

ATTACHMENT 3: FLOOD ASSESSMENT



CIVIL

Flood Assessment

for

Raymond Terrace Bowling Club

for Raymond Terrace Bowling Club

Contents

Acronyms	3
Introduction.....	4
Locality Description	5
Methodology.....	8
TUFLOW Model Setup.....	9
Flood Behaviour	13
Discussion	32
Emergency Response Strategy	43
Conclusion.....	50
Appendix A.....	

Acronyms

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
DCP	Development Control Plan
FPL	Flood Planning Level
LGA	Local Government Area
m	Measure of length / height / distance (metres)
m AHD	Meters above Australian High Datum
PMF	Probable Maximum Flood

Introduction

Northrop Consulting Engineers have been engaged by Raymond Terrace Bowling Club to prepare a flood assessment report for the proposed development at 2 Jacaranda Ave, Raymond Terrace, herein referred as “the subject site”.

The purpose of this correspondence is to present the results from the flood assessment undertaken by Northrop.

Included herein is a:

- Description of the locality.
- Methodology for our assessment.
- Hydraulic model parameters and assumptions
- Existing flood behaviour.
- Flood impact assessment of the proposed development.
- Discussion of the results and our conclusions.

		Date
Prepared by	GB	06/08/2024
Approved by	GB	06/08/2024
Admin	ZJ	06/08/2024

Locality Description

Subject Site

The subject site is located within the Port Stephens LGA at 2 Jacaranda Avenue, Raymond Terrace, otherwise known as Lot 1 Sec 23 DP 758871 and Lot 23 DP1088281. The site is currently occupied by the Raymond Terrace Bowling Club, a raised single-storey building, and three large Bowling Greens with frontage to Jacaranda Avenue and Swan Street.

The site is bordered by Raymond Terrace War Memorial to the north, Port Stephens Street to the west, Swan Street to the southwest, Raymond Terrace Health Centre to the south and Jacaranda Avenue to the east.

The existing site location is presented in **Figure 1** overleaf.

The site terrain elevations range from approximately from 2.0m AHD on the western boundary and to 5.2m AHD on the eastern boundary and over the existing driveway from Jacaranda Avenue.

The existing surface levels of the site are presented in **Figure 3** overleaf.

Proposed Development

The proposed development includes alterations and additions to the existing Raymond Terrace Bowling Club, and demolition of the existing Bowling Green at the corner of Port Stephens Street and Swan Street and construction of a six-storey 50 room hotel including 5 serviced apartments, restaurant, bay, swimming pool gym, function space and office spaces.

The proposed floor levels of the development are summarised below in **Table 1**.

Table 1 - Proposed Hotel Flood levels

Floor	Level (m AHD)
Ground Floor	3.69
First Floor	6.39
Second Floor	9.39
Third Floor	12.39
Fourth Floor	15.39
Fifth Floor	18.59

The revised ground floor plan is presented overleaf in **Figure 2**.



Legend
Subject Site

0 200 400 Metres
1:15,000

Figure 1
Locality

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development



Methodology

This study has been prepared generally following the below methodology:

- Desktop review of previous investigations including the Williams River Flood Study (BMT WBM, 2009), Hunter River Green Rocks to Newcastle Flood Study (DHI, 2010), Williamtown Salt Ash Floodplain Risk Management Study & Plan (BMT WBM, 2017), Williamtown Salt Ash Flood Study Climate Change Review (BMT WBM, 2012) and the Flood Information Certificate provided by the Port Stephens Council, dated 20/12/2022.
- Desktop review of available information including aerial photography and LiDAR survey.
- Review of Architectural Drawings prepared by EJE architecture, dated May 2024.
- Preparation of an existing case two-dimensional TUFLOW hydrologic and hydraulic model to assess the existing flood levels across the site and neighbouring properties.
- Calibration of the model to represent the existing flood level reported in the flood certificate.
- Inclusion of the proposed development into the two-dimensional TUFLOW hydrologic and hydraulic model to assess the impact of the development on existing flood behaviour within the vicinity of the site.
- Flood risk assessment to determine the suitability of the development with respect to The Port Stephens Development Control Plan 2014 (DCP).

A description of the hydraulic modelling and the results of the assessment are presented herein.

TUFLOW Model Setup

The model was developed using the TUFLOW software and the following provides a summary of the parameters used in the development of the two-dimensional flood model.

Hydrological Model Parameters

Inflows from Hunter River and Williams River combine at the confluence at Raymond Terrace upstream of the subject site. To represent the total flow towards the site along the Lower Hunter River, a combined hydrograph for the 1% AEP was entered upstream of the confluence. The original hydrograph was extracted from the Williamstown Salt Ash Flood Study (Figure 5-1 of BMT WBM, 2012) and has been scaled to represent the existing reported flood behaviour of the subject site and the vicinity. The flow has been increased by a further 20 percent to represent the 1% AEP 2100 event.

Hydraulic Model Data

Terrain Data

2013 LiDAR elevation data (1m resolution) obtained from ELVIS – Elevation and Depth – Foundation Spatial Data website was used for the local catchment.

In addition, the detailed survey prepared by Tattersall Lander Pty Ltd, dated the 15th of September 2022 has been incorporated into the model to reflect the existing site conditions.

The existing case topography and the flood model setup are shown in **Figure 3** attached overleaf.

Grid Extent

The grid extends from upstream of the confluence of Hunter River and Williams River and to the south to Heatherbrae and from Thornton to Raymond Terrace covering an area approximately of 57.45km² to the west of A1 Pacific Highway.

The 1% AEP event was modelled using two grid sizes;

- a coarse grid of 8m x 8m to represent the storage areas within the floodplain that are away from the subject site and,
- a finer grid of 2m x 2m to represent the flow behaviour through the river and towards the subject site and vicinity.

A quadtree mesh was constructed to achieve the finer grid resolution within the model and the extent of the modelled grids are presented in **Figure 3** overleaf.

The 1% AEP event was modelled using the TUFLOW HPC Solver (version 2020-10-AD).

Boundary Conditions

A downstream head boundary has been entered along the Hunter River approximately 6.6km downstream of the subject site. The tailwater level used in the model is approximately equal to the 50% AEP design flood condition at this location through the Lower Hunter River, which is consistent with that adopted for the Williamstown Salt Ash Flood Study (2012).

Catchment Roughness and Building Representation

Manning's roughness was estimated based on recent aerial imagery. Roughness values are summarised below in **Table 2**.

