Appendix H

Additional Flood Modelling

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23 March 2010

Malbec Properties
GPO Box 2641
Sydney NSW 2001

Attention: Andrew Towzell

RE: ADDITIONAL FLOOD MODELLING FOR THE SOUTH WEST ROCKS DEVELOPMENT

1. INTRODUCTION

Malbec Properties proposes to undertake a residential development at Belle O'Connor Street, South West Rocks, on Lot 52 DP 831284 and Lot 84 DP 792945. As part of the Development Application process, the NSW Department of Planning (DoP) requested additional Saltwater Creek modelling scenarios. The additional scenarios will determine effects from the increased runoff from the proposed site and assess impacts from climate change.

BMT WBM has developed hydrologic and hydraulic-morphologic models of the Saltwater Creek Catchment as part of the Saltwater Creek Flood Study (WBM, 2006). This study is entitled 'the Flood Study' in the remainder of this letter. The modelling tasks undertaken as part of this investigation are based on the XP-RAFTS and TUFLOW models developed for the Flood Study.

The following sections describe our study methodology, assumptions, model results and conclusions.

2. METHODOLOGY

The additional modelling was undertaken to assess the following three (3) scenarios:

- Additional site runoff from the proposed development site;
- 30% increase in rainfall intensity to assess the potential effects of climate change and;
- Sea level rise of 0.9m at the ocean boundary to assess the potential effects of climate change.

Hydrologic modelling

The existing XP-RAFTS model was modified to simulate additional runoff from the proposed development as a result of the increase in impervious area. Hence, the impervious area for subcatchments 6, 7 and 11 was increased. The impervious area was adopted as 80% of the development site. The adopted fraction impervious is considered appropriate for this assessment.

The previous study identified the 36 hours storm duration as the duration resulting in the higher flood levels (critical duration) at all locations in and upstream of Saltwater Lagoon. Hence, the 36 hour storm duration was adopted for this assessment.

For the climate change scenario, a 30% increase in rainfall intensity was also applied to the hydrologic model. The predicted flow hydrographs were then extracted from the hydrologic model and utilised as inflows to the hydraulic model for the various scenarios.

Hydraulic-morphologic modelling

The flood information provided in this report is based on the TUFLOW hydraulic-morphologic model developed for the Flood Study. No amendments have been made to represent the development (such as changes in topography or land use). Only the boundary conditions (i.e. inflows and ocean levels) have been varied for this assessment.

The previous study took into account the hydraulic and morphologic processes associated with the existing sand berm at the mouth of the creek. For more details on the model setup and assumptions regarding the sand berm height etc, refer to the Saltwater Creek Flood Study (WBM, 2006).

The previous study adopted the peak level of a neap tide cycle (peak level of 0.6 mAHD) to coincide with the catchment flood. This ocean boundary level was adopted for all events up to and including the 100 year ARI event. For the probable maximum flood (PMF) flood event, a 100 year ARI ocean storm surge (peak level of 2.6 mAHD) was adopted for the previous study. These ocean boundary levels were utilised in this assessment. In addition, a 100 year storm surge scenario was modelled (with a 5 year ARI catchment flood). For the climate change scenario, a 0.9m increase in sea level was also applied to the ocean boundary.

Six scenarios were simulated in total for this investigation and these are summarised in Table 2-1.

Table 2-1: Model scenarios for the South West Rock Development

Scenario ID	Rainfall Intensity	Ocean Boundary	Inclusion of additional runoff from proposed development site	Berm Height (mAHD)
1	100 year ARI	Neap tide cycle (0.6mAHD)	Yes	2.0
2	100 year ARI	Neap tide cycle (0.6mAHD)	Yes	3.0
3	100 year ARI + 30%	Neap tide cycle (0.6mAHD)	Yes	2.0
4	100 year ARI + 30%	Neap tide cycle (0.6mAHD)	Yes	3.0
5	5 year ARI	100 year storm surge (2.6mAHD)	Yes	3.0
6	5 year ARI	100 year storm surge plus 0.9m (3.5mAHD)	Yes	3.0

The modelling was undertaken utilising the latest software version of TUFLOW, which has a range of improvements compared to the 2004 version utilised in the previous study. In addition, improvements were made to the representation of runoff inflows to the hydraulic model as part of this assessment.

3. RESULTS

Figure 3-1 shows a comparison of the hydrograph at the outlet of the catchment for the 100 year ARI rainfall event and for the 100 year ARI rainfall event with a 30% increase in rainfall intensity. The peak flow at the outlet of the catchment is 88m³/s and 117m³/s respectively.

The following three flood information maps are provided for each of the six scenarios:

- Peak flood levels (Figure 3-2 to 3-7);
- Peak flow velocities (at the time of the peak flood level) (Figure 3-3 to 3-13); and
- Flood hazard categories as defined in the Flood Study (Figure 3-14 to 3-19).

