QCoast2100
COUNCILS LEADING COASTAL ADAPTATION

Phase 4 & 5 Identify Key Assets Potentially Impacted and Risk Assessment in Coastal Hazard Areas

Bundaberg Region Coastal Hazard Adaptation Strategy

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V01	Report	Richard Sharp	Jo Tinnion	28 June 2019
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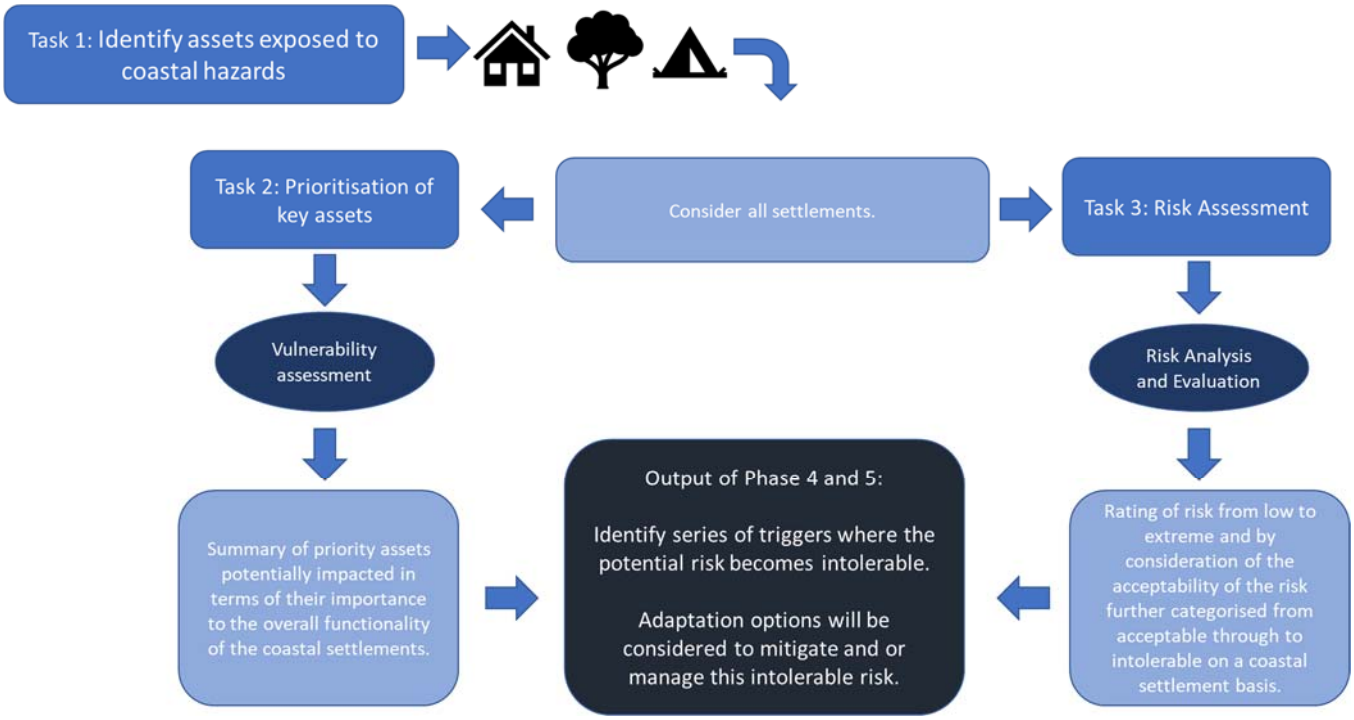
EXECUTIVE SUMMARY

Phases 4 and 5 of the Bundaberg Region Coastal Hazard Adaptation Strategy aim to identify triggers where the potential risk to a coastal settlement or priority asset becomes intolerable to the community. The assessment has used the following process.



Task 1 - Identification of assets exposed to current and future coastal hazards

To understand the changing picture of asset exposure to coastal hazard (coastal erosion and storm tide inundation), identification of a range of assets was undertaken for the present-day, 0.4m and 0.8m sea level rise scenarios. These assets have been counted and mapped to provide an overall picture of the number of assets likely to be exposed to coastal hazard while emphasising the differences in assets likely to be exposed on a settlement by settlement basis.

Task 2: Identification of key assets potentially impacted

To understand the susceptibility of assets identified to coastal hazard and hence prioritise their importance, a vulnerability assessment was undertaken. The assessment considered a range of Bundaberg region specific criteria examining the potential impact of coastal hazard to each asset and the asset's ability to function post-impact. This provides a summary of priority assets potentially impacted in terms of their importance to the overall functionality of the coastal settlements.

Task 3 - Risk assessment of coastal settlements in coastal hazard areas

To estimate the level of risk posed to each coastal settlement and the priority assets identified through the vulnerability assessment a detailed risk analysis and evaluation was undertaken on a coastal settlement basis. The likelihood and consequence of each coastal hazard for each coastal settlement was analysed through examination of the economic, social and environmental consequences of the coastal hazards for a range of sea level rise scenarios and events. The risk analysis categorised the level of risk from low to extreme and through consideration of the acceptability of the risk further categorised it from acceptable through to intolerable on a coastal settlement basis.

Summary of the Vulnerability and Risk Assessment

The results of the risk assessment and vulnerability assessment have identified a series of triggers where the potential risk becomes intolerable for particular scenarios and requires action to reduce this risk. Adaptation options will be considered to mitigate or reduce intolerable risks and maintain or reduce tolerable risks.

Table 1-1 summarises the results of the vulnerability and risk assessment, showing the priority assets within each settlement recommended to be considered for identification of adaptation options to reduce or eliminate the risks. Settlements with a tolerable risk to coastal hazards are also included in Table 1-1 as actions to reduce or maintain tolerable risks may be identified in Phase 6.

TABLE 1-1 SUMMARY OF VULNERABILITY AND RISK ASSSESSMENT

SETTLEMENT	VULNERABILITY ASSESSMENT Highly critical assets	RISK EVALUATION				Description
		Storm tide inundation	Sea level rise scenario	Coastal erosion	Sea level rise scenario	
Miara, Winfield and Norval Park	■ Roads / access ■ Road bridges ■ Beach and other environmental assets ■ Electricity transformer	Tolerable	All scenarios	Tolerable	All scenarios	Potential for major damages to buildings and infrastructure. Regular inundation of key access routes.
Moore Park Beach	■ Roads / access ■ Road bridges ■ Beach ■ Water supply (inc groundwater supply) ■ Powerlines ■ Electricity transformer ■ School	Tolerable	All scenarios	Intolerable	0.4m	Potential for catastrophic damages to buildings and infrastructure. Potential isolation of community.
Burnett Heads	■ Roads / access ■ Road bridges ■ Beaches and other environmental assets ■ Water supply ■ Electricity transformer ■ Wastewater Treatment ■ Waste Disposal ■ Stormwater/Culverts	Intolerable	0.8m	Tolerable	All scenarios	Potential for catastrophic damages to buildings and infrastructure.
Bargara	■ Residential properties ■ Water supply ■ Powerlines ■ Beaches and other environmental assets	Tolerable	All scenarios	Intolerable	0.8m	Potential for catastrophic damages to buildings and infrastructure.

SETTLEMENT	VULNERABILITY ASSESSMENT Highly critical assets	RISK EVALUATION				Description
		Storm tide inundation	Sea level rise scenario	Coastal erosion	Sea level rise scenario	
Innes Park and Coral Cove	■ Water supply ■ Sewer mains ■ Beaches and other environmental assets	Tolerable	All scenarios	Intolerable	0.8m	Potential for catastrophic damages to buildings and infrastructure.
Elliott Heads	■ Residential Properties ■ Beach and other environmental assets ■ Water Supply ■ Powerlines	Tolerable	All scenarios	Tolerable	All scenarios	Potential for major damages to buildings and infrastructure.
Coonarr	■ Roads / access ■ Powerlines ■ Beaches and other environmental assets	Tolerable	All scenarios	Intolerable	0.2m	Potential isolation of community.
Woodgate Beach and Walkers Point	■ Residential properties ■ Roads / access ■ Woodgate WWTP ■ Water supply ■ Powerlines ■ Stormwater and culverts ■ Waste management ■ Beaches and other environmental assets	Intolerable	0.8m	Intolerable	0.4m	Potential for catastrophic damages to buildings and infrastructure. Potential isolation of community.
Buxton	■ Residential Properties ■ Roads / Access ■ Powerlines ■ Environmental assets	Tolerable	All scenarios	Tolerable	All scenarios	Potential for major damages to buildings and infrastructure.

1 INTRODUCTION

1.1 Background to Coastal Hazard Adaptation Planning

Over the last few years, the Queensland coast (and specifically the Bundaberg Region) has experienced disasters which have resulted in significant economic costs and societal impacts. In response, Bundaberg Regional Council has pro-actively developed a unique perspective on the concepts of, approaches to, and challenges involved in building resilience and undertaking activities to adapt to changing circumstances.

Relevantly, current projections for Queensland's coastline by 2100 indicate:

- A projected sea level rise of 0.8m
- Tropical cyclones are projected to become less frequent but those tropical cyclones that do occur are expected to be more intense and may track further south.

The likely impacts associated with these changes mean that rising sea levels combined with storm tides are likely to cause accelerated erosion and increased risk of inundation. For settlements and infrastructure this is likely to result in damage to and loss of dwellings and infrastructure with community-wide impacts. For ecosystems, sea level rise may lead to loss of habitat, and salinisation of soils may cause changes to the distribution of plants and animals.

The impact of increasing coastal hazards will affect Queensland councils in the areas of:

- Litigation and legal liability
- Community expectations
- Land use planning and development assessments
- Asset and infrastructure planning and management

In response to this, the QCoast2100 program was developed to provide councils in Queensland with assistance to advance coastal hazard adaptation planning. The Coastal Hazards Adaptation Program (CHAS/CHAS Program) will support all Queensland local governments impacted by existing and future coastal hazards to advance adaptation planning. The Program will facilitate the development of high-quality information enabling defensible, timely and effective local adaptation decision-making through access to tools, technical and expert support and grants for eligible councils.

The CHAS program will be delivered through eight phases and each of the phases can be categorised under three themes:

- Commit and get ready
  - Phase 1: Plan for life-of-project stakeholder communication and engagement (Completed 2017)
  - Phase 2: Scope coastal hazard issues for the area of interest (Completed 2017)
- Identify and assess
  - Phase 3: Identify areas exposed to current and future coastal hazards (Completed 2019)
  - Phase 4: Identify key assets potentially impacted (Current phase)
  - Phase 5: Risk assessment of key assets in coastal hazard areas (Current phase)
- Plan, respond and embed
  - Phase 6: Identify potential adaptation options
  - Phase 7: Socio-economic appraisal of adaptation options
  - Phase 8: Strategy development, implementation and review

FIGURE 1-1 CHAS PROGRAM PHASES

1.2 Phase 4 - Identify key assets potentially impacted

In accordance with the *QCoast 2100 Developing a Coastal Hazard Adaptation Strategy Minimum Standards and Guideline for Queensland Local Government (the QCoast 2100 Guidelines),* Phase 4 identifies key built, community and natural assets which can be directly or indirectly impacted by coastal hazards. Understanding the multi-faceted nature of vulnerability and exposure is a prerequisite for determining how weather and climate events contribute to the occurrence of disasters, and for designing and implementing effective adaptation and disaster risk management strategies (Cardona et al. 2012). Therefore, it is important to not only map assets, buildings, services, parks and environmentally sensitive areas but also identify the community's vulnerability and exposure to coastal hazards.

1.3 Phase 5 – Risk Assessment of key assets in coastal hazard areas

In accordance with the QCoast 2100 Guideline, Phase 5 undertakes a risk assessment of the key assets and community vulnerability identified in Phase 4. The risk assessment, in conjunction with the vulnerability assessment adopted for the Bundaberg Region CHAS assigns likelihood and consequence ratings to determine the preliminary risk classification. Existing controls have been examined in a similar way as well as adaptive capacity to generate an unmitigated risk classification.

Phase 6 of the CHAS will investigate possible adaptation options which aim to bring risks identified from the coastal hazards as intolerable back into the tolerable range.

The risk assessment undertaken employs the suggested methods of QCoast 2100 Guideline, the Department of Industry, Innovation and Science "Risk Management Handbook" and AS 5334-2013 "Climate change adaptation for settlements and infrastructure - A risk-based approach". The methodology employed in the CHAS also aligns with the Queensland Fire and Emergency Services' Queensland Emergency Risk Management Framework (QERMF). The QERMF process applies a standardised and internationally recognised approach to the prioritisation, mitigation and management of risk. Council has adopted QERMF methodologies in the CHAS to ensure the adaptation and resilience options identified in the CHAS will align with future funding criteria for disaster response and recovery.

1.4 Reporting and technical results

This report contains the key results and commentaries for the asset identification and mapping, the technical summary of the vulnerability assessment and key results and conclusions from the risk assessment and risk evaluation. The report has structured the results using a place-based approach, i.e. by each coastal settlement of the Bundaberg region from north to south. Further technical analyses, mapping, assumptions used in the methodology and more detailed results tables are available in the Technical Evidence Appendix document which accompanies this report.

2 IDENTIFY AND MAP ASSETS

2.1 Coastal hazard areas

The coastal hazard areas in the Bundaberg region were identified and mapped in Phase 3 of the CHAS. To represent the changing picture of asset exposure over time, identification of assets was undertaken for the present-day, 0.4m and 0.8m sea level rise scenarios. The 0.2m sea level scenario was considered in the risk assessment process, as with a range of Annual Exceedance Probability (AEP) likelihood events detailed below.

2.1.1 Storm tide inundation

Storm tide inundation mapping has been prepared for a range AEPs (5% AEP, 2% AEP, 1% AEP and 0.2% AEP). Identification of assets has been undertaken for the 1% AEP storm tide inundation under present-day sea-level conditions, 0.4m and 0.8m sea level rise scenarios, the following section lists the assets exposed to these three mapped extents.

To provide further context of the asset exposure, asset counts have been undertaken using the larger AEP event (0.2% AEP) and the most frequent storm tide inundation event (5% AEP). These asset counts are available in the Technical Evidence Appendix document.

2.1.2 Coastal Erosion

It should be noted that, as reported in Phase 3 of the CHAS, five key study locations were identified for further study and refinement of the coastal erosion extents as they have previously exhibited coastal erosion issues and the default erosion prone area was considered to be too conservative for the purposes of the CHAS.

These areas are:

- Moore Park Beach
- Bargara (Kelly's Beach)
- Innes Park and Coral Cove
- Coonarr
- Woodgate Beach

Asset counts have been undertaken for the 1% AEP coastal erosion event under present-day sea-level conditions, 0.4m and 0.8m sea level rise scenarios within these areas, the following section lists the assets exposed to these three mapped extents.

In all other locations, typically rocky foreshore, estuarine areas or sediment transition zones, assets have been mapped within the coastal erosion hazard extent as represented by the default erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance with the QLD State Erosion Prone Area Mapping.

2.2 Asset identification

In accordance with the QCoast 2100 Guideline, data collation included assets owned and managed by both Council and external organisations. Data considered in the asset counts were obtained from the following organisations:

- Bundaberg Regional Council
- Department of Transport and Main Roads, Queensland Government
- Telstra

- Energy Queensland (formerly Ergon)
- Sunwater
- Queensland Herbarium (regional ecosystems and habitat types).

The term 'asset' will be used in this report and refers to all physical assets, environmental ecosystems, features and infrastructure in the Bundaberg coastal hazard region. Assets that hold environmental significance have been identified, including tourist attractions, environmental features and marine and coastal infrastructure.

Cultural assets including key indigenous sites and features were not available for this project.

2.3 Asset exposure

Key built, community and natural assets which are mapped within the coastal hazard extents have been identified and counted. Across the entire Bundaberg region, the proportion of key built, community and natural assets exposed to coastal hazards is summarised below. Assets exposed are presented as a percentage of all assets in the Bundaberg region.

TABLE 2-1 KEY BUILT, COMMUNITY AND NATURAL ASSETS EXPOSED TO COASTAL HAZARD

Asset	% of Total assets across Bundaberg region exposed to coastal hazard (Storm tide inundation and erosion) and multiple sea level rise conditions (SLR)		
	Present Day	0.4m SLR	0.8m SLR
Residential buildings	1%	2%	3%
Roads / access	1%	1%	2%
Powerlines	1%	1%	2%
Water supply mains	1%	2%	4%
Stormwater mains	2%	6%	9%
Sewerage mains	1%	1%	2%
Educational institutions	4%	5%	7%
Environmental conservation	33%	36%	36%

To understand the settlement-specific nature of coastal hazard exposure, the assets identified within the coastal hazard mapping extents have been grouped by coastal settlement.

The coastal settlements are nine discrete locations used to divide the region. Each location may include more than one township and community within the boundary so that no population centres or communities are omitted from the CHAS. The nine areas are listed below:

- Miara, Winfield and Norval Park
- Moore Park Beach
- Burnett Heads
- Bargara
- Innes Park and Coral Cove
- Elliott Heads
- Coonarr
- Woodgate Beach and Walkers Point
- Buxton

Key habitat types and regional ecosystems within the Bundaberg region are mapped within the coastal hazard extent. These habitats are described in more detail in the Technical Evidence Appendix document and are based on descriptions in Queensland Herbarium 2019.

2.4 Miara, Winfield and Norval Park

This coastal settlement area includes the smaller settlements of Miara on the northern bank of the Kolan River the settlements of Winfield on Baffle Creek, Norval Park to the north and large area of cane lands. Norval Park is a popular dune camping site with access to the sandy beaches. The settlement of Miara encompasses the caravan site at Miara Caravan Park and the shoreline towards Norval Park. Coastal erosion is influenced by both the tide and flood events from the Kolan River and Baffle Creek.

The settlement of Winfield is experiencing coastal erosion under present day conditions and Council are currently monitoring erosion at a site in Colonial Cove from Rocky Point Road to Pangola Street.

Miara Road is likely to experience regular inundation under all sea level scenarios, this is likely to become permanent inundation under a 0.8m sea level rise scenario. The impact of this is considered in the risk assessment component of this report.

Figure 2-1 illustrates the assets identified within the coastal hazard extents.

2.4.1 Storm tide inundation exposure

The mapping indicates the majority of the coastal plains in the Miara, Winfield and Norval Park area as being within the 1% AEP storm tide inundation extent under present-day sea level conditions. Table 2-2 summarises the assets within the storm tide inundation extent for Miara, Winfield and Norval Park.

TABLE 2-2 ASSETS EXPOSED TO STORM TIDE INUNDATION HAZARD

Assets	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential buildings	119[1]	161	204
Commercial buildings	1	1	1
Non-habitable buildings	30	44	74
Stormwater mains	0 m	287 m	373 m
Electricity power line	2,800 m	9,900 m	13,000 m
Electricity transformer[2]	4	8	13
Broadcast transmitters	0	1	1
4WD Tracks	4,600 m	4,800 m	6,700 m
Roads	4,717 m	5,100 m	6,046 m
Bridges	1	2	2
Major Culvert Crossings	-	3	3
Culverts	7	13	14
Council land parcels	6	16	16
Parks, sports and natural areas	2	55	57

[1] Investigations suggest that of the 119 residential properties it is likely that 83 are semi-permanent structures associated with the Miara Caravan Park. These semi-permanent structures are also included in the 0.4m and 0.8m sea level rise scenarios
[2] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

Assets	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Council buildings	4	12	17
Park assets	37	64	64
Grazing native vegetation	347 ha	1269 ha	1454 ha
Irrigated cropping	350 ha	451 ha	473 ha
Marsh / wetland	70 ha	1111 ha	1137 ha

2.4.2 Erosion exposure

The settlement of Winfield is experiencing coastal erosion under present day conditions and Council are currently monitoring erosion at a site in Colonial Cove.

The mapped coastal erosion hazard extent for Miara, Winfield and Norval Park is represented by the erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance with the State Erosion Prone Area Mapping. Assets have been mapped within this single coastal erosion hazard extent as represented by the default erosion prone area width. Table 2-3 summarises the assets within the erosion prone area for Miara, Winfield and Norval Park.

TABLE 2-3 ASSETS EXPOSED TO COASTAL EROSION HAZARD

Asset	Erosion Prone Area +0.8m SLR
Residential buildings	83
Commercial buildings	1
Non-habitable buildings	21
Stormwater mains	41 m
Electricity power line	6100 m
Electricity transformer[3]	5
4WD Tracks	1,400 m
Roads	4,649 m
Bridges	1
Culverts	9
Council land parcels	13
Parks, sports and natural areas	23.9 ha
Council buildings	16
Park assets	43
Boat ramps	7
Grazing native vegetation	902.1 ha
Irrigated cropping	351.4 ha
Marsh / wetland	926.6 ha
Miara Caravan Park	1

[3] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

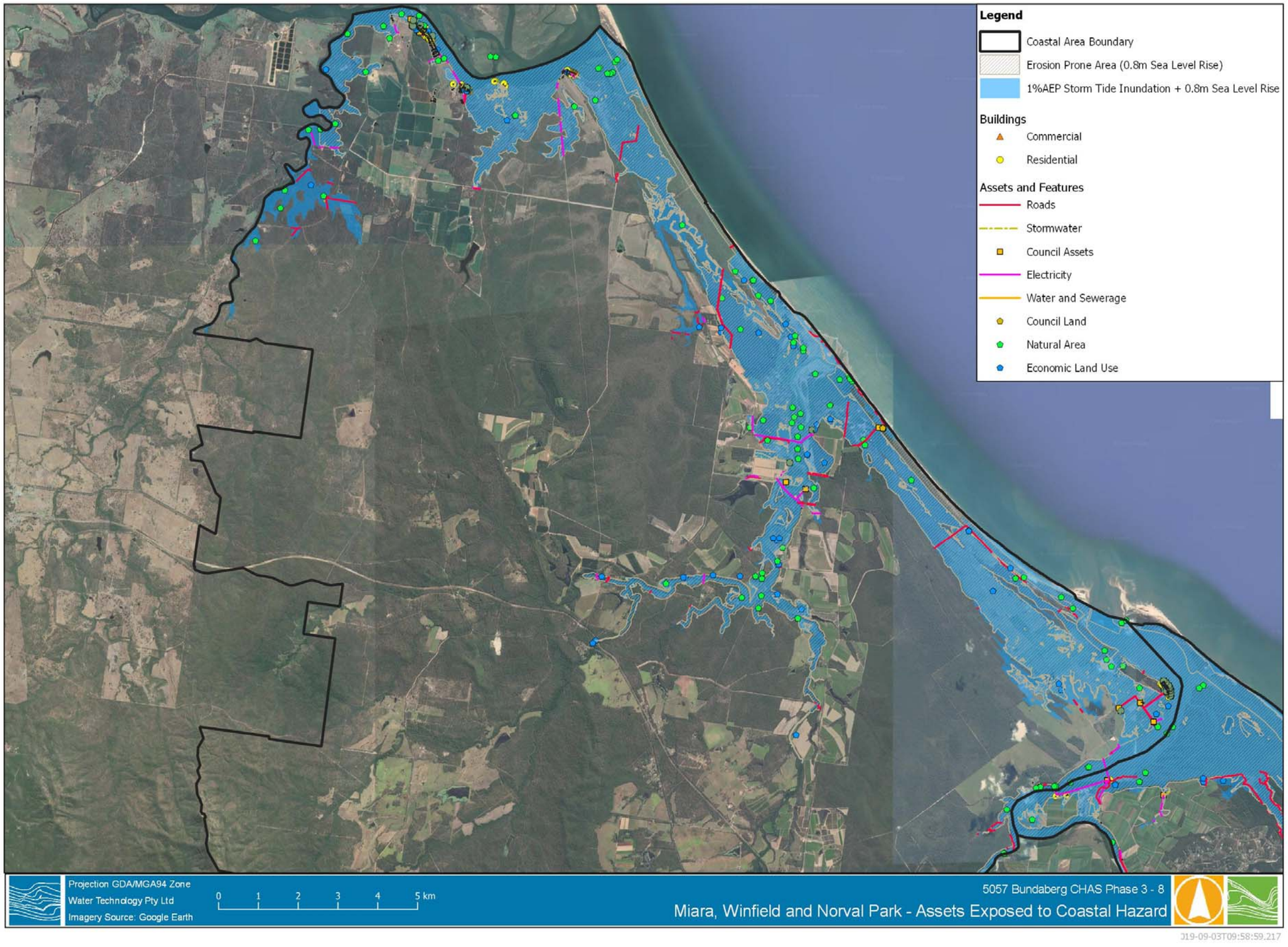


FIGURE 2-1 ASSETS EXPOSED TO COASTAL HAZARDS – MIARA, WINFIELD AND NORVAL PARK

2.5 Moore Park Beach

On the southern bank of the Kolan River, the Moore Park Beach coastal settlement stretches south to the suburbs of Moorland and Welcome Creek. This settlement area includes the Kolan River conservation park and up to 20 km of sandy beach. The northern end of the beach is 4WD accessible and the southern end is a popular bathing spot. The beach is also a nesting site for loggerhead turtles from October to March. The Fairydale drainage system that comprises a number of tidal gates owned both by Council and Bundaberg Sugar manages tidal flows to the east of Moore Park Beach.

Moore Park Beach Road, Malvern Drive and Murdoch's Linking Road are considered key access routes to the settlement of Moore Park Beach and are likely to be permanently inundated in the 0.8m sea level rise scenario. The impact of this is considered in the risk assessment component of this report.

Figure 2-2 illustrates the assets identified within the coastal hazard extents.

2.5.1 Storm tide inundation exposure

It is noted that king tide/drainage gates have been installed across the major flow paths immediately east of the township and inundation has been observed over the road at Moore Park Beach Road as recently as February 2019.

Limited direct inundation from the ocean is predicted to occur at the southern end of Moore Park Beach under present-day sea level rise scenario. However, more extensive inundation of areas to the landward side of the settlement is predicted to occur as described in further detail below. This will be as a result of storm tide inundation of the Kolan River estuary system to the north; and the coastal creeks and the Burnett River to the south.

Water supply in Moore Park Beach is sourced from both surface and groundwater. Whilst, the water treatment plant at Vecellios Road is not within the extent, further consideration and consultation is required to understand the impacts of sea level rise and saltwater intrusion upon groundwater supply in the area.

Table 2-4 summarises the assets within the storm tide inundation extent for Moore Park Beach.

TABLE 2-4 ASSETS EXPOSED TO STORM TIDE INUNDATION HAZARD

Asset	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential buildings	38	111	354
Non-habitable buildings	36	76	165
Electricity power lines	19,000 m	23,000 m	35,000 m
Pipelines	608 m	968 m	1,039 m
Electricity transformers[4]	28	34	45
Water supply mains	4,200 m	6,500 m	15,000 m
Stormwater main	4,800 m	5,700 m	7,400 m
Water supply facilities	2	3	6
4WD tracks	4,800 m	6,000 m	6,800 m
Roads	4,956 m	8,517 m	16,696 m
Bridges	3	3	3
Major Culvert Crossings	2	3	3

[4] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

Asset	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Culverts	21	21	26
Council land	5	8	23
Parks, sports, and natural areas	108 ha	123 ha	161 ha
Park assets	14	26	193
Council buildings	1	3	47
Moore Park State School Buildings	2	3	3
Childcare centre*	1	1	1
Grazing native vegetation	53 ha	69 ha	90 ha
Irrigated cropping	837 ha	924 ha	1019 ha
Irrigated perennial horticulture	35 ha	38 ha	40 ha
Marsh / wetland	176 ha	177 ha	178 ha
Nature conservation	704 ha	735 ha	753 ha
Farming and agricultural land	29 ha	56 ha	119 ha
Conservation park	686 ha	718 ha	734 ha
Moore Park Beach Holiday Park	1	2	2
Moore Park Beach Surf Life Saving Club	1	1	1
Moore Park Floodgates	2	2	2
Fairydale Tide Gates	1	1	1

* *Kids and Co Child Care Centre, Moore Park Beach* has been mapped in the 1% AEP Inundation event, however, confirmation whether the site still operates as a childcare centre is required.

2.5.2 Erosion exposure

Moore Park Beach frontage is a sandy shoreline, with a large estuarine area to the south east. It should be noted that , Moore Park Beach is one of five key study locations identified for further study and refinement of the coastal erosion extents and the mapping and analysis of Moore Park Beach is based on the refined erosion prone area widths estimated in the Phase 3 report of the CHAS. Table 2-5 summarises the assets within the erosion prone area for Moore Park Beach.

TABLE 2-5 ASSETS EXPOSED TO COASTAL EROSION HAZARD

Asset	Erosion Prone Area Present-day	Erosion Prone Area +0.4m SLR	Erosion Prone Area +0.8m SLR
Residential buildings	1	97	307
Non-habitable buildings	7	50	127
Council buildings	21	45	61
Pipeline	0	251 m	617 m
Electricity power lines	8,500 m	19,600 m	25,100 m
Electricity transformers[5]	14	30	33
Stormwater main	4,400 m	5,000 m	5,800 m

[5] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

Asset	Erosion Prone Area Present-day	Erosion Prone Area +0.4m SLR	Erosion Prone Area +0.8m SLR
Water supply	2,500 m	5,600 m	8,200 m
Water supply facilities	0	3	6
Culverts	0	19	23
4WD tracks	1,100 m	4,000 m	5,300 m
Roads	273 m	6,966 m	10,124 m
Bridges	3	3	3
Major Culvert Crossings	2	3	3
Park assets	41	146	223
Moore Park Beach Holiday Park	0	2	2
Moore Park State School	1	3	3
Childcare centre	1	1	1
Council land parcels	15	22	26
Parks, sports, and natural areas	75 ha	110 ha	159 ha
Grazing native vegetation	25 ha	50 ha	67 ha
Irrigated cropping	551 ha	781 ha	891 ha
Irrigated perennial horticulture	13 ha	31 ha	37 ha
Marsh / wetland	102 ha	108 ha	177 ha
Nature conservation	465 ha	517 ha	702 ha
Farming and agricultural land	8 ha	34 ha	94 ha
Conservation Park	459 ha	508 ha	696 ha
Moore Park Floodgates	2	2	2
Fairydale Tide Gates	1	1	1

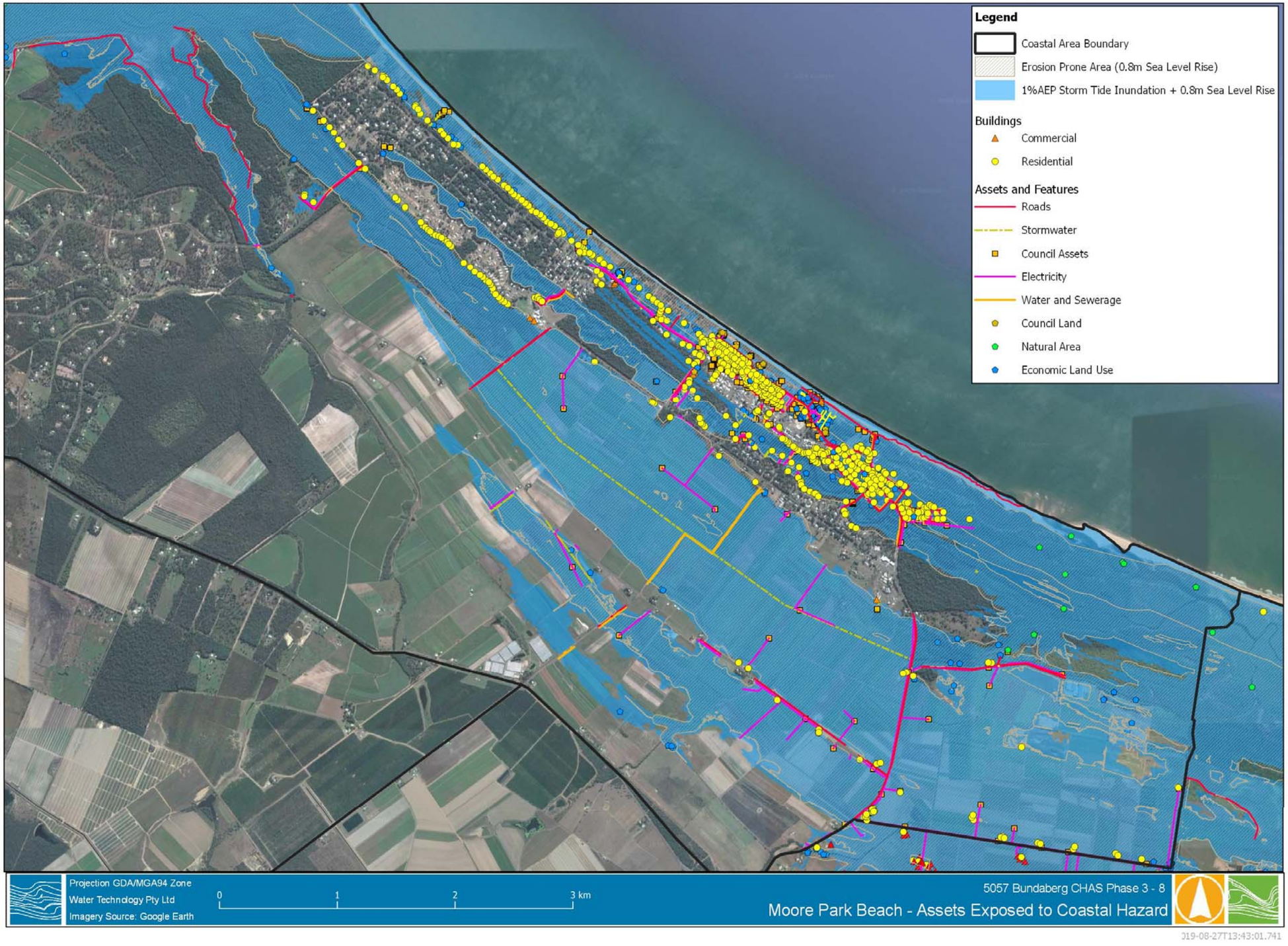


FIGURE 2-2 ASSETS EXPOSED TO COASTAL HAZARDS – MOORE PARK BEACH

2.6 Burnett Heads

The Burnett Heads study area includes the settlement of Burnett Heads as well as the land to the north-east of the Burnett River mouth. The settlement area includes Barubbra Island, Flying Fox Island and Fairydale. The Port of Bundaberg is located approximately 5 km from the mouth of the Burnett River. Burnett Heads' overall exposure to storm tide inundation and coastal erosion is particularly evident on the southern side of the river's mouth. Figure 2-3 illustrates the assets identified within the coastal hazard extents.