Table 2 - Mannings roughness

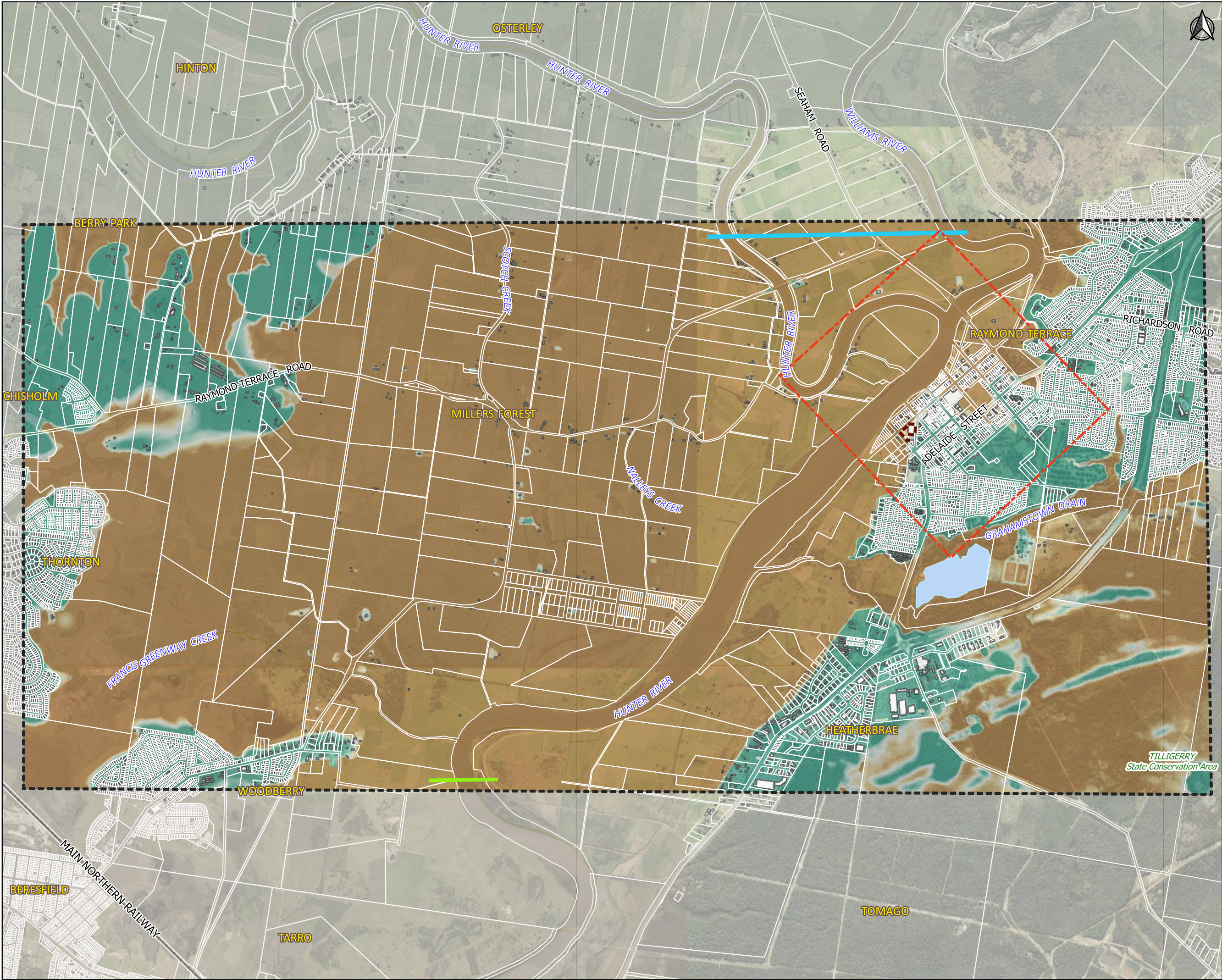
Land use	Manning's Roughness
Grass	0.035
Roads, Car Parks and Tennis Courts	0.018
Medium density vegetation	0.055
Water bodies	0.010
Landscaping (Gardens and fences combined)	0.060
Dense Vegetation	0.080
Concrete Surfaces	0.015

The existing case Manning's roughness is presented in **Figure 4** overleaf.

All buildings located within the model extent have been modelled as inactive areas, effectively assuming 100% blockage, forcing flows around them. **Figure 4** attached shows the inactive areas within close proximity of the site.

External facade wall proposed on the southern site boundary (with frontage to Swan Street) has been modelled as a layered flow constriction with 50% blockage.

Driveways and open space car parking proposed on the development have been modelled as impervious areas with a Manning's roughness value of 0.018.



Legend

- Subject Site
- Model Extent (8m Grid)
- Quadtree Extent (2m Grid)
- Inflow Boundary
- Downstream Tailwater
- Initial Water Level

Topography (m AHD)

6

3

0 500 1,000 Metres

1:31,999.999967

Figure 3
Model Setup & Existing Topography

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





- Legend**
- Subject Site
 - Quadtrees Extent (2m Grid)
 - Buildings (Blocked Out)
 - Manning's Roughness
 - Grass (0.035)
 - Roads, Carports & Tennis Courts (0.018)
 - Medium Density Vegetation (0.055)
 - Water Bodies (0.010)
 - Landscaping (0.060)
 - Dense Vegetation (0.080)
 - Concrete Surfaces & Industrial Areas (0.015)

0 200 400 Metres
1:14,999.999985

Figure 4
Manning's Roughness
Existing Case
(zoomed into the
subject site and
vicinity)

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development



Flood Behaviour

Existing Flood Behaviour

The subject site is affected by mainstream flooding of the Lower Hunter River. Flood water is expected to enter the site through the northern boundary and exits the site through the western and southern boundaries. Characteristics are summarised below in Table 3.

Table 3 - Existing Flood Characteristics

Characteristics	Figure	Comment
Flood Depths	Figure E1-1 Figure E2-1	Up to 2.3 metres in the 1% AEP and approximately 2.8 metres in the 1% AEP 2100.
Flood Elevations	Figure E1-1 Figure E2-1	Elevations up to 4.85m AHD, and 5.27m AHD in the 1% AEP, and 1% AEP 2100 respectively. This is +/-50mm from the flood certificate values.
Flood Velocity	Figure E1-2 Figure E2-2	Up to 1.1m/s in the 1% AEP 2100.
Flood Hazard	Figure E1-3 Figure E2-3	Hazard categories are generally H3-H5 in the 1% AEP. In the 1% AEP 2100 this increases to generally H4 and H5.
Hydraulic Category	Figure E1-4	The highest hydraulic category observed on the site is High Hazard Flood Way and most of the proposed development is located within this area.

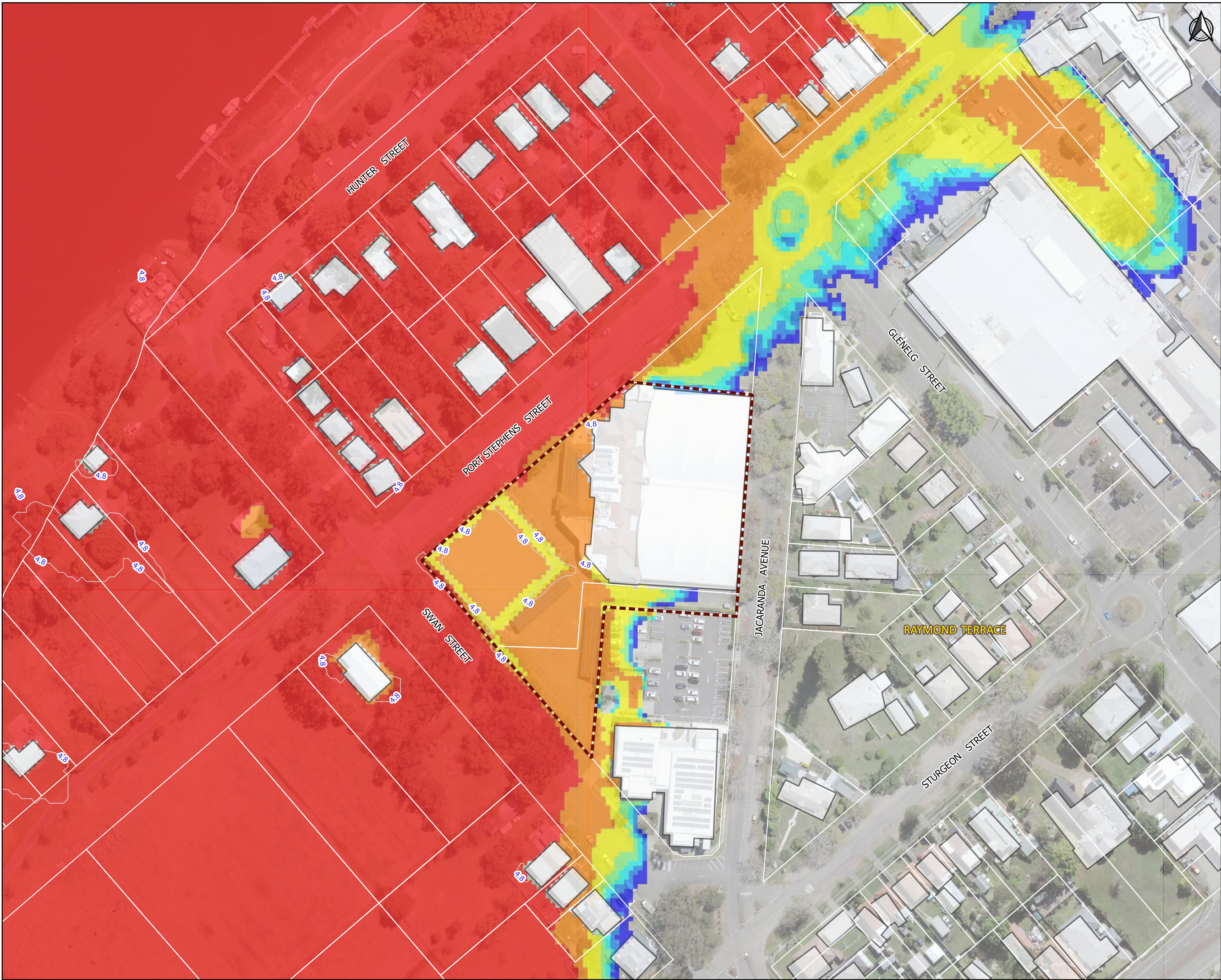
A copy of Council's Flood Certificate is presented in Appendix A.