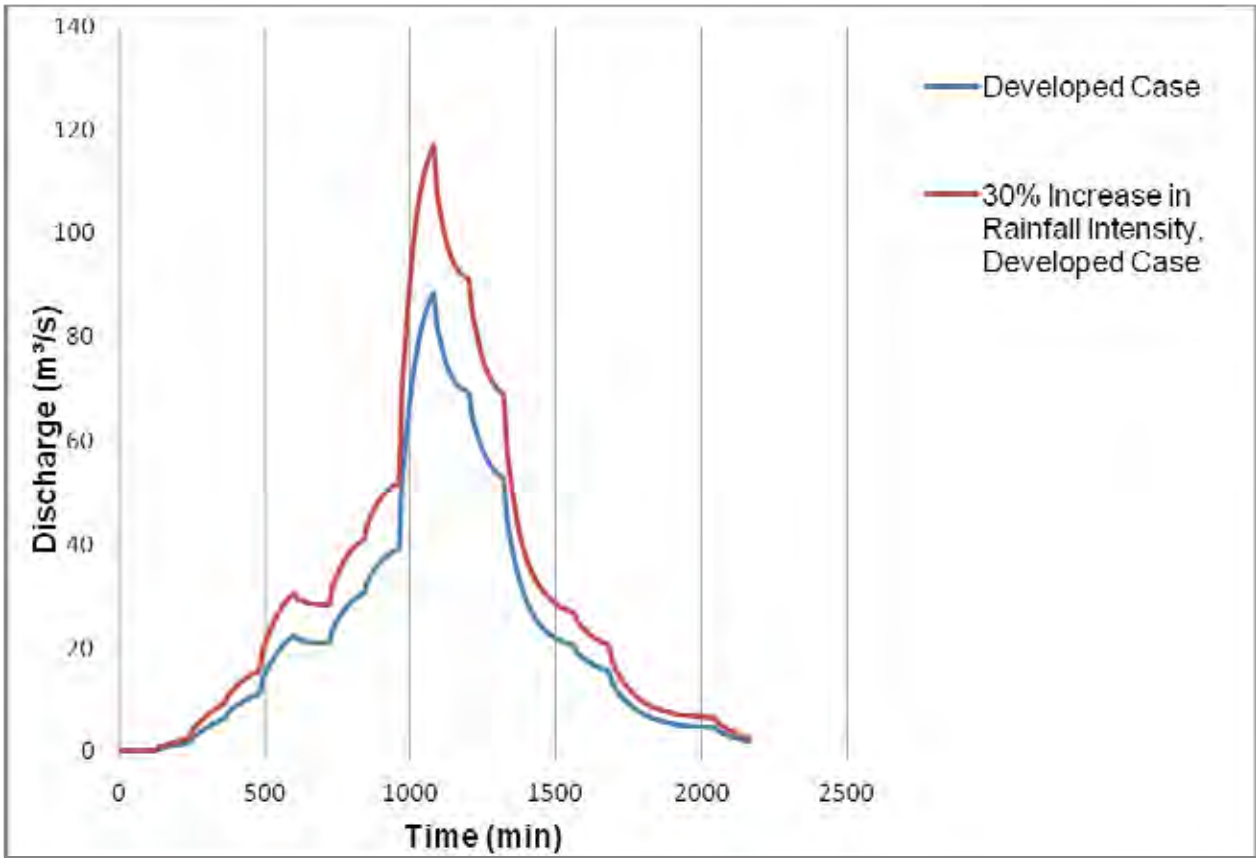


Figure 3-1: Hydrograph at the outlet of the catchment for a 100 year ARI event

The updated existing case model (100 year ARI rainfall, 0.6mAHD ocean boundary) resulted in the following peak flood levels for the 2.0 mAHD and 3.0 mAHD sand berm, respectively:

- 2.0 mAHD berm height: 3.1 mAHD; and
- 3.0 mAHD berm height: 3.4 mAHD.

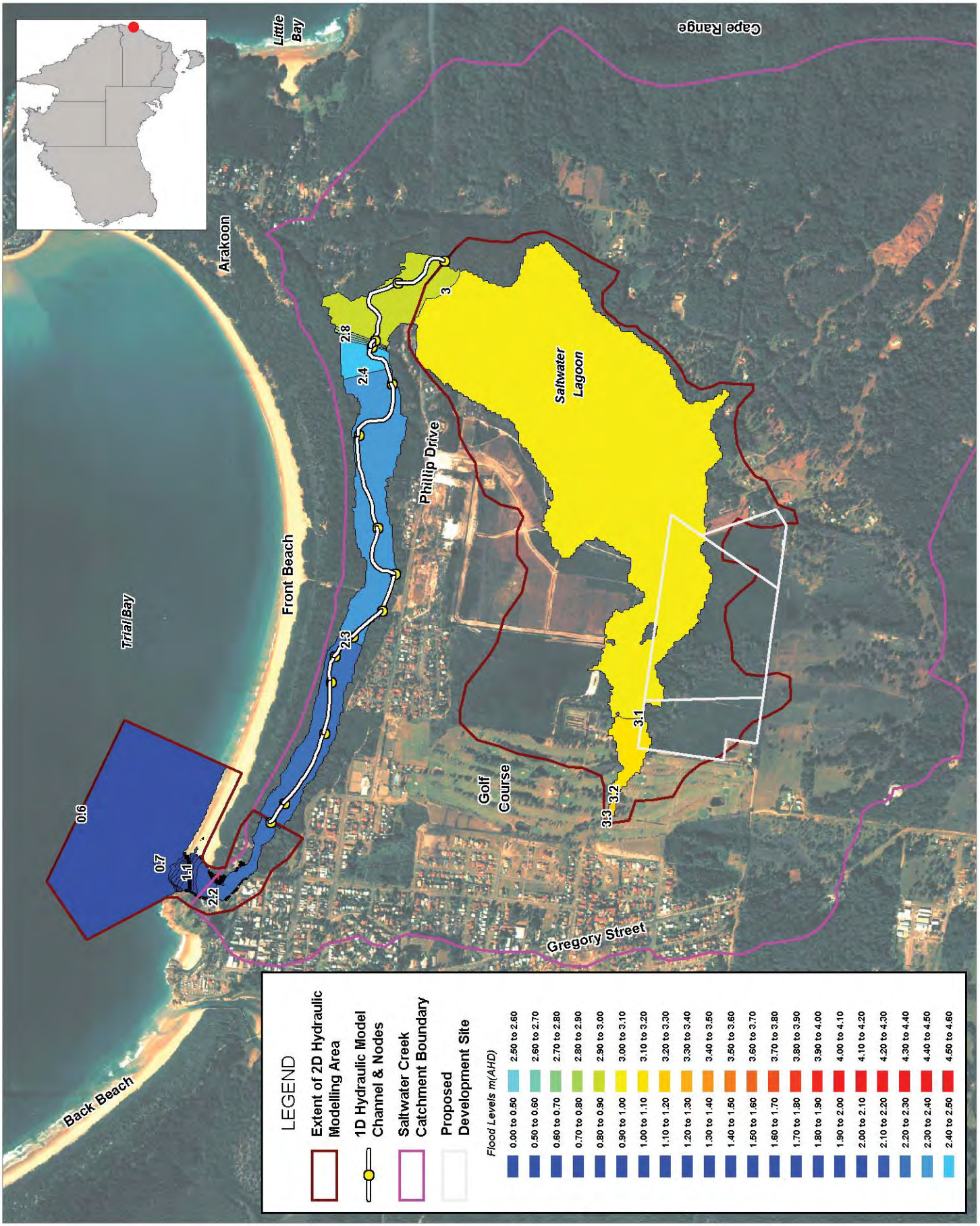
Based on the modelling, the following maximum flood levels are predicted within the site (in the far north-west corner):

