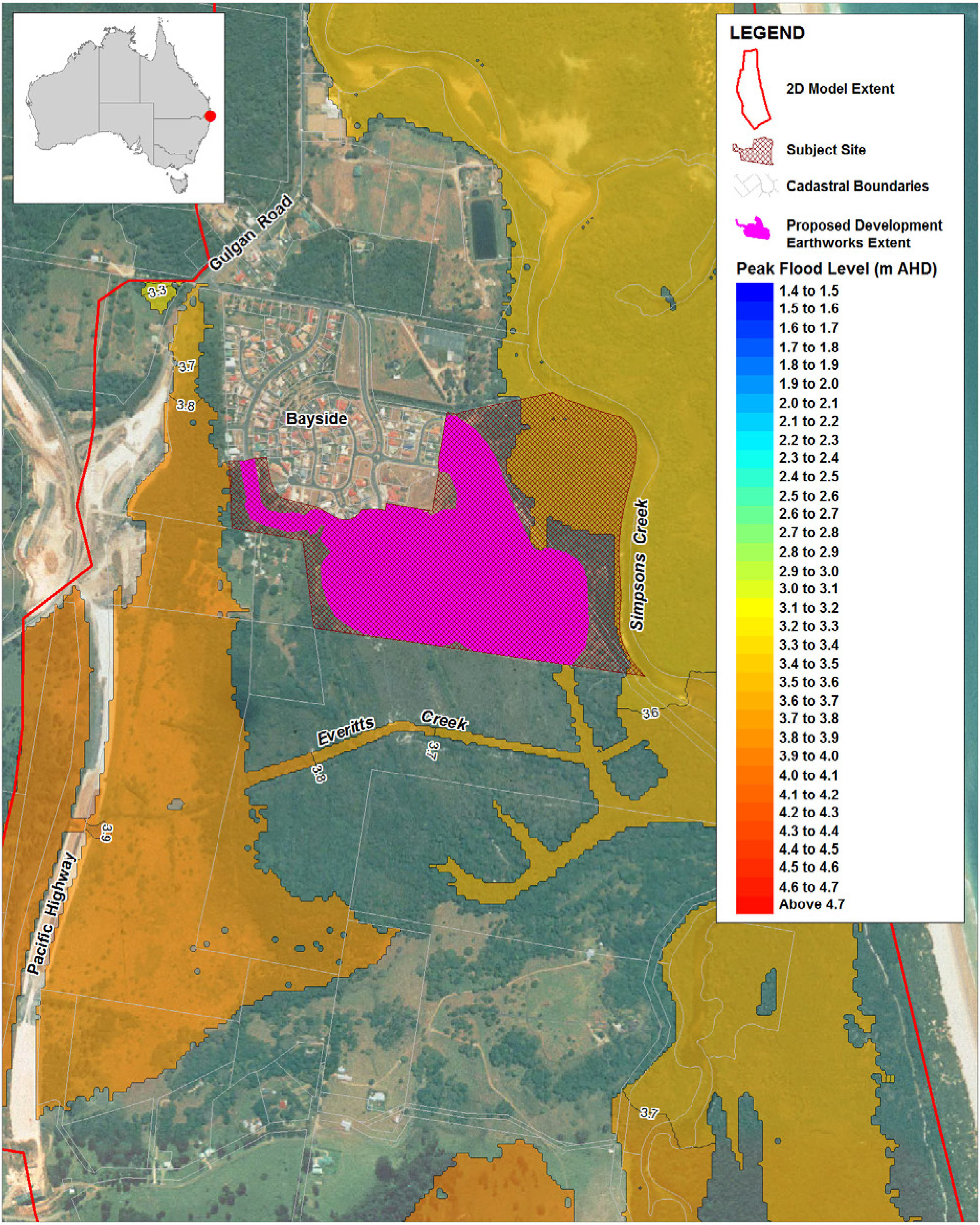

Title:

100 Year ARI Peak Flood Levels - Developed Case BSC Climate Change

Figure: 8-14

Rev: A

N

0 250 500m

Approx. Scale

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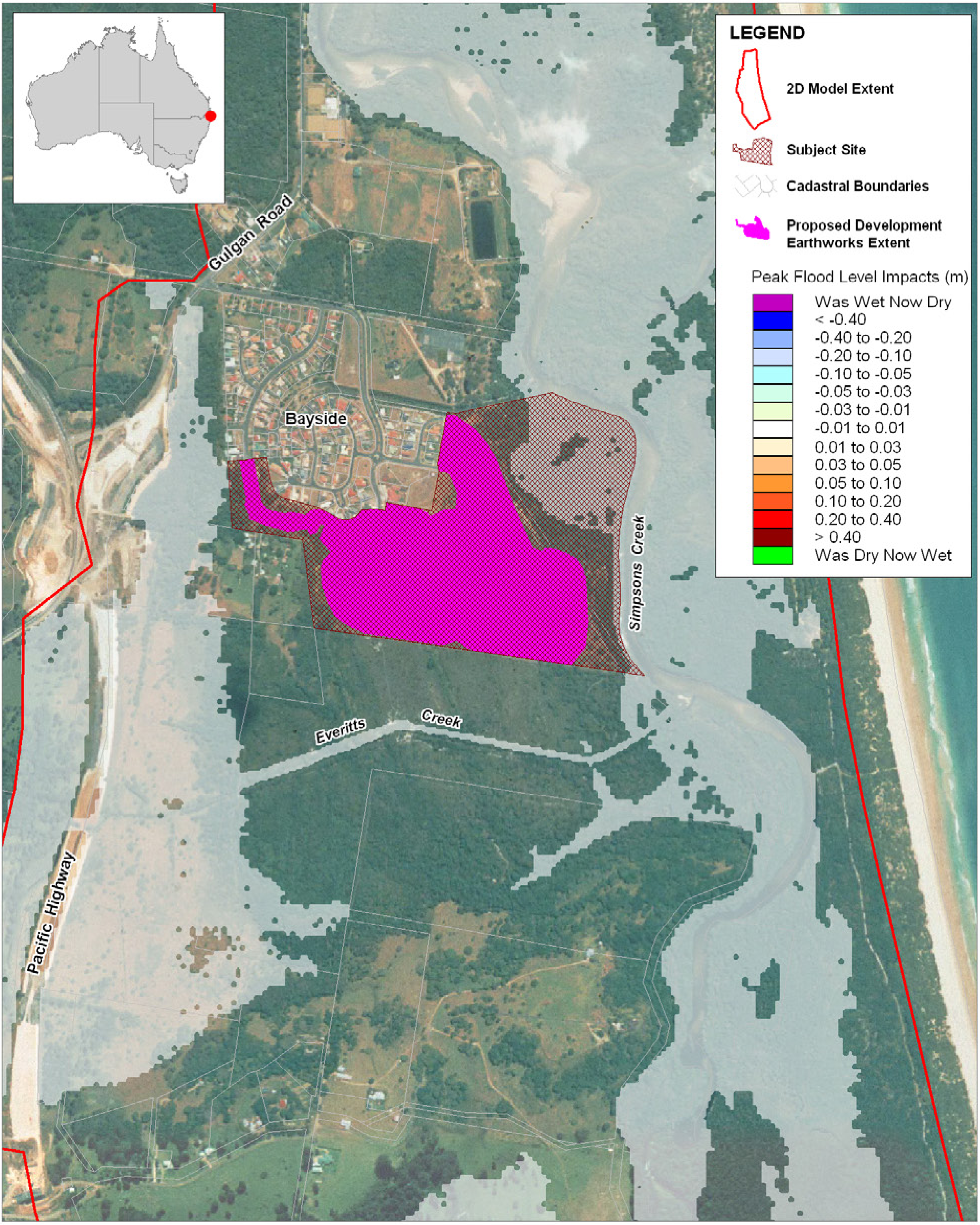

Title:

20 Year ARI Peak Flood Level Impacts - Developed Case Bayside

Figure: 8-15

Rev: A

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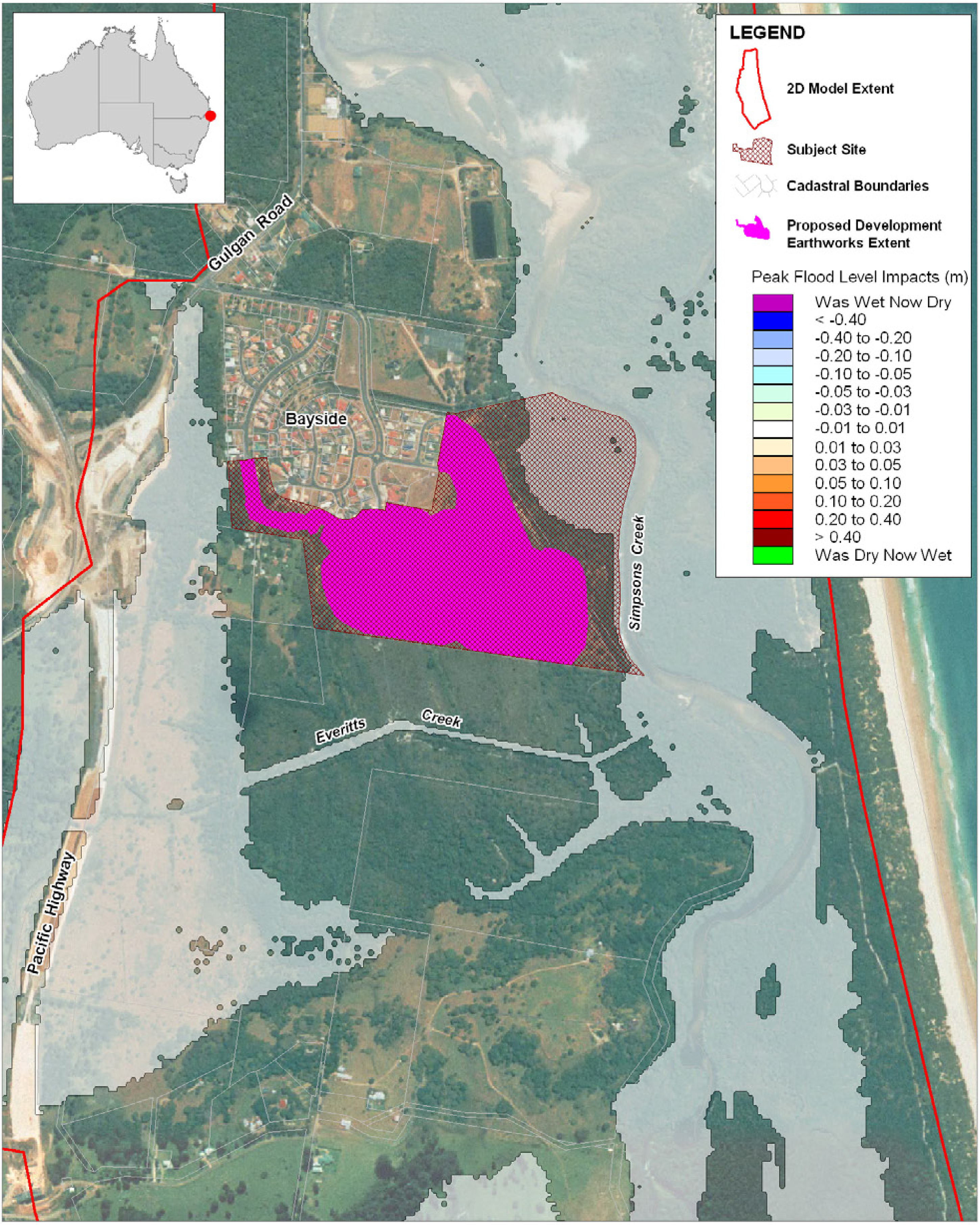

Title:

100 Year ARI Peak Flood Level Impacts - Developed Case Bayside

Figure: 8-16

Rev: A

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0 250 500m

Approx. Scale

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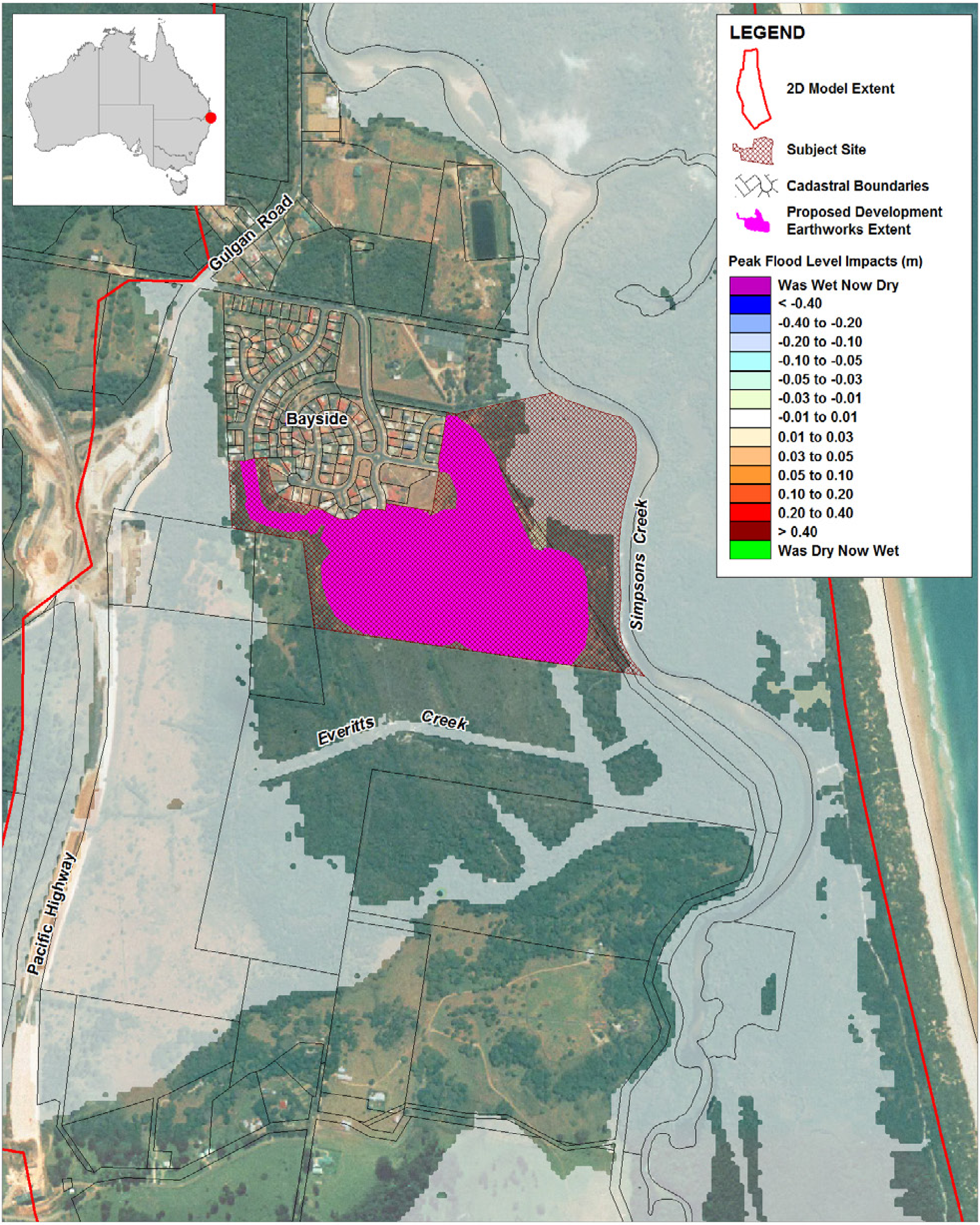

Title:

Probable Maximum Flood Level Impacts - Developed Case Bayside

Figure: 8-17

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9 COASTAL PROCESSES

9.1 Introduction

As part of the Byron Shire Coastal Hazard Definition Study (WBM, 2000) assessment of the coastal processes from Broken Head south of Byron Bay, to Golden Beach north of Brunswick Heads were assessed. The findings of the coastal processes assessment were used in conjunction with shoreline recession estimates accounting for future sea level rise to define 50 and 100 year planning horizon hazard lines.