Hermans Road and Creevey Road are likely to experience regular inundation under all sea level scenarios, this is likely to become permanent inundation inundated under a 0.8m sea level rise scenario. The impact of this is considered in the risk assessment component of this report.

2.6.1 Storm tide inundation exposure

Storm tide inundation is likely to have some impacts on Burnett Heads, i.e. some of the local road network is within the inundation mapping both in present-day and sea level rise conditions. Moreover, impacts to the east of Hermans Road and west of Buss Street are predicted to occur as a result of storm tide inundation of the low-lying wetlands and the coastal creek. Table 2-6 summarises the assets within the storm tide inundation extent for the Burnett Heads and Burnett River area.

TABLE 2-6 ASSETS EXPOSED TO STORM TIDE INUNDATION HAZARD

Assets	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential homes	1	168	278
Electricity power line	25,000 m	34,000 m	45,000 m
Electricity transformer[6]	33	41	54
Broadcast transmitter	0	0	1
Water supply	2,400 m	4,800 m	7,100 m
Stormwater mains	3,300 m	5,400 m	6,300 m
Sewerage facilities	2	3	4
Sewerage mains (Rubyanna WWTP)	598 m	649 m	1,300 m
4WD tracks	8,700 m	11,000 m	12,000 m
Roads	8,506 m	12,073 m	15,767 m
Bridges	2	2	2
Culverts	33	36	46
Council land parcels	10	13	19
Parks, sports, and natural areas	40 ha	44 ha	48 ha
Park assets	75	95	107
Council buildings	27	27	31
Marine Rescue or Coast Guard Station	0	0	1
Educational institution	0	0	1

[6] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

Assets	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Grazing native vegetation	112 ha	151 ha	205 ha
Irrigated cropping	2,288 ha	2,699 ha	2,933 ha
Irrigated perennial horticulture	1 ha	6 ha	10 ha
Manufacturing and industrial[7]	54 ha	66 ha	73 ha
Marsh / wetland	996 ha	1,006 ha	1,009 ha
Nature conservation	307 ha	309 ha	310 ha
Conservation park	216 ha	219 ha	220 ha
Burnett Heads Holiday Park	0	1	1

2.6.2 Erosion exposure

Assets have been identified within one coastal erosion hazard extent within the Burnett Heads settlement, represented by the default erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance with the Queensland State Erosion Prone Area Mapping. The erosion prone area also exists over areas subject to inundation by HAT plus 0.8m sea-level rise.

Burnett Heads is not an area that has been identified for further refinement of the erosion prone area. Table 2-7 summarises the assets within the erosion prone area for Burnett Heads coastal settlement area.

[7] Manufacturing and industrial includes all land as defined in the Qld Spatial Land use planning layer, contains uses pertaining to manufacturing as well as light, medium and heavy industries.

TABLE 2-7 ASSETS EXPOSED TO COASTAL EROSION HAZARD

Asset	Erosion Prone Area (+0.8m SLR)
Residential buildings	157[8]
Commercial buildings	6
Non-habitable buildings	123
Electricity transformers[9]	39
Electricity power line	29,380 m
Sewerage mains	597 m
Stormwater mains	3,442 m
Water supply	6317 m
4WD tracks	11,100 m
Roads	12,039 m
Bridges	2
Culverts	30
Council land parcels	31
Parks, sports, and natural areas	43 ha
Sewerage facilities	3
Council buildings	58
Park assets	132
Grazing native vegetation	143 ha
Irrigated cropping	323 ha
Irrigated perennial horticulture	3 ha
Manufacturing and industrial[10]	59 ha
Marsh / wetland	1019 ha
Nature conservation	531 ha
Residential and farming infrastructure	43 ha
Conservation park	223 ha

[8] The erosion prone area also exists over areas subject to inundation by HAT plus 0.8m sea-level rise. Burnett Heads coastal settlement is not an area that has been identified for further refinement of the erosion prone area. The 157 residential buildings identified in this extent include those properties located along the Burnett River edge and in low lying areas behind the Harbour Esplanade. The impacts of this exposure are considered in the risk assessment.

[9] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

[10] Manufacturing and industrial includes all land as defined in the Qld Spatial Land use planning layer contains uses pertaining to manufacturing as well as light, medium and heavy industries.

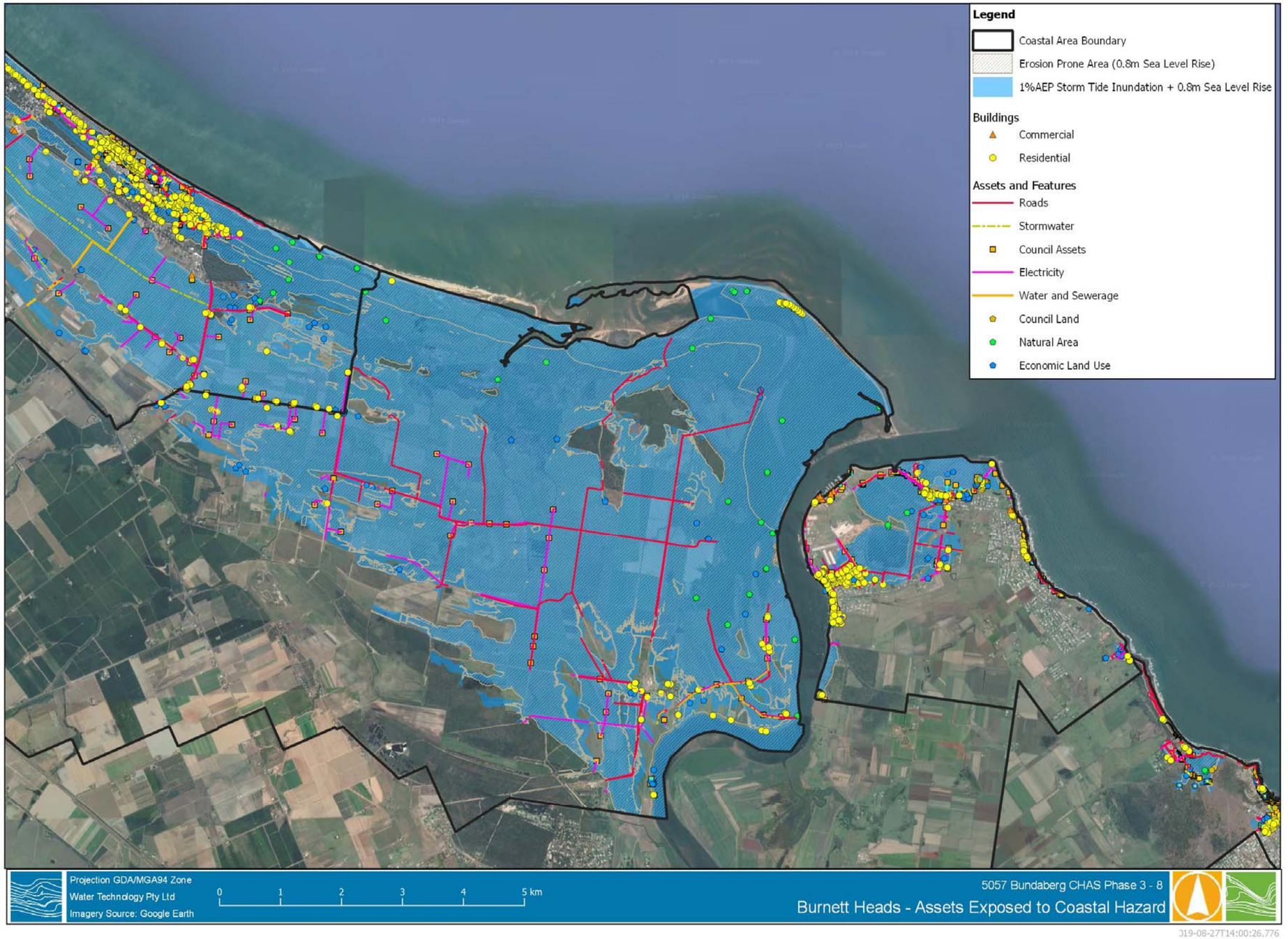


FIGURE 2-3 ASSETS EXPOSED TO COASTAL HAZARDS – BURNETT HEADS

2.7 Bargara

The Bargara coastal settlement includes the population settlements of Nielson Park, Bargara and Kelly's Beach to the south and is delineated by Woongarra Scenic Drive. The coastline contains many popular and important destinations such as the Mon Repos Turtle Centre, the Bundaberg Surf Life Saving Club at Nielson Park, the Bargara Caravan Park at Nielson Park, swimming beaches as well as "The Basin"; a popular historic swimming spot.

The foreshore at Bargara and Nielson Park is experiencing coastal erosion under present day conditions and Council are currently monitoring erosion along the shoreline in front of the Esplanade and Fred Courtice Avenue.

Figure 2-4 illustrates the assets identified within the coastal hazard extents.

2.7.1 Storm tide inundation exposure

The storm tide inundation mapping indicates that the extent is likely to be limited to the existing beach areas and the estuarine/lagoon areas associated with Moneys Creek. Under future sea level rise scenarios, there is a predicted increase in the inundation area within the estuary and potential for impacts on The Causeway road, Causeway Drive and streets around Ian Cossart Park. The Mon Repos Turtle Centre is within the coastal settlement boundary however the buildings associated with Turtle Centre are not within the storm tide inundation extent. Table 2-8 summarises the assets within the storm tide inundation extent for the Bargara settlement area.

TABLE 2-8 ASSETS EXPOSED TO STORM TIDE INUNDIATION HAZARD

Assets	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential buildings	1	2	52
Non-habitable buildings	0	1	11
Electricity power line	100 m	1,100 m	3,400 m
Water supply	180 m	1,100 m	3,200 m
Stormwater mains	403 m	792 m	2,100 m
Sewerage mains (Bargara WWTP Catchment)	104 m	664 m	2,600 m
Roads	148 m	1,223 m	2,905 m
4WD tracks	0 m	1100 m	1,500 m
Culverts	3	8	9
Park assets	125	285	391
Parks, sports and natural areas	16 ha	26 ha	40 ha
Grazing native vegetation	0.1 ha	7 ha	16 ha
Marsh / wetland	2 ha	3 ha	3 ha
Farming and agricultural land	5 ha	13 ha	22 ha

2.7.2 Erosion exposure

The shoreline at Bargara is a mix of sandy shoreline and hard rock shoreline. Mon Repos Turtle Centre is located behind the sandy shoreline to the north of Bargara, however, is not within the erosion prone area extent under all sea level conditions. For most of the Bargara shoreline, the erosion prone area is represented by the erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance with the State Erosion Prone Area Mapping. The estuary area behind Kelly's Beach is likely to be susceptible to erosion hazard affecting the wetlands and the golf course.

The beach at Nielson Park and the Bargara foreshore is experiencing coastal erosion under present day conditions and Council are currently monitoring erosion activity, however the caravan park at Neilson's Park is not mapped within in the erosion prone area extent. Kelly's Beach is one of five key study locations identified for further study and refinement of the coastal erosion extents as the area has previously exhibited coastal erosion issues and the default erosion prone area was considered to be too conservative for the purposes of the CHAS. The mapping and analysis of Kelly's Beach is based on the refined erosion prone area widths estimated in the Phase 3 report of the CHAS. Table 2-9 summarises the assets within the erosion prone area for Bargara settlement area.

TABLE 2-9 ASSETS EXPOSED TO COASTAL EROSION HAZARD

Asset	Erosion Prone Area Present-day	Erosion Prone Area 0.4m SLR	Erosion Prone Area 0.8m SLR
Residential buildings	25	54	167
Commercial buildings	0	0	4
Non-Habitable buildings	0	5	19
Water supply	6 m	597 m	2,341 m
Stormwater mains	165 m	1,106 m	1,980 m
Sewerage mains	60 m	532 m	2,293 m
Electricity transformers[11]	0	0	1
Electricity power line	100 m	300 m	3,100 m
Roads	15 m	404 m	3,688 m
4WD tracks	300 m	600 m	3,500 m
Bikeways / walkways	0 m	0 m	1,100 m
Culverts	0	2	3
Parks, sports and natural areas	0 ha	0 ha	41.1 ha
Park assets	35	114	899
Council assets	0	0	5
Council buildings	0	0	120
Bundaberg Surf Life Saving Club	0	0	1
Grazing native vegetation	2 ha	5 ha	9 ha
Marsh / wetland	2.3 ha	2.5 ha	3 ha
Nature conservation	0 ha	0 ha	58 ha
Irrigated cropping	0 ha	0 ha	0 ha
Farming and agricultural land	5 ha	11 ha	35 ha

[11] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

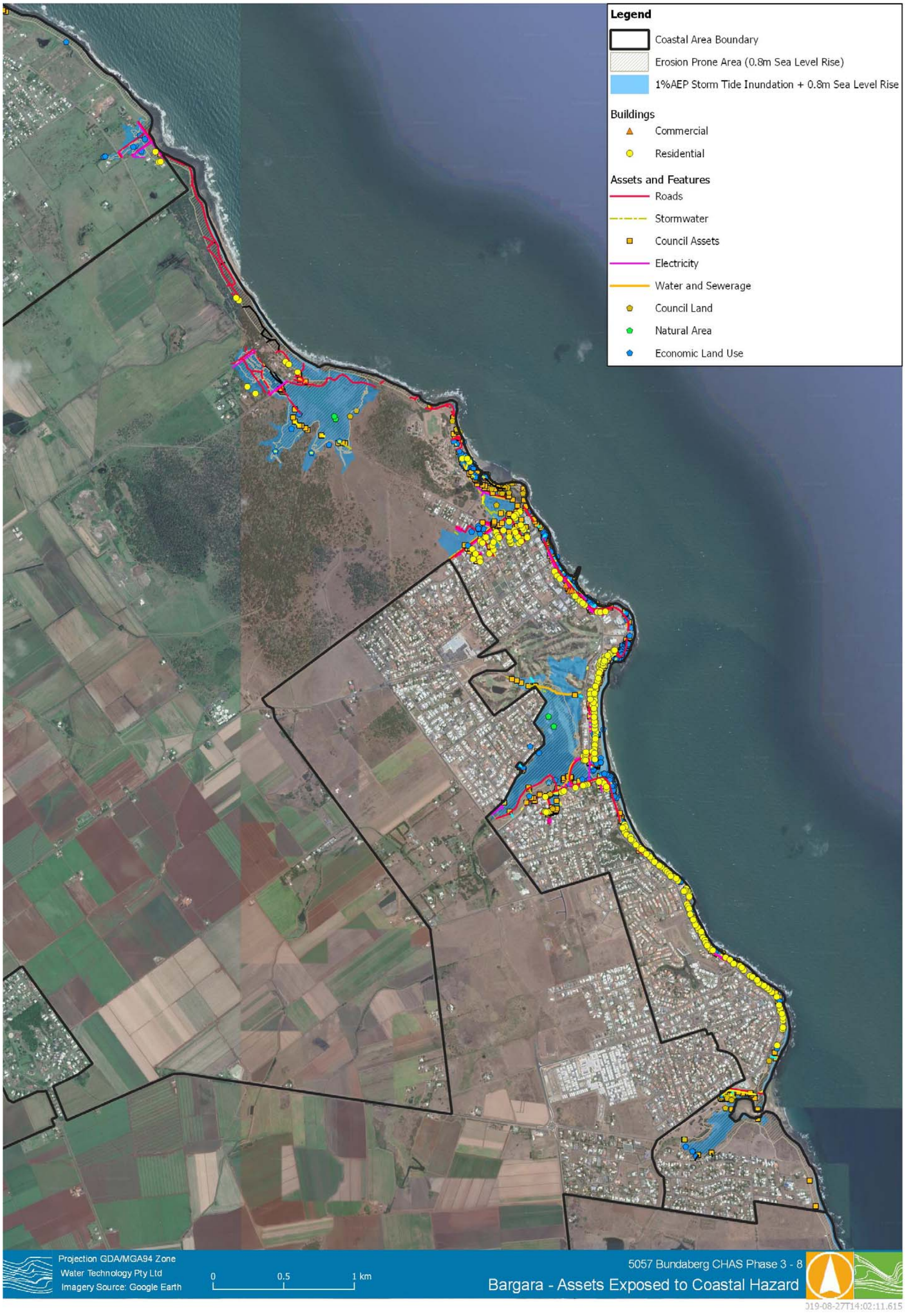


FIGURE 2-4 ASSETS EXPOSED TO COASTAL HAZARDS - BARGARA

2.8 Innes Park and Coral Cove

The Innes Park and Coral Cove coastal settlement area includes the settlements south of Woongarra Scenic Drive and south to Coral Cove Golf Club. The area lies to the east of Bundaberg and is bisected by Palmer Creek. Innes Park is a residential area on a low, rocky section of coastline with two small beaches. Coral Cove is largely residential. Figure 2-5 illustrates the assets identified within the coastal hazard extents.

2.8.1 Storm tide inundation exposure

The storm tide inundation hazard area at Innes Park and Coral Cove is mapped along the edges of Palmer Creek with some shoreline impacts across the open coastline area. Table 2-10 summarises the assets within the storm tide inundation extent for Innes Park and Coral Cove.

TABLE 2-10 ASSETS EXPOSED TO STORM TIDE INUNDATION HAZARD

Assets	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential buildings	8	8	8
Non-habitable buildings	6	6	6
Electricity transformers[12]	0	1	1
Electricity powerline	66 m	865 m	996 m
Water supply	48 m	706 m	956 m
Stormwater mains	1 m	173 m	221 m
Sewerage main	0 m	4 m	15 m
Roads	250 m	348 m	495 m
Bridges	1	1	1
Park assets	7	12	16
Parks, sports and natural areas	11.0 ha	12.2 ha	13 ha
Council land	0.03 ha	0.1 ha	0.2 ha
Grazing native vegetation	4 ha	5 ha	7 ha
Marsh / wetland	15 ha	15 ha	15 ha
Farming and agricultural land	4 ha	7 ha	8 ha

2.8.2 Erosion exposure

Innes Park and Coral Cove is one of five key study locations identified for further study and refinement of the coastal erosion extents as the area has previously exhibited coastal erosion issues and the default erosion prone area was considered to be too conservative for the purposes of the CHAS. The mapping and analysis of Innes Park and Coral Cove is based on the refined erosion prone area widths estimated in the Phase 3 report of the CHAS. The erosion prone area predominantly impacts Palmer Creek and its mouth, the erosion prone area is noticeably larger than the storm tide inundation area at Innes Park, with erosion hazards potentially impacting significantly more inland properties and assets.

Table 2-11 summarises the assets within the erosion prone area for Innes Park and Coral Cove.

[12] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

TABLE 2-11 ASSETS EXPOSED TO COASTAL EROSION HAZARD

Asset	Erosion Prone Area Present-day	Erosion Prone Area 0.4m SLR	Erosion Prone Area 0.8m SLR
Residential buildings	0	5	52
Non-habitable buildings	0	1	12
Water supply	39 m	896 m	2,156 m
Stormwater mains	0 m	0 m	524 m
Sewerage main	64 m	227 m	227 m
Electricity transformers[13]	0	1	1
Electricity powerline	53 m	835 m	2,405 m
Roads	14 m	465 m	1,520 m
Culverts	0	0	1
Bridges	1	1	1
Park assets	6	32	118
Parks, sports and natural areas	9 ha	13 ha	22 ha
Council buildings	0	0	20
Grazing native vegetation	3 ha	8 ha	16 ha
Marsh / wetland	15 ha	16 ha	16 ha
Farming and agricultural land	17 ha	3 ha	18 ha

[13] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

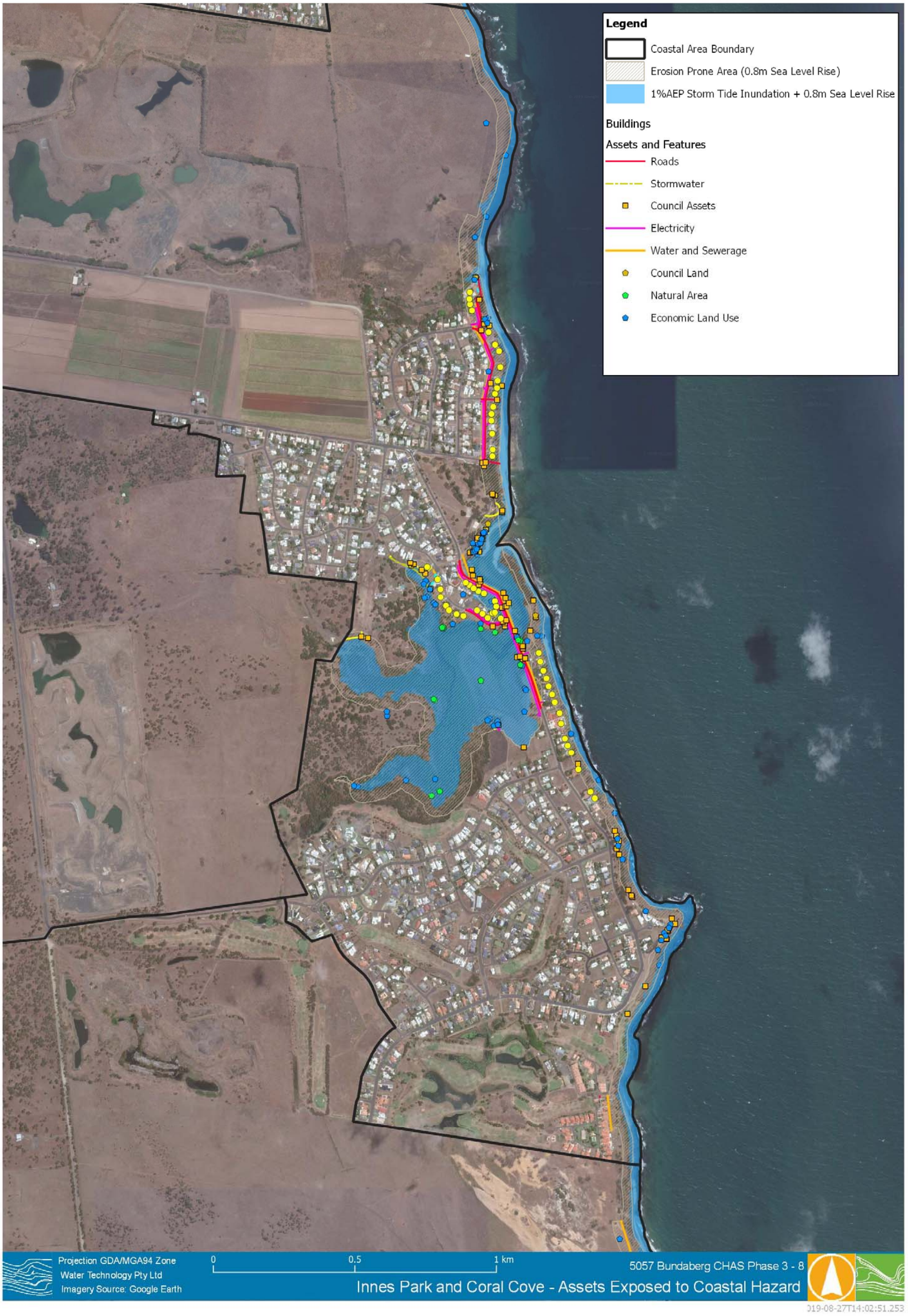


FIGURE 2-5 ASSETS EXPOSED TO COASTAL HAZARDS – INNES PARK AND CORAL COVE

2.9 Elliott Heads

Elliott Heads coastal settlement includes the settlement and properties of Calavos and Elliott Heads. The area is located at the mouth of the Elliott River and contains surf and still water beaches promoting a range of water-based activities. The township is surrounded by small crop and sugarcane farms and is home to several eateries and a caravan park. The foreshore is a prominent location within the town acting as a focal point for residents and visitors.

Figure 2-6 illustrates the assets identified within the coastal hazard extents.

2.9.1 Storm tide inundation exposure

The storm tide inundation hazard extent within the Elliott Heads coastal settlement area is limited to the low-lying areas associated with the Elliott River waterway and backwaters. The soft rocky foreshore buffers the immediate hinterland somewhat from storm tide inundation events.

Table 2-12 summarises the assets within the storm tide inundation extent for Elliott Heads.

TABLE 2-12 ASSETS EXPOSED TO STORM TIDE INUNDATION HAZARD

Assets	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential buildings	1	2	2
Non-habitable buildings	0	0	1
Culverts	2	2	6
Stormwater mains	8 m	12 m	47 m
Water supply	1,300 m	1,400 m	1,900 m
Roads	0 m	68 m	254 m
Electricity powerline	263 m	547 m	897 m
Electricity transformers[14]	0	1	2
Council land	3	3	3
Park assets	21	26	44
Council buildings	5	6	7
Parks, sports, and natural areas	3 ha	7 ha	9 ha
Grazing native vegetation	72 ha	90 ha	112 ha
Intensive animal production	1 ha	1 ha	1 ha
Irrigated cropping	0 ha	0 ha	1 ha
Marsh / wetland	298 ha	304 ha	306 ha
Farming and agricultural land	7 ha	10 ha	13 ha

[14] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

2.9.2 Erosion exposure

The coastal erosion hazard extent for Elliott Heads is represented by the erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance with the State Erosion Prone Area Mapping. Assets have been mapped within the coastal erosion hazard extent as represented by the default erosion prone area width. Table 2-13 summarises the assets within the erosion prone area for Elliott Heads.

TABLE 2-13 ASSETS EXPOSED TO COASTAL EROSION HAZARD

Asset	Erosion Prone Area (0.8m SLR)
Residential buildings	10
Non-habitable buildings	2
Commercial buildings	1
Council buildings	29
Water supply	2311 m
Stormwater mains	526 m
Culverts	8
Roads	1,114 m
Electricity transformers[15]	2
Electricity powerline	1,488 m
Surf Life Saving Club	1
Park assets	180
Parks, sports and natural areas	27 ha
Grazing native vegetation	140 ha
Intensive animal production	4 ha
Irrigated cropping	5 ha
Irrigated seasonal horticulture	1 ha
Marsh / wetland	315 ha
Farming and agricultural land	22 ha
Services	12 ha

[15] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

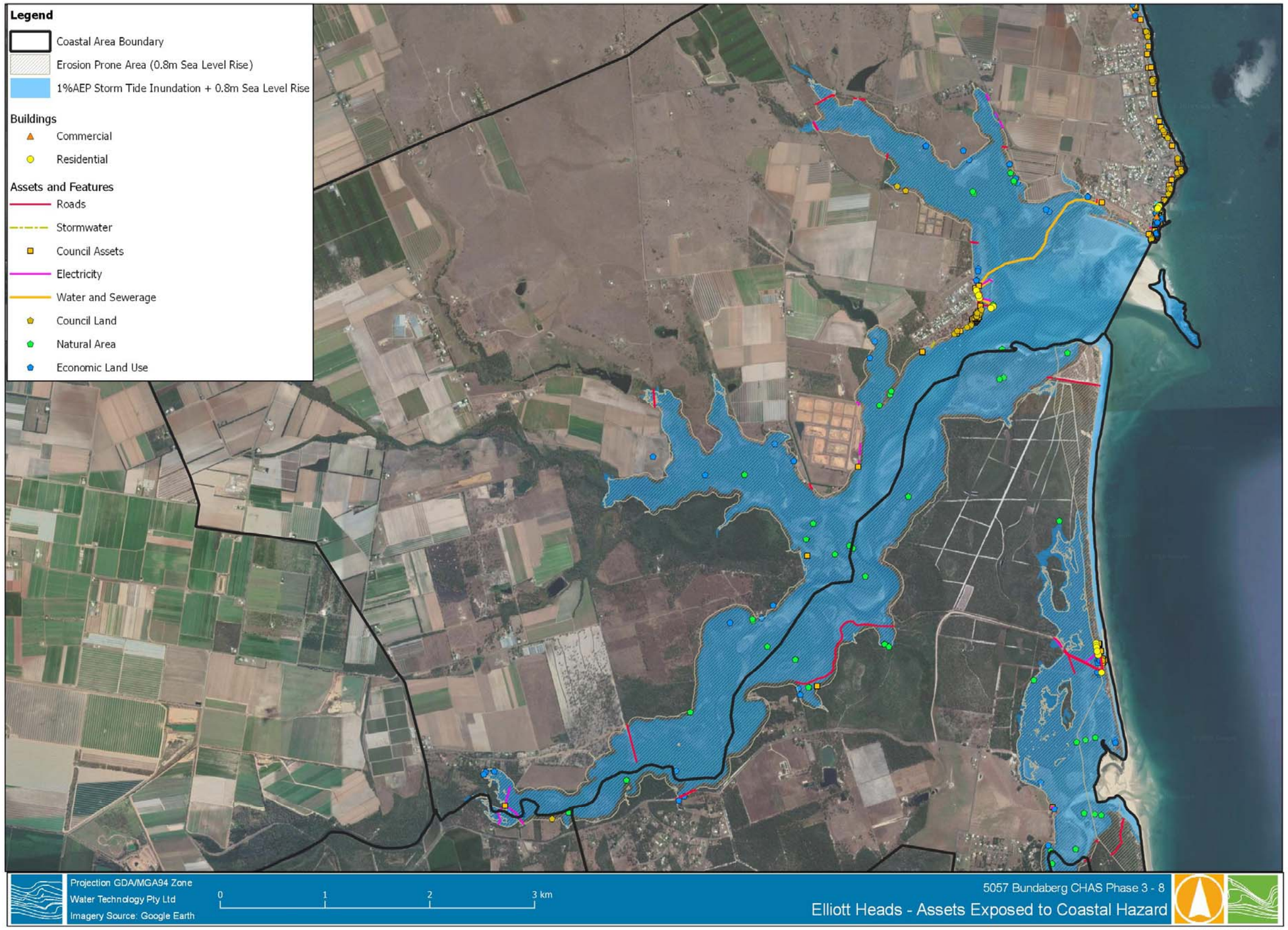


FIGURE 2-6 ASSETS EXPOSED TO COASTAL HAZARDS – ELLIOTT HEADS

2.10 Coonarr

Coonarr coastal settlement includes properties to the south of the Elliott River along Coonarr Road. The area includes the small settlement at the end of Coonarr Beach Road and the large natural areas south the edge of the Burrum Coast National Park, which is north of the Woodgate Beach settlement area. The area includes the Coonarr township. Most built structures and infrastructure are generally set back from the long stretch of foreshore.

Figure 2-7 illustrates the assets identified within the coastal hazard extents.

Coonarr Road is considered a key access route to the settlement of Coonarr and is likely to be permanently inundated in the 0.2m sea level rise scenario.

2.10.1 Storm tide inundation exposure

The storm tide inundation hazard extent Coonarr limited the backwater low-lying areas. The sandy shoreline foreshore buffers the immediate hinterland somewhat from storm tide inundation events and the Coonarr township is not inundated by the mapped storm tide scenarios.

Table 2-14 summarises the assets within the storm tide inundation extent for Coonarr.

TABLE 2-14 ASSETS EXPOSED TO STORM TIDE INUNDATION HAZARD

Assets	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential buildings	0	1	1
Electricity power line	288 m	336 m	533 m
Park assets	0	1	3
Council land	1	2	2
4WD tracks	0 m	10 m	28 m
Roads	279 m	322 m	538 m
Parks, sports and natural areas	3 ha	3.8 ha	5.1 ha
Grazing native vegetation	16 ha	21 ha	25 ha
Marsh / wetland	202 ha	208 ha	210 ha
Nature conservation	0.01 ha	0.01 ha	0.01 ha

2.10.2 Erosion exposure

Coonarr is one of five key study locations identified for further study and refinement of the coastal erosion extents as the area has previously exhibited coastal erosion issues and the default erosion prone area was considered to be too conservative for the purposes of the CHAS. The mapping and analysis of Coonarr is based on the refined erosion prone area widths estimated in the Phase 3 report of the CHAS.

The erosion hazard analysis has indicated that the coastal roads, including at the front of properties near Coonarr Park, are particularly vulnerable to erosion hazards. This analysis has also shown that due to the development of built assets, erosion of the sandy shoreline has generally been limited outside the Coonarr Park area.

Table 2-15 summarises the assets within the erosion prone area for Coonarr.