- Scenario 1: 3.2 mAHD;
- Scenario 2: 3.4 mAHD;
- Scenario 3: 3.4 mAHD;
- Scenario 4: 3.6 mAHD;
- Scenario 5: 3.1 mAHD; and
- Scenario 6: 3.2 mAHD.

The following observations have also been made:

- Scenarios 5 and 6 result in lower levels upstream of Phillip Drive Bridge (and within the site) compared to scenarios 3 and 4.
- Scenario 4 (100 year ARI with 30% increase in rainfall intensity, 3 mAHD berm height) results in the highest flood levels within the proposed development site.

- The flood velocity is below 0.25m/s within the site for all scenarios.
- The flood hazard category within the site ranges up to high hazard for all scenarios. Depending on the scenario, the fringe of the inundated area is categorised as low or intermediate hazard.



Title:

Scenario 1 Maximum Flood Levels : 100 Year ARI Flood with 2.0mAHD Berm Crest

Figure: **3-2**

Rev: **A**

N

0 0.5 1km

Approx. Scale

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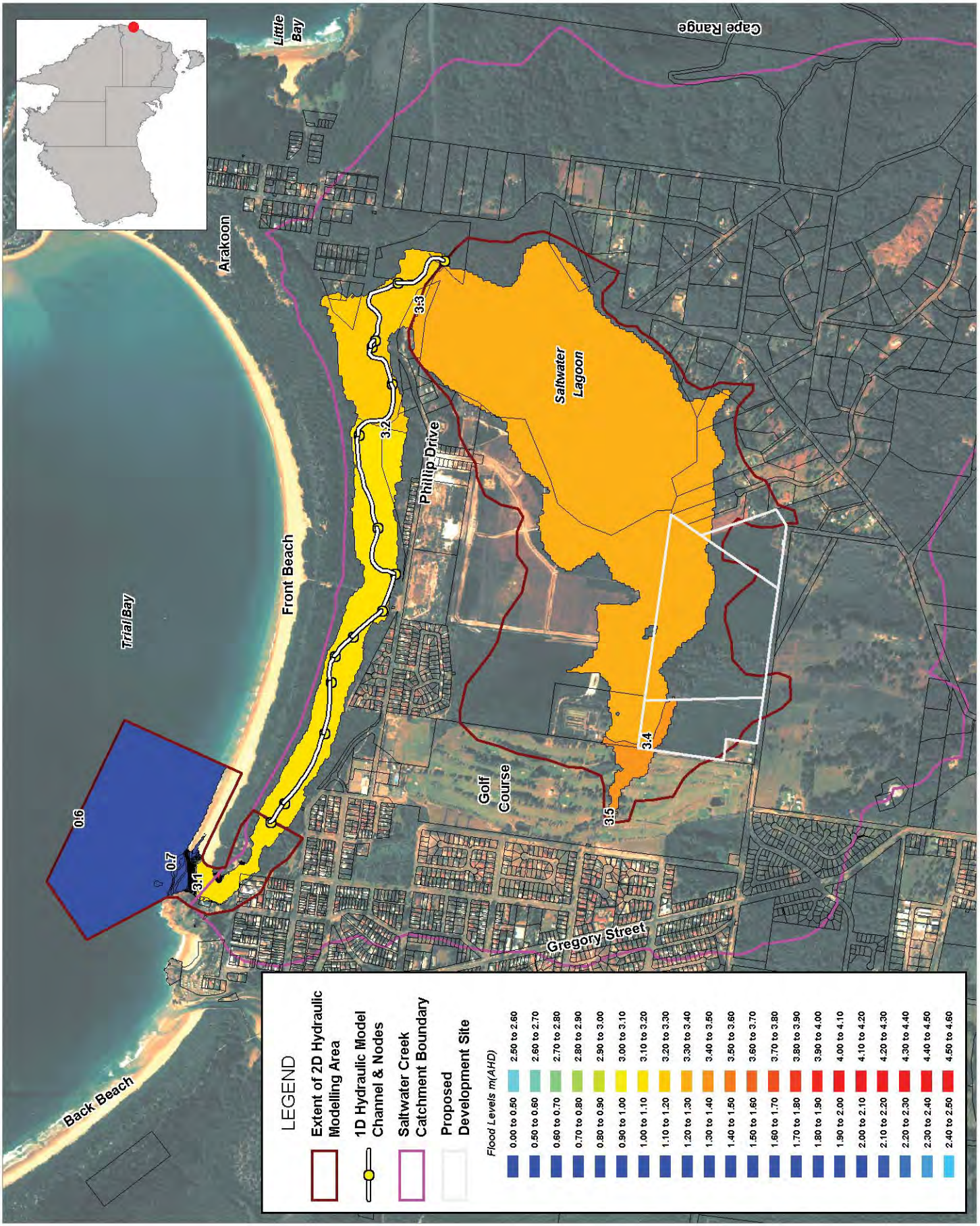
Filepath : I:\B17867_I_SW_Rocks\DRG\FLD_007_100309 Flood Level Desgin at 100yr ARI at 2.0m AHD.wor