Developed Case Flood Behaviour

The developed flood behaviour and comparisons are summarised below in Table 4.

Table 4 - Developed Flood Characteristics

Characteristics	Figure	Comment
Flood Depths	Figure D1-1 Figure D2-1	Generally, the same as existing.
Flood Elevations	Figure D1-1 Figure D2-1	Generally, the same as existing.
Flood Velocity	Figure D1-2 Figure D2-2	Generally, the same as existing.
Flood Hazard	Figure D1-3 Figure D2-3	Reduction in hazard due to the included buildings.
Hydraulic Category	Figure D1-4	Reduction in floodway due to included buildings.
Elevation Comparison	Figure C1-1 Figure C2-1	Increases in Port Stephens Street is generally 15mm or less and localised.
Velocity Comparison	Figure C1-2 Figure C2-2	Generally small reductions, less than 0.5m/s, downstream of the included building obstructions.



Legend

- Subject Site
- Existing Buildings
(Blocked Out)

Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0
- 100mm Flood Contour

0 20 40 Metres
1:1,500

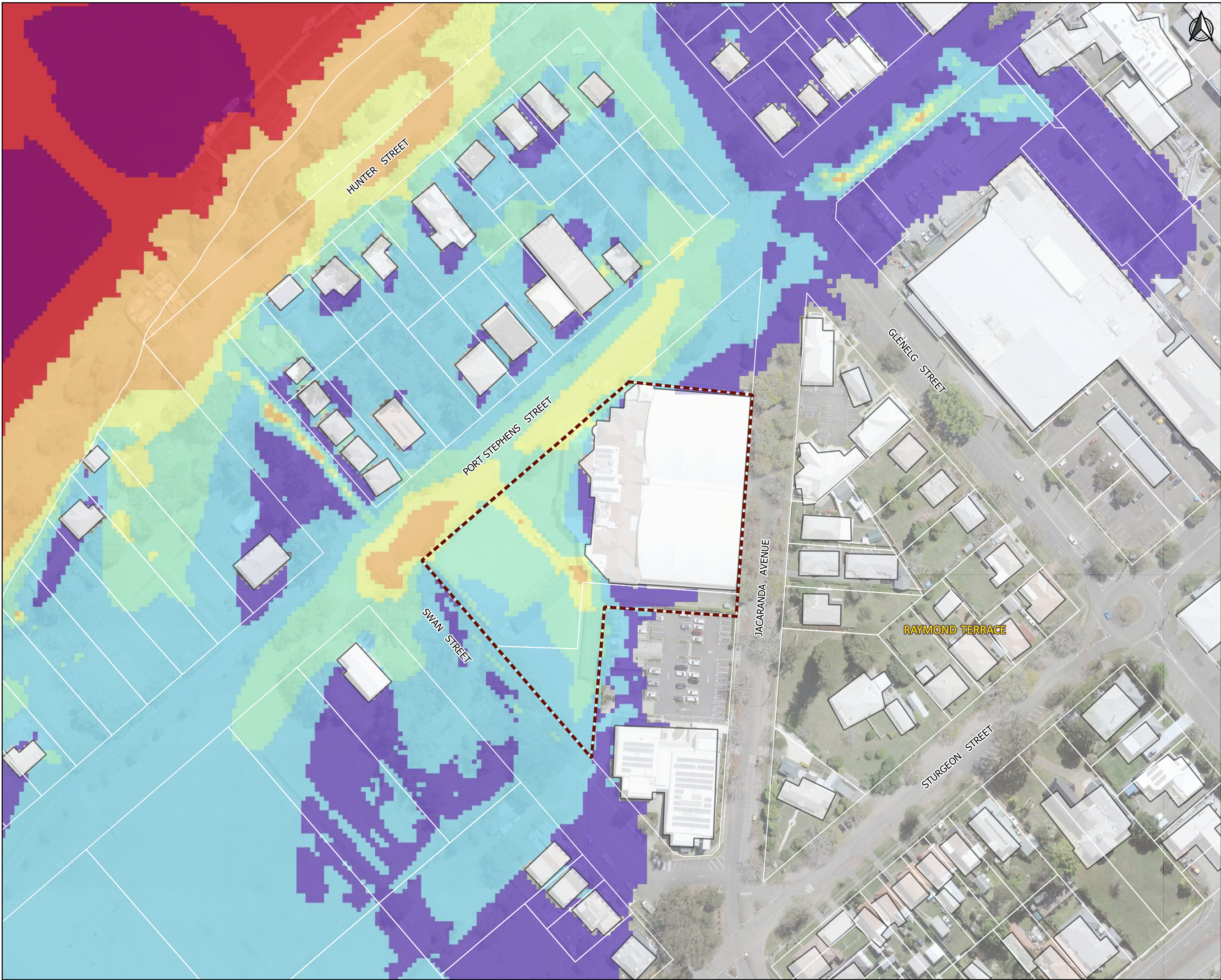
Figure E1-1

1% AEP Flood Depth
and Elevation

Existing Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

- Subject Site
- Existing Buildings
(Blocked Out)
- Velocity (m/s)
 - Less than 0.20
 - 0.21 - 0.50
 - 0.51 - 0.80
 - 0.81 - 1.00
 - 1.01 - 2.00
 - 2.01 - 3.00
 - Greater than 3.00

0 20 40 Metres
1:1,500

Figure E1-2
1% AEP Flood Velocity
Existing Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

Subject Site

Existing Buildings
(Blocked Out)

Hazard

H1

H2

H3

H4

H5

H6

0 20 40 Metres
1:1,500

Figure E1-3
1% AEP Flood Hazard
Existing Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

Subject Site

Existing Buildings
(Blocked Out)