The definition of the hazard lines was calculated based on the addition of three unique coastal processes:

1 Short term storm demand;

2 Long term recession/accretion trends; and

3 Shoreline recession response to future sea level rise.

The following sections summaries the definition of each of these processes and the revised hazard line definition for South Brunswick Heads Beach accounting for recent sea level rise guideline values (DECCW, 2009).

9.2 Short Term Storm Demand

In the short term (up to a few years), most stable beaches exhibit a form of dynamic equilibrium. This dynamic equilibrium is one in which the beach is constantly changing in response to changing wave conditions, but tends to restore itself to an average accreted state after periods of large-scale short term change.

During severe storms or a series of storms in succession, increased wave heights and elevated water levels result in wave attack of the beach berm and foredune region. Sand is eroded from the beach face and transported in an offshore direction to the seabed below the water in depths up to 10 to 15 metres. Often this forms one or more nearshore sand bars under the water parallel to the shoreline.

The volume transported offshore is known as the storm demand or storm bite. The amount of linear recession of the dune associated with such volume loss is related to the beach/dune profile and height. In this regard, the amount of rebuilding that has occurred since the last storm and the volume of sand reserves in the dune system or nearshore areas are important.

The sand that is transported offshore during a storm event is generally not lost from the overall beach system. The sand is gradually transported back onshore following the storm by lower swell waves forming a beach berm. As the beach builds up again, the sand above high tide becomes dry and may be blown landward by the prevailing onshore winds. In natural, and on well managed coastal areas, native dune grasses and shrubs adapted to the harsh coastal environment trap the sand and rebuild the dune.

On beaches which are in long term ‘dynamic equilibrium’, the amount of sand which returns to the beach is equal to the amount eroded during the storm. That is, the beach maintains a stable long term alignment on which the short term fluctuations are superimposed. However, for a beach which is experiencing long term recession, the sand may not all be returned with an erosion scarp typically moving landward over time in response to storm activity.

As part of the Byron Shire Coastal Hazard Definition Study (WBM, 2000) the short term storm demand for South Brunswick Heads Beach was defined based on:

- Review of historical information on storm events;
- Direct measurement of beach profiles before and after storm events; and
- Using empirical relationships based on field measurements and large scale physical model tests.

The short term storm demand for South Brunswick Heads Beach was defined to be approximately 35m relative to the surveyed 1999 erosion escarpment. This value has also been adopted for this study.

9.3 Long Term Erosion Component

The Byron Shire Coastal Hazard Definition Study (WBM, 2000) identified a trend of persistent longer term shoreline recession along the coastline from Broken Heads to Golden Beach.

The long term shoreline trends were assessed using:

- Measured erosion rates from available photogrammetric data and other survey information;
- Available geological evidence; and
- An understanding and assessment of the prevailing coastal processes which lead to long term recession.

In adopting long term recession rates for future planning, consideration needs to be given not only to the best estimate but also the potential uncertainty and natural variability that will occur. Over 50 and 100 year planning periods, it can be expected that there will periods of higher and lower rates of erosion and recovery. Although commonly defined as an average annual rate for planning purposes, long term erosion typically is not physically manifested at a consistent rate every year. It must be recognised that during stormy periods, erosion of the coastline occurs rapidly during the duration of the discreet storm event(s). During calmer weather, subsequent natural recovery takes place, generally over a significantly longer time scale, commonly of the order of months or in some cases years. On receding coastlines, the net movement of the active beach system is landward. The long term erosion rate is the underlying net trend over which periods of higher and lower erosion rates and subsequent natural recovery are superimposed.

In total, the WBM (2000) study used over 50 years of recorded data to define the long term shoreline recession trends at Brunswick Heads. During the 50 year period, both periods of extensive erosion and subsequent recovery were recorded. Overall however, a persistent erosion trend was recorded. From the recorded data it was considered a long term erosion rate of 0.1m/yr represented the reasonable best estimate of the long term average recession rate at South Brunswick Heads Beach.

In addition to the best estimate value, the WBM (2000) study also reported a minimum and maximum recession rate of 0.2m/yr and 0.05m/yr respectively. The adoption of these rate limits for planning purposes account for uncertainty and future variability associated with potential increased storminess, storm surges and alterations to the predominant wave direction resulting from climate change (as distinct from the impact of sea level rise).