TABLE 2-15 ASSETS EXPOSED TO COASTAL EROSION

Asset	Erosion Prone Area Present-day	Erosion Prone Area 0.4m SLR	Erosion Prone Area 0.8m SLR
Residential buildings	0	6	6
Non-habitable buildings	0	0	1
Council buildings	0	1	2
Electricity transformers[16]	0	1	2
Electricity powerline	55 m	441 m	661 m
Culverts	0	0	1
4WD tracks	0 m	286 m	1,645 m
Roads	184 m	471 m	807 m
Park assets	48	61	61
Parks, sports and natural areas	3 ha	7 ha	11 ha
Grazing native vegetation	12.9 ha	28 ha	39 ha
Marsh / wetland	173.7 ha	180 ha	212 ha
Nature conservation	0.5 ha	1 ha	1 ha
Farming and agricultural land	0 ha	0 ha	3 ha
Services	18 ha	3 ha	5 ha

[16] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

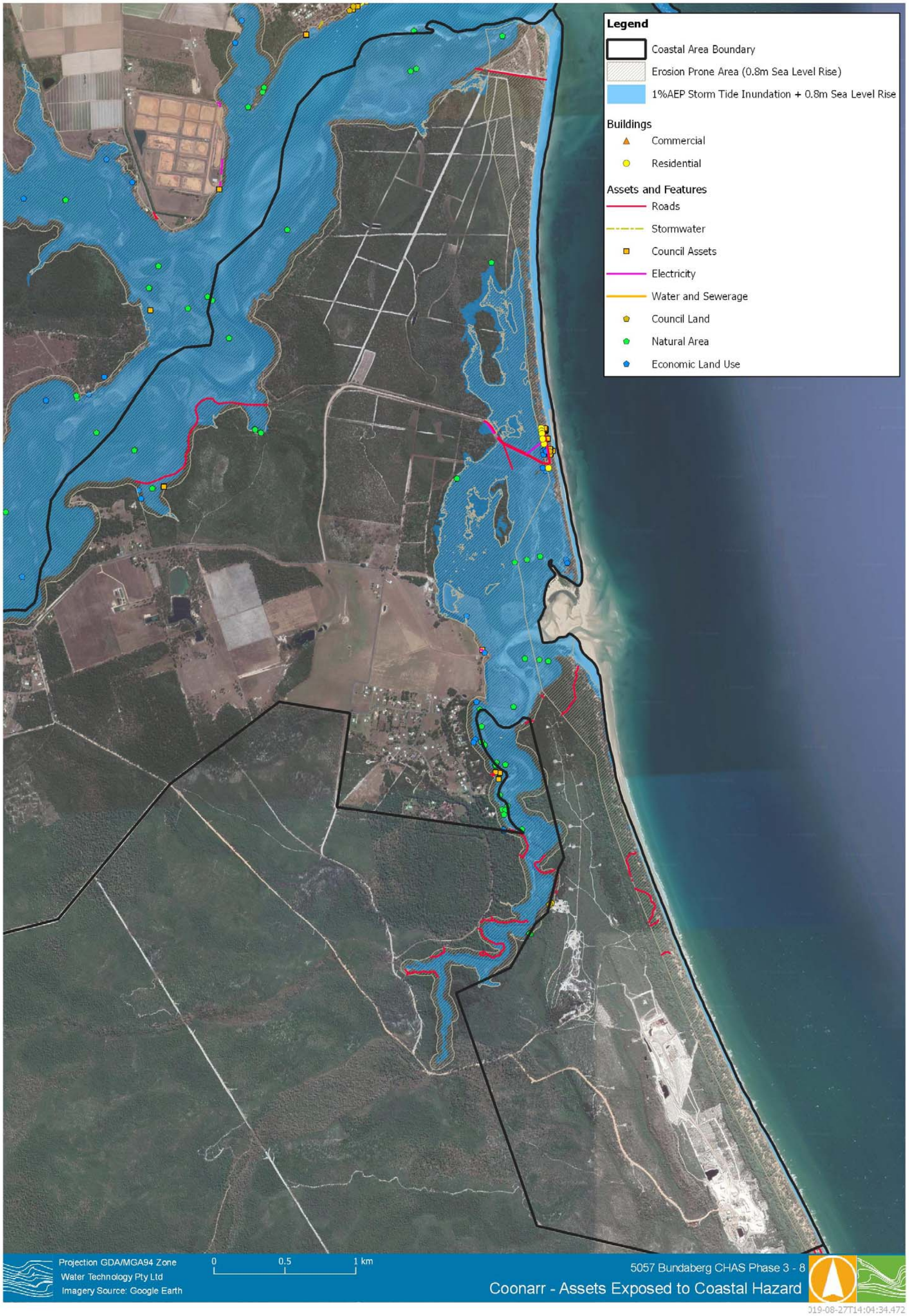


FIGURE 2-7 ASSETS EXPOSED TO COASTAL HAZARDS – COONARR

2.11 Woodgate Beach and Walkers Point

Woodgate Beach coastal settlement area includes the popular Woodgate Beach township, named after the 20,000 hectares of National Park, that surrounds the sandy beach and the small community of Walkers Point situated on the Burrum River south of Woodgate. The southern limit is bound by the Gregory River. The area includes the expanse of the Burrum Coast National Park and Kinkuna Beach camping area to the north of Woodgate Beach.

Figure 2-8 and Figure 2-9 illustrate the assets identified within the coastal hazard extents for Woodgate Beach and Walkers Point respectively.

Woodgate Road, Acacia Street and Theodolite Creek Drive are considered key access routes to the settlement of Woodgate Beach and are likely to be permanently inundated in the 0.8m sea level rise scenario. The impact of this is considered in the risk assessment component of this report.

2.11.1 Storm tide inundation exposure

Much of Woodgate Beach and Walkers Point settlements are not within the storm tide inundation extents, however, the low-lying land between First Avenue and Ocean View Drive to Acacia Street are subject to inundation due to their location within a potential flow path originating from Theodolite Creek.

Table 2-16 summarises the assets within the storm tide inundation extent for the Woodgate Beach and Walkers Point settlement area.

TABLE 2-16 ASSETS EXPOSED TO INUNDATION

Asset	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential buildings	3	4	34
Non-habitable buildings	0	1	10
Council buildings	0	0	4
Council land (number of lots)	3	5	5
Electricity power lines	2,000 m	3,000 m	5,100 m
Electricity transformers[17]	0	3	4
Culverts	5	5	5
Major Culvert Crossings	2	2	2
Footbridge	1	1	1
Stormwater mains	1,100 m	1,300 m	3,200 m
Water supply	800 m	1,400 m	3,000 m
Waste management facilities	2	2	3
Waste treatment and disposal	3 ha	5 ha	6 ha
Water supply facilities	3	3	4
Park assets	4	13	28
Boat ramps	8	12	12
4WD tracks	3,300 m	4,600 m	6,400 m
Bikeways / walkways	700 m	1,300 m	2,200 m

[17] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

Asset	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Roads	636 m	1,908 m	4,248 m
Grazing native vegetation	13 ha	19 ha	28 ha
Parks, sports, and natural areas	118 ha	131 ha	144 ha
Marsh / wetland	321 ha	335 ha	340 ha
Nature conservation	727 ha	992 ha	1,200 ha
National Park	671 ha	930 ha	1,129 ha
Telephone exchange	0	0	1

2.11.2 Erosion exposure

Woodgate Beach is one of five key study locations identified for further study and refinement of the coastal erosion extents as the area has previously exhibited coastal erosion issues and the default erosion prone area was considered to be too conservative for the purposes of the CHAS. The mapping and analysis of Woodgate Beach and Walkers Point is based on the refined erosion prone area widths estimated in the Phase 3 report of the CHAS.

Table 2-17 summarises the assets within the erosion prone area for the Woodgate Beach and Walkers Point settlement area.

TABLE 2-17 ASSETS EXPOSED TO COASTAL EROSION HAZARD

Asset	Erosion Prone Area Present-day	Erosion Prone Area 0.4m SLR	Erosion Prone Area 0.8m SLR
Commercial buildings	0	4	5
Residential buildings	0	68	201
Non-Habitable buildings	0	17	48
Council buildings	42	47	54
Culverts	2	4	6
Water supply	1,325 m	5,957 m	8,700 m
Stormwater mains	4 m	1,536 m	4,100 m
Water supply facilities	3	4	4
Waste management facility	2	3	3
Waste treatment and disposal	2 ha	5 ha	6 ha
Woodgate WWTP	0	0	1
Electricity transformers[18]	0	3	6
Electricity powerline	2720 m	9578 m	15,500 m
4WD tracks	2915 m	7404 m	26,200 m
Bikeways / walkways	256 m	575 m	4,100 m
Roads	2,837 m	7,019 m	12,268 m

[18] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

Asset	Erosion Prone Area Present-day	Erosion Prone Area 0.4m SLR	Erosion Prone Area 0.8m SLR
Major Culvert Crossings	2	2	2
Footbridge	1	1	1
Park assets	133	165	348
Boat ramps	6	6	12
Parks, sports and natural areas	98 ha	120 ha	166 ha
Council land	0	0	6
Telephone exchange	0	0	1
Grazing native vegetation	9 ha	30 ha	56 ha
Marsh / wetland	291 ha	317 ha	345 ha
Nature conservation	549 ha	888 ha	1483 ha
National Park	521 ha	849 ha	1413 ha
Farming and agricultural land	12 ha	38 ha	67 ha
Services	12 ha	16 ha	19 ha
Mining	0 ha	0 ha	0.1 ha
Irrigated seasonal horticulture	0 ha	0 ha	1 ha

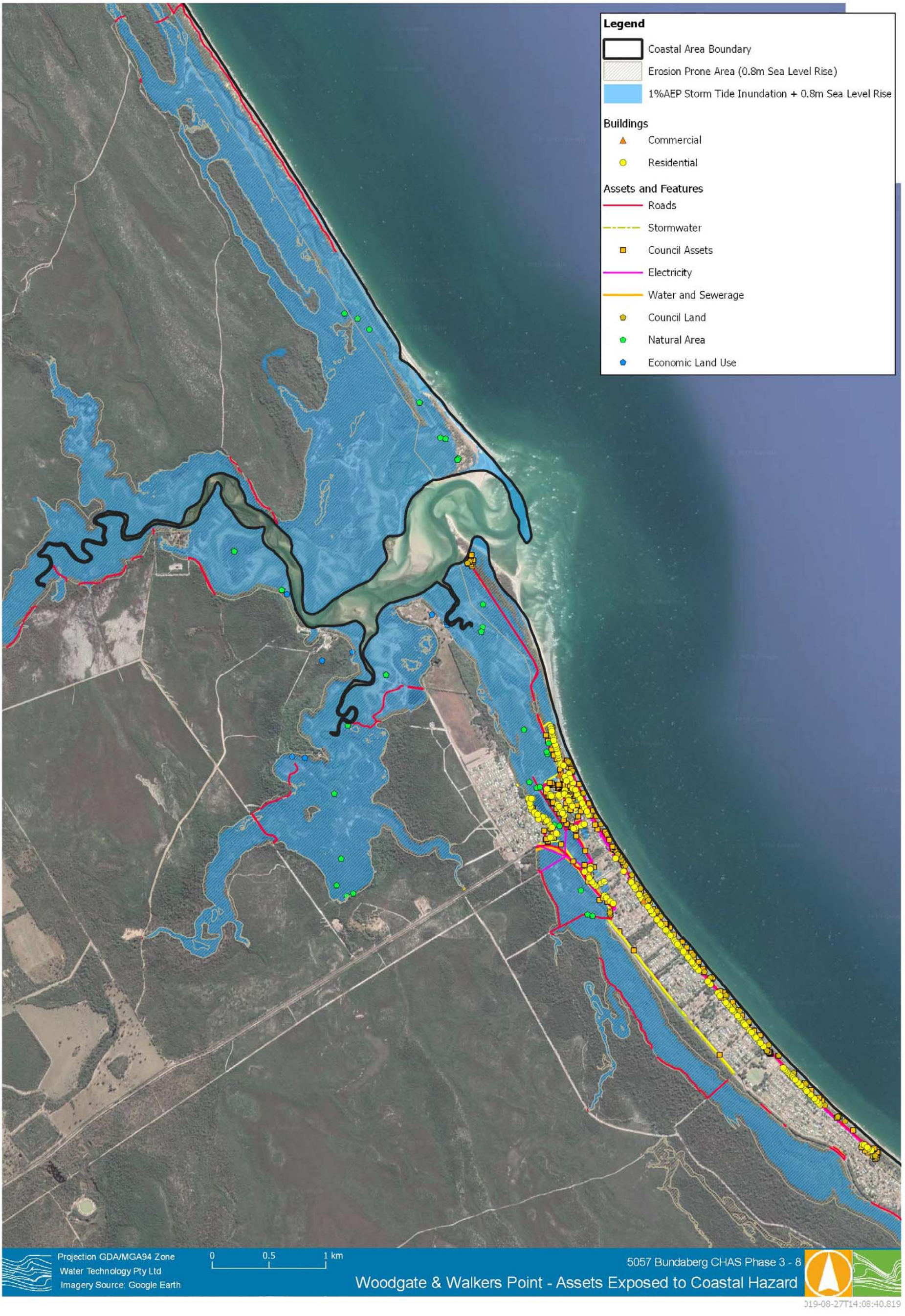


FIGURE 2-8 ASSETS EXPOSED TO COASTAL HAZARDS – WOODGATE BEACH

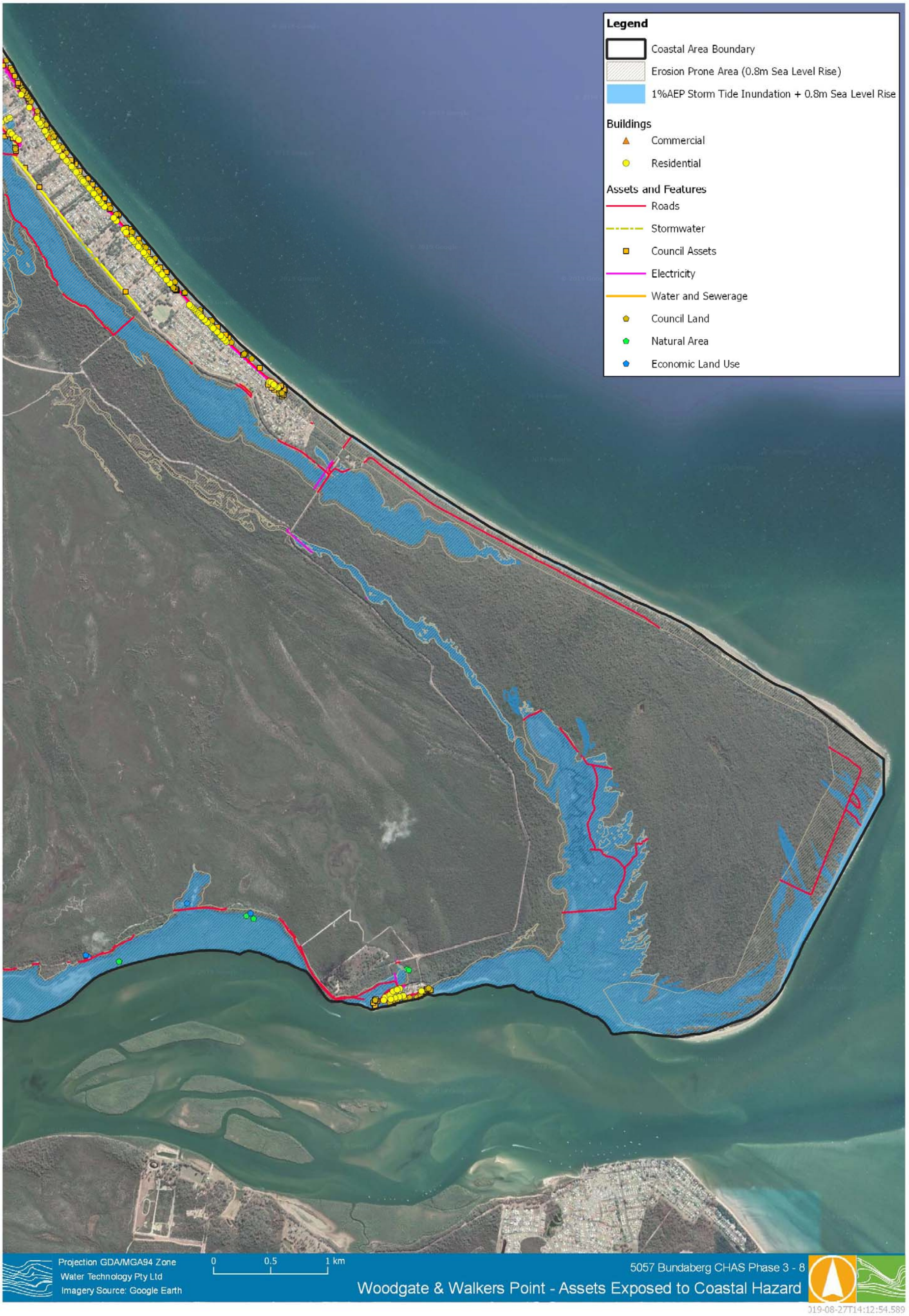


FIGURE 2-9 ASSETS EXPOSED TO COASTAL HAZARDS – WALKERS POINT

2.12 Buxton

The Buxton coastal area includes the small fishing town of the same name located along the Burrum River, upstream of Walkers Point. The township is predominantly residential. Larger rural residential blocks are located further upstream and offer some river frontage, these are also included in the coastal settlement area.

Buxton is experiencing coastal erosion under present day conditions and Council are currently monitoring erosion along the Buxton foreshore Reserve from Watkins Street to the Esplanade.

Figure 2-10 illustrates the assets identified within the coastal hazard extents.

2.12.1 Storm tide inundation exposure

Storm tide inundation affects the low-lying areas on the banks of Burrum River and Gregory Creek. In these areas, some of the local road network and utility infrastructure is impacted in the present-day and 0.8m sea level rise scenarios.

Table 2-18 summarises the assets within the storm tide inundation extent for the Buxton settlement area.

TABLE 2-18 ASSETS EXPOSED TO INUNDATION

Asset	1% AEP Storm Tide Inundation	1% AEP +0.4m Sea Level Rise	1% AEP +0.8m Sea Level Rise
Residential buildings	4	22	32
Non-habitable buildings	0	7	11
Council buildings	32	75	82
Electricity power lines	458 m	1,089 m	1,718 m
Electricity transformers[19]	0	1	1
Major Culvert Crossings	2	2	2
Culverts	1	2	4
Park assets	25	115	115
Roads	134 m	769 m	1,129 m
4WD tracks	2 m	118 m	418 m
Marsh / wetland	97 ha	104 ha	104 ha
Nature conservation	32 ha	38 ha	48 ha
Grazing native vegetation	49 ha	70 ha	96 ha
Parks, sports and natural areas	11 ha	16 ha	16 ha
Farming and agricultural land	17 ha	29 ha	35 ha

2.12.2 Erosion exposure

Buxton is experiencing coastal erosion under present day conditions and is being monitored by Council. The mapped coastal erosion hazard extent for Buxton is represented by the erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance

[19] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

with the State Erosion Prone Area Mapping. Assets have been mapped within the coastal erosion hazard extent as represented by the default erosion prone area width.

Table 2-19 summarises the assets within the erosion prone area for the Buxton settlement area.

TABLE 2-19 ASSETS EXPOSED TO COASTAL EROSION

Asset	Erosion Prone Area
Residential buildings	38
Non-habitable buildings	11
Council buildings	78
Culverts	4
Electricity power lines	2,232 m
Electricity transformers[20]	2
Park assets	132
Major Culvert Crossings	2
Roads	1,317 m
4WD tracks	1,236 m
Grazing native vegetation	143 ha
Marsh / wetland	108 ha
Nature conservation	83 ha
Parks, sports and natural areas	19 ha
Farming and agricultural land	49 ha

[20] Electricity transformers include pole and pad mounted transformers that distribute voltage to settlements

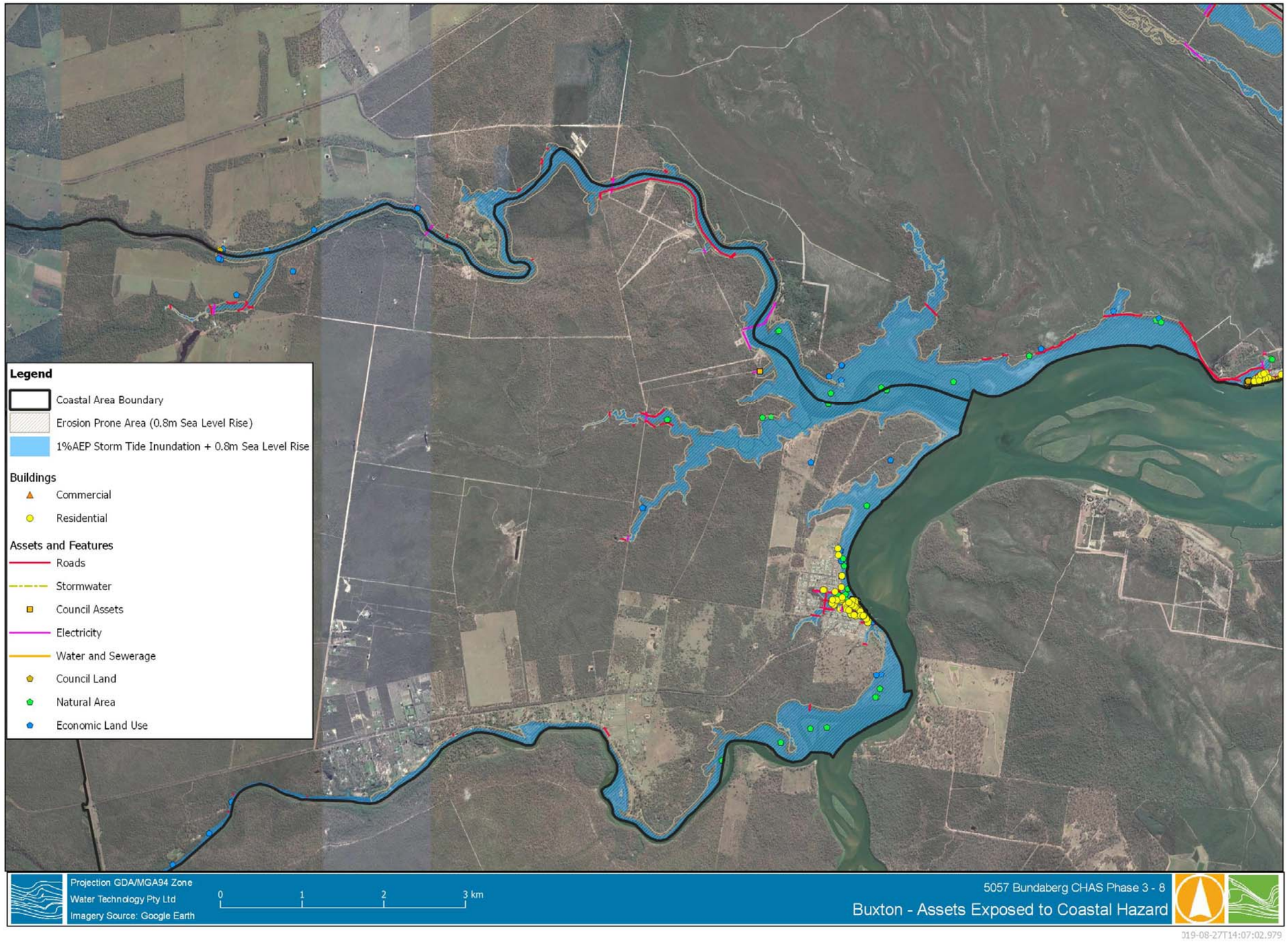


FIGURE 2-10 ASSETS EXPOSED TO COASTAL HAZARDS – BUXTON

2.13 Environmental asset exposure

The suite of habitat types and regional ecosystems in each settlement mapped within the 1% AEP storm tide inundation for the 0.8m sea level rise scenario are listed in Table 2-20.

TABLE 2-20 HABITAT TYPES MAPPED IN THE STORM TIDE 1% AEP PLUS 0.8M SLR

Habitat Type / Regional Ecosystem	Miara, Winfield and Norval Park	Moore Park Beach	Burnett Heads	Bargara	Innes Park and Coral Cove	Elliott Heads	Coonarr	Woodgate Beach and Walkers Point	Buxton
Estuary	✓	✓	✓	✓	✓	✓	✓	✓	✓
Small inlet	✓	✓		✓		✓	✓		✓
Beach	✓	✓	✓	✓	✓	✓	✓	✓	
Rocky and coral reefs	✓		✓	✓	✓	✓	✓	✓	
Seagrass	✓		✓	✓	✓	✓		✓	✓
Soft bottom habitat	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tidal flats and beaches, Casuarina glauca woodland	✓	✓	✓			✓	✓	✓	
Tidal flats and beaches, Saltpan vegetation	✓	✓	✓	✓		✓	✓	✓	✓
Tidal flats and beaches, Mangrove shrubland	✓	✓	✓	✓	✓	✓	✓	✓	✓
Coastal dunes, Microphyll/notophyll vine forest	✓	✓					✓		
Coastal dunes, Melaleuca quinquenervia forest	✓	✓	✓				✓	✓	
Coastal dunes, Banksia aemula low open woodland	✓						✓	✓	
Coastal dunes, Corymbia tessellaris woodland	✓	✓	✓	✓	✓	✓	✓	✓	✓
Coastal dunes, Closed heath	✓						✓	✓	
Coastal dunes, Foredune complex	✓	✓	✓				✓	✓	
Coastal dunes, closed sedgeland in coastal swamps.	✓						✓	✓	
Coastal dunes, Permanent and semi-permanent window lakes	✓								
Alluvial river and creek flats, Eucalyptus woodland	✓	✓	✓			✓			
Alluvial river and creek flats, Melaleuca open forest	✓				✓	✓	✓	✓	✓
Alluvial river and creek flats, Melaleuca, Eucalyptus, Corymbia open forest	✓					✓		✓	✓
Alluvial river and creek flats, Eucalyptus, Casuarina, Melaleuca fringing woodland.	✓		✓			✓		✓	✓
Alluvial river and creek flats, naturally occurring instream waterholes and lagoons	✓		✓					✓	✓
Alluvial river and creek flats, Billabongs and ox-bow lakes	✓								
Alluvial river and creek flats, Eucalyptus, Corymbia intermedia open forest			✓			✓	✓	✓	✓
Alluvial river and creek flats, Eucalyptus, Melaleuca woodland			✓					✓	✓
Alluvial river and creek flats, closed heathland		✓					✓	✓	✓
Alluvial river and creek flats, Banksia aemula low woodland								✓	
Alluvial river and creek flats, Simple notophyll fringing forest	✓	✓	✓						

Habitat Type / Regional Ecosystem	Miara, Winfield and Norval Park	Moore Park Beach	Burnett Heads	Bargara	Innes Park and Coral Cove	Elliott Heads	Coonarr	Woodgate Beach and Walkers Point	Buxton
Alluvial river and creek flats, Melaleuca, Casuarina, Eucalyptus open forest			✓						
Old loamy and sandy plains, Corymbia, Eucalyptus woodland.	✓						✓		
Old loamy and sandy plains, Eucalyptus, Corymbia, Angophora woodland	✓	✓				✓	✓		✓
Old loamy and sandy plains, Eucalyptus, Corymbia intermedia open forest.	✓								
Old loamy and sandy plains, Corymbia, Eucalyptus fibrosa open forest.	✓								
Old loamy and sandy plains, Eucalyptus open woodland			✓						✓
Old loamy and sandy plains, Eucalyptus, Banksia aemula low open woodland						✓	✓	✓	
Basalt plains and hills, Araucarian vine forest			✓						
Basalt plains and hills, Eucalyptus woodland					✓	✓			
Hills and lowlands on metamorphic rocks, Eucalyptus woodland	✓								

2.14 Summary of asset identification

The following section illustrates a summary of the distribution, by settlement, of the assets exposed to coastal hazard. This summary provides an overall picture of the quantum of assets likely to be exposed to coastal hazard and illustrates the scale of exposure on a settlement by settlement basis.

The identification of assets exposed to coastal hazard has not considered the relative vulnerability of the asset nor does this consider the consequences of a range of likelihood events or sea level rise scenarios. These components are analysed later in the vulnerability and risk assessment chapters of the report.

Figure 2-11 to Figure 2-15 show the distribution of assets likely to be exposed to coastal hazard by settlements for storm tide inundation in 0.8m SLR scenario.