Title:

Scenario 2 Maximum Flood Levels : 100 Year ARI Flood with 3.0mAHD Berm Crest

Figure: 3-3

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0 0.5 1km

Approx. Scale

BMT WBM

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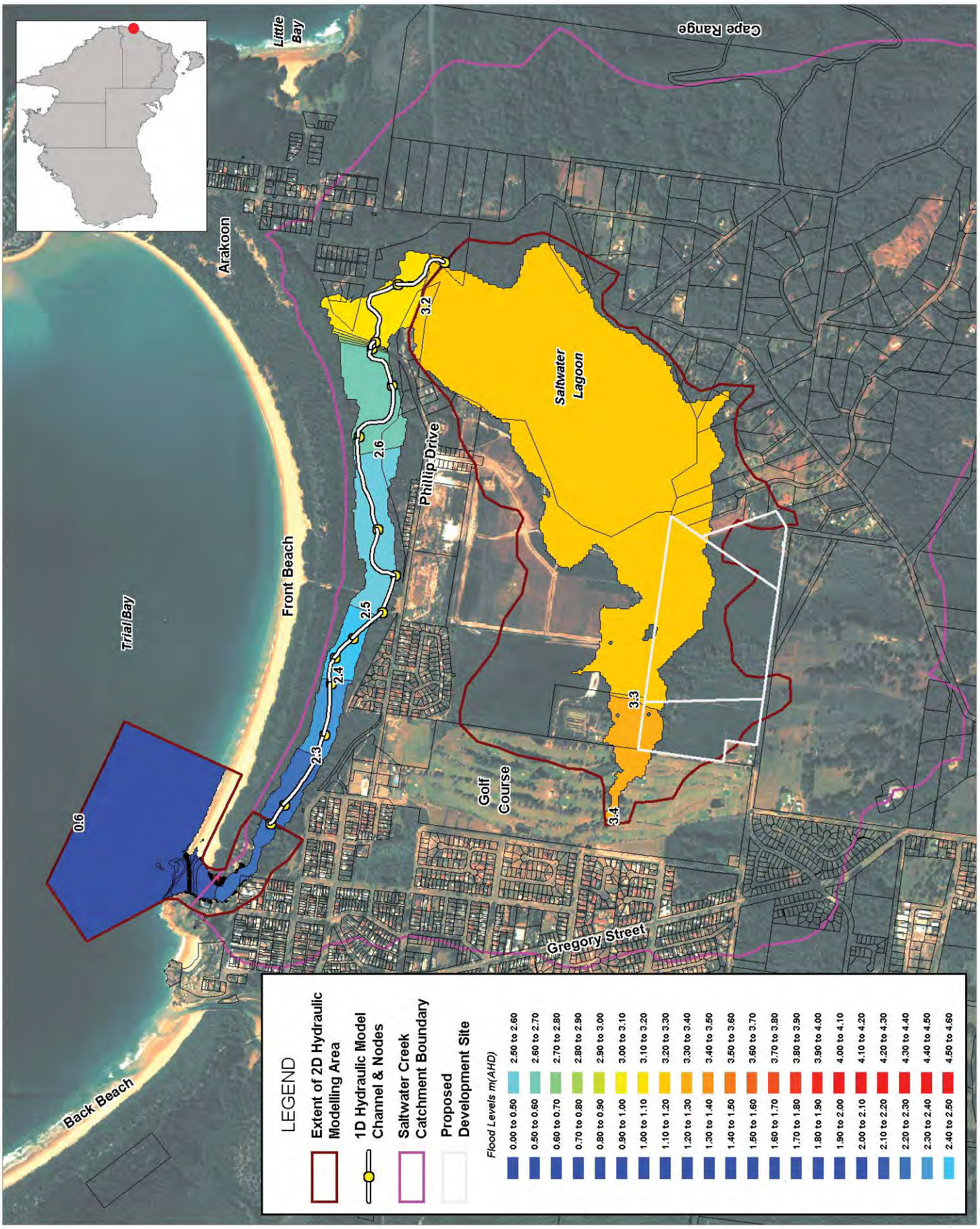
Filepath : I:\B17867_I_SW_Rocks\DRG\FLD_008_100309 Flood Level Desgin at 100yr ARI at 3.0m AHD.wor