Hazard

H1

H2

H3

H4

H5

H6

0 20 40 Metres
1:1,500

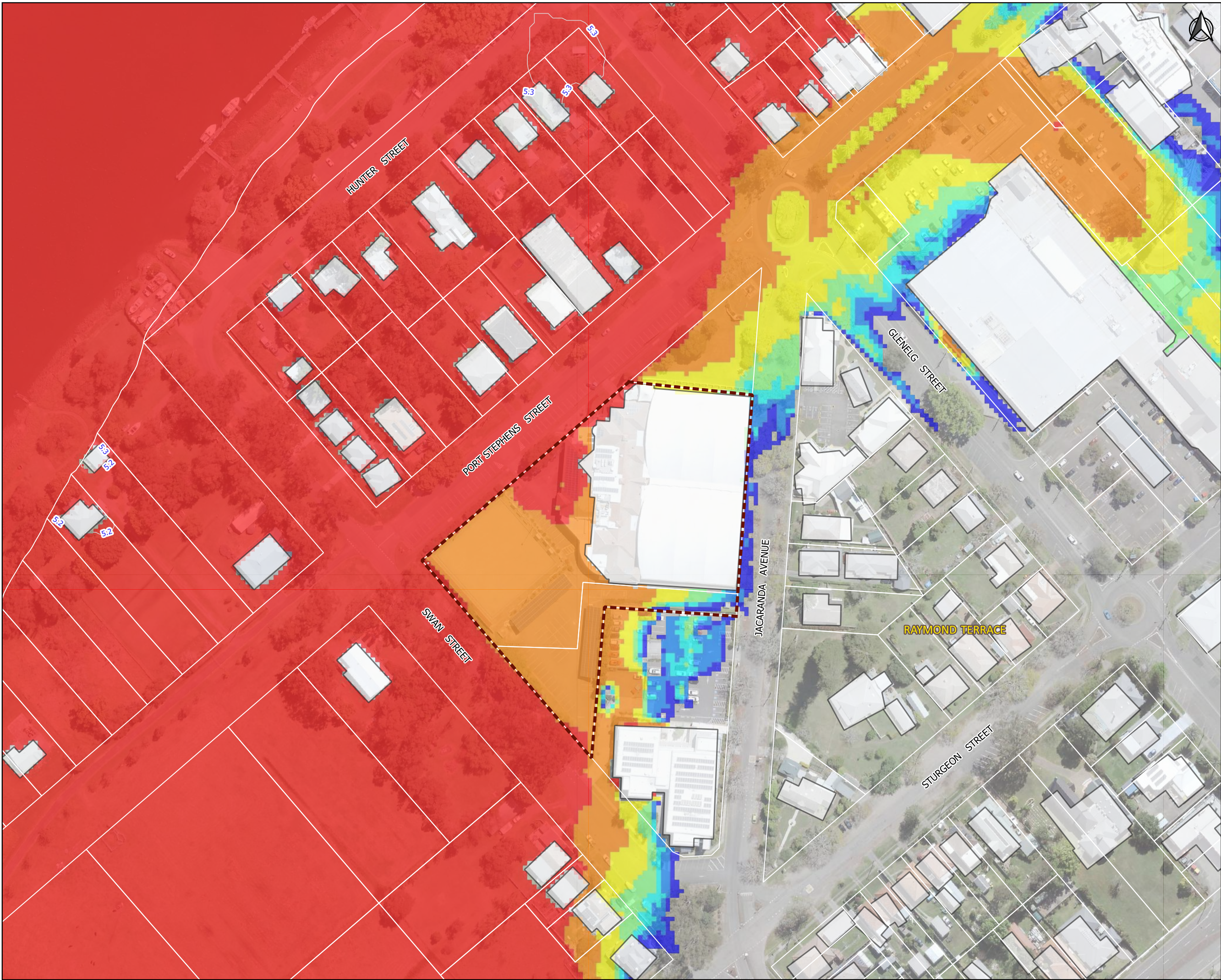
Figure E1-4

1% AEP Hydraulic
Categories

Existing Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

- Subject Site
- Existing Buildings (Blocked Out)

Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0
- 100mm Flood Contour

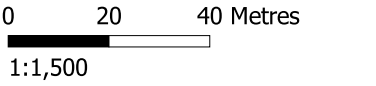
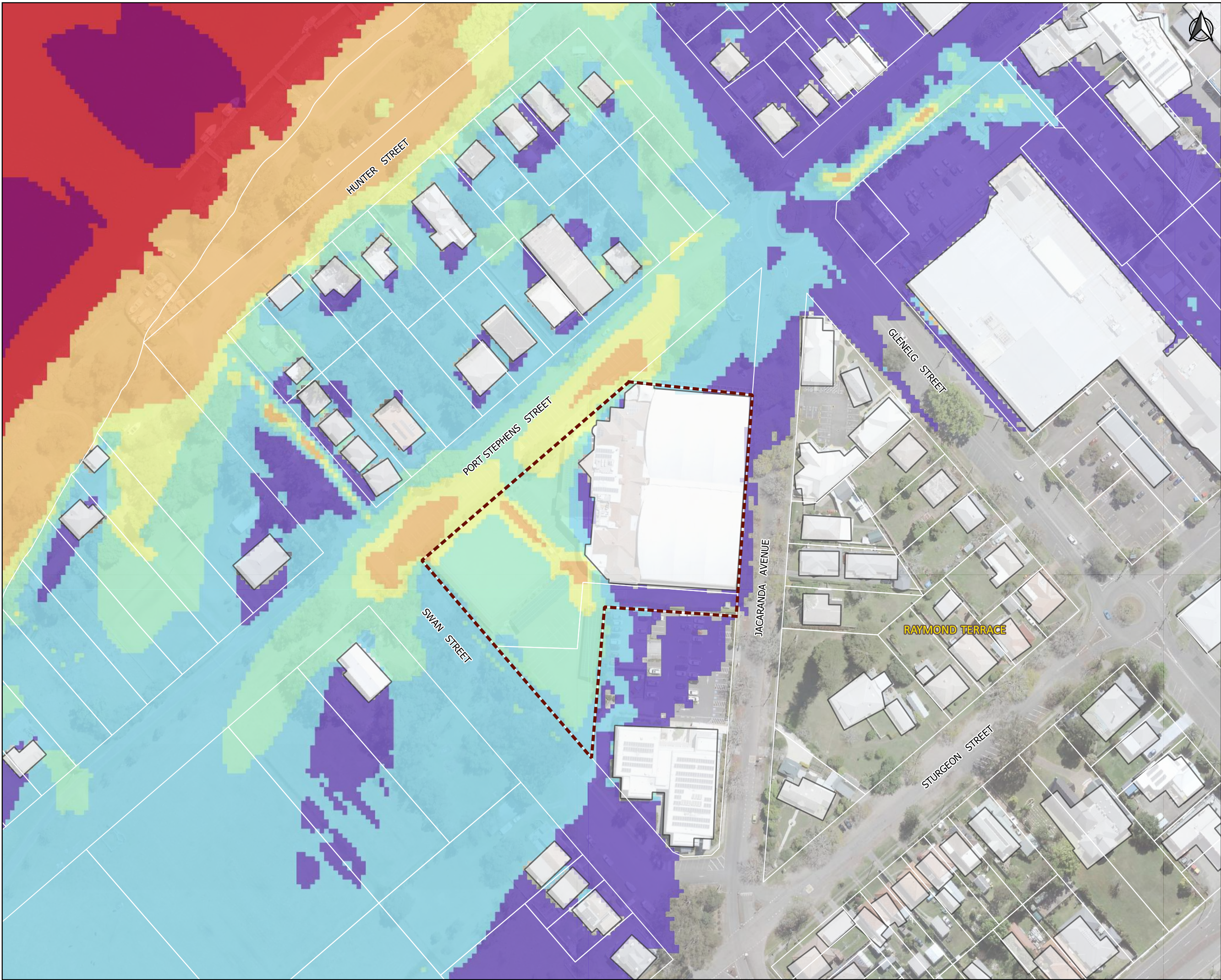


Figure E2-1

1% AEP 2100 Flood
Depth and Elevation

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

- Subject Site
- Existing Buildings (Blocked Out)
- Velocity (m/s)
 - Less than 0.20
 - 0.21 - 0.50
 - 0.51 - 0.80
 - 0.81 - 1.00
 - 1.01 - 2.00
 - 2.01 - 3.00
 - Greater than 3.00

0 20 40 Metres
1:1,500

Figure E2-2

1% AEP 2100 Flood
Velocity

Existing Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

Subject Site

Existing Buildings
(Blocked Out)