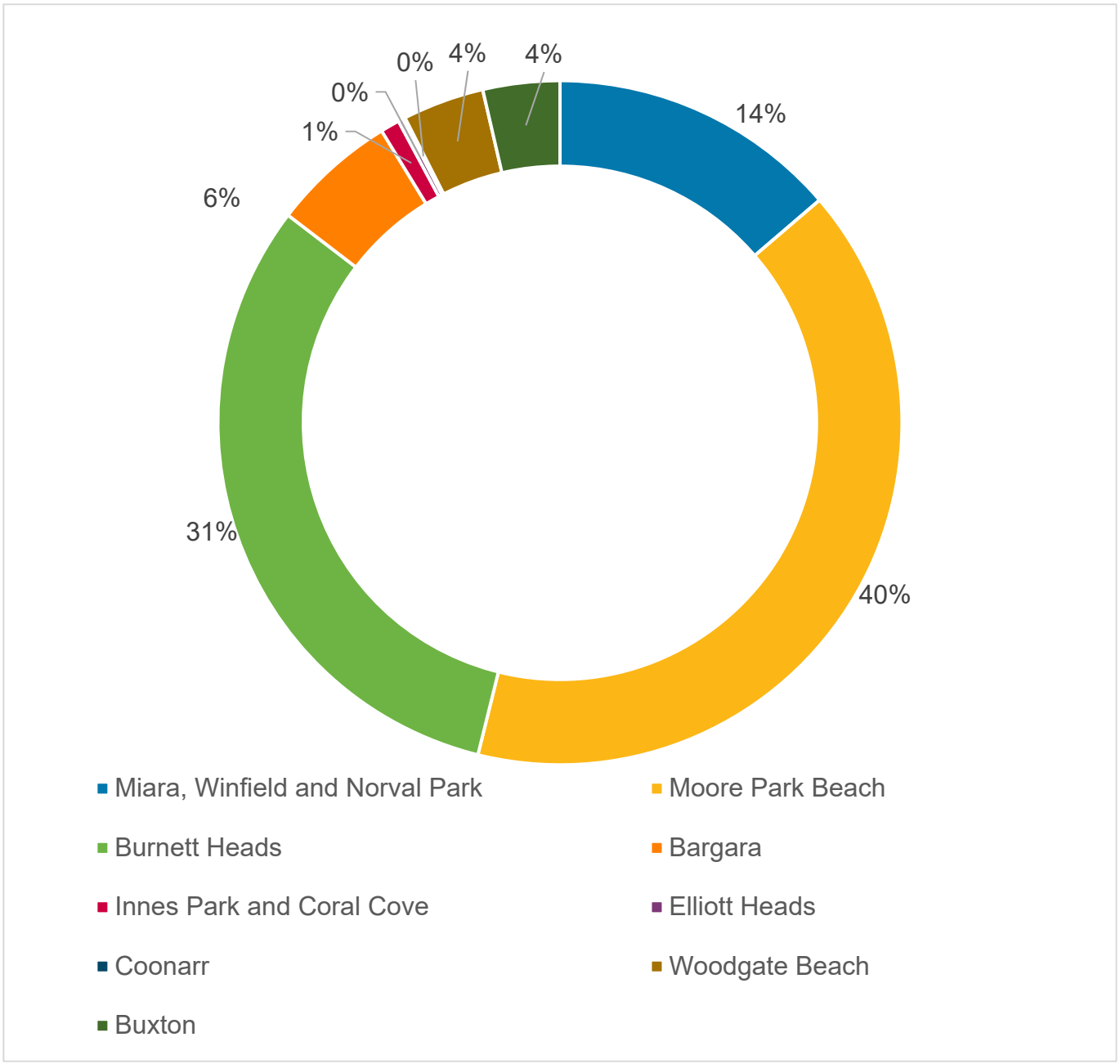


FIGURE 2-11 DISTRIBUTION OF RESIDENTIAL BUILDINGS EXPOSED TO STORM TIDE INUNDATION

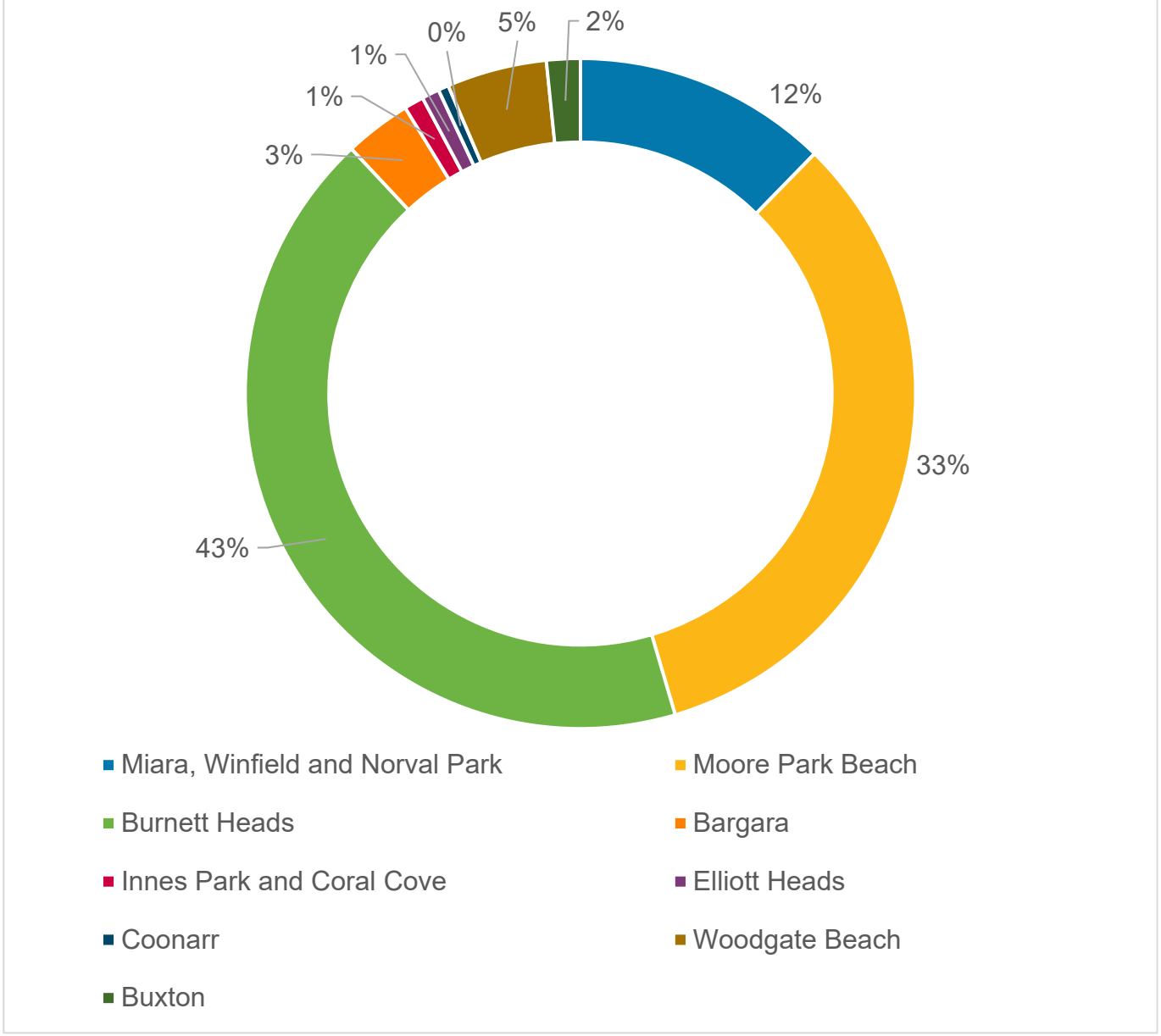


FIGURE 2-12 DISTRIBUTION OF ELECTRICITY POWERLINE EXPOSED TO STORM TIDE INUNDATION

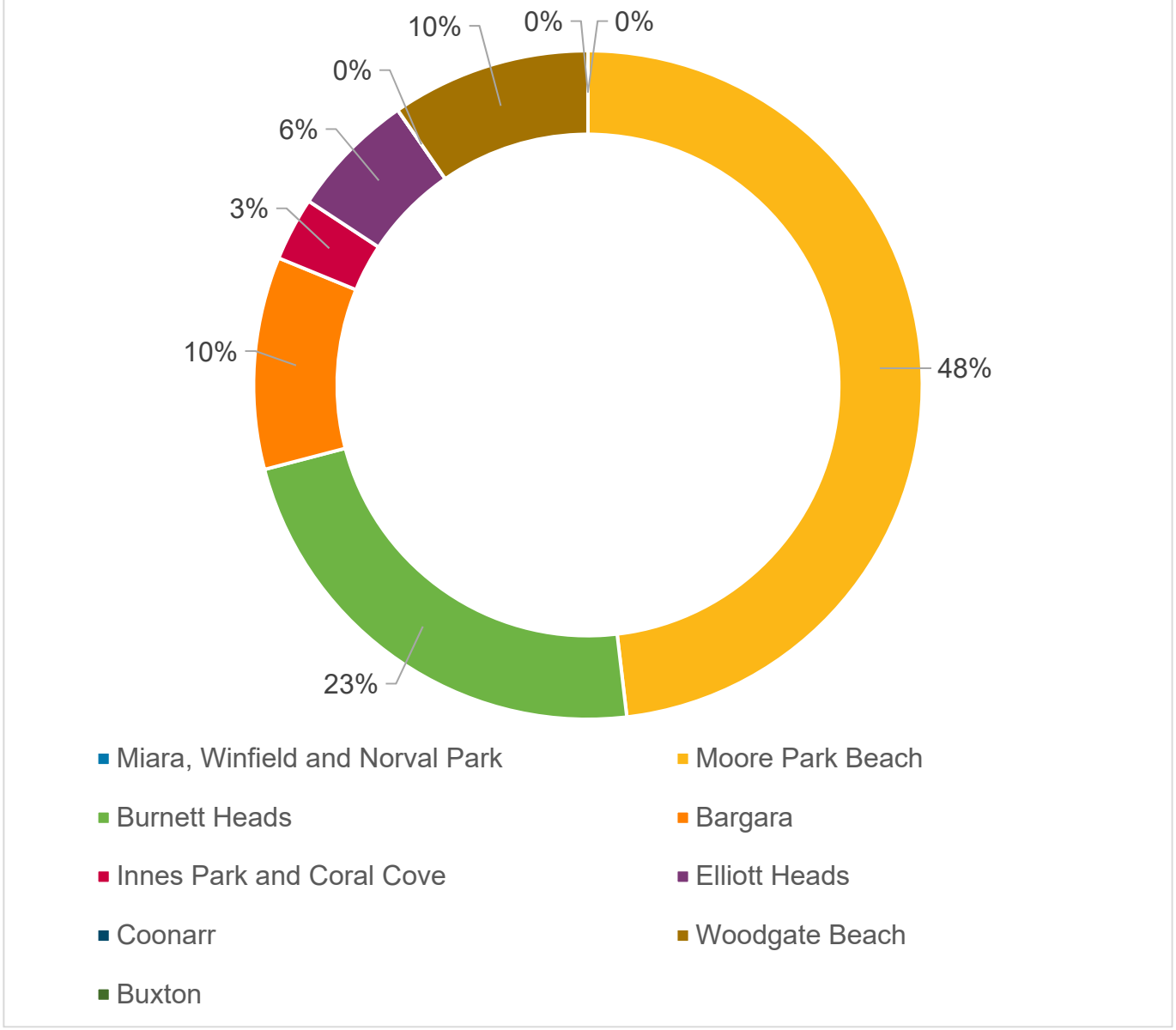


FIGURE 2-13 DISTRIBUTION OF WATER SUPPLY MAINS EXPOSED TO STORM TIDE INUNDATION

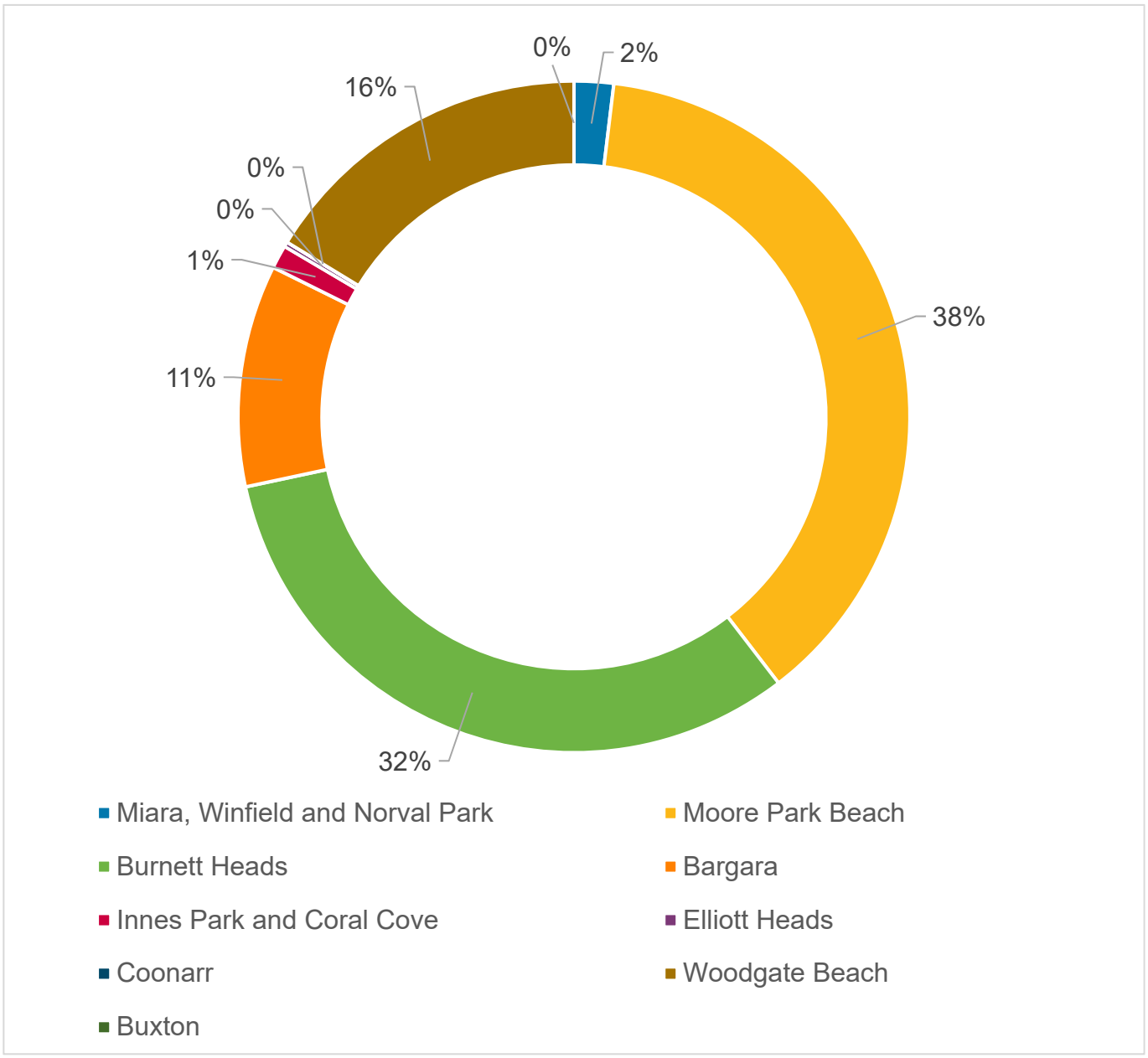


FIGURE 2-14 DISTRIBUTION OF STORMWATER MAINS EXPOSED TO STORM TIDE INUNDATION

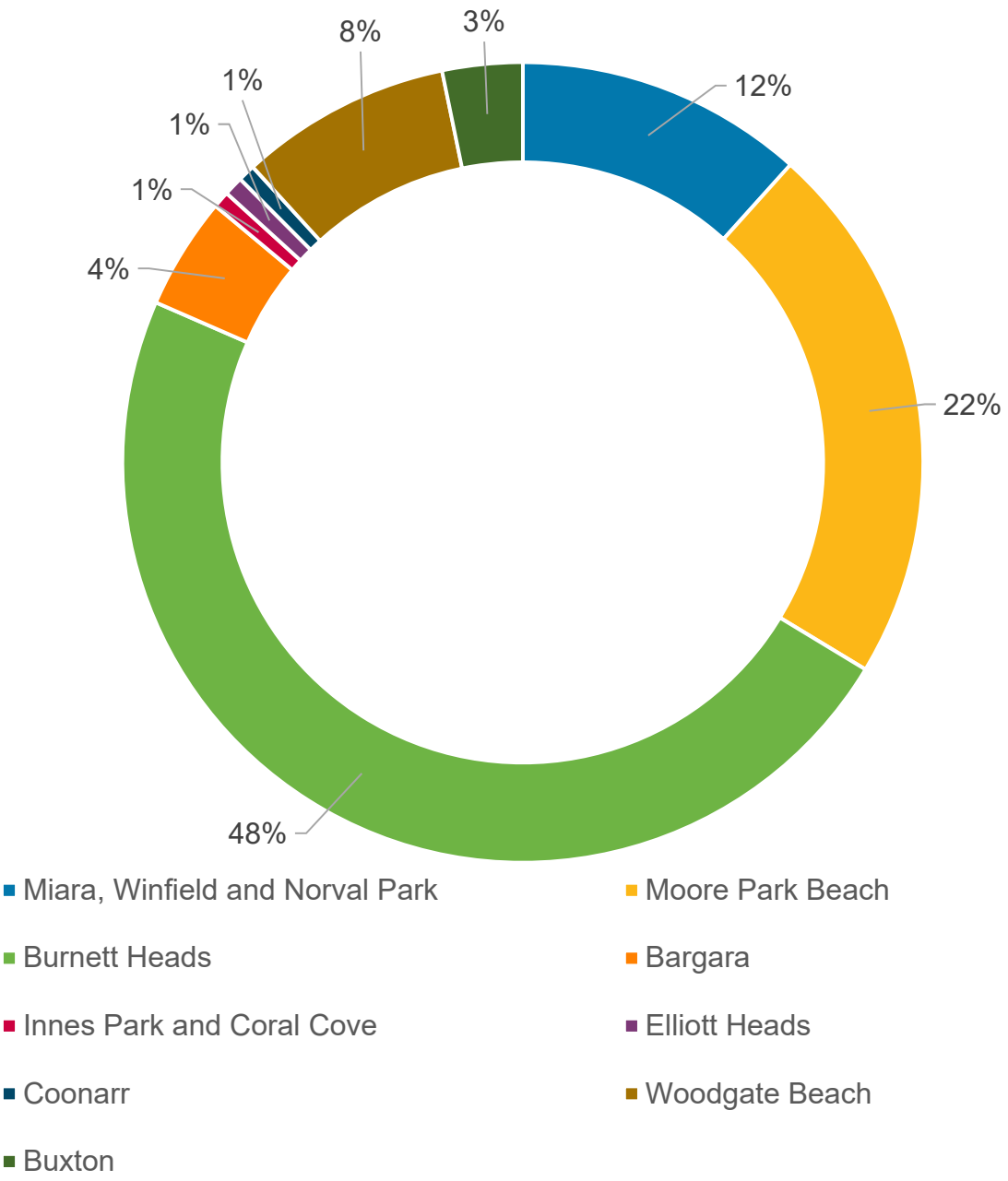


FIGURE 2-15 DISTRIBUTION OF ROADS EXPOSED TO STORM TIDE INUNDATION

3 ASSET VALUATION

This section presents the methodology and assumptions used in the valuation of tangible and non-tangible assets by settlement. Valuation of the assets identified in the coastal hazard extents will be considered either in monetary terms i.e. financial replacement cost, or non-monetary terms i.e. by assigning key intangible values to assets. The assets will then be prioritised via the vulnerability assessment which considers the assets overall exposure, sensitivity and adaptive capacity, but also settlement specific factors that defines how each coastal settlement generally relies upon the asset for the function of society or economy.

3.1 Assumptions

The key stakeholders have provided asset datasets for the Bundaberg region, data fields supplied for analysis included locality, size, key descriptions, maintenance, design life and where possible, financial value.

The value of the building structures considered was obtained from the average 2018 construction costs per square metre for Australian buildings combined with a factor to account for demolition and clean up. Land value is also required to assess permanent losses of a private lot resulting from coastal erosion. The replacement value of non-residential buildings was taken from a dataset developed by the Flood Hazard Research Centre (FHRC, 2013) at Middlesex University in the UK and updated and converted to be appropriate for Australia, the values were adopted for consistency with the damage model selected and used in the consequence assessment. Monetary valuation (replacement cost) of buildings mapped in the 1% AEP storm tide inundation event in the 0.8m sea level rise scenario by coastal settlement is provided in the tables below.

Built assets have been assigned a financial value where available, otherwise the following assumptions have been used within the tangible valuation of assets:

3.1.1 Residential buildings

- Combined with demolition costs, an assumption is used for residential property content replacement. Overall the resulting replacement costs including demolition are:
  - Single storey houses: $459,333;
  - Double storey houses: $1,050,164;
  - Units: $218,640.

- The value of land was required to assess permanent losses of the lot resulting from erosion or sea level rise. These were obtained from average current residential land selling price per square meter used in real estate for beach-front lots (or lots close to the beach) within the study area, and were: It was then assumed an average lot area of 1,000 m^2:
  - Burnett Heads: $150
  - Moore Park Beach: $100
  - Woodgate Beach: $350
  - Miara, Winfield and Norval Park: $100
  - Bargara: $400
  - Buxton: $100
  - Coonarr: $50;
  - Elliott Heads: $250

- Innes Park and Coral Cove: $250
- Remainder of Bundaberg LGA: $100.

3.1.2 Commercial buildings

- The replacement costs of commercial and industrial buildings are inflated to present day by obtaining the following replacement costs, which include building structure and contents:
  - Commercial buildings: $2,241 / m2
  - Industrial buildings: $1,870 / m2

3.1.3 Infrastructure

Where financial value is available from asset owners, total replacement cost has been used. The estimated total replacement cost is used to assist with the asset prioritisation process within the vulnerability assessment.

3.2 Tangible Asset Valuation

The total tangible asset valuation (replacement cost) of infrastructure mapped in the 1% AEP storm tide inundation event in the 0.8m sea level rise scenario by coastal settlement is provided in the following table:

ESTIMATED TANGIBLE ASSET VALUATION

Location	Buildings - Replacement Cost	Infrastructure – Replacement Cost	Total Replacement Cost
Miara, Winfield and Norval Park	$17 million[21]	$4 million	**$21 million**
Moore Park Beach	$ 197 million	$ 36.2 million	**$ 233.2 million**
Burnett Heads	$ 95.4 million	$ 28.9 million	**$ 124.3 million**
Bargara	$ 34.2 million	$ 13.3 million	**$ 47.5 million**
Innes Park and Coral Cove	$ 5.8 million	$ 2.2 million	**$ 8.0 million**
Elliott Heads	$ 1.6 million	$ 1.6 million	**$ 3.2 million**
Coonarr	$ 0.5 million	$ 1.0 million	**$ 1.5 million**
Woodgate Beach and Walkers Point	$ 23.9 million	$ 6.8 million	**$ 30.7 million**
Buxton	$ 25.9 million	$ 2.3 million	**$ 28.2 million**

The tangible asset valuation of assets mapped within the coastal hazard extents has shown, for example, that approximately $485 million of buildings, over $106 million of infrastructure could to be impacted within the most extreme coastal hazard extents.

[21] 83 semi-permanent structures are not included in the total estimated asset valuation.

3.3 Intangible asset valuation

A simple additive approach has been used to determine value of ecological units using existing environmental and regulatory mapping. The Regional Ecosystem (RE) Mapping provides a good base layer of mapping polygon for ecosystems down to Highest Astronomical Tide (HAT). In doing so, depending on the habitat type or regional ecosystem, this valuation is also representative of its environmental significance and contribution to the conservation of Australian biodiversity. There is not (as yet) any similar mapping for ecosystems for ecosystems below HAT, nor for freshwater waterways in the area. The State Wetland Program is progressing with this mapping; however, it will not be available for this area in the timeframes of this study.

For the purpose of assessing the key natural land use types throughout each of the Bundaberg coastal settlements, each habitat type and regional ecosystem has been assigned a specific value. The methodology to assign values is presented below.

INTANGIBLE ASSET VALUATION, VALUE SYSTEM

Environmental status / regulatory mapping	Value		
	0	1	2
Regional Ecosystem	Not mapped as remnant	Mapped as Remnant	
Aquatic Habitats	Not mapped	Mapped	
Matters of state environmental significance – protected areas	Not in protected area	In a protected area	
Matters of state environmental significance – regulated vegetation	Not endangered or of concern	Of concern	Endangered
Matters of state environmental significance – Key habitat	Not key habitat		Key habitat
Wetland dependent ecosystems	Not mapped	Mapped	
High Ecological Significance Wetland	Not mapped	Mapped	
High Ecological Significance Waterway	Not mapped	Mapped	

The total intangible asset valuation score is then assigned to each coastal settlement from 1 to 10. The following tables show the overall intangible asset value by settlement.

- A score of 10 for the coastal settlement represents a range of complex regional ecosystems that hold significant intangible value across local, regional and national scale.
- A score of 1 represents the lowest intangible value. The coastal settlement does not contain any ecosystems or habitats that have been classified as locally, regionally or nationally significant.

MIARA, WINFIELD AND NORVAL PARK – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1
Matters of state environmental significance – protected areas	1
Matters of state environmental significance – regulated vegetation	1
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	1

Environmental status / regulatory mapping	Valuation Score
High Ecological Significance Wetland	1
High Ecological Significance Waterway	1
Total intangible asset valuation score	**9**

MOORE PARK BEACH – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1
Matters of state environmental significance – protected areas	1
Matters of state environmental significance – regulated vegetation	2
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	1
High Ecological Significance Wetland	1
High Ecological Significance Waterway	1
Total intangible asset valuation score	**10**

BURNETT HEADS – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1
Matters of state environmental significance – protected areas	1
Matters of state environmental significance – regulated vegetation	0
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	0
High Ecological Significance Wetland	0
High Ecological Significance Waterway	1
Total intangible asset valuation score	**6**

BARGARA – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1
Matters of state environmental significance – protected areas	1
Matters of state environmental significance – regulated vegetation	0

Environmental status / regulatory mapping	Valuation Score
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	0
High Ecological Significance Wetland	0
High Ecological Significance Waterway	1
Total intangible asset valuation score	**6**

INNES PARK AND CORAL COVE – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1
Matters of state environmental significance – protected areas	0
Matters of state environmental significance – regulated vegetation	0
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	0
High Ecological Significance Wetland	0
High Ecological Significance Waterway	1
Total intangible asset valuation score	**5**

ELLIOTT HEADS – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1
Matters of state environmental significance – protected areas	1
Matters of state environmental significance – regulated vegetation	2
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	0
High Ecological Significance Wetland	0
High Ecological Significance Waterway	1
Total intangible asset valuation score	**8**

COONARR – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1

Environmental status / regulatory mapping	Valuation Score
Matters of state environmental significance – protected areas	1
Matters of state environmental significance – regulated vegetation	1
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	1
High Ecological Significance Wetland	1
High Ecological Significance Waterway	1
Total intangible asset valuation score	**9**

WOODGATE BEACH AND WALKERS POINT – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1
Matters of state environmental significance – protected areas	1
Matters of state environmental significance – regulated vegetation	0
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	1
High Ecological Significance Wetland	1
High Ecological Significance Waterway	1
Total intangible asset valuation score	**8**

BUXTON – INTANGIBLE ASSET VALUATION

Environmental status / regulatory mapping	Valuation Score
Regional Ecosystem	1
Aquatic Habitats	1
Matters of state environmental significance – protected areas	1
Matters of state environmental significance – regulated vegetation	1
Matters of state environmental significance – Key habitat	2
Wetland dependent ecosystems	0
High Ecological Significance Wetland	1
High Ecological Significance Waterway	1
Total intangible asset valuation score	**8**

The non-monetary valuation of intangible assets mapped within the coastal hazard extents has shown, for example, that most coastal settlements contain a range of complex regional ecosystems that hold significant intangible value across local, regional and national scale that are mapped within the coastal hazard extents.

4 VULNERABILITY ASSESSMENT

4.1 Methodology

This vulnerability assessment goes beyond the conventional risk assessment by including the adaptive capacity of assets. It also bears out location-specific characteristics appropriate to the Bundaberg region that may increase vulnerability in a location, and thus increase the relative criticality or importance of certain assets in those areas. Taking this approach ensures Council has a full understanding of asset vulnerability, prioritised by those most impacted by operational failure or climate change. The following diagram provides a place-based approach to assessing vulnerability, including the components that make up the assessment (Figure 4-1).

The relationship between the vulnerability of assets to coastal hazard, and the inherent vulnerabilities of the differing settlements within which these assets are found is complex and inter-related. In some ways, some settlements are made more vulnerable because of reliance upon highly exposed assets, while the inherent socio-economic vulnerability of other settlements may be magnified due to these exposed assets. Therefore, vulnerability is not simply about the exposure of present-day assets to coastal hazard, and their sensitivity to the hazard. A highly exposed electrical substation may create a nuisance if it is damaged in one locality, while exacerbating significant socio-economic vulnerability in another.

This vulnerability assessment recognises this intrinsic link between settlement-level vulnerabilities, and asset-specific vulnerabilities. It provides an integrated approach that recognises both as contributing to coastal hazard vulnerability. It also considers the characteristics of the population which can affect their response and hence vulnerability.

The methodology below for developing the vulnerability assessment is based upon the guidance provided by the QCoast 2100 Guidelines (namely, section 2.4.3) that refers to the *South Australian guidelines for developing a climate change adaptation plan and undertaking an integrated climate change vulnerability assessment.*

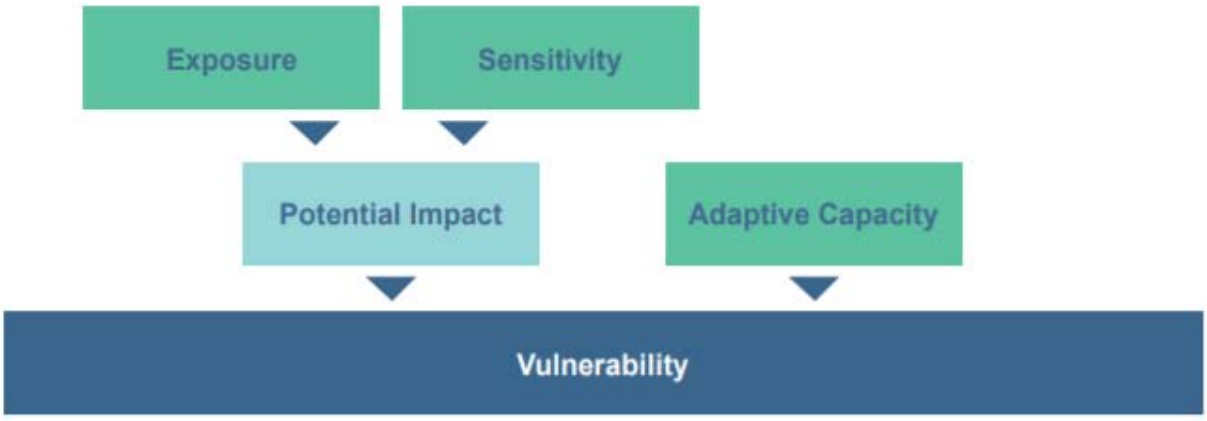


FIGURE 4-1 VULNERABILITY ASSESSMENT COMPONENTS

The methodology is derived from the categorisation and scoring approach developed by the South Australian guidelines and applied relative to the specific data availability and context of the Bundaberg region. A vulnerability assessment tool based on the above methodology was developed specifically for this purpose. Local settlement characteristics are included in the vulnerability assessment as part of the potential impact component. Specifically, the factors included in the assessment account for:

- Dependency of the settlement upon an asset
- Planned future growth of the settlement based on the Bundaberg Planning Scheme

- Extent of the local economy, environment and demographics of the population based on census data.

The key steps are described in more detail in the Technical Evidence Appendix Report.

4.2 Vulnerability Assessment Summary

The vulnerability analysis was performed using a specifically developed Microsoft Excel tool for the purpose. Detailed results of the analysis per locality and asset type are provided in the Technical Evidence Appendix Report. Summarised observations for each coastal settlement are provided below.

4.2.1 Miara, Winfield and Norval Park

Exposure to coastal hazard in Miara, Winfield and Norval Park is comparatively higher than other localities in Bundaberg, on an asset percentage basis. More than 50% of the Miara Caravan site, and commercial sites within the area, are exposed to coastal hazard. Substantial areas of residential assets are also affected.

However, future growth intent for this coastal settlement is low, being located outside the current LGIP area for the Bundaberg region. Key assets include the existing residential and commercial development in the locality, transport infrastructure, electricity, and farm infrastructure in nearby rural properties.

Maintaining services to this existing community, addressing the coastal hazard impacts to the residential and commercial development, and maintaining vehicular access are considered to be important considerations for this coastal settlement.

Examination of the effects of coastal hazard on the environmental assets in the coastal settlement is also considered important given the beach was one of the assets of highest criticality to the local area, and a wide range of endangered vegetation communities also scored highly.

4.2.2 Moore Park Beach

Coastal hazard exposure is moderately high in the Moore Park Beach area for multiple assets, particularly community facilities and services, and infrastructure. Growth intent for Moore Park Beach is also moderate, with some zoned growth and LGIP-driven asset upgrades planned for the coastal settlement.

A key asset identified in the analysis is the Fairydale drainage system, which is important to the local economy, specifically managing tidal flows to canelands east of Moore Park Beach.

Water supply is sourced from both town water mains and groundwater and the groundwater supply in particular is likely to be vulnerable to the effects of coastal hazards. Whilst the water treatment plant at Vecellios Road is not exposed, further consideration and consultation is required to understand the impacts of sea level rise and saltwater intrusion upon groundwater supply in the area.

Key assets include electricity, as well as important local services such as the school and local transport infrastructure is also of a concern. Addressing the role these services play in supporting the local community over time is worthy of further consideration, as is maintaining access to the community and addressing future growth.

4.2.3 Burnett Heads

Coastal hazard exposure of assets in Burnett Heads is comparatively higher than other coastal locations within Bundaberg. Multiple asset classes experience more than 50% exposure of their cohort, including waste treatment and disposal, parks, sportsgrounds, natural areas, and Council buildings.

Growth intent for Burnett Heads is high, with significant areas of zoned land for future development and related LGIP focus in this coastal settlement. Existing residential development is impacted only to a minor degree in Burnett Heads.

Total vulnerability scores and relative asset criticality were therefore comparatively higher in Burnett Heads than other localities. Key assets include utilities infrastructure such as sewerage, water supply, electricity/telecommunications, road infrastructure, and Council buildings. Continuity of service (i.e. resilience) for existing and future critical infrastructure is therefore considered of high importance in Burnett Heads, particularly to support the existing settlements, and emerging industrial development.

4.2.4 Bargara

Exposure of current-day assets in Bargara to storm tide inundation is relatively limited compared to the total asset counts for this coastal settlement. However, growth intent for Bargara is high, with significant zoned land and LGIP focus on future urban development in this locality, particularly through infill and intensification.

Total vulnerability scores and relative asset criticality for settlement and economic assets were therefore comparatively low for Bargara. Key assets include residential development, water supply infrastructure, electricity infrastructure, sewerage, and roads.

Environmental assets were the highest scoring asset type, with a significant priority placed on the beaches, rocky and coral reefs, estuaries and inlets, and the like. This is consistent with the presence of assets of high environmental value such as the turtle rookery on Mon Repos Beach.

Park assets were also considered of higher criticality than other assets in Bargara as they contribute to the important tourism component of the economy in Bargara.

The primacy of the environment, and continuity of service (i.e. resilience) for existing and future critical infrastructure, are therefore considered of high importance in Bargara if future intensification of the existing centre is to occur.

4.2.5 Innes Park and Coral Cove

Exposure of current-day assets (including residential development) in Innes Park and Coral Cove to coastal hazard is relatively limited compared to the total asset counts for this locality. However, growth intent for the area is high, with significant land zoned for future development, particularly through greenfield expansion and related LGIP focus in this locality.

Key assets included water supply, sewerage mains, and the farm infrastructure present on existing properties in the area.

Examination of the effects of coastal hazard on the environmental assets in the coastal settlement is also considered important given the beach was the asset of highest criticality to the local area. Other environmental assets such as marshes or wetlands, and recreation assets like parks and sports areas were also identified higher than other assets in this locality. Resilience of future critical infrastructure is also a consideration if development is to occur in this locality.

4.2.6 Elliott Heads

Exposure of current-day assets in Elliott Heads to coastal hazard is relatively limited compared to the total asset counts for this coastal settlement. There is some growth intent for Elliott Heads, with some land zoned for future urban development, particularly limited greenfield development and LGIP focus in this locality.

Key assets include utilities infrastructure such as water supply and electricity, while transport infrastructure also rated higher than other assets. Maintaining services to this existing community, and vehicular access, are considered to be important considerations for this coastal settlement.

Examination of the effects of coastal hazard on the environmental assets in the coastal settlement is also considered important given the beach was one of the assets of highest criticality to the local area.

4.2.7 Coonarr

Exposure of current-day assets (including residential development) in Coonarr to coastal hazard is relatively limited compared to the total asset counts for this coastal settlement. Future growth intent for this locality is also low, being located outside the current LGIP area for the Bundaberg region.

Maintaining vehicular access and electricity supply to this community are relevant considerations for this coastal settlement.

Examination of the effects of coastal hazard on the environmental assets in the coastal settlement is also considered important given the beach was the asset of highest criticality to the local area.

4.2.8 Woodgate Beach and Walkers Point

Coastal hazard exposure is moderately high in the Woodgate Beach area for multiple assets, particularly utilities infrastructure, and recreation assets such as parks and associated infrastructure. Growth intent for Woodgate is also moderate, with some land zoned for growth and LGIP-driven asset upgrades planned for the locality.

Key assets include utilities such as the Woodgate wastewater treatment plant, water supply and electricity. Affected residential development is also of a focus, while roads and recreation assets are also vulnerable.

Continuity of service (i.e. resilience) for existing and future critical infrastructure, and appropriate access to the community, is considered of high importance in Woodgate Beach if intensification of the existing settlement is to occur.

Examination of the effects of coastal hazard on the environmental assets in the coastal settlement is also considered important given the beach was the asset of highest criticality to the local area.

4.2.9 Buxton

Exposure of current-day assets (including residential development) in Buxton to coastal hazard is relatively limited compared to the total asset counts for this coastal settlement. Future growth intent for this locality is also low, being located outside the current LGIP area for the Bundaberg region.

Key assets include utilities infrastructure such as electricity powerlines, while transport infrastructure also rated higher than other assets. Maintaining services to this existing community, and vehicular access, are considered to be important considerations for this coastal settlement.

4.2.10 Vulnerability summary

The analysis above has shown that coastal hazard affects the settlements in each coastal settlement in differing ways, relative to their existing exposures, community contexts, social and economic functions and characteristics, and future growth intents.

- Burnett Heads, Moore Park Beach, and Woodgate Beach exhibit the highest vulnerability scores and criticality of assets than other localities. Exposure of assets in these localities tends to be higher than other localities, and the relative importance to/dependency of these assets to their communities is higher. These localities also have future urban growth plans that may exacerbate vulnerability over time.
- Bargara is not as exposed to inundation as other localities but has significant urban growth intent and already plays a significant socio-economic role in the region. It also has highly prioritised environmental assets such as the beach. Therefore, a continued focus on the resilience of critical infrastructure in this coastal settlement is of importance in future phases, as is a continued focus on the coastal hazard impacts on environmental assets;

- The coastal villages of Buxton, Coonarr, Elliott Heads, and Miara, Winfield and Norval Park are reliant on maintaining existing services and access than other localities, and the criticality of environmental assets to these locations is high;
- The more suburban contexts of Innes Park and Coral Cove exhibit a need to focus on environmental and recreation assets as well as resilience of critical infrastructure; and
- The priority of environmental assets for consideration in future phases is a key observation in most localities. The beaches, estuaries/inlets, reefs, and endangered vegetation communities all tended to score as highly critical to localities across the study area;

The assets of highest importance to each settlement which have been scored an asset criticality level of 1 to 5 are shown in Table 4-1, i.e. the most vulnerable assets to be put forward for adaptation options with consideration of the priority risks.