Title:

Scenario 3 Maximum Flood Levels: 100 Year ARI Flood with 30% Increase in Rainfall Intensity with 2.0mAHD Berm Crest

Figure: **3-4**

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0 0.5 1km

Approx. Scale

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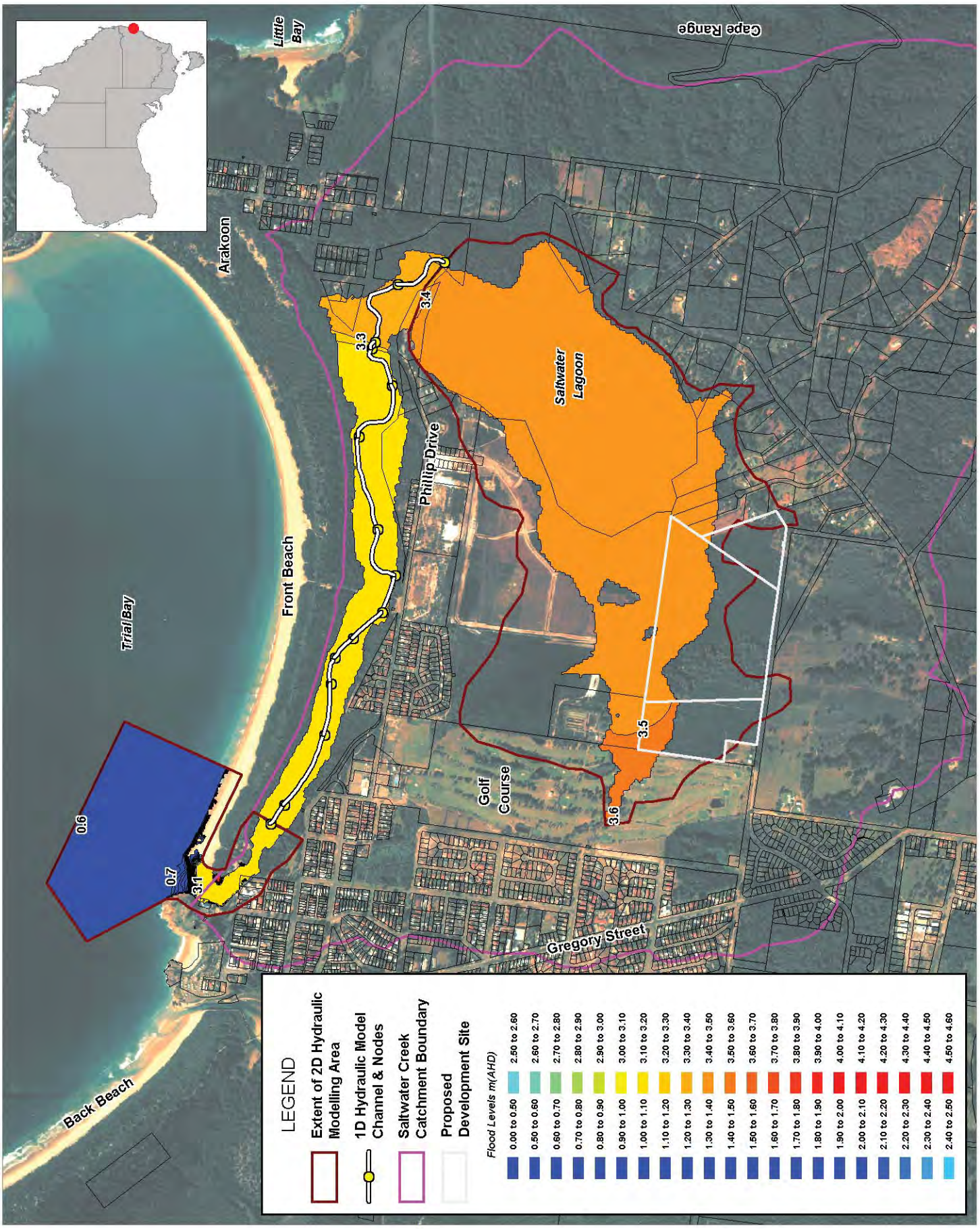
Filepath : I:\B17867_I_SW_Rocks\DRG\FLD_009_100309 Flood Level Desgin at 100yr ARI at 2.0m AHD with 30% increase Rainfall.wor



Title:

Scenario 4 Maximum Flood Levels : 100 Year ARI Flood with 30% Increase in Rainfall Intensity with 3.0mAHD Berm Crest