Hazard

H1

H2

H3

H4

H5

H6

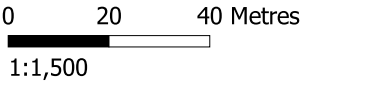
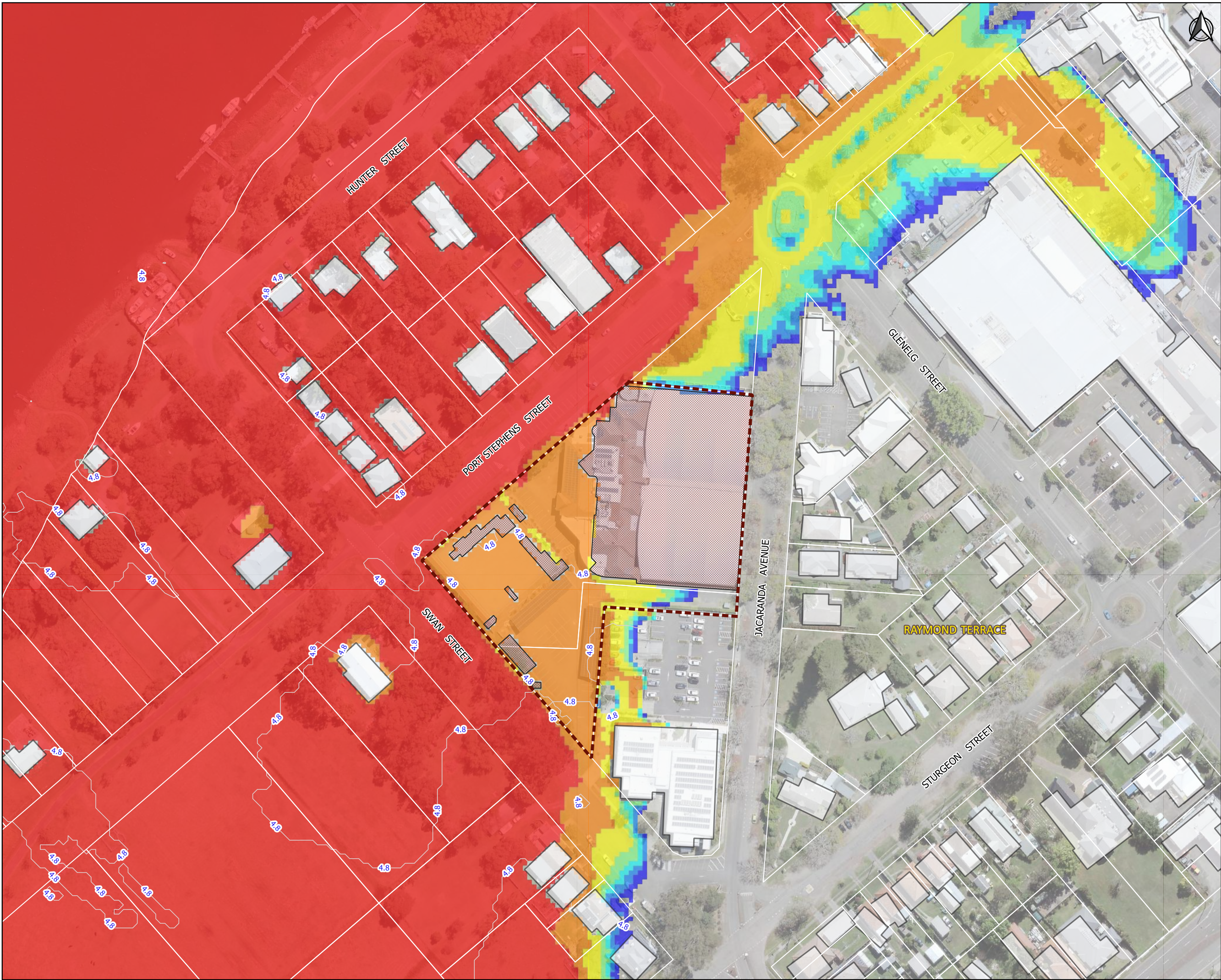


Figure E2-3
1% AEP 2100 Flood
Hazard

Existing Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

- Subject Site
- Existing Buildings (Blocked Out)
- Proposed Buildings (Blocked Out)

Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

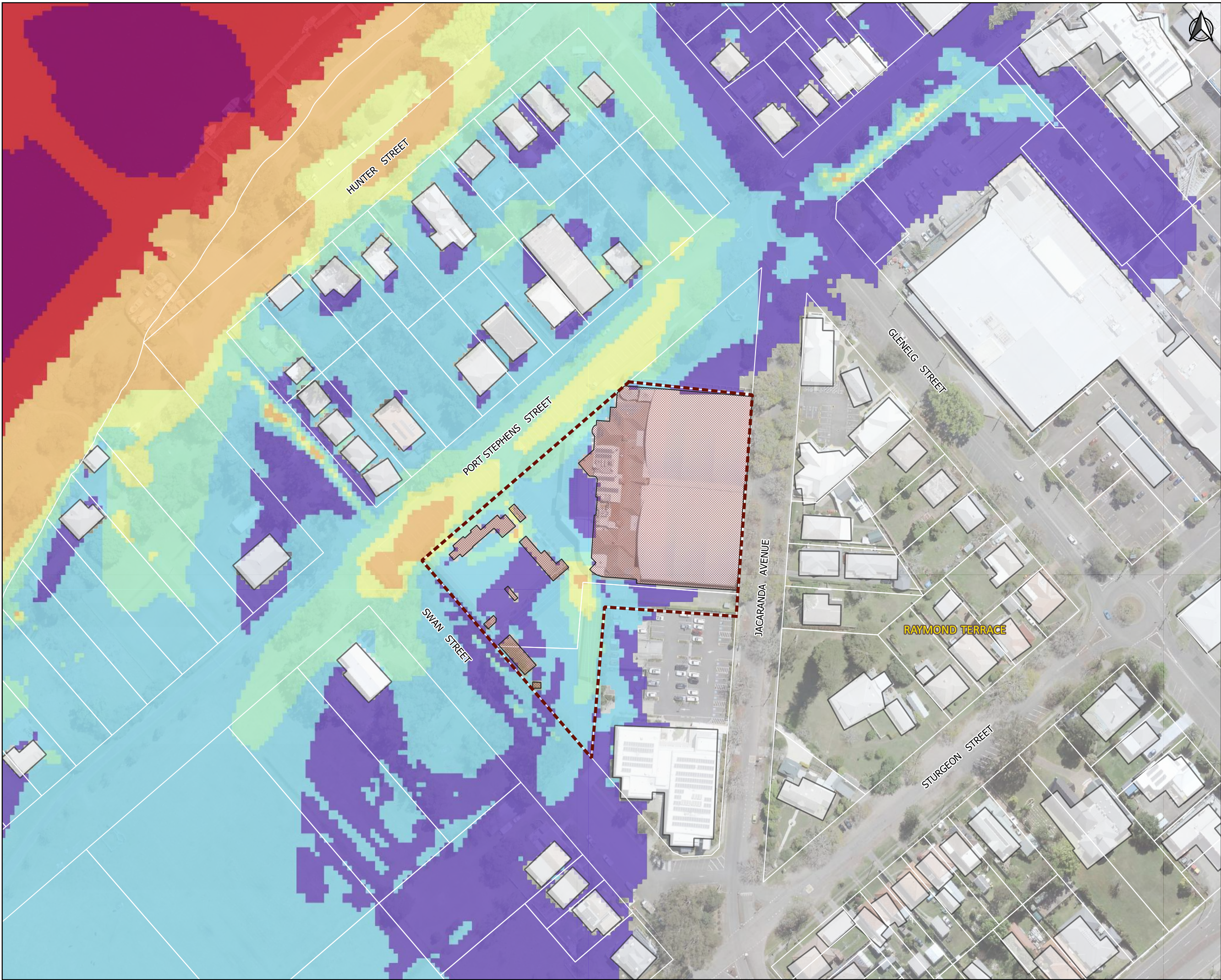
100mm Flood Contour

0 20 40 Metres
1:1,500

Figure D1-1
1% AEP Flood Depth and Elevation
Developed Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

- Subject Site
- Existing Buildings (Blocked Out)
- Developed Buildings (Blocked Out)

Velocity (m/s)

- Less than 0.20
- 0.21 - 0.50
- 0.51 - 0.80
- 0.81 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- Greater than 3.00

0 20 40 Metres
1:1,500

Figure D1-2
1% AEP Flood Velocity
Developed Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

Subject Site

Existing Buildings (Blocked Out)

Proposed Buildings (Blocked Out)

Hazard

H1

H2

H3

H4

H5

H6

0 20 40 Metres
1:1,500

Figure D1-3
1% AEP Flood Hazard
Developed Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

- Subject Site
- Existing Buildings (Blocked Out)
- Proposed Buildings (Blocked Out)