TABLE 4-1 VULNERABILITY ASSESSMENT RESULT SUMMARY – PRIORITY ASSETS

	Miara, Norval Park and Winfield	Moore Park Beach	Burnett Heads	Bargara	Innes Park & Coral Cove	Elliott Heads	Coonarr	Woodgate Beach & Walkers Point	Buxton
Residential Properties	●	●	●	●	●	●	●	●	●
Roads / Access	● Miara Road	● Moore Park Road, Murdoch's Linking Road, and Lindemans Road	● Hermans Road, Creevey Road				● Coonarr Beach Road	● Walkers Point Road, Woodgate Road, Acacia Street, Theodolite Creek Drive	● Powers Street, Wharf Street, Charlton Street
Road Bridges	● N. Litabella Road, Rosedale Road	● Moore Park Road, Norton Road	● Harbour Esplanade						
Beach	●	●	●	●	●	●	●	●	
Water Supply		● Groundwater Supply infrastructure	●	●	●	●			
Powerlines		●		●		●	●	●	●
Electricity transformer	●	●	●						
Schools		● Moore Park School							

	Miara, Norval Park and Winfield	Moore Park Beach	Burnett Heads	Bargara	Innes Park & Coral Cove	Elliott Heads	Coonarr	Woodgate Beach & Walkers Point	Buxton
Sewer Mains		●			●				
Stormwater / Culverts		● Including: major culverts Malvern Drive	●					●	
Tidal Gates		● Fairydale and Moore Park drainage system							
Wastewater Treatment			●					●	
Waste Disposal			●					●	
Other environmental assets	●		●	●	●	●	●	●	●
	Tidal Flats Coastal dunes Alluvial river and creek flats		Tidal Flats Rocky & coral reefs Seagrass Alluvial river and creek flats	Rocky & coral reefs	Rocky & coral reefs Seagrass	Tidal Flats Rocky & coral reefs Seagrass Alluvial river and creek flats	Rocky & coral reefs Coastal dunes Alluvial river and creek flats Old loamy and sandy plains	Alluvial river and creek flats Tidal Flats Rocky & coral reefs Seagrass Coastal dunes Estuary Soft Bottom Habitat	Alluvial river and creek flats Old loamy and sandy plains

● Vulnerable Asset – a relative asset criticality level of 1 – 5, i.e. the assets considered to have the highest vulnerability.

4.3 Relationship of vulnerability and risk assessment

The vulnerability analysis provides an overall picture of vulnerability for each coastal settlement and the priority assets for adaptation. It identifies what is important to each coastal settlement that should be of primary focus when considered in combination with the risk assessment.

When coupled with the risk assessment, which will assign a risk rating to each settlement, adaptation options will be put forward for mitigating intolerable risks on the priority assets in particular.

5 RISK ASSESSMENT

5.1 Introduction

The risk assessment undertaken for the Bundaberg region is consistent with QCoast 2100 Guidelines and the National Emergency Risk Assessment Guidelines – AIDR Handbook 10 (NERAG).

The risk assessment is the overall process of risk identification, risk analysis and risk evaluation:

- Risk identification has been undertaken in chapter 2 and 4, by recognising and describing the exposure to coastal hazards across the region.
- Risk analysis is the process to comprehend the level of risk by examining likelihood and consequence of coastal hazards to generate a risk rating for each coastal settlement.
  - Likelihood examines the probability of an inundation or coastal erosion event occurring. For the CHAS, the likelihood of coastal erosion and storm surges were assumed to be independent, meaning that any given AEP erosion event will not necessarily be triggered by the corresponding AEP storm surge event.
  - Consequence examines the impact to the assets as a result of the coastal hazard. This is both the physical impact of the event on an asset, as well as that of the economic, social and environmental values attributed to the asset.
- Risk evaluation is the process of comparing the results of the risk analysis with an agreed tolerance scale to determine whether a risk is acceptable, tolerable or intolerable.

5.2 Risk Analysis

The risk analysis identifies the likely level risk to all the coastal settlements, ranging from low to extreme depending on a combination of coastal hazard events and sea level rise scenarios.

The risk analysis has been summarised in tables for each coastal settlement and presented in full detail within Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3. This includes all possible combinations of consequence (economic, social, environmental), coastal hazard (storm tide inundation and coastal erosion), and sea level conditions (i.e. current sea level, +0.2m, +0.4m and 0.8m increase).

5.2.1 Likelihood

Likelihood is expressed as the hazard's Annual Exceedance Probability (AEP), representing the probability that a hazard of a given intensity has to be reached or exceeded every year. The following AEP events were considered when assessing risk:

- Storm tide inundation 5% AEP, 2% AEP, 1% AEP, 0.2% AEP
- Coastal erosion 5%AEP, 2% AEP, 1% AEP[22]
- Present-day sea-level conditions and 0.2.m, 0.4m and 0.8m sea level rise scenarios have been assessed within the risk assessment.

[22] It should be noted that, as reported in Phase 3 of the CHAS, five key study locations were identified for further study and refinement of the coastal erosion extents: Moore Park Beach, Bargara (Kelly's Beach), Innes Park and Coral Cove, Coonarr, Woodgate Beach.

In all other locations, typically rocky foreshore or estuarine areas, the coastal erosion hazard extent is represented by the default erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance with the Queensland State Erosion Prone Area Mapping. The risk assessment includes the economic, social and environmental consequences applied to the 0.8m sea level rise scenario, to ensure the CHAS aligns with the State Planning Policy 2016 (SPP) specifically addressing the coastal hazard component of the State interest policy.

5.2.2 Consequence

The following consequences were assessed:

- **Economic:** including impacts on the built environment (buildings and infrastructure). Damage estimates accounted for residential and non-residential buildings, including commercial and industrial buildings. Infrastructure damage considered transport, electricity, telecommunication and, water and sewerage assets that, if damaged, would result in long-term interruptions of basic community services and functioning mechanisms. Each settlement is then assigned a value which equates to the consequence within Table 5-1 . Where possible, damages were quantified in monetary terms and converted to Net Present Value (NPV) to discount future costs to present-day values to account for the time value of money.
- **Social:** including impacts on people's health and life; to measure intangible, social damages consistent with best practice, this study estimated social/intangible damage to be 25% of total residential and commercial/industrial damages. Each settlement is then assigned a value which equates to the consequence within Table 5-1. Furthermore, the implications of isolation due to permanent inundation of key access roads was also considered.
- **Environmental:** impacts on coastal ecosystems of significant ecological, conservational or biodiversity value were assessed by proportioning the range and scale of the ecosystem types impacted combined with the ability of ecosystem to recover from coastal hazard events and the sensitivity of the ecosystem assigned within the Vulnerability Assessment.

TABLE 5-1 CONSEQUENCE SCALES APPLIED TO RISK ASSESSMENT

Consequence	Economic – Queensland Emergency Risk Management Framework (QERMF)	Social – QERMF	Environmental – QERMF
Catastrophic	Permanent decline of economic activity or government revenues from industries (e.g. mining, agriculture, tourism). Loss or failure of an industry and / or loss of asset as a direct result of emergency event that requires Federal and State Government financial assistance. The recovery from the loss of essential infrastructure would be prolonged and complicated and require Federal and State Government financial assistance. (>$100million damages)[23]	The community's social connectedness is irreparably broken, such that the community ceases to function effectively, breaks down and disperses in its entirety. This can be characterised by widespread loss of objects of cultural significance and impacts beyond emotional and psychological capacity across all parts of the community.[23] (>90% of intangible value lost) Isolation of the community due to permanent inundation of key access route.	Permanent destruction of an ecosystem or species recognised at the local, regional, State or national level and / or severe damage to or loss of an ecosystem or species recognised at the State and national level and / or significant loss or impairment of an ecosystem or species recognised at the national level. Permanent destruction of environmental values of interest. Consequence rating > 160
Major	Longer term decline of economic activity (e.g. several years) or government revenues from industries (e.g. mining, agriculture, tourism). Significant structural adjustment of an industry and / or significant damage to an asset that requires Federal and State Government financial assistance. The recovery from loss of essential infrastructure would be possible through State Government financial assistance. ($10 to $100million damages)	The community's social connectedness is significantly broken, such that extraordinary external resources are required to return the community to functioning effectively, with significant permanent dispersal. This can be characterised by reduced quality of life within the community, significant loss of or damage to most objects of cultural significance and impacts beyond emotional and psychological capacity in large parts of the community. (>70% of intangible value lost) Regular inundation of key access route that causes significant impacts to key services.	Minor damage to ecosystems or species recognised at the national level and / or significant loss or impairment of an ecosystem or species recognised at the State level and / or severe damage to or loss of an ecosystem or species recognised at the Local or regional level. Severe damage to environmental values of interest. Consequence rating between 120 and 160
Moderate	Medium term decline of economic activity (12 months or more) or government revenues from industries (e.g. mining, agriculture, tourism). Impairment of an industry and / or damage to an asset that requires State Government financial assistance resulting in medium term (12 months or more). The recovery from loss of essential infrastructure is simple but requires financial assistance beyond the allocated budget. ($1 to $10million damages)	The community's social connectedness is broken, such that community requires significant external resources to return the community to functioning effectively, with some permanent dispersal. This can be characterised by permanent damage to some objects of cultural significance and impacts beyond cultural and emotional capacity in some parts of the community. (>50% of intangible value lost)	Minor damage to ecosystems and species recognised at the State level and / or significant loss or impairment of an ecosystem or species recognised at the Local or regional level. Significant damage to environmental values of interest. Consequence rating between 80 and 120
Minor	Short term decline of economic activity (less than one year) and / or government revenues from industries (e.g. mining, agriculture, tourism). Minor damage to an industry and / or damage to an asset that requires the reallocation of budget for recovery, resulting in short term disruption (less than one year). The recovery from the loss of essential infrastructure achievable in short term through budget reallocation. ($250,000 to $1million damages)	The community's social connectedness is damaged, such that community requires some external resources to return the community to functioning effectively, with no permanent dispersal. This can be characterised by repairable damage to objects of cultural significance and impacts within emotional and psychological capacity of the community (>20% of intangible value lost)	Minor damage to ecosystems and species recognised at the Local or regional level. Minor damage to environmental values of interest. Consequence rating between 40 and 80
Insignificant	Short term disruption to economic activity and / or loss of assets within an industry or sector. Inconsequential business sector disruption due to emergency event. Recovery from loss of essential infrastructure achievable within current budget allocations. (<$250,000 damages)	The community's social connectedness is disrupted, such that the reprioritisation and / or reallocation of existing resources is required to return the community to functioning effectively, with no permanent dispersal. There is no or minor damage to objects of cultural significance, and no adverse emotional and psychological impacts. (<20% of intangible value lost)	No damage to ecosystems at any level. Inconsequential damage to environmental values of interest. Consequence rating < 40

[23] The consequence scale figures have been adapted from the Federal Department of Industry, Innovation and Science – Risk Management Handbook

5.2.3 Risk matrix

The risk rating corresponding to each likelihood and consequence is present in Table 5-2

TABLE 5-2 RISK MATRIX (QCOAST2100 GUIDELINES)

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
5% (Likely)					
2% (Possible)					
1% (Unlikely)					
0.2% (Rare)					

Risk Rating
Extreme Risk
High Risk
Medium Risk
Low Risk

5.3 Risk Evaluation

The level of risk has been further categorised based on what society would reasonably accept, tolerate or find intolerable. The NERAG Guidelines describe risk tolerance as the organisations readiness to bear the risk after risk treatment in order to achieve its objectives. In the context of Bundaberg Regional Council, that being continuation of service provision to the wider Bundaberg region.

The risk tolerance scale applied to the CHAS is presented in the following table:

TABLE 5-3 RISK TOLERANCE SCALE (QCOAST2100 GUIDELINES)

Risk Rating	Risk Profile
Extreme Risk	Intolerable
High Risk	Tolerable
Medium Risk	Tolerable
Low Risk	Acceptable

The objective of the CHAS is to identify the risk of coastal hazards to settlements and priority asses and identify adaptation options to reduce or maintain that the level of risk to a tolerable or acceptable level. The priority areas will therefore be those settlements subject to intolerable risks.

5.4 Risk Analysis and Evaluation Results

This section presents a summary of the risk analysis and evaluation for each coastal hazard, describing the likelihood / consequence and sea level rise scenario likely to result in the highest level of risk for each coastal settlement.

A risk profile is presented for each coastal settlement illustrating how the risk is likely to change with rising sea level conditions.

As part of the vulnerability assessment the assets identified were prioritised for each coastal settlement. The risk assessment applies an equitable assessment of the economic, social and environmental consequences across each coastal settlement to quantify the level of risk across the Bundaberg region.

5.4.1 Miara, Winfield and Norval Park

The relatively high exposure to coastal hazard in Miara, Winfield and Norval Park has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for this settlement can be found Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.1.

Figure 5-1 shows the risk profile for Miara, Winfield and Norval Park. Risk from both storm tide inundation and coastal erosion is discussed below. The risk from storm tide inundation is considered high and therefore tolerable across all sea level scenarios, the risk from coastal erosion is considered high under a 0.8m sea level rise scenario.

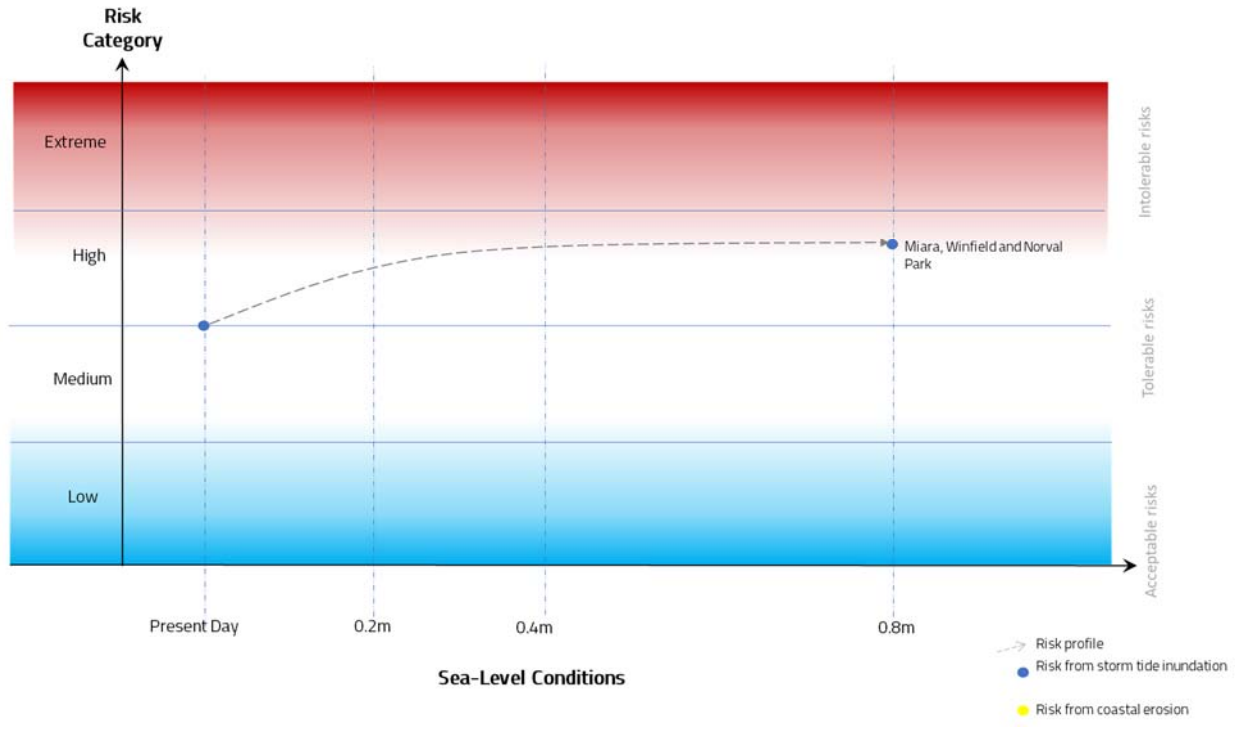


FIGURE 5-1 RISK PROFILE – MIARA, WINFIELD AND NORVAL PARK

STORM TIDE INUNDATION

- Residential properties and electricity transformers are the priority assets likely to experience storm tide inundation across all sea level conditions.

- The economic damages analysis has considered this to be a moderate consequence under present day, 0.2m and 0.4m of sea level rise. The economic consequences are considered major under a 0.8m sea level rise scenario.
- The social and environmental consequences are also considered major under a 0.8m sea level rise scenario.
- Figure 5-2 shows the priority assets in Miara, Winfield and Norval Park and the result of the risk assessment.
- Table 5-4 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario

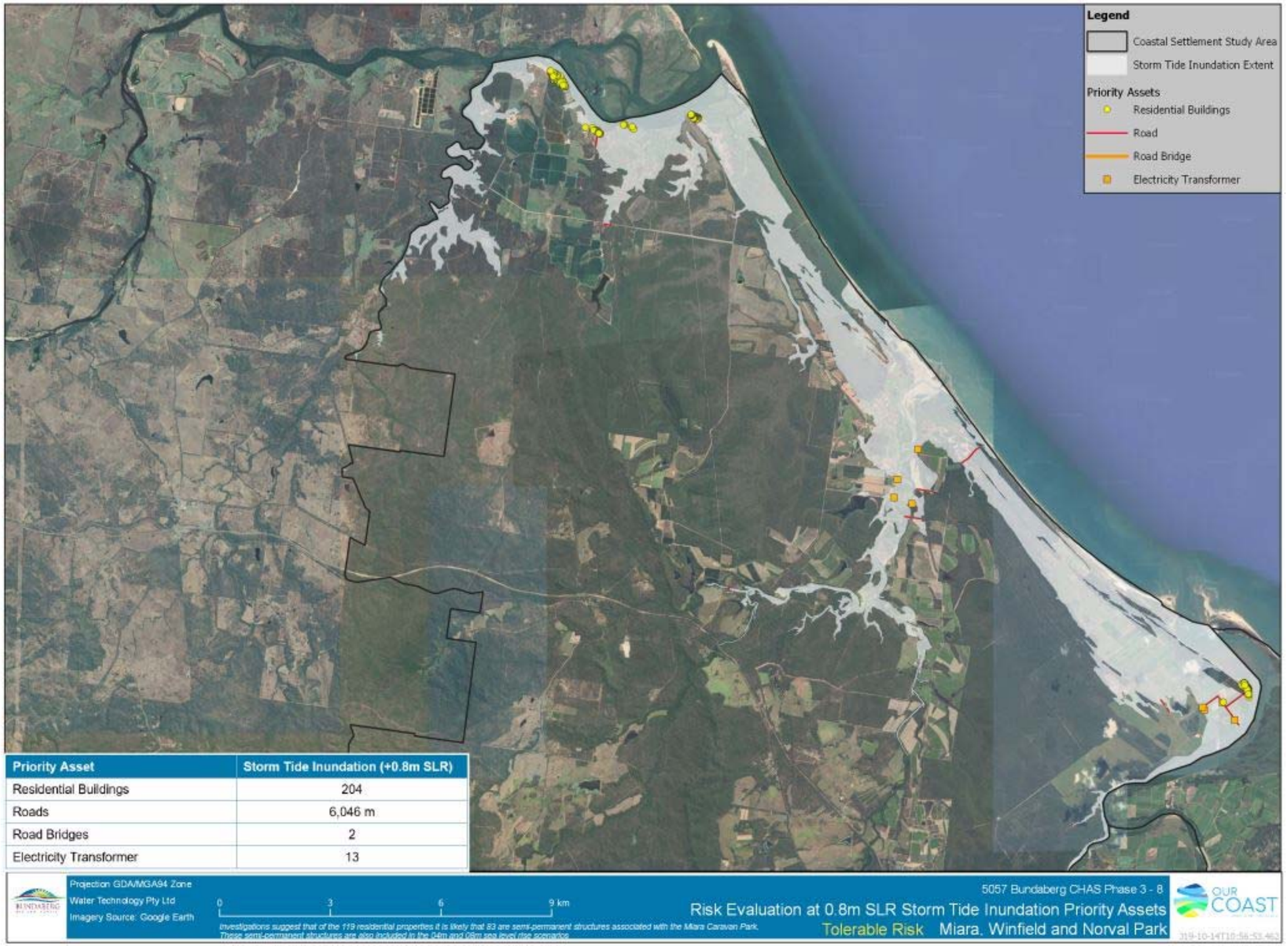


FIGURE 5-2 PRIORITY ASSETS AND RISK ASSESSMENT MAP, MIARA, WINFIELD AND NORVAL PARK

TABLE 5-4 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, MIARA, WINFIELD AND NORVAL PARK

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate	$10 to $100 million economic damages Major	$10 to $100 million economic damages Major
Social	>70% of intangible values and population at risk Moderate	Regular inundation of key access route that causes significant impacts to key services. Major	Regular inundation of key access route that causes significant impacts to key services. Major	Regular inundation of key access route that causes significant impacts to key services. Major
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Minor damage to ecosystems or species recognised at the National level and / or significant loss or impairment of an ecosystem or species. Environmental consequence score between 120 and 160 Major	Minor damage to ecosystems or species recognised at the National level and / or significant loss or impairment of an ecosystem or species. Environmental consequence score between 120 and 160 Major

- Table 5-5 shows the risk rating for a range of likelihood storm tide inundation events.

TABLE 5-5 STORM TIDE INUNDATION RISK ANALYSIS MIARA, WINFIELD AND NORVAL PARK

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	High	High	High	Extreme
2% (Possible)	High	High	High	High
1% (Unlikely)	Medium	Medium	Medium	High
0.2% (Rare)	Medium	Medium	Medium	High

- The risk from storm tide inundation coastal hazard within the Miara, Winfield and Norval Park coastal settlement is generally **high-risk** across all sea level scenarios and therefore is considered to be a **tolerable risk.**
- Please refer to Appendix F, Table I-1 for the full set of risk assessment results for Miara, Winfield and Norval Park.

COASTAL EROSION

- One coastal erosion scenario considered for this coastal settlement study area, i.e. the default erosion prone area width using the 0.8m sea level rise scenario in accordance with the Queensland State Erosion Prone Area Mapping.
- Residential properties, electricity transformers are the priority assets exposed to coastal erosion.

- The economic damages analysis has considered this to be a major consequence under a 0.8m sea level rise scenario.
- Miara Road is likely to experience regular inundation and likely to be permanently inundated in the 0.8m sea level rise scenario. The road is not classified as a key access route. The social consequence analysis has considered this to be a major social consequence given then moderate adaptive capacity of the semi-permanent structures in the Miara Caravan Park.
- Table 5-6 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) for the 0.8m sea level rise scenario.

TABLE 5-6 COASTAL EROSION CONSEQUENCE SUMMARY, MIARA, WINFIELD AND NORVAL PARK

Consequence	0.8m SLR
Economic	$10 to $100 million economic damages Major
Social	Regular inundation of key access route that causes significant impacts to key services. Major
Environmental	Minor damage to ecosystems or species recognised at the national level and / or significant loss or impairment of an ecosystem or species. Environmental score between 120 and 160 Major

- Table 5-7 shows a summary of the risk rating for the one coastal erosion extent, across a range of likelihood events.

TABLE 5-7 COASTAL EROSION RISK ANALYSIS SUMMARY, MIARA, WINFIELD AND NORVAL PARK

Likelihood	0.8m SLR
5% (Likely)	Extreme
2% (Possible)	High
1% (Unlikely)	High

- The risk rating for coastal erosion hazard is generally **high** for the **0.8m sea level rise scenario**[24], and therefore is considered to be a **tolerable risk**
- Please refer to Appendix F, Table I-1 for the full set of risk assessment results for Miara, Winfield and Norval Park.

SENSITIVITY ANALYSIS OF MIARA CARAVAN PARK

It is important to note that approximately 83 semi-permanent structures associated with the Miara Caravan Park were not included in the economic assessment. A further sensitivity analysis of the economic assumptions has been undertaken to include the semi-permanent structures from the damage's calculation. This analysis is shown in Appendix E, Section 3.3.

[24] Only one scenario considered for coastal erosion in this settlement.

5.4.2 Moore Park Beach

The relatively moderate exposure to coastal hazard in Moore Park Beach Park has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for this settlement can be found in Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.2

Moore Park Beach is more impacted by coastal erosion than storm tide inundation. The risk from coastal erosion is considered high under present-day sea-level conditions and this increases to extreme and therefore **intolerable risk** under a 0.4m sea level rise scenario.

Figure 5-3 shows the risk profile for Moore Park Beach. Risk from both storm tide inundation and coastal erosion is discussed below.

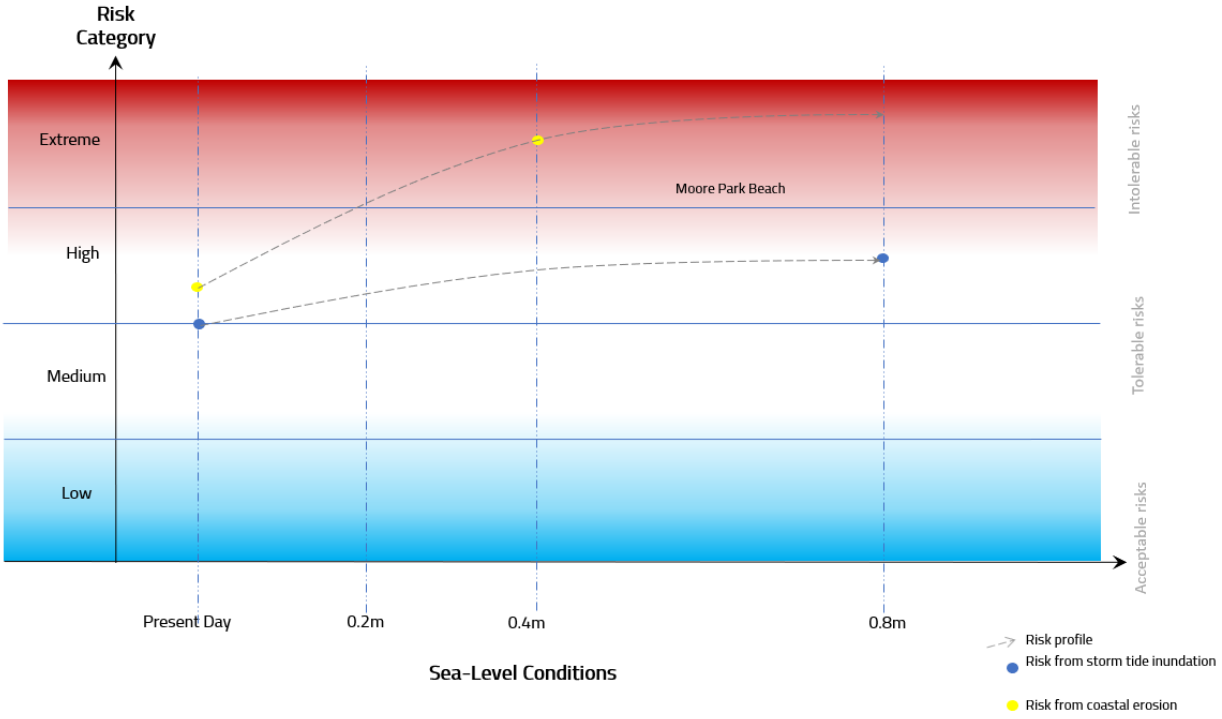


FIGURE 5-3 RISK PROFILE – MOORE PARK BEACH

COASTAL EROSION

- Moore Park Beach settlement study area identified for further refinement of erosion prone area mapping. Multiple sea level scenarios considered for this settlement
- Residential properties, electricity transformers, powerlines, water supply infrastructure, Moore Park School, sewerage and stormwater mains and tidal drainage system are exposed to coastal erosion
- The economic damages analysis has considered this to be of moderate consequence under present-day sea-level conditions, this increases to major under a 0.2m sea level rise and catastrophic under a 0.4m sea level rise scenario.
- Moore Park Beach Road, Lindeman Road, Murdoch's Linking Road and Malvern Drive are all likely to be permanently inundated in the 0.8m sea level rise scenario. These roads are considered as a key access route. The social consequence analysis has considered this to be a catastrophic social consequence given the likely isolation of the community.
- Figure 5-4 shows the priority assets in Moore Park Beach and the result of the risk assessment.
- Table 5-8 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

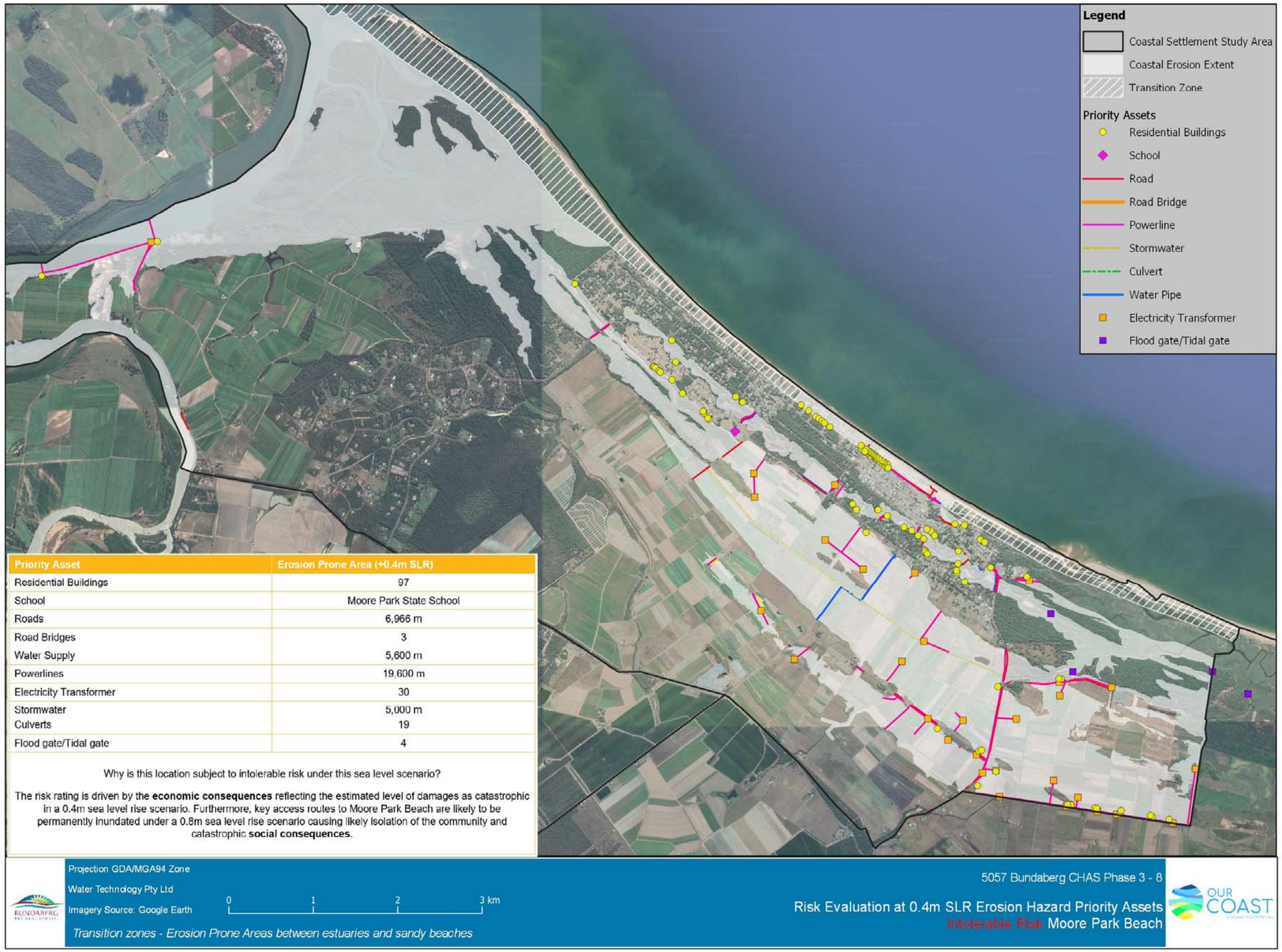


FIGURE 5-4 PRIORITY ASSETS AND RISK ASSESSMENT MAP, MOORE PARK BEACH

TABLE 5-8 COASTAL EROSION CONSEQUENCE SUMMARY, MOORE PARK BEACH

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$1 to $10 million economic damages Moderate	$10 to $100 million economic damages Major	> $100 million economic damages Catastrophic	> $100 million economic damages Catastrophic
Social	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	Regular inundation of key access route that causes significant impacts to key services. Major	Isolation of the community due to permanent inundation of key access route. Catastrophic
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Minor damage to ecosystems or species recognised at the National level and / or significant loss or impairment of an ecosystem or species. Environmental consequence score between 120 and 160 Major

- Table 5-9 shows the risk rating for a range of likelihood coastal erosion events.

TABLE 5-9 COASTAL EROSION RISK ANALYSIS SUMMARY, MOORE PARK BEACH

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	High	Extreme	Extreme	Extreme
2% (Possible)	High	High	Extreme	Extreme
1% (Unlikely)	Medium	High	Extreme	Extreme

- The risk ratings for coastal erosion hazard indicate generally **high risk** under present day and a 0.2m sea level rise scenario, increasing to **extreme risk** under a **0.4m sea level rise scenario**, and Moore Park Beach therefore is considered to be subject an **intolerable risk.**
- Please refer to Appendix F, Table I-3 for the full set of risk assessment results for Moore Park Beach.

STORM TIDE INUNDATION

- Residential properties, electricity transformers, powerlines, water supply infrastructure, Moore Park School, sewerage and stormwater mains and tidal drainage system are likely to experience storm tide inundation across all sea level conditions.
- The economic damages analysis has considered this to be a moderate consequence under present-day sea-level conditions, increasing to major under a 0.2m, 0.4m and 0.8m sea level rise scenarios.
- The social and environmental consequences of storm tide inundation are minor under present day se level conditions which increase to major and catastrophic in much rarer events under a 0.8m sea level scenario.

- Table 5-10 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario

TABLE 5-10 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, MOORE PARK BEACH

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$1 to $10 million economic damages Moderate	$10 to $100 million economic damages Major	$10 to $100 million economic damages Major	> $100 million economic damages (rare events only) Catastrophic
Social	>20% of intangible values and population at risk Minor	>20% of intangible values and population at risk Minor	>50% of intangible values and population at risk Moderate	>90% of intangible values and population at risk (rare events only) Catastrophic
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Minor damage to ecosystems or species recognised at the National level and / or significant loss or impairment of an ecosystem or species. Environmental consequence score between 120 and 160 Major

- Table 5-11 shows the risk rating for a range of likelihood storm tide inundation events.