Figure: **3-5**

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0 0.5 1km

Approx. Scale

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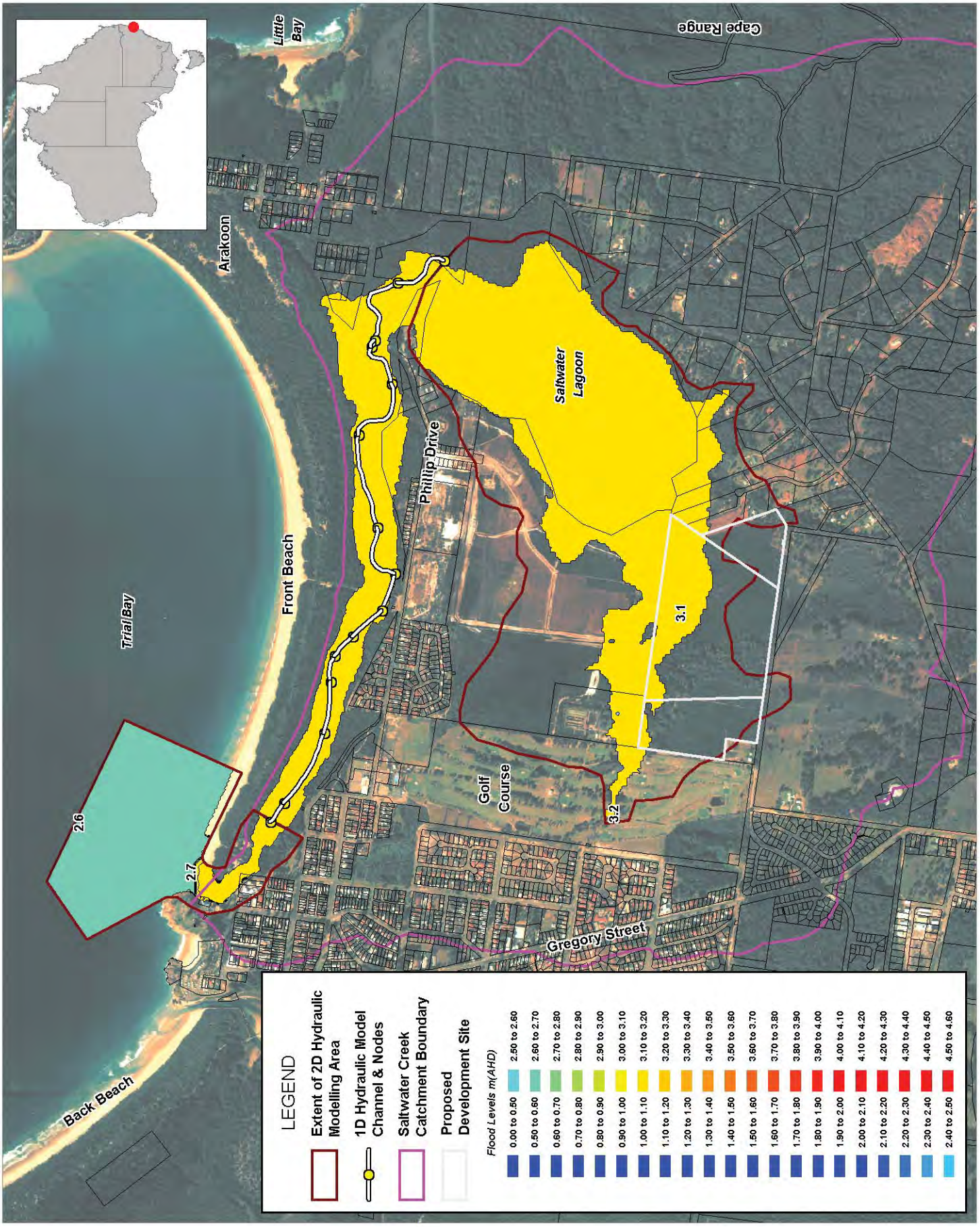

Title:

Scenario 5 Maximum Flood Levels: 100 Year Storm Surge with 3.0mAHD Berm Crest

Figure: 3-6

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0 0.5 1km

Approx. Scale

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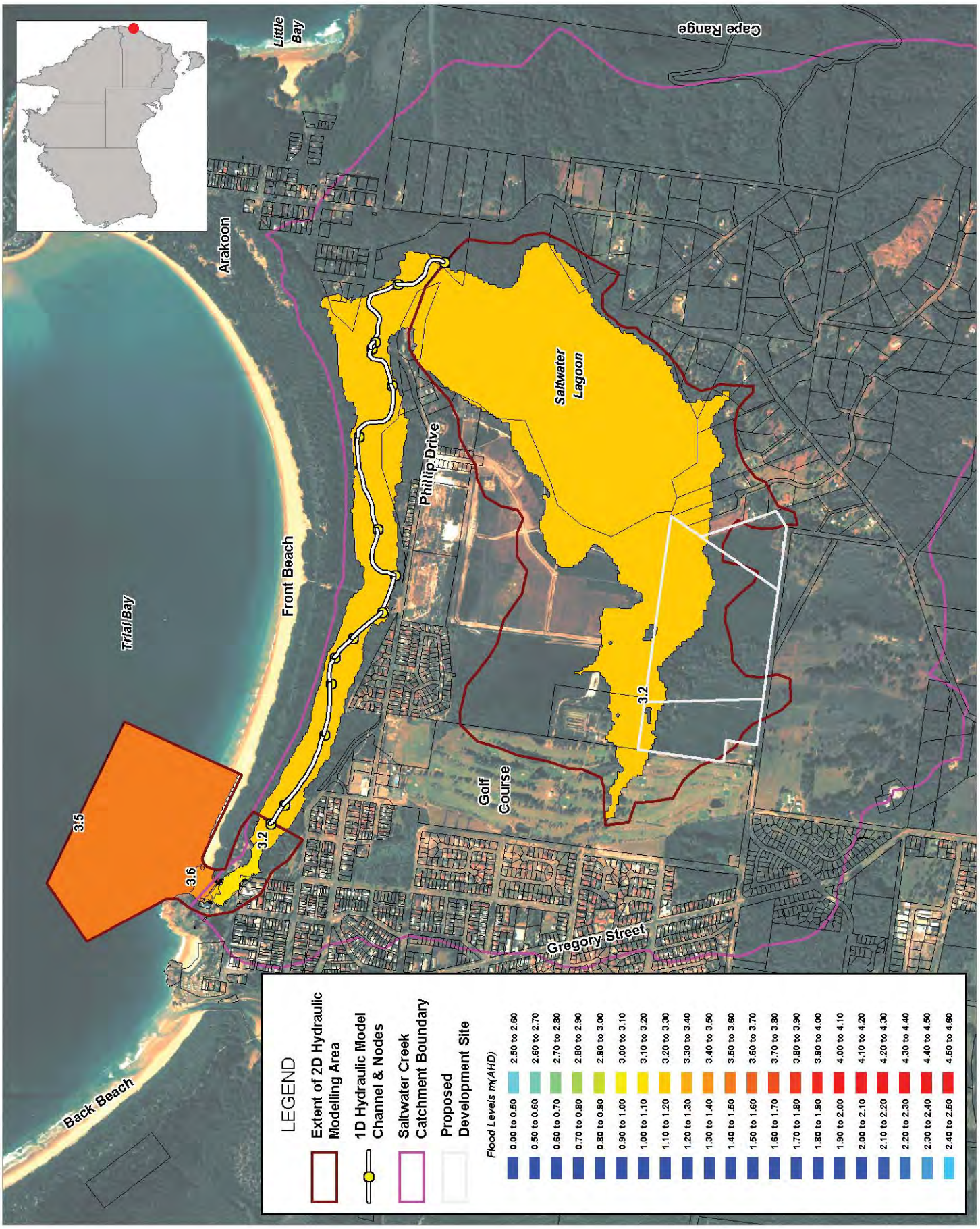

Title:

Scenario 6 Maximum Flood Levels: 100 Year Storm Surge Plus 0.9m Increase with 3.0mAHD Berm Crest

Figure: 3-7

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0 0.5 1km

Approx. Scale

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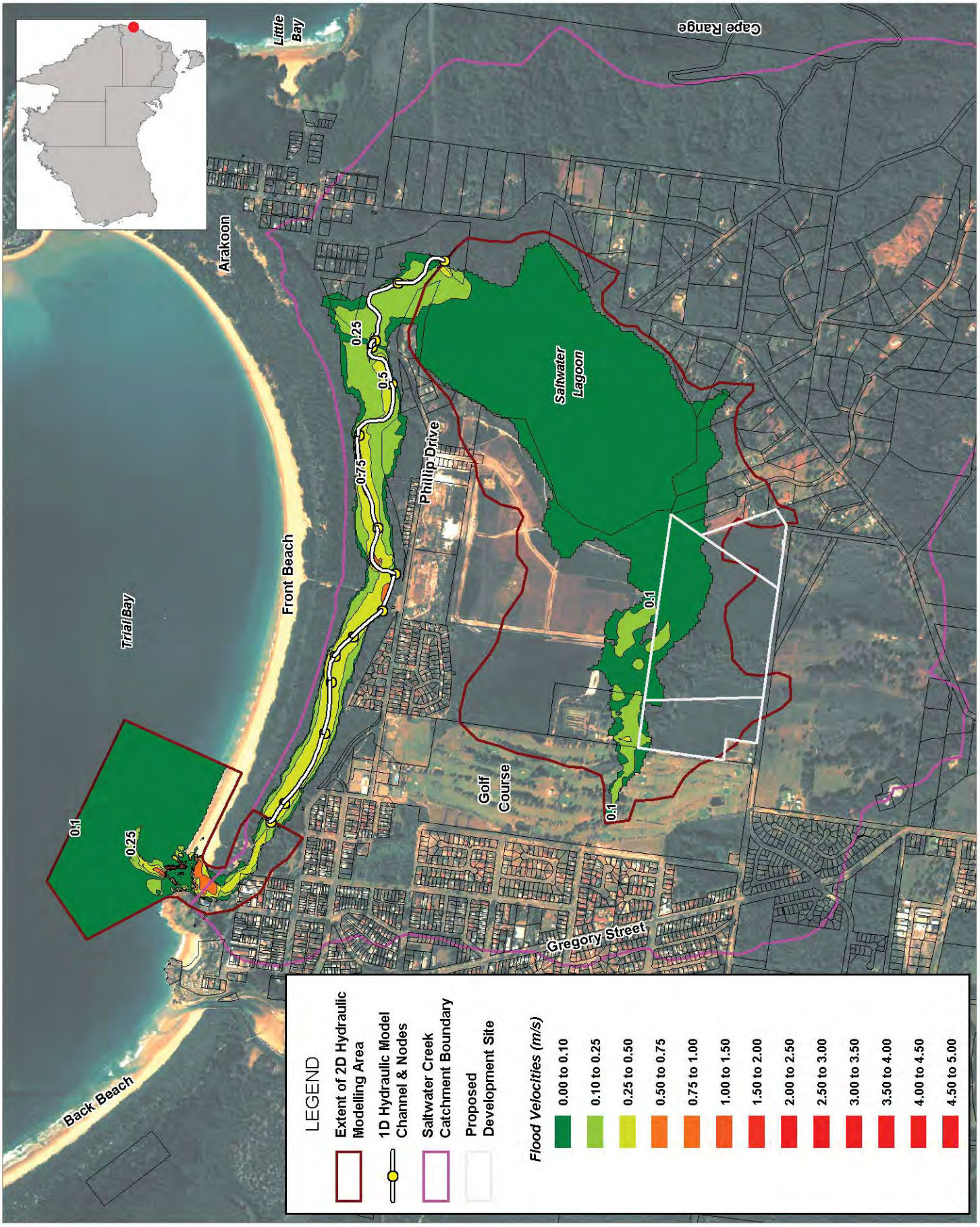
Filepath : I:\B17867_I_SW_Rocks\DRG\FLD_012_100309 Flood Level Desgin at 005yr ARI at 3.0m AHD with 0.9m Plus.wor