The long term erosion trend rates calculated as part of the WBM (2000) study have been adopted for this study.

9.4 Sea Level Rise Components

Sea level rise results in the upward and landward translation of the beach profile, as shown in Figure 9-1. Assessment of shoreline recession resulting from sea level rise is calculated using the “Bruun Rule” (Bruun, 1962). The Bruun Rule is given by:

$$r = \frac{Ba}{D}$$

Where a (metres) is the sea level rise, B (metres) is the active surfzone width, and D (metres) is the depth to closure including the dune height.

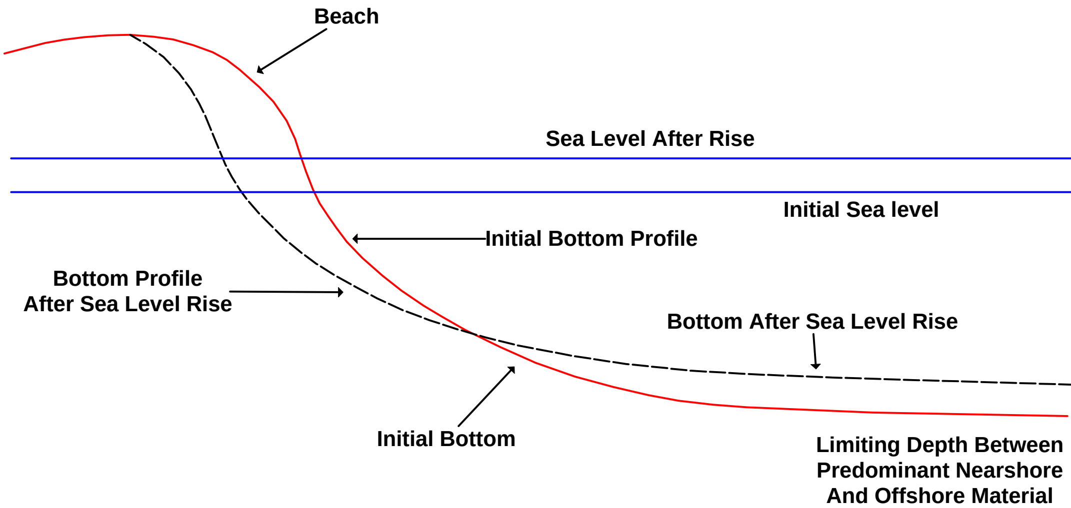

Figure 9-1 Bruun Rule for Shoreline Response to Rising Sea Level

As part of the WBM (2000) study, shoreline recession estimates were calculated based on sea level rise projections of 0.2m and 0.5m for the 2050 and 2100 planning horizons. The calculated shoreline recession associated with these sea level rise values at South Brunswick Heads Beach were 11m (2050) and 27.5m (2100).

In October of 2009 the DECCW published sea level rise guidelines for NSW. For planning purposes, the guideline document defines the 2050 and 2100 sea level rise values to be 0.4m and 0.9m respectively. In accordance with these sea level rise guideline values, the sea level rise shoreline recession estimates calculated as part of the Byron Shire Coastal Hazard Definition Study (WBM, 2000) have been revised.

The revised shoreline recession values have been calculated to be:

- 2050 planning horizon: 22.0m; and
- 2100 planning horizon: 49.5m.

9.5 Projected Coastline Hazard Zones

The above coastline hazard components have been combined to calculate the hazard line definitions for the 2050 and 2100 planning periods at South Brunswick Heads Beach. These are shown in Table 9-1 and Figure 9-2.

Within Figure 9-2, the coastline hazard zone bands have been calculated and defined relative to an adopted 1999 erosion escarpment position.