TABLE 5-11 STORM TIDE INUNDATION RISK ANALYSIS MOORE PARK BEACH

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	High	Extreme	Extreme	Extreme
2% (Possible)	High	High	High	High
1% (Unlikely)	Medium	High	High	High
0.2% (Rare)	Medium	Medium	Medium	High

- The risk ratings from storm tide inundation coastal hazard within the Moore Park Beach coastal settlement are generally **high** across all sea level scenarios and therefore is considered to be a **tolerable risk.**
- Please refer to Appendix F, Table I-3 for the full set of risk assessment results for Moore Park Beach.

5.4.3 Burnett Heads

The relatively high exposure to coastal hazard in Burnett Heads coastal area has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for Burnett Heads can be found in Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.3.

The risk from storm tide inundation is considered high under present-day sea-level conditions and increases to extreme risk and is therefore intolerable under a 0.8m sea level rise scenario.

Figure 5-5 shows the risk profile for Burnett Heads. Risk from both storm tide inundation and coastal erosion is discussed below.

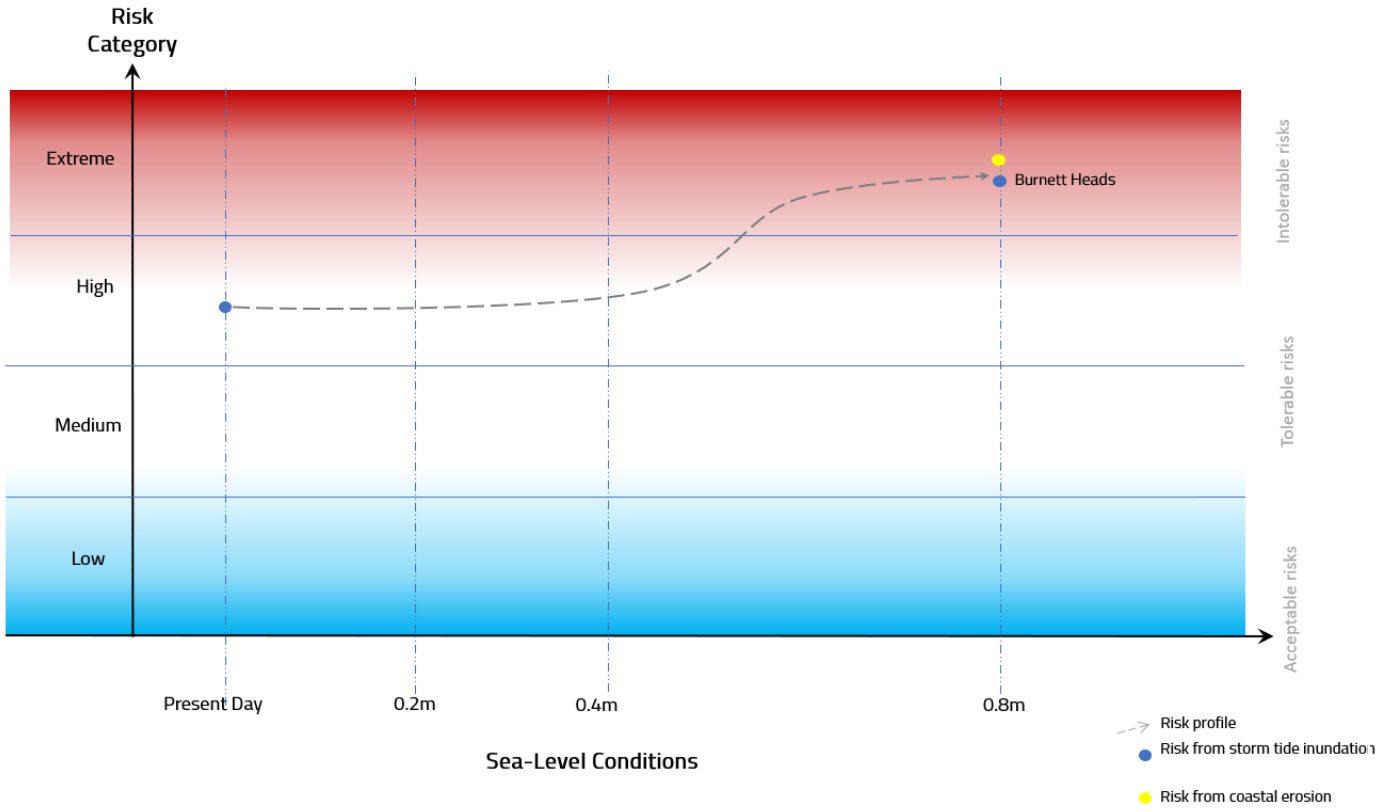
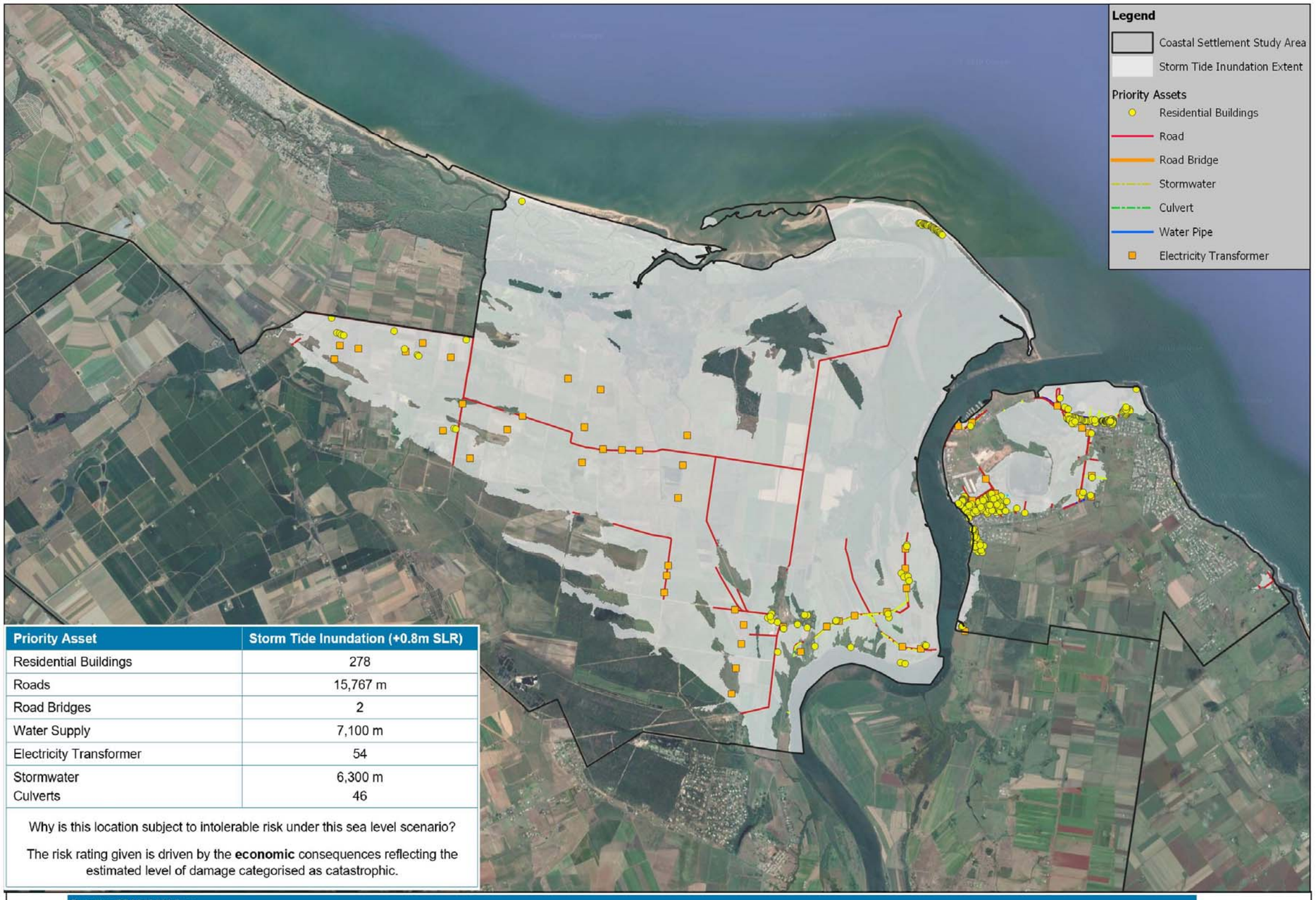


FIGURE 5-5 RISK PROFILE – BURNETT HEADS

STORM TIDE INUNDATION

- Residential properties, electricity transformers, water supply infrastructure, the Harbour Esplanade road bridge, Hermans Road and Creevey Road are likely to experience storm tide inundation across all sea level conditions.
- The economic damages analysis has considered this to be a major consequence under present day, 0.2m and 0.4m of sea level rise. The economic consequences are considered catastrophic under a 0.8m sea level rise scenario.
- The social consequences are considered catastrophic under a 0.8m sea level rise scenario.
- Figure 5-6 shows the priority assets in Burnett Heads and the result of the risk assessment.
- Table 5-12 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.



Priority Asset	Storm Tide Inundation (+0.8m SLR)
Residential Buildings	278
Roads	15,767 m
Road Bridges	2
Water Supply	7,100 m
Electricity Transformer	54
Stormwater Culverts	6,300 m 46

Why is this location subject to intolerable risk under this sea level scenario?

The risk rating given is driven by the **economic** consequences reflecting the estimated level of damage categorised as catastrophic.

FIGURE 5-6 PRIORITY ASSETS AND RISK ASSESSMENT MAP, BURNETT HEADS

TABLE 5-12 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, BURNETT HEADS

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$10 to $100 million economic damages Major	$10 to $100 million economic damages Major	$10 to $100 million economic damages Major	> $100 million economic damages Catastrophic
Social	>50% of intangible values and population at risk Moderate	>50% of intangible values and population at risk Moderate	>70% of intangible values and population at risk Major	>90% of intangible values and population at risk (rare events only) Catastrophic
Environmental	No damage to ecosystems at any level. Inconsequential damage to environmental values of interest. Environmental consequence score < 40 Insignificant	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor

- Table 5-13 shows the risk rating for a range of likelihood storm tide inundation events.

TABLE 5-13 STORM TIDE INUNDATION LIKELIHOOD AND CONSEQUENCE SUMMARY, BURNETT HEADS

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Extreme	Extreme	Extreme	Extreme
2% (Possible)	High	High	High	Extreme
1% (Unlikely)	High	High	High	Extreme
0.2% (Rare)	Medium	Medium	Medium	High

- The risk ratings for storm tide inundation coastal hazard within the Burnett Heads coastal settlement are generally **high** under present-day sea-level conditions, a 0.2m sea level rise and a 0.4m sea level rise scenario. This moves to **extreme risk** under a 0.8m sea level rise scenario and therefore is considered to be an **intolerable risk.**
- Please refer to Appendix F, Table I-4 for the full set of risk results for Burnett Heads.

COASTAL EROSION

- One coastal erosion scenario considered for this coastal settlement study area, i.e. the default erosion prone area width using the 0.8m sea level rise scenario in accordance with the Queensland State Erosion Prone Area Mapping.
- Residential buildings, electricity transformers, water supply infrastructure and the Harbour Esplanade road bridge are exposed to coastal erosion.

- The economic damages analysis has considered this to be a major consequence under a 0.8m sea level rise scenario.
- The risk ratings for erosion coastal hazard has indicated generally **high-risk** for the **0.8m sea level rise scenario**[25], and therefore is considered to be a **tolerable risk.**
- Table 5-14 show a summary of the overriding consequences (economic, social or environmental) for coastal erosion under a 0.8m sea level rise scenario.

TABLE 5-14 COASTAL EROSION CONSEQUENCE SUMMARY, BURNETT HEADS

Consequence	0.8m SLR
Economic	> $100 million economic damages Catastrophic
Social	>20% of intangible values and population at risk Minor
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor

- Table 5-15 shows the risk rating for a range of likelihood coastal erosion events

TABLE 5-15 COASTAL EROSION LIKELIHOOD AND CONSEQUENCE SUMMARY, BURNETT HEADS

Likelihood	0.8m SLR
5% (Likely)	Extreme
2% (Possible)	High
1% (Unlikely)	High

- The risk ratings for coastal erosion hazard is generally **high** for the **0.8m sea level rise scenario**[26], and therefore is considered to be a **tolerable risk.**
- Please refer to Appendix F, Table I-4 for the full set of risk assessment results for Burnett Heads.

[26] Only one scenario considered for coastal erosion in Burnett Heads.

5.4.4 Bargara

The limited exposure to coastal hazard in the Bargara coastal area has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for Bargara can be found in Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.4 and 3.3.5.

Bargara is more impacted by coastal erosion than storm tide inundation, particularly along the foreshore of Nielson's Park and Kelly's Beach. Kelly's Beach is an area that has been identified for further refinement of the erosion prone area mapping and a separate risk analysis has been undertaken for north and south Kelly's Beach.

The risk from coastal erosion is considered **extreme** to the settlement of Bargara and is therefore subject to **intolerable risk** under a 0.8m sea level rise scenario.

Figure 5-7 shows the risk profile for Bargara, including the risk analysis and evaluation undertaken for Kelly's Beach. Risk from both storm tide inundation and coastal erosion is discussed below.

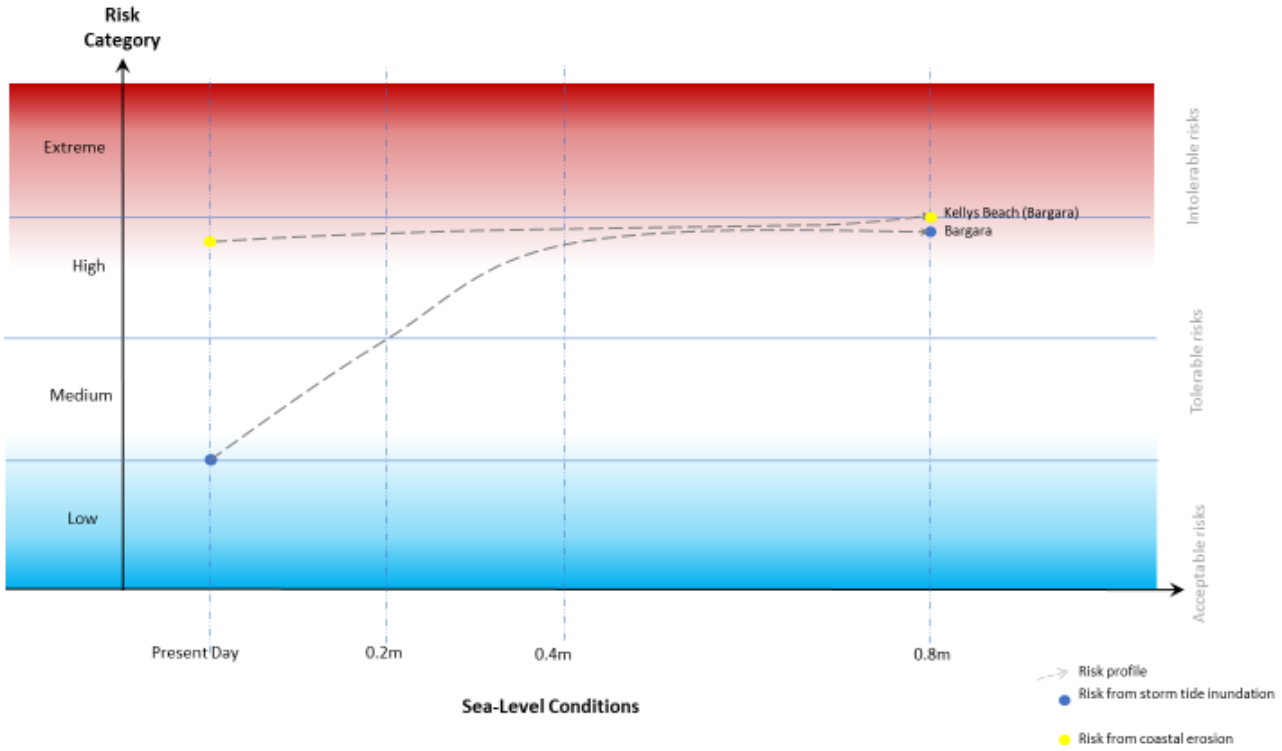


FIGURE 5-7 RISK PROFILE – BARGARA (INC KELLYS BEACH)

COASTAL EROSION – BARGARA

- The Bargara coastal settlement study area is represented by the default erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance with the QLD State Erosion Prone Area Mapping.
- Residential properties, powerlines, water supply infrastructure, the beach and other environmental assets are exposed to coastal erosion
- The economic damages analysis has considered this to be a catastrophic consequence under a 0.8m sea level rise scenario.
- The social consequences are considered to be moderate and environmental consequences to be minor under a 0.8m sea level rise scenario.

FIGURE 5-8 PRIORITY ASSETS AND RISK ASSESSMENT MAP, BARGARA

- Figure 5-8 shows the priority assets in Bargara and the result of the risk assessment and Table 5-16 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) for the 0.8m sea level rise scenario.

TABLE 5-16 COASTAL EROSION CONSEQUENCE SUMMARY, BARGARA

Consequence	0.8m SLR
Economic	> $100 million economic damages Catastrophic
Social	>50% of intangible values and population at risk Moderate
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor

- Table 5-17 shows the risk rating for a range of likelihood coastal erosion events

TABLE 5-17 COASTAL EROSION LIKELIHOOD AND CONSEQUENCE SUMMARY, BARGARA

Likelihood	0.8m SLR
5% (Likely)	Extreme
2% (Possible)	Extreme
1% (Unlikely)	Extreme

- The risk ratings for coastal erosion hazard is generally **extreme** for the **0.8m sea level rise scenario**[27], and therefore is considered to be an **intolerable risk.**
- Please refer to Appendix F, Table I-5 for the full set of risk assessment results for Bargara.

COASTAL EROSION – KELLYS BEACH

- Kelly's Beach has been identified for further refinement of erosion prone area mapping. Multiple sea level scenarios considered for this section of the shoreline
- Residential properties, powerlines, water supply infrastructure, the beach and other environmental assets are exposed to coastal erosion
- The economic damages analysis has considered this to be a major consequence under all sea level conditions.
- The social consequences are considered to be of a minor nature under present-day sea-level conditions increasing to major under a 0.8m sea level rise scenario.
- Table 5-18 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

[27] Only one scenario considered for coastal erosion for Bargara, with the exception of Kelly's Beach.

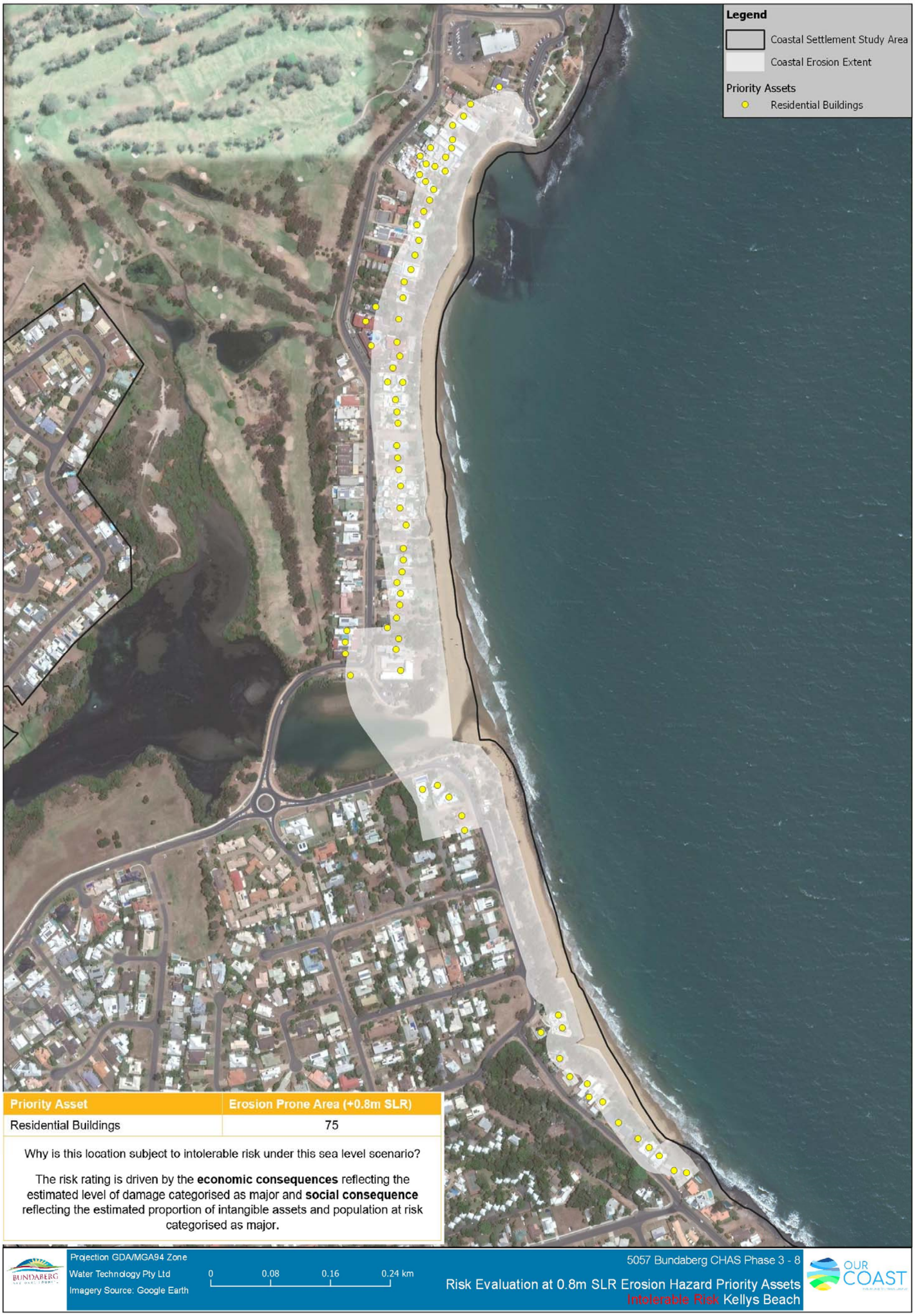


FIGURE 5-9 PRIORITY ASSETS AND RISK ASSESSMENT MAP, BARGARA (KELLYS BEACH)

- Figure 5-9 shows the priority assets in Kellys Beach and the result of the risk assessment.
- Table 5-18 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across a range if sea level scenarios.

TABLE 5-18 COASTAL EROSION CONSEQUENCE SUMMARY, KELLY'S BEACH, BARGARA

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$10 to $100 million economic damages Major	$10 to $100 million economic damages Major	$10 to $100 million economic damages Major	$10 to $100 million economic damages Major
Social	>20% of intangible values and population at risk Minor	>50% of intangible values and population at risk Moderate	>50% of intangible values and population at risk Moderate	>70% of intangible values and population at risk Major
Environmental	No damage to ecosystems at any level. Inconsequential damage to environmental values of interest. Environmental consequence score < 40 Insignificant	No damage to ecosystems at any level. Inconsequential damage to environmental values of interest. Environmental consequence score < 40 Insignificant	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor

- Table 5-19 shows the risk rating for a range of likelihood coastal erosion events.

TABLE 5-19 COASTAL EROSION RISK ANALYSIS SUMMARY, KELLY'S BEACH, BARGARA

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Extreme	Extreme	Extreme	Extreme
2% (Possible)	High	High	High	High
1% (Unlikely)	High	High	High	High

- The risk ratings for coastal erosion hazard is generally **high** across all sea level scenarios, however as stated above, the risk ratings for coastal erosion hazard is **extreme** and considered to be an **intolerable risk** for the coastal settlement of Bargara.
- Please refer to Appendix F, Table I-6 for the full set of risk assessment results for Kelly's Beach Bargara.

STORM TIDE INUNDATION

- Residential properties, powerlines, water supply infrastructure, the beach and other environmental assets are likely to experience storm tide inundation across all sea level conditions.
- The economic damages analysis has considered this to be a minor consequence under present day and 0.2m of sea level rise. The economic consequences are considered moderate and major under a 0.4m and 0.8m sea level rise scenario.
- The social and environmental consequences are largely insignificant under all sea level conditions.
- Table 5-20 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

TABLE 5-20 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, BARGARA

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$250,000 to $1 million economic damages Minor	$250,000 to $1 million economic damages Minor	$1 to $10 million economic damages Moderate	$10 to $100 million economic damages Major
Social	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	>50% of intangible values and population at risk Moderate	>50% of intangible values and population at risk Moderate
Environmental	No damage to ecosystems at any level. Inconsequential damage to environmental values of interest. Environmental consequence score < 40 Insignificant	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate

- Table 5-21 shows the risk rating for a range of likelihood storm tide inundation events.

TABLE 5-21 STORM TIDE INUNDATION LIKELIHOOD AND CONSEQUENCE SUMMARY, BARGARA

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Low	Low	Low	Extreme
2% (Possible)	Low	Low	Low	High
1% (Unlikely)	Medium	Medium	Medium	High
0.2% (Rare)	Low	Low	Medium	Medium

- The risk ratings for storm tide inundation within the Bargara coastal settlement are generally **low to medium** under present-day sea-level conditions, 0.2m sea level rise and 0.4m sea level rise scenarios.

This moves to **high risk** under a 0.8m sea level rise scenario and therefore is considered to be **tolerable risk.**

- Please refer to Appendix F, Table I-5 for the full set of risk results for Bargara.

5.4.5 Innes Park and Coral Cove

The limited exposure to coastal hazard in Innes Park and Coral Cove has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for this settlement can be found in Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.6.

Innes Park and Coral Cove is more impacted by coastal erosion than storm tide inundation. The risk from coastal erosion is considered low under present-day sea-level conditions and this increases to extreme and therefore **intolerable risk** under a 0.8m sea level rise scenario.

Figure 5-10 shows the risk profile for Moore Park Beach. Risk from both storm tide inundation and coastal erosion is discussed below.

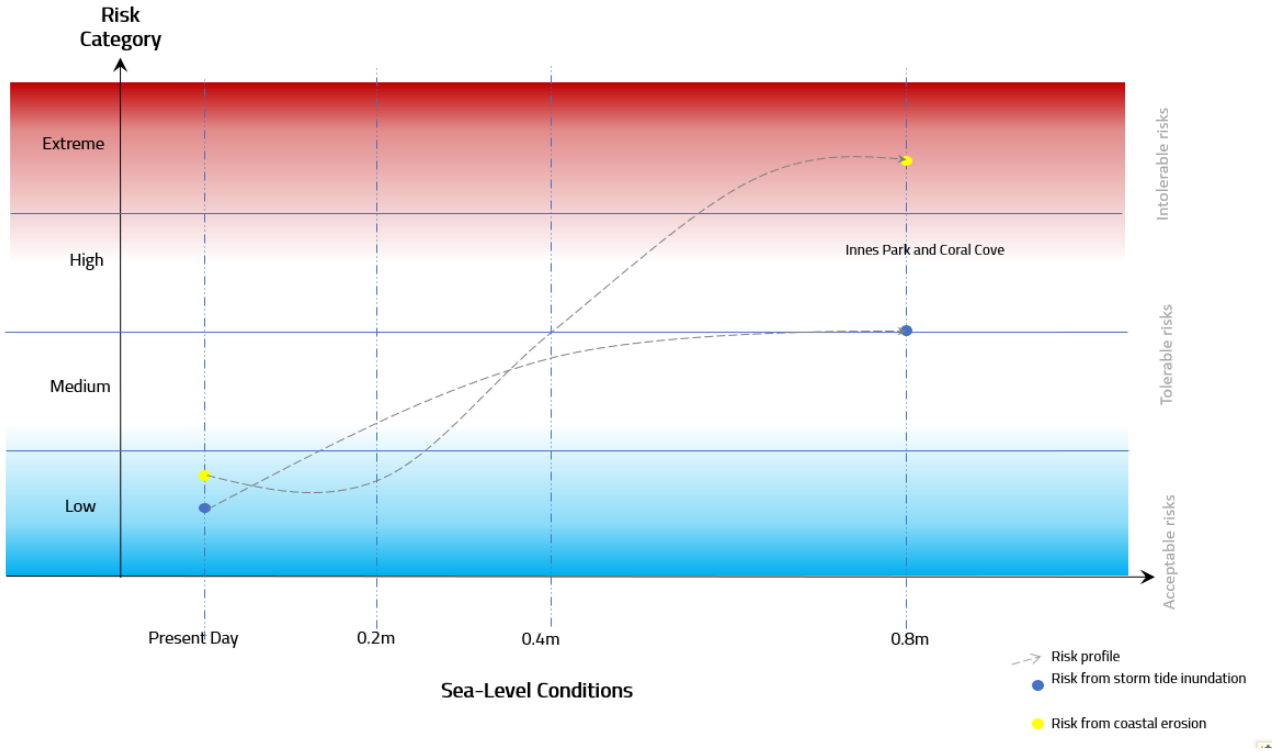


FIGURE 5-10 RISK PROFILE – INNES PARK AND CORAL COVE

COASTAL EROSION

- Innes Park and Coral Cove coastal settlement study area has been identified for further refinement of erosion prone area mapping. Multiple sea level scenarios considered for this section of the shoreline
- Residential properties, water supply infrastructure, sewer mains, the beach and other environmental assets are exposed to coastal erosion
- The economic damages analysis has considered this to be an insignificant consequence under present-day sea-level conditions increasing to moderate under a 0.4m sea level rise scenario and major under a 0.8m sea level rise scenario

- The social consequences are considered to be insignificant under present-day sea-level conditions increasing to minor under a 0.4m sea level rise scenario and catastrophic under a 0.8m sea level rise scenario
- Figure 5-11 shows the priority assets in Innes Park and Coral Cove and the result of the risk assessment.
- Table 5-22 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

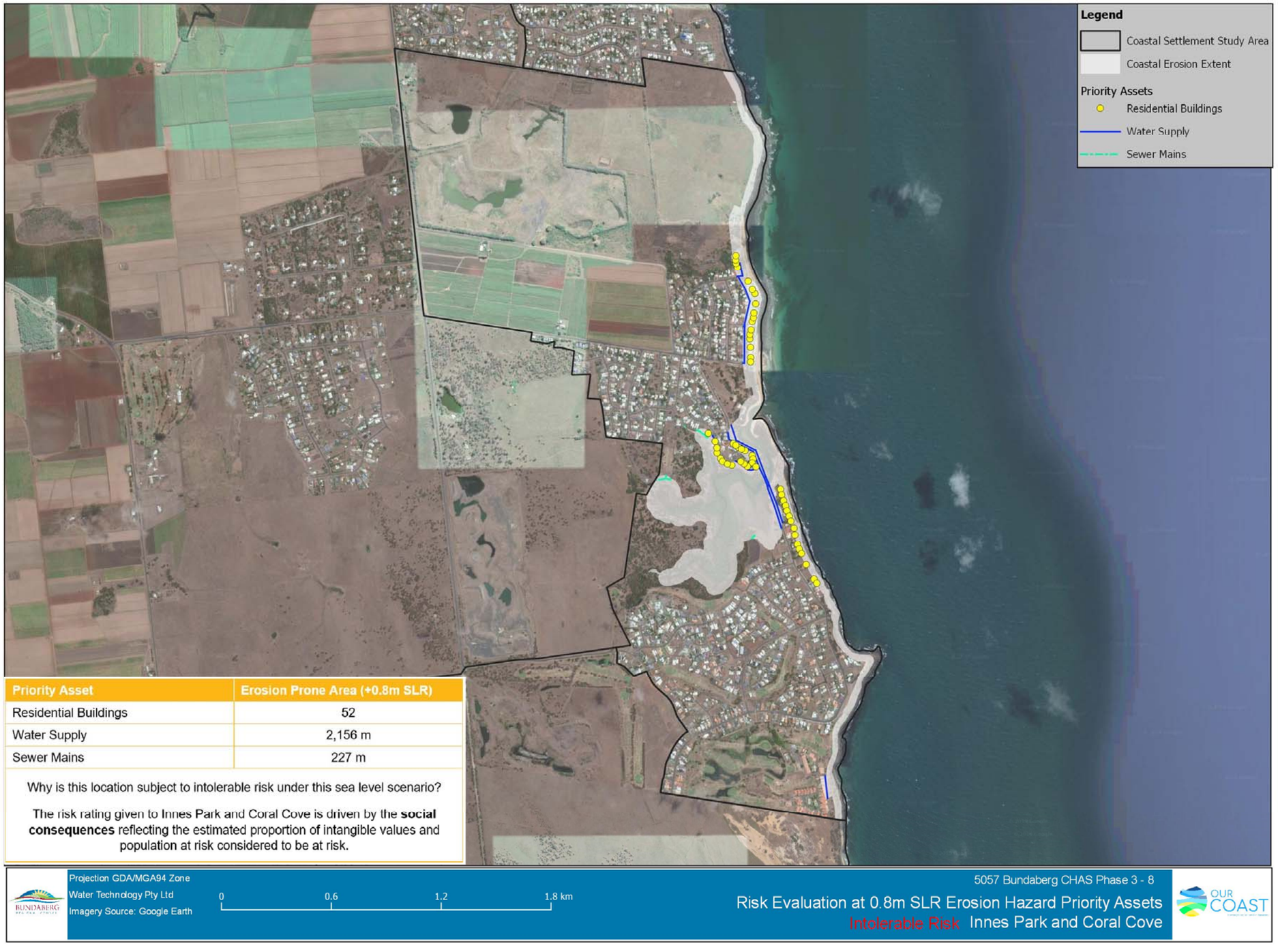


FIGURE 5-11 PRIORITY ASSETS AND RISK ASSESSMENT MAP, INNES PARK AND CORAL COVE

TABLE 5-22 COASTAL EROSION CONSEQUENCE SUMMARY, INNES PARK AND CORAL COVE

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$0 to $250,000 economic damages Insignificant	$0 to $250,000 economic damages Insignificant	$1 to 10 million economic damages Moderate	$10 to $100 million economic damages Major
Social	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	>20% of intangible values and population at risk Minor	>90% of intangible values and population at risk Catastrophic
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate

- Table 5-23 shows the risk rating for a range of likelihood coastal erosion events.