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

0 20 40 Metres
1:1,500

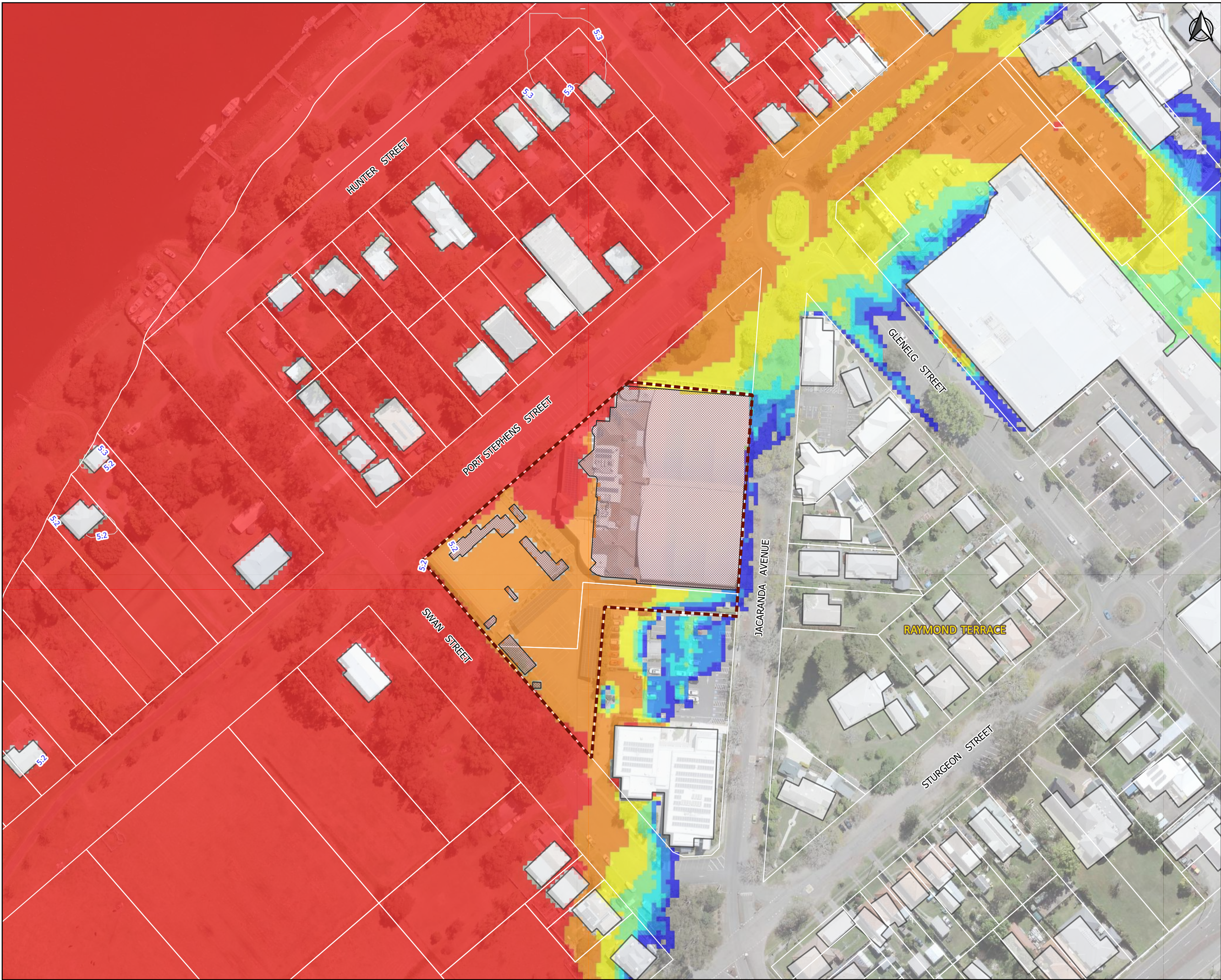
Figure D1-4

1% AEP Hydraulic Categories

Developed Scenario

Upgrade of Raymond Terrace Bowling Club & Hotel Development





Legend

- Subject Site
- Existing Buildings (Blocked Out)
- Proposed Buildings (Blocked Out)

Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

100mm Flood Contour

0 20 40 Metres
1:1,500

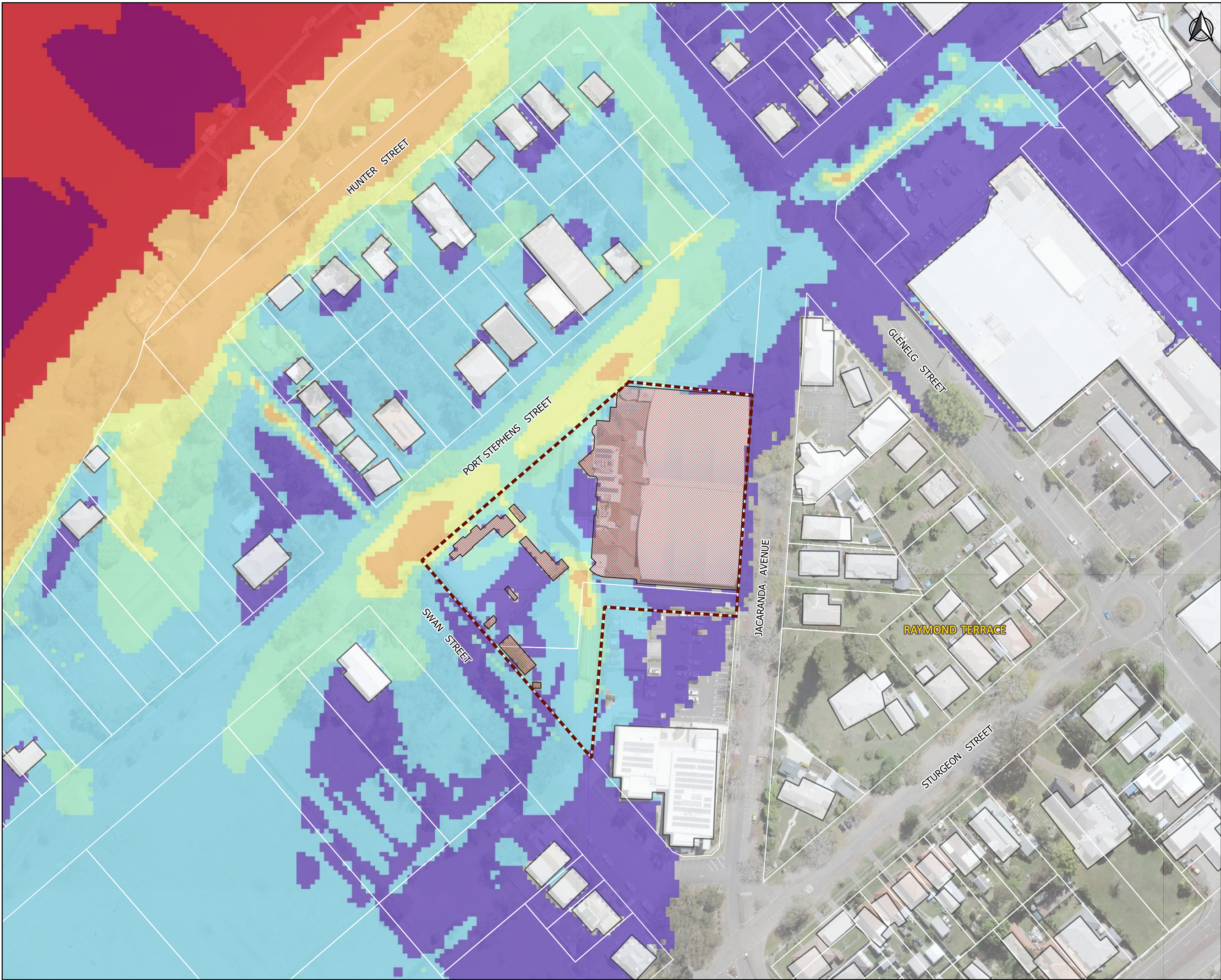
Figure D2-1

1% AEP 2100 Flood
Depth and Elevation

Developed Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

Subject Site

Existing Buildings (Blocked Out)

Developed Buildings (Blocked Out)

Velocity (m/s)

Less than 0.20

0.21 - 0.50

0.51 - 0.80

0.81 - 1.00

1.01 - 2.00

2.01 - 3.00

Greater than 3.00

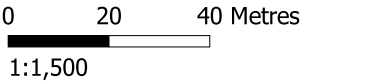


Figure D2-2
1% AEP 2100 Flood Velocity
Developed Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

Subject Site

Existing Buildings (Blocked Out)

Proposed Buildings (Blocked Out)