Table 9-1 Coastal Hazard Zone Definition

Coastline Hazard Component	Immediate (2010)	2050 Planning Horizon			2100 Planning Horizon		
		Min	Best	Max	Min	Best	Max
Short Term (m)	35	35	35	35	35	35	35
Long Term (m)	0	2.5	5	10	5	10	20
Sea Level Rise (m)	0	22	22	22	49.5	49.5	49.5
Total (m)	**35**	**69.5**	**72**	**77**	**104.5**	**109.5**	**119.5**

Review of the calculated hazard lines show that the proposed development site boundary is located approximately 300m inland from the upper limit (Max) 2100 planning horizon hazard line. Due to this large buffer, it is unlikely that the proposed site development will be affected by future coastal processes within the 2100 planning horizon timeframe. Similarly, due to its inland location, the proposed development of the site is unlikely to impact the existing coastal processes for neighbouring beach units.

Title:

Immediate, 2050 and 2100 Year Planning Horizon Coastal Hazard Zones

Figure: 9-2

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10 CONCLUSIONS AND RECOMMENDATIONS

This report has been prepared to address the flooding and coastal hazard related items of the Director General's Environmental Assessment Requirements (DGRs) for the preparation of a Concept Plan for Stage 2 of the proposed Bayside Brunswick development.

To address the flooding related items, a two-dimensional / one-dimensional (2D/1D) dynamically linked flood model has been developed for Simpsons Creek. The flood model developed, which includes a hydrological WBMN model and a hydraulic TUFLOW model, has been verified against a recent significant rainfall event (May 2009 event).

The sensitivity of key modelling assumptions has been investigated and reported. A critical duration analysis has also been undertaken to assess the critical duration event for the catchment (providing the highest flood levels).

The verified flood model has then been used for assessment of the following:

- Peak flood levels, depths, velocity and hazard for the 20, 100 year ARI and PMF events;
- Possible impacts of climate change on flood conditions at the development site; and
- Peak flood level impacts on surrounding properties.

The following conclusions have been drawn from the study:

- The subject site is affected by flooding during 100 year ARI design flood events, however the proposed filling for the development has been restricted to areas not inundated during the 100 year ARI event;
- Fill will however be required to provide an appropriate flood immunity to the urban areas of the proposed development accounting for specified freeboard requirements (500mm);
- It is recommended that fill levels are based on modelled 100 year ARI design peak flood levels that incorporate an appropriate allowance for potential climate change impacts. It is considered that the climate change allowance recommended by the Department of Environment, Climate Change and Water (based on 2100 planning horizon) provides an adequate degree of conservatism for the establishment of minimum fill levels; and
- The required filling associated with the proposed development has been shown to have no significant impact on peak flood levels outside of the property boundaries.

In addition to the above listed flood related conclusions, assessment of coastal hazards adjacent to the site have found that the proposed site location is sufficiently setback from the coast to be unaffected by coastal processes, based on the 2100 planning horizon accounting for future climate change.

11 ACKNOWLEDGEMENTS AND REFERENCES

11.1 Acknowledgements

The project team would like to acknowledge the assistance of the following authorities and individuals for the provision of information, data and advice with respect to local flooding issues:

- Byron Shire Council;
- NSW Department of Environment, Climate Change and Water;
- NSW Roads and Traffic Authority;
- Mark Ward (landowner); and
- Tony Lewis (landowner).

11.2 References

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WBM (2000) *“Byron Shire Coastline Hazard Definition Study”*, prepared for Byron Shire Council

APPENDIX A: PRELIMINARY SITE LAYOUT PLAN

LEGEND

- PROPOSED LOT POLYGON (lot layout to be confirmed)
- TYPICAL DRAINAGE FLOW DIRECTION
- CUT DEPTH
- FILL DEPTH
- BULK FILL AREA (CONCEPTUAL ONLY)
- BULK CUT AREA (CONCEPTUAL ONLY)

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PROPOSED URBAN SUBDIVISION
BAYSIDE WAY, BRUNSWICK HEADS
LOT 1 DP 871039

PROPOSED SUBDIVISION BULK EARTHWORKS CONCEPT PLAN

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1 of 1

Dwg. No. **LM080082-DR19** — Issue **B**

APPENDIX B: PHOTOS

Photo 1: Floodplain Looking West (upstream) from the Casino-Murwillumbah Railway (S_11.01)

Photo 2: Looking East (downstream) from the Casino-Murwillumbah Railway (S_11.02)

Photo 3: Casino-Murwillumbah Railway Bridge between S_11.01 and S_11.02

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