TABLE 5-23 COASTAL EROSION RISK ANALYSIS SUMMARY, INNES PARK AND CORAL COVE

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Low	Low	High	Extreme
2% (Possible)	Low	Low	High	Extreme
1% (Unlikely)	Medium	Medium	Medium	Extreme

- The risk ratings for coastal erosion hazard is generally **low risk** under present-day sea-level conditions, increasing to **extreme risk** under a **0.8m sea level rise scenario**, and therefore is considered to be subject to **intolerable risk.**

Please refer to Appendix F, Table I-7 for the full set of risk assessment results for Innes Park and Coral Cove.

STORM TIDE INUNDATION

- Residential properties, water supply infrastructure, sewer mains, the beach and other environmental assets are likely to experience storm inundation under all sea level conditions.
- The economic damages analysis has considered this to be a minor consequence under present-day sea-level conditions which increases to moderate under a 0.4m and 0.8m sea level rise scenario.
- The social consequences are considered to be of a minor nature under all-day sea-level conditions.
- The environmental consequences are considered to be minor under present-day sea-level conditions increasing to major under a 0.8m sea level rise scenario.

- Table 5-24shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

TABLE 5-24 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, INNES PARK AND CORAL COVE

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$250,000 to $1 million economic damages Minor	$250,000 to $1 million economic damages Minor	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate
Social	>20% of intangible values and population at risk Minor	>20% of intangible values and population at risk Minor	>20% of intangible values and population at risk Minor	>20% of intangible values and population at risk Minor
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Minor damage to ecosystems or species recognised at the National level and / or significant loss or impairment of an ecosystem or species. Environmental consequence score between 120 and 160 Major

- Table 5-25 shows the risk rating for a range of likelihood coastal erosion events.

TABLE 5-25 STORM TIDE INUNDATION RISK ANALYSIS SUMMARY, INNES PARK AND CORAL COVE

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Low	Low	High	High
2% (Possible)	Low	Low	High	High
1% (Unlikely)	Medium	Medium	Medium	Medium
0.2% (Rare)	Low	Low	Medium	Medium

- The risk ratings for storm tide inundation within the Innes Park and Coral Cove coastal settlement are generally **low to medium** under present-day sea-level conditions and 0.2m sea level rise scenario. This increases to **high risk** under a 0.4 and 0.8m sea level rise scenarios and therefore is considered to be a **tolerable risk.**
- Please refer to Appendix F, Table I-7 for the full set of risk assessment results for Innes Park and Coral Cove.

5.4.6 Elliott Heads

The limited exposure to coastal hazard in Elliott Heads has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for this settlement can be found in Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.7.

Elliott Heads is impacted more by storm tide inundation than by coastal erosion. The risk from storm tide inundation is considered medium under present-day sea-level conditions and this increases to high and therefore a **tolerable risk** under a 0.8m sea level rise scenario.

Figure 5-12 shows the risk profile for Elliott Heads. Risk from both storm tide inundation and coastal erosion is discussed below.

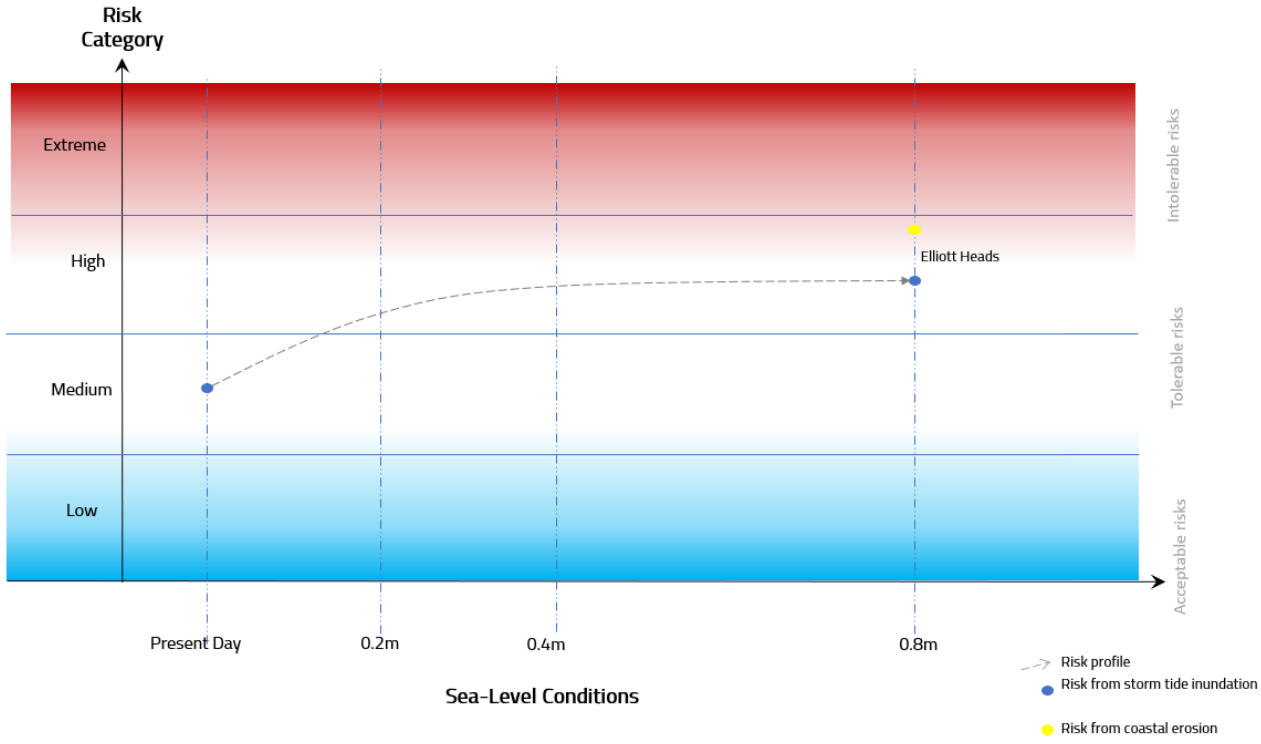


FIGURE 5-12 RISK PROFILE – ELLIOTT HEADS

STORM TIDE INUNDATION

- Residential properties, powerlines, water supply infrastructure, the beach and other environmental assets are likely to experience storm tide inundation across all sea level conditions.
- The economic damages analysis has considered this to be a moderate consequence under all sea level conditions
- The social consequences are largely insignificant under all sea level conditions
- The environmental consequences are minor under present-day sea-level conditions, this increases to major under a 0.8m sea level rise scenario
- Figure 5-13 shows the priority assets in Elliott Heads and the result of the risk assessment.
- Table 5-26 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

Priority Asset	Storm Tide Inundation (+0.8m SLR)
Residential Buildings	2
Powerlines	254 m
Water Supply	1,900 m

FIGURE 5-13 PRIORITY ASSETS AND RISK ASSESSMENT MAP, ELLIOTT HEADS

TABLE 5-26 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, ELLIOTT HEADS

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate
Social	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	>50% of intangible values and population at risk Moderate
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Minor damage to ecosystems or species recognised at the National level and / or significant loss or impairment of an ecosystem or species. Environmental consequence score between 120 and 160 Major

- Table 5-27 shows the risk rating for a range of likelihood storm tide inundation events.

TABLE 5-27 STORM TIDE INUNDATION LIKELIHOOD AND CONSEQUENCE SUMMARY, ELLIOTT HEADS

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Medium	Medium	Medium	High
2% (Possible)	Medium	Medium	Medium	High
1% (Unlikely)	Medium	Medium	Medium	High
0.2% (Rare)	Medium	Medium	Medium	Medium

- The risk ratings for storm tide inundation within the Elliott Heads coastal settlement are **medium** under present-day sea-level conditions, under a 0.2m and 0.4m sea level rise scenarios. This moves to **high risk** under a 0.8m sea level rise scenario and therefore is considered to be **tolerable risk.**
- Please refer to Appendix F, Table I-8 for the full set of risk results for Elliott Heads.

COASTAL EROSION

- One coastal erosion scenario considered for the Elliott Heads coastal settlement study area, i.e. the default erosion prone area width using the 0.8m sea level rise scenario in accordance with the Queensland State Erosion Prone Area Mapping.

- Residential buildings, powerline, water supply infrastructure, the beach and other environmental assets are exposed to coastal erosion.
- The economic damages analysis has considered this to be a major consequence under a 0.8m sea level rise scenario.
- The risk analysis has assessed the coastal erosion hazard as generally **high risk** for the **0.8m sea level rise scenario**[28], and therefore is considered to be a **tolerable risk.**
- Table 5-28 show a summary of the overriding consequences (economic, social or environmental) for coastal erosion under a 0.8m sea level rise scenario.

TABLE 5-28 COASTAL EROSION CONSEQUENCE SUMMARY, ELLIOTT HEADS

Consequence	0.8m SLR
Economic	$10 to $100 million economic damages Major
Social	>50% of intangible values and population at risk Moderate
Environmental	Minor damage to ecosystems or species recognised at the National level and / or significant loss or impairment of an ecosystem or species. Environmental consequence score between 120 and 160 Major

- Table 5-29 shows the risk rating for a range of likelihood coastal erosion events

TABLE 5-29 COASTAL EROSION LIKELIHOOD AND CONSEQUENCE SUMMARY, ELLIOTT HEADS

Likelihood	0.8m SLR
5% (Likely)	Extreme
2% (Possible)	High
1% (Unlikely)	High

- The risk ratings for coastal erosion hazard is generally **high** for the **0.8m sea level rise scenario**[29], and therefore is considered to be a **tolerable risk.**
- Please refer to Appendix F, Table I-8 for the full set of risk assessment results for Elliott Heads.

[29] Only one scenario considered for coastal erosion in Elliott Heads.

5.4.7 Coonarr

The limited exposure to coastal hazard in Coonarr has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for this settlement can be found in Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.8.

Coonarr is impacted more by coastal erosion than storm tide inundation. The risk rating from coastal erosion is considered **low** under present-day sea-level conditions and this increases to **extreme** and therefore **intolerable** risk under a 0.2m sea level rise scenario.

Figure 5-14 shows the risk profile for Coonarr. Risk from both storm tide inundation and coastal erosion is discussed below.

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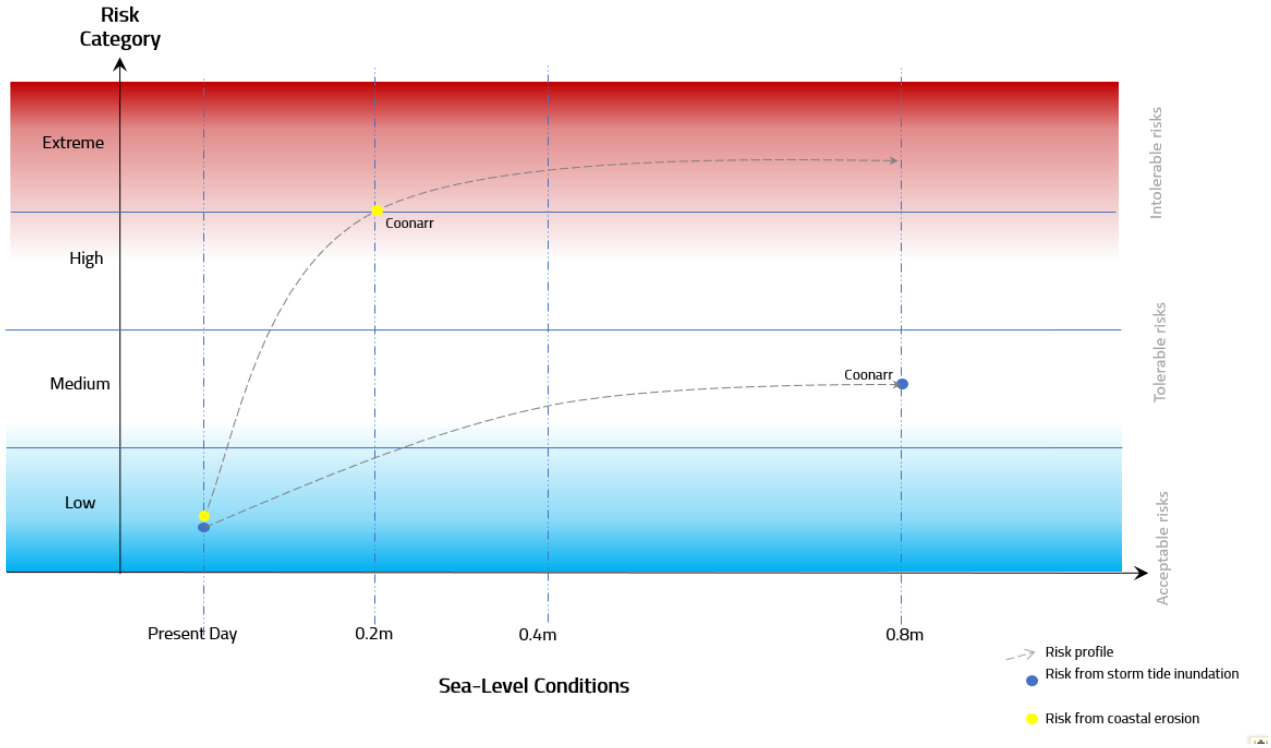

FIGURE 5-14 RISK PROFILE – COONARR

COASTAL EROSION

- Coonarr coastal settlement study area has been identified for further refinement of erosion prone area mapping. Multiple sea level scenarios considered for this settlement
- Residential properties, roads and access routes, powerlines, the beach and other environmental assets are exposed to coastal erosion
- The economic damages analysis has considered this to be of insignificant consequence under present-day sea-level conditions, this increases to moderate under a 0.2m sea level rise scenario.
- Coonarr Beach Road is likely to be permanently inundated in the 0.2m sea level rise scenario. This road is considered as a key access route. The social consequence analysis has considered this to be a catastrophic social consequence given the likely isolation of the community.
- The environmental consequence is considered insignificant under present-day sea-level conditions, this increases to minor under a 0.2m sea level rise scenario and moderate under a 0.8m sea level rise scenario.

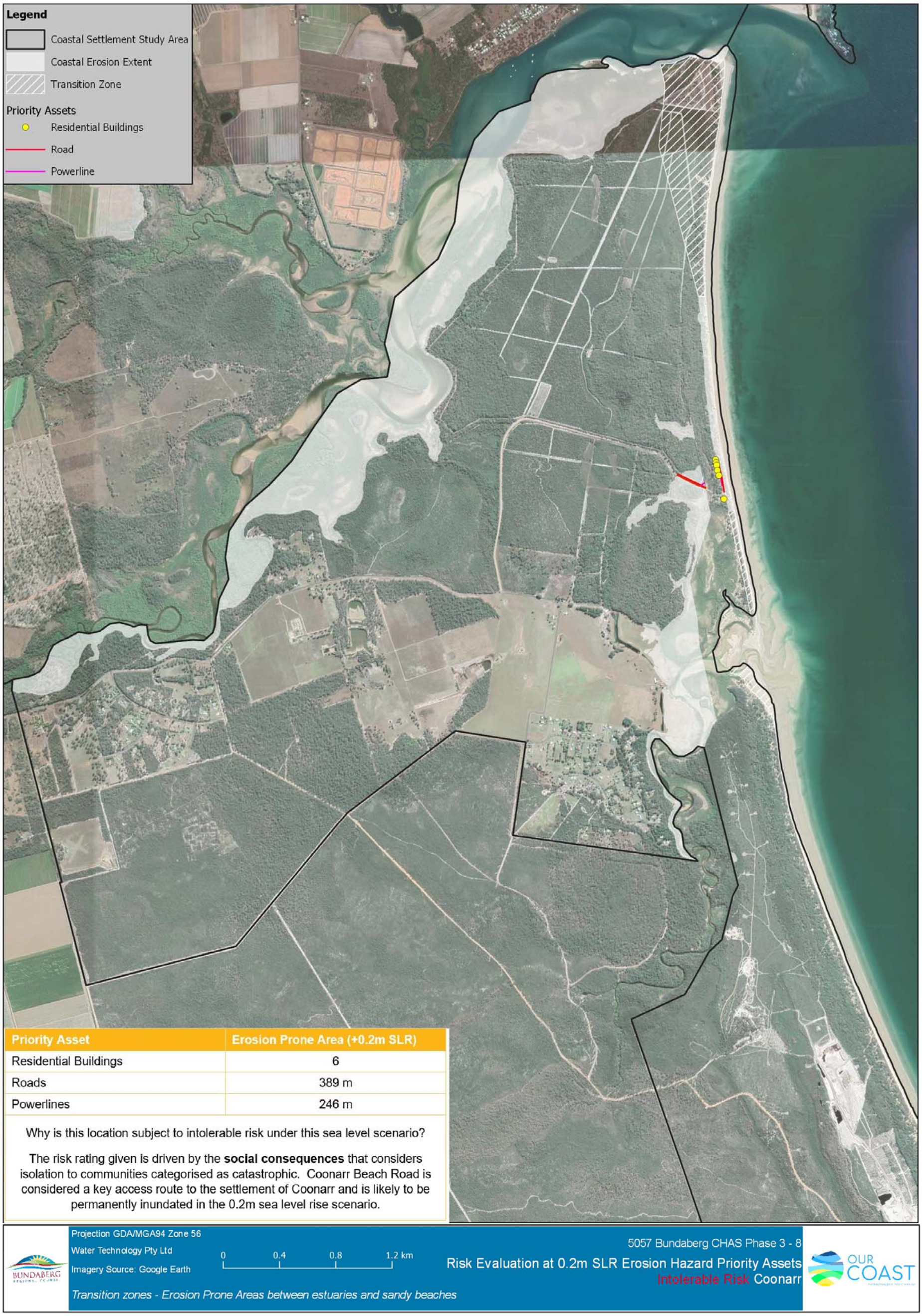

FIGURE 5-15 PRIORITY ASSETS AND RISK ASSESSMENT MAP, COONARR

- Figure 5-15 shows the priority assets in Coonarr and the result of the risk assessment.

TABLE 5-30 COASTAL EROSION CONSEQUENCE SUMMARY, COONARR

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$0 to $250,000 economic damages Insignificant	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate
Social	<20% of intangible values and population at risk Insignificant	Isolation of the community due to permanent inundation of key access route. Catastrophic	Isolation of the community due to permanent inundation of key access route. Catastrophic	Isolation of the community due to permanent inundation of key access route. Catastrophic
Environmental	No damage to ecosystems at any level. Inconsequential damage to environmental values of interest. Environmental consequence score < 40 Insignificant	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate

- Table 5-31shows the risk rating for a range of likelihood coastal erosion events.

TABLE 5-31 COASTAL EROSION RISK ANALYSIS SUMMARY, COONARR

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Low	Extreme	Extreme	Extreme
2% (Possible)	Low	Extreme	Extreme	Extreme
1% (Unlikely)	Low	Extreme	Extreme	Extreme

- The risk ratings for coastal erosion hazard indicate **low risk** under present day, increasing to **extreme risk** under a **0.2m sea level rise scenario** and therefore subject to an **intolerable risk.**
- Please refer to Appendix F, Table I-9 for the full set of risk assessment results for Coonarr.

STORM TIDE INUNDATION

- Residential properties, access roads, powerlines, the beach and other environmental assets are likely to experience storm tide inundation across all sea level conditions.
- The economic damages analysis has considered this to be an insignificant consequence under present-day sea-level conditions, increasing to major under a 0.8m sea level rise scenario
- The social consequences are largely insignificant under all sea level conditions

- The environmental consequences are minor under present-day sea-level conditions, this increases to major under a 0.8m sea level rise scenario.
- Table 5-32 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

TABLE 5-32 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, COONARR

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$0 to $250,000 economic damages Insignificant	$0 to $250,000 economic damages Insignificant	$0 to $250,000 economic damages Insignificant	$250,000 to $1 million economic damages Minor
Social	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Minor damage to ecosystems or species recognised at the National level and / or significant loss or impairment of an ecosystem or species. Environmental consequence score between 120 and 160 Major

- Table 5-33 shows the risk rating for a range of likelihood storm tide inundation events.

TABLE 5-33 STORM TIDE INUNDATION LIKELIHOOD AND CONSEQUENCE SUMMARY, COONARR

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Low	Low	Low	Medium
2% (Possible)	Low	Low	Medium	Medium
1% (Unlikely)	Low	Medium	Medium	Medium
0.2% (Rare)	Low	Low	Medium	Medium

- The risk analysis for storm tide inundation has specified a **low-risk** rating under present-day sea level conditions. However, the risk rating increases to a **medium** risk rating under the **0.4m sea level rise scenario** and is therefore subject to a **tolerable risk**.
- Please refer to Appendix F, Table I-9 for the full set of risk assessment results for Coonarr.

5.4.8 Woodgate Beach and Walkers Point

The relatively high exposure to coastal hazard in Woodgate Beach and Walkers Point has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for this settlement can be found in Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.9.

Woodgate Beach and Walkers Point is impacted by both coastal erosion and storm tide inundation. The risk rating from coastal erosion is considered **medium** under present-day sea-level conditions and this increases to **extreme** and therefore **intolerable** risk under a 0.4m sea level rise scenario. The risk rating from storm tide inundation is considered **medium** under present-day sea-level conditions and this increases to **extreme** and therefore **intolerable** risk under a 0.8m sea level rise scenario.

Figure 5-16 shows the risk profile for Woodgate Beach and Walkers Point. Risk from both storm tide inundation and coastal erosion is discussed below.

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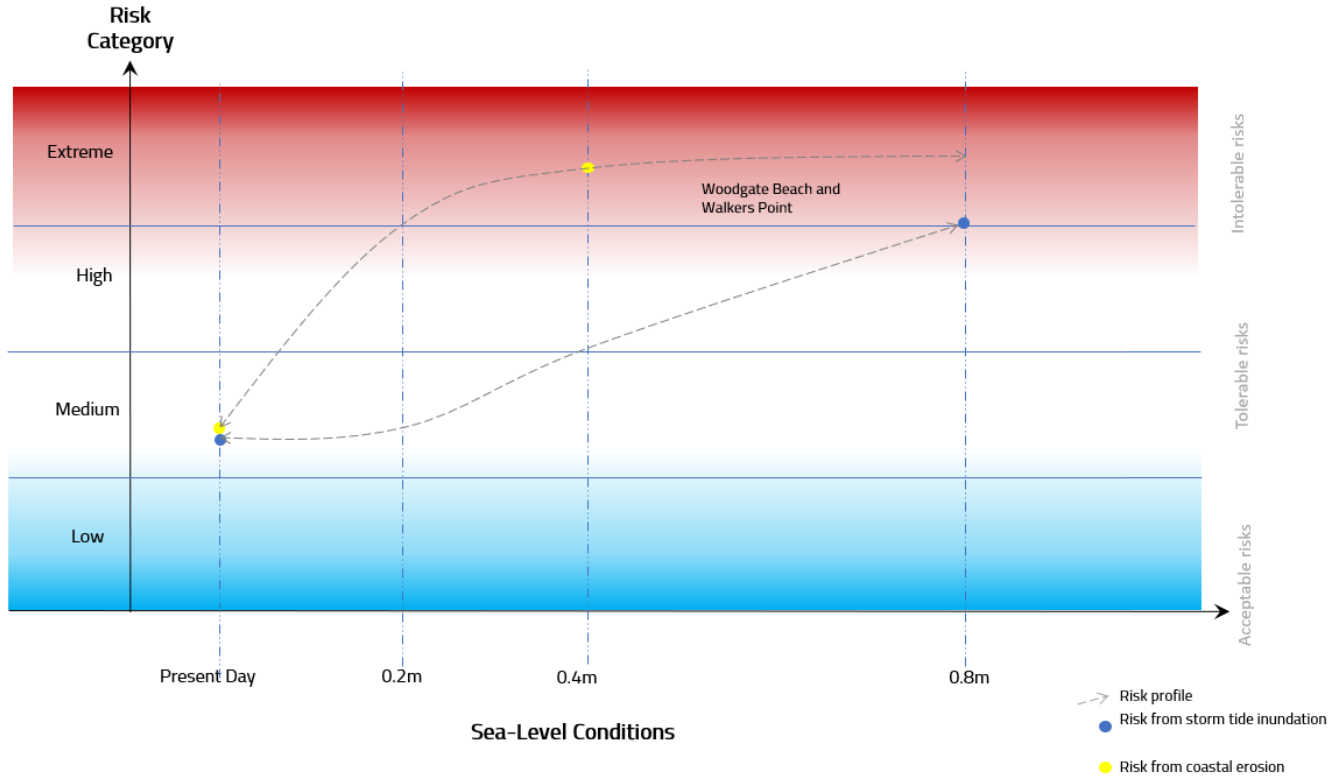


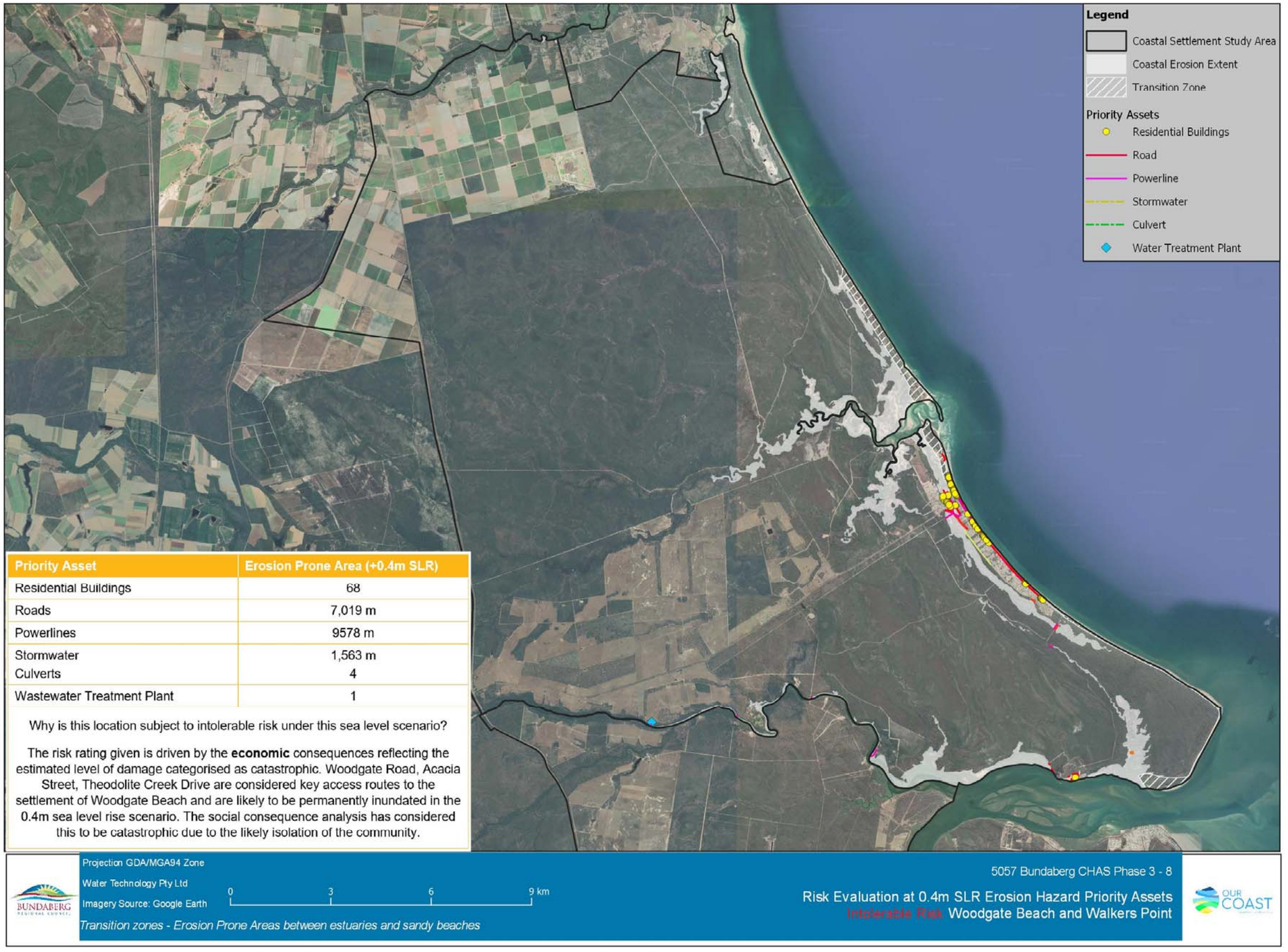
FIGURE 5-16 RISK PROFILE – WOODGATE BEACH AND WALKERS POINT

COASTAL EROSION

- Woodgate Beach settlement identified for further refinement of erosion prone area mapping. Multiple sea level scenarios considered for this settlement
- Residential properties, roads and access routes, powerlines, stormwater and culverts, waste disposal and wastewater treatment, the beach and other environmental assets are exposed to coastal erosion
- The economic damages analysis has considered this to be of insignificant consequence under present-day sea-level conditions, this increases to catastrophic under a 0.4m sea level rise scenario
- Walkers Point Road, Woodgate Road, Acacia Street, Theodolite Creek Drive are likely to be permanently inundated in the 0.8m sea level rise scenario. These roads are considered as key access routes. The

social consequence analysis has considered this to be a catastrophic social consequence given the likely isolation of the community.

- The environmental consequence is considered minor under present-day sea-level conditions, this increases to moderate under a 0.4m sea level rise scenario and catastrophic under a 0.8m sea level rise scenario.
- Figure 5-17 shows the priority assets in Woodgate Beach and Walkers Point and the result of the risk assessment.
- Table 5-30 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.



Priority Asset	Erosion Prone Area (+0.4m SLR)
Residential Buildings	68
Roads	7,019 m
Powerlines	9578 m
Stormwater Culverts	1,563 m 4
Wastewater Treatment Plant	1

Why is this location subject to intolerable risk under this sea level scenario?

The risk rating given is driven by the **economic** consequences reflecting the estimated level of damage categorised as catastrophic. Woodgate Road, Acacia Street, Theodolite Creek Drive are considered key access routes to the settlement of Woodgate Beach and are likely to be permanently inundated in the 0.4m sea level rise scenario. The social consequence analysis has considered this to be catastrophic due to the likely isolation of the community.

FIGURE 5-17 PRIORITY ASSETS AND RISK ASSESSMENT MAP, WOODGATE BEACH AND WALKERS POINT, EROSION

- Figure 5-17 shows the priority assets in Woodgate Beach and Walkers Point and the result of the risk assessment for coastal erosion.
- Table 5-34 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

TABLE 5-34 COASTAL EROSION CONSEQUENCE SUMMARY, WOODGATE BEACH AND WALKERS POINT

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$0 to $250,000 economic damages Insignificant	$10 to $100 million economic damages Major	>$100 million economic damages Catastrophic	>$100 million economic damages Catastrophic
Social	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	>20% of intangible values and population at risk Minor	Isolation of the community due to permanent inundation of key access route. Catastrophic
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Permanent destruction of an ecosystem or species recognised at the local, regional, State or national level and / or severe damage to or loss of an ecosystem or species recognised at the State and national level and / or significant loss or impairment of an ecosystem or species recognised at the national level. Permanent destruction of environmental values of interest. Consequence rating > 160 Catastrophic

- Table 5-35 shows the risk rating for a range of likelihood coastal erosion events.

TABLE 5-35 COASTAL EROSION RISK ANALYSIS SUMMARY, WOODGATE BEACH AND WALKERS POINT

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Low	Extreme	Extreme	Extreme
2% (Possible)	Medium	High	High	Extreme
1% (Unlikely)	Medium	High	Extreme	Extreme

- The risk ratings for coastal erosion hazard indicate generally **medium risk** under present-day sea-level conditions, increasing to **extreme risk** under a **0.4m sea level rise scenario** and therefore subject to an **intolerable risk.**
- Please refer to Appendix F, Table I-10 for the full set of risk assessment results for Woodgate Beach and Walkers Point.

STORM TIDE INUNDATION

- Residential properties, roads and access routes, powerlines, stormwater and culverts, waste disposal and wastewater treatment, the beach and other environmental assets are exposed to storm tide inundation across all sea level scenarios
- The economic damages analysis has considered this to be of minor consequence under present-day sea-level conditions, this increases to moderate under a 0.4m and major under a 0.8m sea level rise scenario
- The social consequence is considered insignificant under present-day sea-level conditions, this increases to minor under a 0.8m sea level rise scenario
- The environmental consequences are considered minor under present-day sea-level conditions, this increases to catastrophic under a 0.8m sea level rise scenario
- Table 5-36 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario.

TABLE 5-36 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, WOODGATE BEACH AND WALKERS POINT

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate	$10 to $100 million economic damages Major
Social	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	<20% of intangible values and population at risk Insignificant	>20% of intangible values and population at risk Minor
Environmental	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate	Permanent destruction of an ecosystem or species recognised at the local, regional, State or national level and / or severe damage to or loss of an ecosystem or species recognised at the State and national level and / or significant loss or impairment of an ecosystem or species recognised at the national level. Permanent destruction of environmental values of interest. Consequence rating > 160 Catastrophic

- Table 5-37 shows the risk rating for a range of likelihood storm tide inundation events.

TABLE 5-37 STORM TIDE INUNDATION LIKELIHOOD AND CONSEQUENCE SUMMARY, WOODGATE BEACH AND WALKERS POINT

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Medium	Medium	High	Extreme
2% (Possible)	Medium	Medium	High	High

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
1% (Unlikely)	Medium	Medium	Medium	Extreme
0.2% (Rare)	Medium	Medium	Medium	High

- The risk rating for storm tide inundation within the Woodgate Beach and Walkers Point coastal settlement is **medium** under present-day sea-level conditions and under a 0.2m sea level rise scenario. This moves to **high risk** under a 0.4m sea level rise scenario and **extreme risk** under a 0.8m sea level rise scenario and therefore is considered to be subject to **intolerable risk.**

Please refer to Appendix F, Table I-10 for the full set of risk results for Woodgate Beach and Walkers Point.