Hazard

H1

H2

H3

H4

H5

H6

0 20 40 Metres
1:1,500

Figure D2-3
1% AEP 2100 Flood Hazard
Developed Scenario

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

- Subject Site
- Existing Buildings (Blocked Out)
- Proposed Buildings (Blocked Out)

Depth Difference (m)

- ≤ -0.50
- $-0.50 - -0.10$
- $-0.10 - -0.05$
- $-0.05 - -0.03$
- $-0.03 - -0.01$
- $-0.01 - 0.01$
- $0.01 - 0.03$
- $0.03 - 0.5$
- $0.05 - 0.10$
- $0.10 - 0.50$
- >0.50

Wet Dry

- Was Wet Now Dry
- Was Dry Now Wet

0 20 40 Metres
1:1,500

Figure C1-1

1% AEP Pre to Post
Flood Elevation

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

- Subject Site
- Existing Buildings (Blocked Out)
- Proposed Buildings (Blocked Out)
- Velocity Difference (m/s)
 - <-2.0
 - 2.0 - -1.5
 - 1.5 - -1.0
 - 1.0 - -0.5
 - 0.5 - -0.1
 - 0.1 - 0.1
 - 0.1 - 0.5
 - 0.5 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - >2.0
- Wet Dry
 - Was Wet Now Dry
 - Was Dry Now Wet

0 20 40 Metres
1:1,500

Figure C1-2

1% AEP Pre to Post
Flood Velocity

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development





Legend

Subject Site

Existing Buildings (Blocked Out)

Proposed Buildings (Blocked Out)

Depth Difference (m)

≤ -0.50

$-0.50 - -0.10$

$-0.10 - -0.05$

$-0.05 - -0.03$

$-0.03 - -0.01$

$-0.01 - 0.01$

$0.01 - 0.03$

$0.03 - 0.5$

$0.05 - 0.10$

$0.10 - 0.50$

>0.50

Wet Dry

Was Wet Now Dry

Was Dry Now Wet

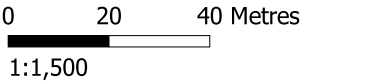


Figure C2-1

1% AEP 2100 Pre to Post Flood Elevation

Upgrade of Raymond Terrace Bowling Club & Hotel Development





Legend

Subject Site

Existing Buildings (Blocked Out)

Proposed Buildings (Blocked Out)

Velocity Difference (m/s)

- <-2.0
- 2.0 - -1.5
- 1.5 - -1.0
- 1.0 - -0.5
- 0.5 - -0.1
- 0.1 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- >2.0

Wet Dry

- Was Wet Now Dry
- Was Dry Now Wet

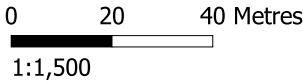


Figure C2-2

1% AEP 2100 Pre to
Post Flood Velocity

Upgrade of Raymond Terrace
Bowling Club &
Hotel Development



Discussion

Council Requirements and Assessment

Council requirements have been obtained from The Port Stephens Development Control Plan 2014 (DCP) Section B5 Flooding. The applicable requirements for development on all flood prone lands are summarised in Table 5.

Table 5 - Council's Requirements for all flood prone lands

Clause	Requirement	Assessment
B5.1 Site Selection	If multiple flood hazard categories are specified for a site on a flood certificate , the proposed development must be located on the land with the lowest flood risk.	As per Council's flood certificate attached, multiple hazard categories present on the site and the proposed development spreads across the site. The proposed development falls into the 'All other development' (as per Figure BI of the DCP) on High Hazard Floodway and a performance-based approach has been considered. This is discussed in the following sections.
B5.2 Finished Floor Levels	Development must meet the minimum FFL as specified in Figure BJ (reproduced below in Figure 14). Note: The National Construction Code may provide minimum FFLs for some categories of development which prevail to the extent of any inconsistency with these controls.	The development falls into the category of Commercial Premises and the following FFLs are applied. - Habitable rooms – Flood Planning Level (5.8m AHD). - Non-habitable rooms – onsite wastewater level (3.5m AHD) All hotel rooms are proposed on or above the first floor (6.39m AHD) of the hotel and are compliant with the Flood Planning Level requirement of the Council.
B5.2 Finished Floor Levels	The finished surface of open space car parking, carports and driveways should be designed having regard to vehicle stability, including consideration of depths and velocity during inundation by flood waters.	Based on ARR 2019 Hazard categories (Figure D1-3), H3 to H4 hazard is present over the majority of the open parking suggesting these areas are unsafe for vehicles. The following requirements for open car parking and driveway are applied:

Clause	Requirement	Assessment
		- The finished surface level – Current Day 1% AEP flood level (4.8m AHD) or, - Flood immunity of the connecting public road The finished surface level of open car parking area and the driveway of the existing Bowling Club are set at 3.28m AHD. The car parking at the lower level of the proposed hotel development is set at approximately 3.50m AHD to 3.70m AHD. All car parking maintains the current immunity of the connecting road.
B5.3 Flood Compatible Design	Development for a building (and/or an associated driveway or access) must be of a flood compatible design and construction and shall meet the relevant requirements in the Construction of Buildings in Flood Hazard Areas (Australian Building Codes Board). Council may also require structural certification for development proposed on land which becomes a floodway in the PMF .	The development is of robust construction, and it is considered feasible to implement flood compatible material in the final design. As per Williamstown Salt Ash Floodplain Risk Management Study & Plan (BMT WBM, 2017- Figure A8: PMF Design Event – Hydraulic Categories), the subject site is expected to become a floodway in the PMF event. As such, a structural certification may be required to prove the structural integrity of the development.
B5.4 Fencing	Fencing on flood prone land should be stable in events up to the current day 1% AEP flood event and not obstruct the flow of floodwater.	A variety of perimeter landscaping and an external open style facade is proposed around the undercroft parking. 50% blockage of the external facade (frontage to Swan Street) has been assumed in Northrop's flood modelling and the results suggest that there is no significant adverse impact on Swan Street to the south of the development. Open style fencing such as palisade to be incorporated in the open car parking area. Generally, this matches the existing arrangement.
B5.5 Electrical Features	All incoming main power service equipment, including all metering equipment, and all electrical fixtures, such as power	The current design does not provide details on the electrical features.

Clause	Requirement	Assessment
	points, light fittings, switches, heating, ventilation and other service facilities must be located above the FPL, or where possible above the PMF. Where the above cannot be achieved, the following features shall be used: • Electrical cabling is not to be installed within walls, or chased into walls; and • Any circuit containing switches, power points or any other electrical fitting that are located below the FPL, shall connect to the power supply through an individual Residual Current Device (RCD), located in the meter box.	We recommend consideration is given to locating infrastructure above the FPL, and should this not be possible consideration given to the mitigation measures listed.
B5.6 Potentially hazardous and/or polluting material	The storage of hazardous or potentially hazardous materials, potentially polluting material or material that could be washed from site and cause harm downstream must be stored above the FPL with appropriate bunding.	The storage areas are part of the existing developed arrangement.
B5.7 Potentially hazardous and/or polluting material	Items that may wash away during flood events (e.g., rainwater tanks, hot water tanks, gas cylinders, shipping containers) must be elevated above the 1% AEP flood event level in the year 2100 (without freeboard) or anchored to resist buoyancy and impact forces.	We recommend all items that may wash away during flooding to be elevated above 5.8m AHD or securely fastened. Screening of the carparking areas and management measures are proposed to minimise the likelihood of cars floating away in flood events. It is expected that details of these items will be provided at the detailed design stage of the development.
B5.8 Flood Impact and Risk Assessment	A flood impact and risk assessment is required for: • Any fill on land identified as floodway. • Any fill located in a flood storage area, unless: - The net volume of fill does not exceed the lesser of 20% or 2000m³ of the flood volume of the lot in the 1% AEP flood event in the year 2100 (this includes	This report has been prepared as a simple Flood Impact and Risk Assessment due to the presence of Floodway.

