minimum finished floor levels and requirements for piled foundations below new dwellings).

These measures should provide adequate protection if they are implemented and maintained appropriately. Consequently there is a very low risk of erosion threat associated with failure of the works. Nevertheless, the performance of the works should be monitored during severe storm conditions.

In the central section of Lennox Head, immediately north of the village (ie north of Byron Street), the immediate erosion hazard zone extends across Pacific Parade and into the private property between Foster Street and Byron Streets (refer Figure 2.2). As discussed in Section 2.1, this hazard zone has been assessed on the basis of no outcropping bedrock or seawalls.

It is recognised that a rock wall remains buried below the dune system in this area. During a major storm event, this wall will be exposed. Depending on the severity of the storm and the status of the wall, it may be sufficient to prevent any further erosion.

Should extreme storm conditions occur, there is a risk that the wall could fail with a subsequent erosion threat to the southern end of Pacific Parade in the first instance. Again depending on the severity of the storm, the status of the buried wall and any actions Council may or may not be able to take to protect Pacific Parade, the erosion threat may extend to the private property behind.

If Council is able to implement sufficient works to protect Pacific Parade, this will also provide protection to the private property behind. In the event of an extreme storm and Council not undertaking any further protection works, there is a risk that erosion may threaten private property between Foster Street and Byron Street. However, the presence of the buried seawall is likely to provide some resistance to erosion and hence the risk of a direct erosion threat to private property is very low.

Further north, the immediate erosion hazard zone remains within the reserve seaward of Pacific Parade. However, the surf club building at Lake Ainsworth and the car park to the south may be threatened by erosion in a severe storm event. This threat is again dependent on the severity of the storm and the ability of the buried seawall to prevent or limit further erosion. Given that these facilities are at the rear of the immediate hazard zone (determined on the basis of no walls), it is considered that there is a very low risk that they will be threatened during the interim period covered by the BCIMAP.

While the buried seawalls seaward of the Lake Ainsworth Sport and Recreation Centre are likely to be exposed during a severe storm event, all facilities are landward of the immediate erosion hazard zone as assessed without walls. Therefore facilities at this Centre are unlikely to be threatened in the short term irrespective of the degree of protection provided by the walls.

It should be recognised that a zone of reduced bearing capacity with a potential width of around 10 to 15m will exist landward of any receding erosion scarp.

2.4.2 Short Term Inundation Threat

Specific threat from oceanic inundation occurs where development is located close to the coastline behind dunes or barriers which may be overtopped or breached during severe storm conditions.

To the South of the Richmond River, development is limited and set well back behind dunes which are sufficient to prevent overtopping. Accordingly, oceanic inundation in this area is unlikely.

The Ballina Pocket Beaches between the Richmond River and Lennox Head contain a number of low dune areas where there is a risk of wave runup overtopping the dunes under extreme oceanic conditions. However, the only development under threat from such processes is an isolated property at Boulder Beach near Skennars Head. Individual waves at the peak of the storm may runup and overtop the beach ridge causing overland flow of limited depth. Major inundation is unlikely apart from low-lying land behind which may also be influenced by rainfall runoff.

At Lennox Head the heights of the dunes and seawalls in some parts are such that wave runup and overtopping may occur during extreme oceanic conditions. Again this may result in episodic or infrequent overland flow of a limited depth and for a limited time (several hours) at high tide.

The average ocean water level at the beach, during severe storm events could be around RL 2.1m AHD including an allowance for wave set up. Wave runup on the dunes or seawalls, from individual waves will occur to a much higher level.

In the Lennox Head Beach Management Works area, the seawalls generally have a crest level of around RL 5.2m AHD at the southern end and between RL 5.5m and 6.0m AHD at the northern end. The land behind typically slopes down away from the crest such that any water from waves running up and overtopping the walls will flow inland. This will be of limited depth and over a limited distance. Under DCP 3, new developments have had minimum floor levels established to cater for such potential (RL 5.25m AHD at southern end and RL 6.0m AHD at the northern end) but older structures with low floors may be at risk from inundation.

In the central section of the Beach Management Works, the constructed dune has a crest level which is as low as RL 4.8m AHD in places but is generally at least RL 5.0m to 5.5m AHD as determined from photogrammetry. It is noted that the DCP 3 design works plan indicates a dune crest level of 5.5m AHD. Accordingly there may be an enhanced risk of overtopping in this area. Landward of this dune there is a low swale with levels between about RL 2.5m to 3.3m AHD. Development behind also drains through this swale to stormwater outlets across the beach.

Minimum floor levels in this area have been set at RL 3.4m AHD (under DCP 3). While it is assumed that the drainage system and floor levels of properties have been designed to accommodate stormwater runoff, any overtopping of the dune system may contribute to additional ponding. Again, such overtopping is likely to be limited provided the crest level and integrity of the dune is maintained. In the event that the dune system is breached, extensive inundation of the swale behind could occur. Further investigation would be required to determine the potential consequences associated with such inundation.

At the southern end of Pacific Parade, immediately north of Lennox Head Village, the dunes have a crest level of less than RL 6.0m AHD with general land levels behind being around RL 4.5m to 4.8m AHD. Episodic wave runup and overtopping may again occur during extreme oceanic conditions and particularly if the dune crest is eroded away. However, the extent of inundation will be limited to some minor overland flow.

At the northern end of Lennox Head, the crest level of the dunes is such that overtopping and oceanic inundation is unlikely.

2.4.3 Longer Term Erosion Threat

The Coastline Hazard Definition Study has also identified zones subject to potential longer-term erosion threat as described in Section 2.1. While not being important with respect to dealing with immediate threats, the fact that this land has been identified as prone to erosion has implications with respect to how this threat will be managed in the longer term.

Options to manage this threat will be considered as part of the future Coastline Management Study as discussed further in Section 3 below. However, in the interim period, consideration needs to be given to how applications made now or in the near future for development or usage of the land will be handled, as discussed further in Section 5 below.

Apart from a slight incursion of the 100-year hazard zone at Patches Beach (refer Figure 2-1), the only developed areas within longer-term hazard zones are at Lennox Head. North of Byron Street, the 50-year hazard zone extends into all property seaward of Cliff Murray Lane to varying degrees while the 100 year hazard zone, extends into the properties landward of Cliff Murray Lane (refer Figure 2-2 and Figure 2-3). The longer-term hazard zones also extend into the Lake Ainsworth Sport and Recreation Centre.

Again the potential for this recession to be realised is dependent on the structural capacity and maintenance of existing seawalls. However, more importantly it is dependent on what future coastline management strategies are adopted.