5.4.9 Buxton

The relatively limited exposure to coastal hazard in Buxton has been assessed in terms of the economic, social and environmental consequences across a range of likelihoods events and sea level rise scenarios. The full results of the damages assessment for this settlement can be found in Appendix E – Risk Analysis – Economic and Social Consequence, Section 3.3.10.

Buxton is impacted more by storm tide inundation than coastal erosion. The risk rating from storm tide inundation is considered **medium** under present-day sea-level conditions and this increases to **high** under a 0.2m, 0.4m and 0.8m sea level rise scenarios and is therefore considered to be subject to **tolerable risk**.

Figure 5-18 shows the risk profile for Buxton. Risk from both storm tide inundation and coastal erosion is discussed below.

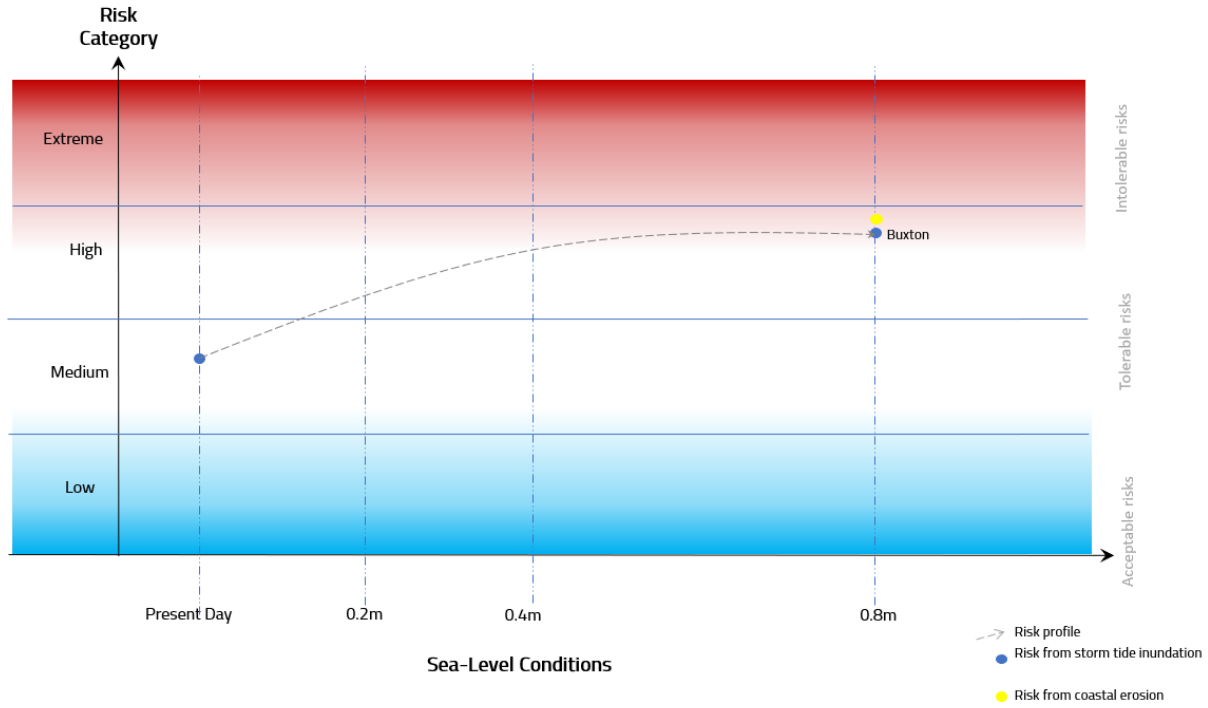
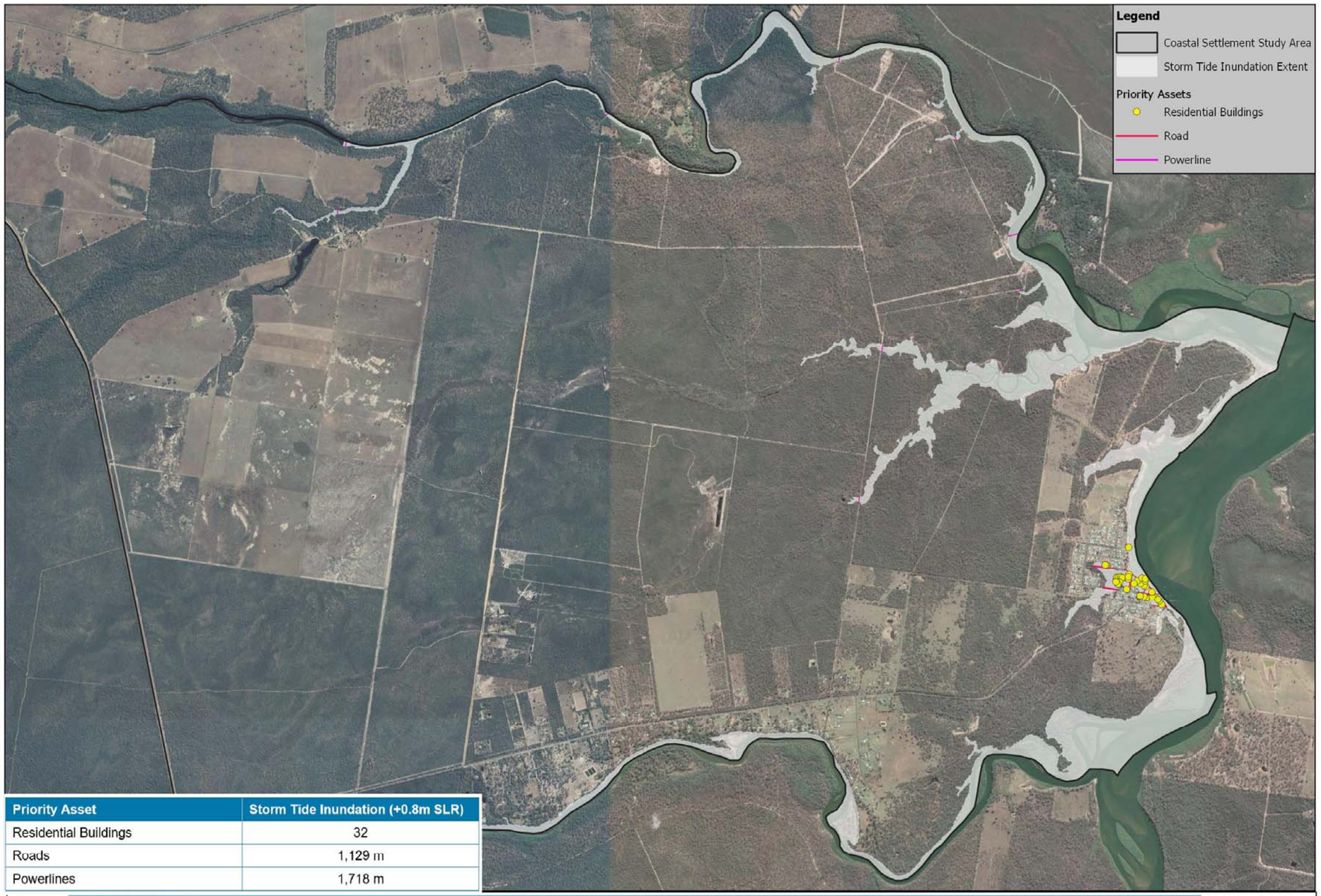


FIGURE 5-18 RISK PROFILE – BUXTON

STORM TIDE INUNDATION

- Residential properties, roads, powerlines and environmental assets are the priority assets likely to experience storm tide inundation across all sea level conditions.
- The economic damages analysis has considered this to be a moderate consequence under present day and under 0.2m of sea level rise. The economic consequences are considered major under a 0.4 and 0.8m sea level rise scenario.
- The social consequences are also considered major under a 0.8m sea level rise scenario.



Priority Asset	Storm Tide Inundation (+0.8m SLR)
Residential Buildings	32
Roads	1,129 m
Powerlines	1,718 m

FIGURE 5-19 PRIORITY ASSETS AND RISK ASSESSMENT MAP, BUXTON

- Figure 5-19 shows the priority assets in Buxton and the result of the risk assessment.
- Table 5-38 shows a summary of the highest scale of consequence for each category (i.e. economic, social or environmental) across each sea level rise scenario

TABLE 5-38 STORM TIDE INUNDATION CONSEQUENCE SUMMARY, BUXTON

Consequence	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
Economic	$1 to $10 million economic damages Moderate	$1 to $10 million economic damages Moderate	$10 to $100 million economic damages Major	$10 to $100 million economic damages Major
Social	<20% of intangible values and population at risk Insignificant	>50% of intangible values and population at risk Moderate	>70% of intangible values and population at risk Major	>70% of intangible values and population at risk Major
Environmental	No damage to ecosystems at any level. Inconsequential damage to environmental values of interest. Environmental consequence score < 40 Insignificant	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the Local or regional level. Environmental consequence score between 40 and 80 Minor	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate

- Table 5-39 shows the risk rating for a range of likelihood storm tide inundation events.

TABLE 5-39 STORM TIDE INUNDATION RISK ANALYSIS BUXTON

Likelihood	Present Day	0.2m SLR	0.4m SLR	0.8m SLR
5% (Likely)	Medium	High	Extreme	Extreme
2% (Possible)	Medium	High	High	High
1% (Unlikely)	Medium	Medium	High	High
0.2% (Rare)	Medium	Medium	Medium	Medium

- The risk analysis of storm tide inundation coastal hazard within the Buxton coastal settlement has indicated **medium-risk** under present day sea level conditions, this increases to generally **high risk** under a 0.2m, 0.4m and 0.8m sea level scenario and therefore is considered to be subject to **tolerable risk.**
- Please refer to Appendix F, Table I-11 for the full set of risk assessment results for Buxton.

COASTAL EROSION

- One coastal erosion scenario considered for Buxton coastal settlement, i.e. the default erosion prone area width using the 0.8m sea level rise scenario in accordance with the Queensland State Erosion Prone Area Mapping.

- Residential buildings, roads, powerlines and environmental assets are exposed to coastal erosion.
- The economic damages analysis has considered this to be a major consequence under a 0.8m sea level rise scenario.
- The risk analysis has assessed the coastal erosion hazard as generally **high risk** for the **0.8m sea level rise scenario**[30], and therefore is considered to be a **tolerable risk.**
- Table 5-40 shows a summary of the overriding consequences (economic, social or environmental) for coastal erosion under a 0.8m sea level rise scenario.

TABLE 5-40 COASTAL EROSION CONSEQUENCE SUMMARY, BUXTON

Consequence	0.8m SLR
Economic	$10 to $100 million economic damages Major
Social	>70% of intangible values and population at risk Major
Environmental	Minor damage to ecosystems and species recognised at the State level. Environmental consequence score between 80 and 120 Moderate

- Table 5-41shows the risk rating for a range of likelihood coastal erosion events

TABLE 5-41 COASTAL EROSION LIKELIHOOD AND CONSEQUENCE SUMMARY, BUXTON

Likelihood	0.8m SLR
5% (Likely)	Extreme
2% (Possible)	High
1% (Unlikely)	High

- The risk ratings for coastal erosion hazard is generally **high** for the **0.8m sea level rise scenario**[31], and therefore is considered to be a **tolerable risk.**

Please refer to Appendix F, Table I-11 for the full set of risk assessment results for Buxton.

[31] Only one scenario considered for coastal erosion in Buxton.

5.5 Risk Evaluation Results Summary

The risk evaluation has further categorised the risk ratings into **intolerable, tolerable** or **acceptable** risks based on thresholds in accordance with the State Planning Policy – State interest guideline for natural hazards, risk and resilience (SPP).

5.5.1 Risk Evaluation Definitions

The SPP defines the risk evaluation categories, used in this CHAS, as follows:

ACCEPTABLE RISK

An acceptable risk is a risk that, following an understanding of the likelihood and consequences, is sufficiently low to require no new treatments or actions to reduce risk further. Individuals and society can live with this risk without feeling the necessity to reduce the risk any further.

TOLERABLE RISK

A tolerable risk is a risk that, following an understanding of the likelihood and consequences, is low enough to allow the exposure to continue, and at the same time high enough to require new treatments or actions to reduce risk **in the short to medium term.** Society can live with this risk but believes that, as much as is reasonably practical, steps should be taken to reduce the risk further.

INTOLERABLE RISK

An intolerable risk is a risk that, following an understanding of the likelihood and consequences, is so high that it requires actions to avoid or reduce the risk. Individuals and society will not accept this risk and measures are to be put in place to reduce the risk to at least a tolerable level.

5.5.2 Summary of Coastal Hazard Risk Profile for Bundaberg Region

The following section summarises the risk evaluation for each settlement study area and profiles the risk over a range of sea level scenarios.

The storm tide inundation risk profile of each coastal settlement is presented in

Table 5-42 and the coastal erosion risk profile is presented in Table 5-43 and Table 5-44.

TABLE 5-42 STORM TIDE INUNDATION RISK PROFILE OF EACH COASTAL SETTLEMENT

Coastal Settlement	Present-Day Sea-Level Conditions	0.2m SLR Scenario	0.4m SLR Scenario	0.8m SLR Scenario
Miara, Winfield and Norval Park	Tolerable	Tolerable	Tolerable	Tolerable
Moore Park Beach	Tolerable	Tolerable	Tolerable	Tolerable
Burnett Heads	Tolerable	Tolerable	Tolerable	Intolerable
Bargara	Acceptable	Acceptable	Tolerable	Tolerable
Innes Park and Coral Cove	Acceptable	Acceptable	Tolerable	Tolerable
Elliott Heads	Tolerable	Tolerable	Tolerable	Tolerable
Coonarr	Acceptable	Acceptable	Tolerable	Tolerable
Woodgate Beach and Walkers Point	Tolerable	Tolerable	Tolerable	Intolerable
Buxton	Tolerable	Tolerable	Tolerable	Tolerable

TABLE 5-43 COASTAL EROSION RISK PROFILE OF COASTAL SETTLEMENT WITH REFINED EROSION MAPPING

Coastal Settlement	Present-Day Sea-Level Conditions	0.2m SLR Scenario	0.4m SLR Scenario	0.8m SLR Scenario
Moore Park Beach	Tolerable	Tolerable	Intolerable	Intolerable
Kelly's Beach (Bargara)	Tolerable	Tolerable	Tolerable	Intolerable
Innes Park and Coral Cove	Acceptable	Acceptable	Tolerable	Intolerable
Coonarr	Acceptable	Intolerable	Intolerable	Intolerable
Woodgate Beach and Walkers Point	Tolerable	Tolerable	Intolerable	Intolerable

TABLE 5-44 COASTAL EROSION RISK PROFILE OF THE REMAINING COASTAL SETTLEMENTS

Coastal Settlement	0.8m SLR Scenario[32]
Miara, Winfield and Norval Park	Tolerable
Burnett Heads	Tolerable
Bargara	Intolerable
Elliott Heads	Tolerable
Buxton	Tolerable

[32] In these locations, typically rocky foreshore or estuarine areas, the coastal erosion hazard extent is represented by the default erosion prone area width of the maximum of Highest Astronomical Tide (HAT) plus 40m inland or HAT plus 0.8m sea level rise in accordance with the Queensland State Erosion Prone Area Mapping. The risk assessment includes the economic, social and environmental consequences applied to the 0.8m sea level rise scenario, to ensure the CHAS aligns with the State Planning Policy 2016 (SPP) specifically addressing the coastal hazard component of the State interest policy.

5.5.3 Intolerable risk

The purpose of the CHAS is to identify priority assets and locations to be considered for identification of adaptation options to reduce or eliminate the risks. The settlements identified as being subject to intolerable risks are considered priority locations, the sea level rise scenarios which 'trigger' the risk to become intolerable are summarised in Figure 5-20.

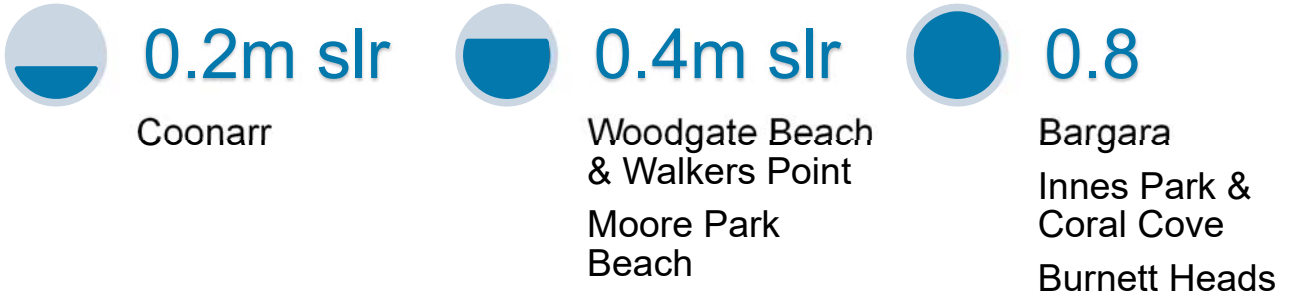


FIGURE 5-20 COASTAL SETTLEMENTS SUBJECT TO INTOLERABLE RISKS

The following coastal settlements are considered to have an acceptable or tolerable risk to coastal hazards under present-day sea-level conditions increasing to intolerable under a **0.2m sea level rise scenario**:

- Coonarr

The following coastal settlements are considered to have tolerable risk to coastal hazards under present-day sea-level conditions increasing to intolerable under a **0.4m sea level rise scenario**:

- Woodgate Beach and Walkers Point
- Moore Park Beach

The following coastal settlements are considered to have tolerable risk to coastal hazards under present-day sea-level conditions increasing to intolerable under a **0.8m sea level rise scenario**:

- Burnett Heads
- Bargara
- Innes Park and Coral Cove.

Figure 5-21, Figure 5-22 and Figure 5-23 show the risk profiles of settlements subject to intolerable risk as described above.

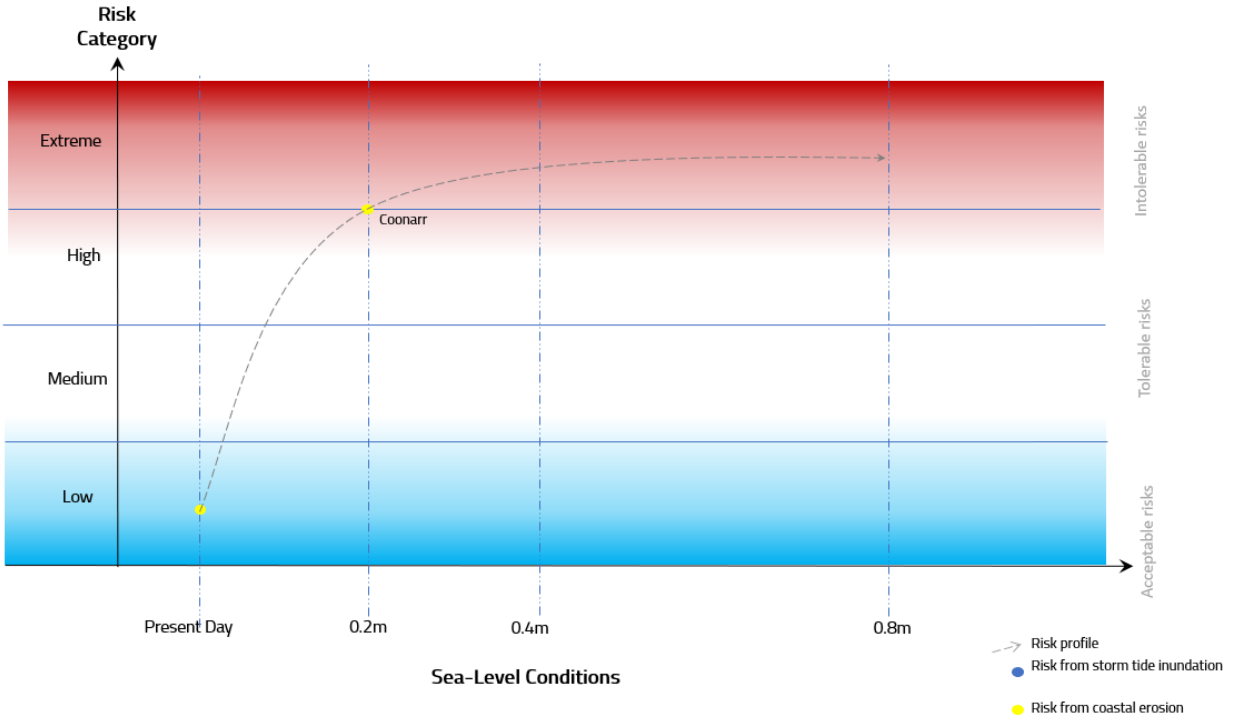


FIGURE 5-21 RISK PROFILE COASTAL SETTLEMENTS – INTOLERABLE RANGE 0.2M SLR

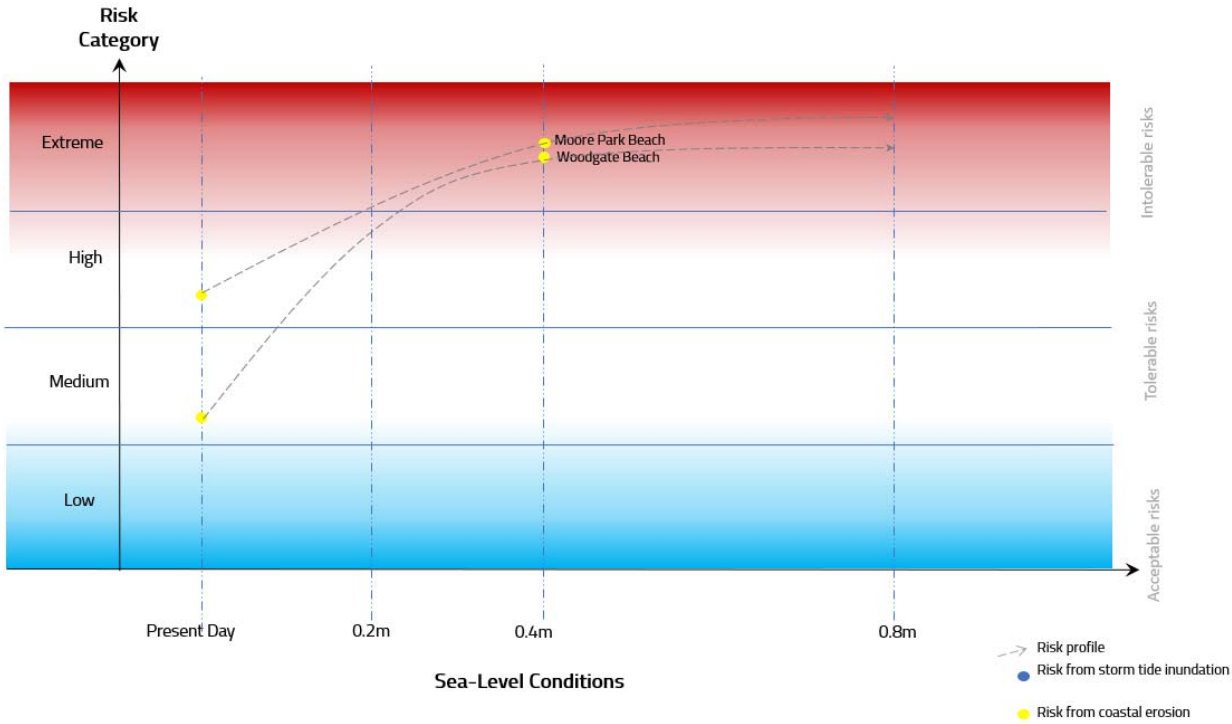


FIGURE 5-22 RISK PROFILE COASTAL SETTLEMENTS - INTOLERABLE RANGE 0.4M SLR

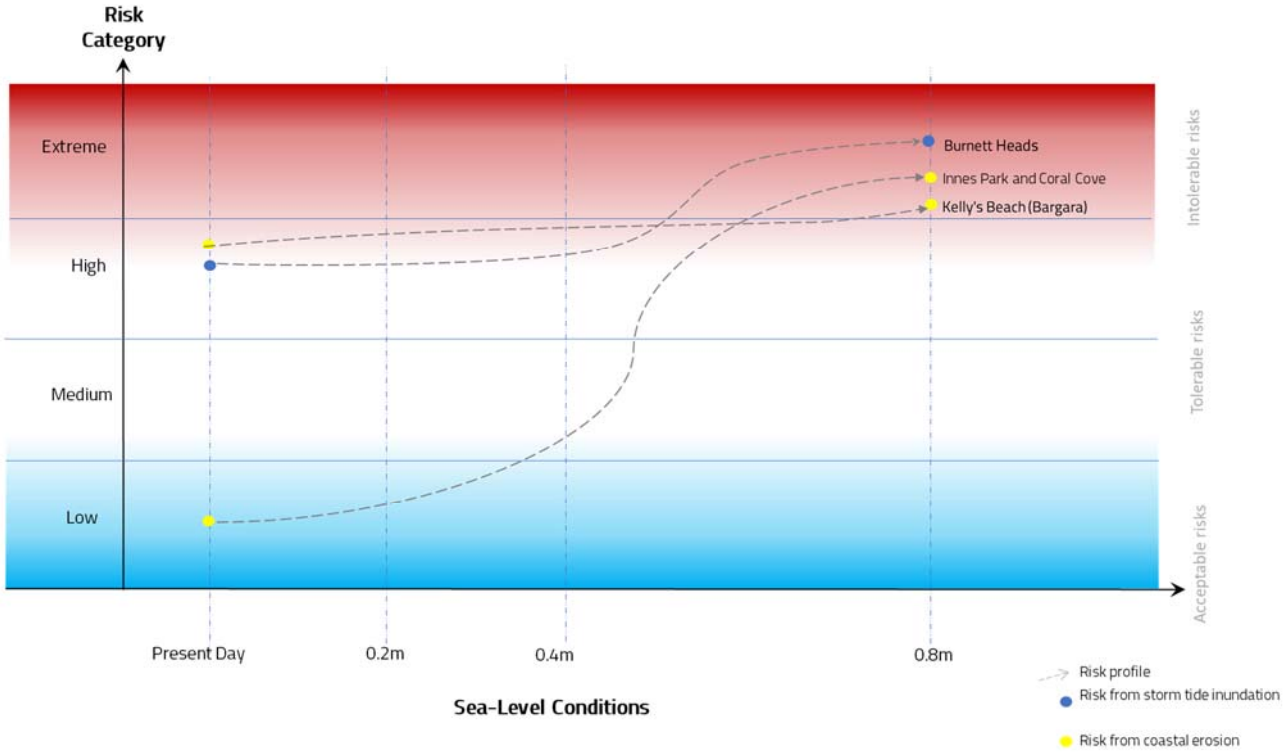


FIGURE 5-23 RISK PROFILE COASTAL SETTLEMENTS – INTOLERABLE RANGE 0.8M SLR

5.5.4 Acceptable and tolerable risk

The following coastal settlements are considered to have an acceptable or tolerable level of risk under all sea level conditions.

- Miara, Winfield and Norval Park
- Elliott Heads
- Buxton

Figure 5-24 shows the risk profile of settlements subject to acceptable or tolerable risk.

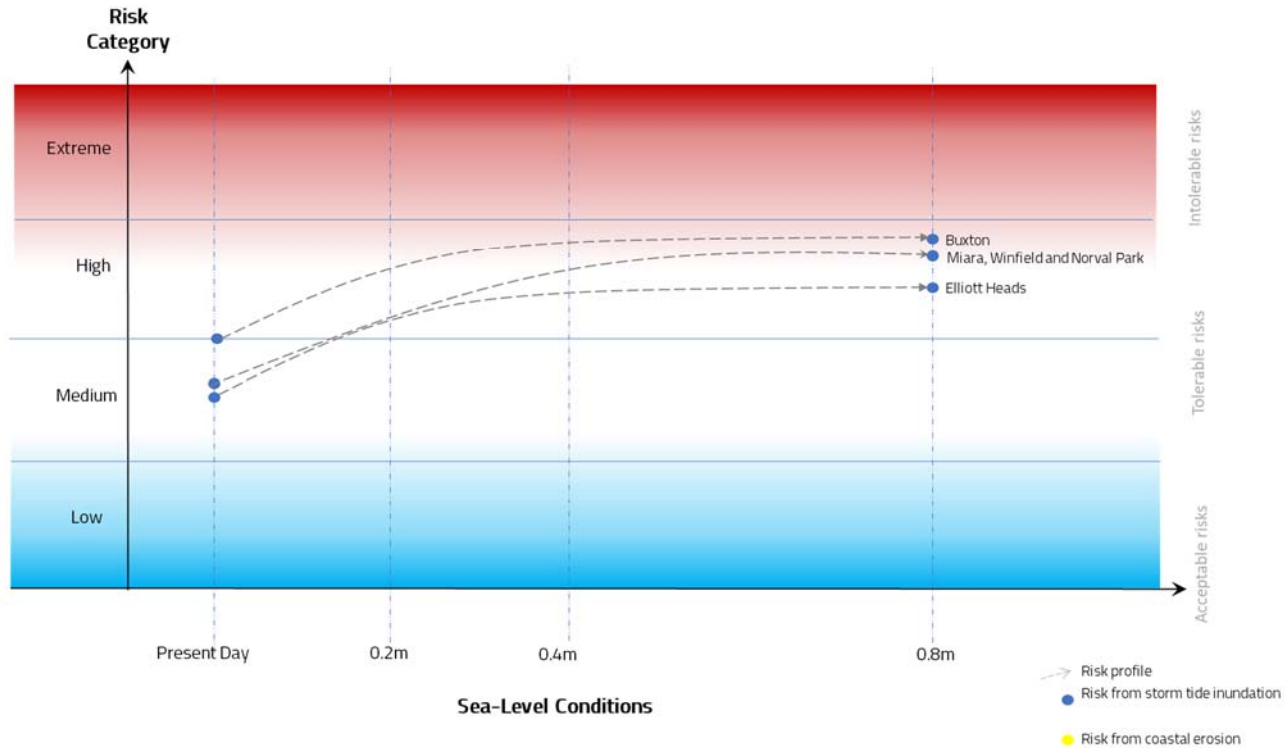


FIGURE 5-24 RISK PROFILE COASTAL SETTLEMENTS TOLERABLE RANGE UNDER ALL SEA LEVEL SCENARIOS

6 SUMMARY

The distribution of exposure, vulnerability and risk across the Bundaberg region has shown that the impacts of coastal hazard affect the settlements in each locality in differing ways, relative to their existing exposures, community contexts, social and economic functions and characteristics, and future growth intents.

Table 6-1 summarises the results of the vulnerability and risk assessment.

- The vulnerability assessment process has identified and prioritised assets based on the criticality of an asset to the settlement.
- The risk analysis and evaluation has assigned a risk rating to each settlement and identified a series of triggers where the potential risk becomes **intolerable**.
- All settlements will be considered for identification of adaptation options within Phase 6 to **reduce** or **eliminate intolerable risk**; or **maintain tolerable risks**.

Note - Whilst Council is undertaking a trigger-based approach to adaptation, some options to maintain tolerable risks will need to be considered in the short term. There are also a suite of measures that Council already implements to mitigate risks from coastal hazard, such as land use planning and development controls, disaster management coordination and awareness raising activities, these will be discussed further in Phase 6.

TABLE 6-1 SUMMARY OF VULNERABILITY AND RISK ASSESSMENT

SETTLEMENT	VULNERABILITY ASSESSMENT Highly critical assets	RISK EVALUATION				Description
		Storm tide inundation	Sea level rise scenario	Coastal erosion	Sea level rise scenario	
Miara, Winfield and Norval Park	■ Roads / access ■ Road bridges ■ Beach and other environmental assets ■ Electricity transformer	Tolerable	All scenarios	Tolerable	All scenarios	Potential for major damages to buildings and infrastructure. Regular inundation of key access routes.
Moore Park Beach	■ Roads / access ■ Road bridges ■ Beach ■ Water supply (inc groundwater supply) ■ Powerlines ■ Electricity transformer ■ School	Tolerable	All scenarios	Intolerable	0.4m	Potential for catastrophic damages to buildings and infrastructure. Potential isolation of community.
Burnett Heads	■ Roads / access ■ Road bridges ■ Beaches and other environmental assets ■ Water supply ■ Electricity transformer ■ Wastewater Treatment ■ Waste Disposal ■ Stormwater/Culverts	Intolerable	0.8m	Tolerable	All scenarios	Potential for catastrophic damages to buildings and infrastructure.
Bargara	■ Residential properties ■ Water supply ■ Powerlines ■ Beaches and other environmental assets	Tolerable	All scenarios	Intolerable	0.8m	Potential for catastrophic damages to buildings and infrastructure.

SETTLEMENT	VULNERABILITY ASSESSMENT Highly critical assets	RISK EVALUATION				Description
		Storm tide inundation	Sea level rise scenario	Coastal erosion	Sea level rise scenario	
Innes Park and Coral Cove	■ Water supply ■ Sewer mains ■ Beaches and other environmental assets	Tolerable	All scenarios	Intolerable	0.8m	Potential for catastrophic damages to buildings and infrastructure.
Elliott Heads	■ Residential Properties ■ Beach and other environmental assets ■ Water Supply ■ Powerlines	Tolerable	All scenarios	Tolerable	All scenarios	Potential for major damages to buildings and infrastructure.
Coonarr	■ Roads / access ■ Powerlines ■ Beaches and other environmental assets	Tolerable	All scenarios	Intolerable	0.2m	Potential isolation of community.
Woodgate Beach and Walkers Point	■ Residential properties ■ Roads / access ■ Woodgate WWTP ■ Water supply ■ Powerlines ■ Stormwater and culverts ■ Waste management ■ Beaches and other environmental assets	Intolerable	0.8m	Intolerable	0.4m	Potential for catastrophic damages to buildings and infrastructure. Potential isolation of community.
Buxton	■ Residential Properties ■ Roads / Access ■ Powerlines ■ Environmental assets	Tolerable	All scenarios	Tolerable	All scenarios	Potential for major damages to buildings and infrastructure.

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