Title:

Scenario 1 Maximum Flood Velocities: 100 Year ARI Flood with 2.0mAHD Berm Crest

Figure: **3-8**

Rev: **A**

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0 0.5 1km

Approx. Scale

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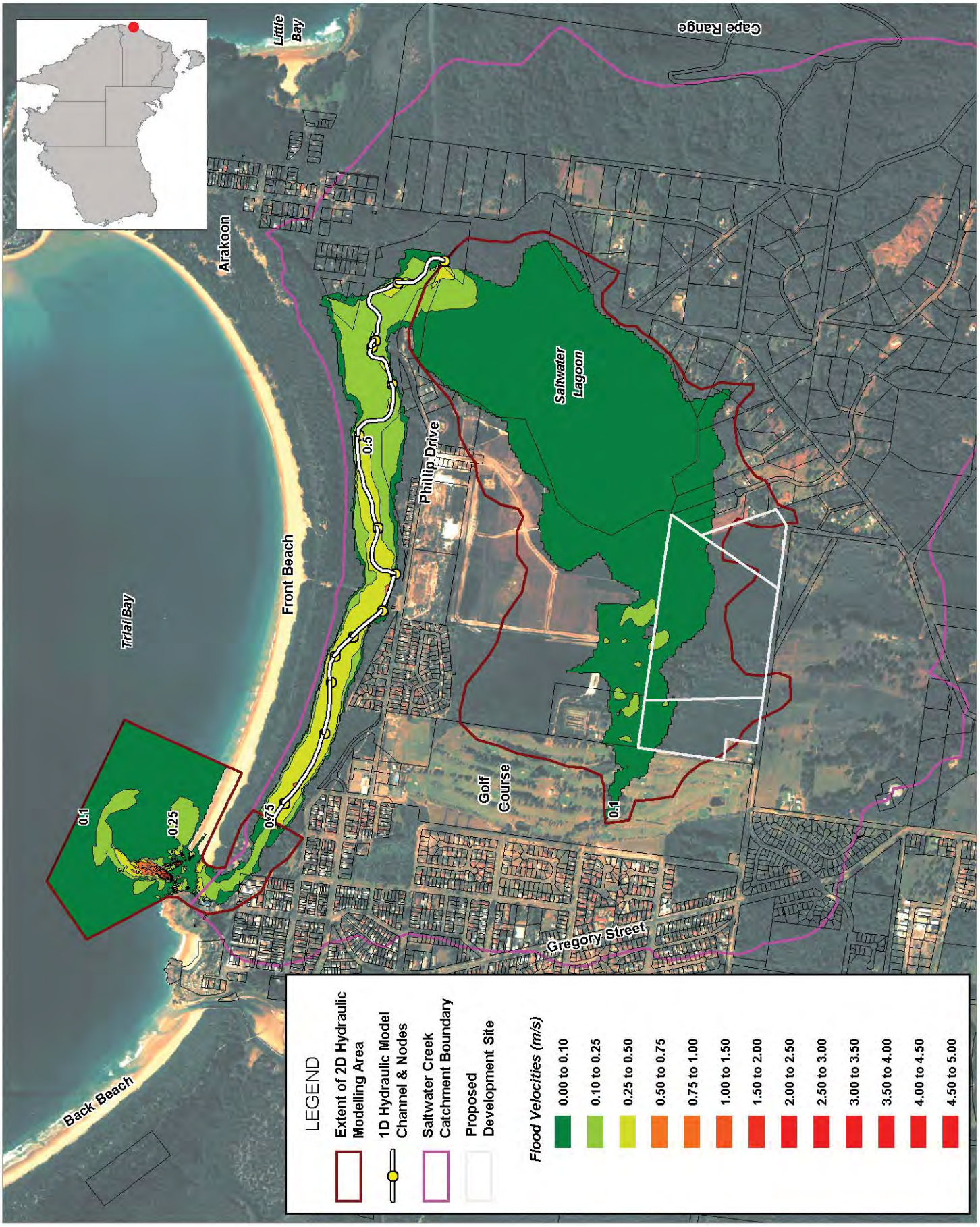
Filepath : I:\B17867_I_SW_Rocks\DRG\FLD_013_100309 Flood Velocities Desgin at 100yr ARI at 2.0m AHD.wor



Title:

Scenario 2 Maximum Flood Velocities: 100 Year ARI Flood with 3.0mAHD Berm Crest

Figure: 3-9

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N

0 0.5 1km

Approx. Scale

BMT WBM

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Filepath : I:\B17867_I_SW_Rocks\DRG\FLD_014_100309 Flood Velocities Desgin at 100yr ARI at 3.0m AHD.wor