Clause	Requirement	Assessment
	consideration of previous fill volumes); and - It is demonstrated that the fill does not adversely affect local drainage patterns of all events up to the 1% AEP flood event in the year 2100. Development Control Plan Port Stephens Council 33 B5 Development controls Note: Fill in flood storage areas greater than the abovementioned volume can be offset by flood storage. Offsetting can be achieved through consolidation of lots and/or assigning an 'easement to flood land' on the compensatory lot/s. Compensatory lots must be located within the zone of influence of the proposed fill (as demonstrated by the flood impact and risk assessment) or adjacent to the proposed fill and be of the same hazard category of the subject site. - Any fill for the purposes of a livestock flood refuge mound, unless the livestock flood refuge mound is located in an identified flood fringe area: - The volume/size and location of the livestock flood refuge mound meets the criteria in Figure BK; and - The size of the mound must have regard to the agricultural capacity of the land. The design and size of the mound shall be determined by reference to the NSW Department of Primary Industries –Agriculture. 2009, 'Primefacts: Livestock flood refuge mounds'; and - Where the proposed development could change flood behaviour, affect existing flood risk, or expose people to flood risks that require management or; - If Council determines a flood impact and risk assessment is necessary for any other reason.	

Clause	Requirement	Assessment
B5.11 Driveways and Access	Access from the building envelope to the public road is to have a minimum finished access level of: • The flood immunity of the connecting public road; or • The current day 1% AEP flood event level for the site.	The car parking in the undercroft area is proposed to be sited at approximately 3.50 to 3.70m AHD, which is below the current day 1% AEP flood level of 4.8m AHD. The undercroft parking area has been included in Northrop's flood model as an open area allowing flood water to traverse the car park. The results from the flood modelling do not produce any significant adverse impacts on the existing roads or neighbouring properties. The carparking meets the requirement for immunity of the connecting public road.
B5.12 Driveways and Access	Earthworks for driveways and access must satisfy the objectives of B3.C of the DCP and LEP. These controls are listed below. B3.3 Development may need to provide a bulk earthworks plan in order to adequately address the above matters when: • cut exceeds 2m in depth • fill has a total area of 100m² or more • is within 40m of the top bank of a riparian corridor as defined under the Water Management Act 2000 B3.4 Fill must consist of virgin excavated natural material (VENM) as defined under the Protection of Environment Operations Act 1997 or any other waste-derived material the subject of a resource recovery exemption under clause 91 of the Protection of the Environment Operations (Waste) Regulation 2014 that is permitted to be used as fill material.	Refer to Civil Plans for details of new finished surface levels.

Clause	Requirement	Assessment
B5.14 Emergency Onsite Flood Refuge	If evacuation egress from residential accommodation, a commercial premises, an industrial premises, fill or development vulnerable to emergency response and critical infrastructure to flood free areas cannot be achieved via a route that is flood free in the current day 1% AEP flood event or is a low hazard flood area, an onsite flood refuge must be provided meeting the following criteria: • Is located above the PMF level; • Is intrinsically accessible to all people on the site, plainly evident and selfdirecting; • Is accessible in sufficient time for all occupants with fail safe access and no reliance on elevators; • Has unobstructed external access for emergency boats during flooding; • Caters for the number of persons that could reasonably be expected on-site at any one time (approx. 2m2 per person); • Provides adequate shelter from the storm and has natural lighting and ventilation; and • Contains sufficient clean water, a first aid kit, portable radio with spare batteries and a torch with spare batteries. Note: If a flood refuge is required, the DA must be accompanied by structural certification.	Evacuation to offsite emergency refuge is possible via Jacaranda Avenue to the east towards the Pacific Highway during the 1% AEP and early evacuation is recommended for the development. Flood free land in the PMF is located approximately 300 metres away from the site in Adelaide Street. During the PMF, the site and the surrounding areas will be completely inundated by flooding and evacuation to flood free land will be difficult to achieve. For anyone trapped within the site during flooding, on-site refuge is available as an option of last resort within the proposed hotel development. The proposed hotel has several floor levels above the PMF level (8.7m AHD) and the second floor (proposed at 9.39m AHD) or above levels of the hotel development are suitable for onsite refuge. We believe the development will be able to provide adequate emergency response through early evacuation, with on-site refuge as an option of last resort. Refer to the Emergency Response Strategy section for further information.
B5.16 Appropriate Development in a floodway	Development other than farm buildings and/or fill is not supported on land identified as either low hazard floodway or high hazard floodway	The proposed development falls into the 'All other development' (as per Figure BI of the DCP) on High Hazard Floodway and a performance-based approach is required to determine the suitability.

Clause	Requirement	Assessment
B5.17 Fencing in a Floodway	Fencing in a floodway should not include non-permeable materials or fencing types that could restrict or redirect flood waters.	Fencing is discussed as above.

Performance Based Approach

Clause	Requirement	Assessment
B5.18 Risk to Life	The proposed land use is consistent with Figure BI, which shows suitable land uses by flood hazard category (as identified on a flood certificate) and the proposed development incorporates adequate measures to manage risk to human life from flooding, including: • Evacuation access from an area affected by flooding to an area free of risk from flooding, taking into account any potential access restrictions; • Warning times and procedures to make people aware of the need to evacuate; • Consideration of the current and potential future occupants; and Consistency with the most recent Council adopted flood study or floodplain risk management study that has been undertaken for the site.	The proposed development entails alteration and addition to the existing Bowling Club and the construction of a multi-storey hotel development and falls into the 'All other development' (as per Figure BI of the DCP) on High Hazard Floodway. However, results from the flood impact assessment suggest the proposed development does not significantly change the existing flood risk of the site, and in the post developed conditions, the development is not expected to result in a significant adverse impact in adjacent properties. Furthermore, the proposed design mostly reflects the existing use of the site and is expected to remain compatible with the existing building and connections with the street. <u>Evacuation Access</u> As discussed above, early evacuation is recommended for the development. Evacuation to an offsite emergency refuge is possible via Jacaranda Avenue to the east towards the Pacific Highway during the 1% AEP. For anyone trapped within the site during flooding, on-site refuge is also available as an option of last resort within the proposed hotel development. The proposed hotel has several floor levels above the PMF level (8.7m AHD) and the second floor (proposed at 9.39m AHD) or above levels of the hotel development are suitable for onsite refuge. <u>Warning Times</u> As per Williamtown Salt Ash Floodplain Risk Management Study & Plan, available flood warning times for the Lower Hunter River (Raymond Terrace and downstream areas) exceed 12 hours and as such, it is expected sufficient warning time will be available for the site to make the staff and patrons aware of the need evacuate the site as early as possible. <u>Current and future occupants</u> Similar to the current arrangement, the site will be managed within a club / hotel arrangement. As such, it is expected that

Clause	Requirement	Assessment
		the flood risk within the site may be managed by the preparation of a site-specific Flood Emergency Response Plan prior to Construction Certificate whereby; the facility shall be closed following receipt of a Flood Warning with rainfall intensities that have the capability to impact the subject site. <u>Consistency with the most recent Council adopted flood study or floodplain risk management study.</u> A comparison of pre to post developed flood hydraulic categories and flood hazard across the site suggests that the development does not significantly change the existing flood risk of the site or on surrounding properties and the proposed design remain consistent with the findings in Williamtown Salt Ash Floodplain Risk Management Study & Plan (BMT WBM, 2017).
B5.19 Risk to Property	The proposed development will not increase the potential individual or cumulative flood impacts on other development or properties that are likely to occur in the same floodplain.	The results presented in the Flood Behaviour section above concludes that the proposed development is not expected to result in a significant adverse impact within adjacent properties.
B5.20 Flood hazard compatibility	The proposed development must be compatible with the flood hazard category of the land (as identified on a flood certificate) or include mitigation measures or offsets to reduce the flood risk. In determining compatibility, Council will consider: • Whether there is other land on the site with lower flood risks where the development could be located; • Depth of flood inundation on the site and the adjacent land; • Flow velocity on the site as well as upstream and downstream from the site; • Suitability of design so that the development does not become isolated by high hazard floodwaters; and	The existing development is located in an area of existing flood risk. The proposed develop responds to this existing flood risk through provision of flow paths at the low level, and refuge on the higher levels. <u>Feasibility of relocating to other land</u> The proposed development consists of the existing Bowling Club, and the remainder of the site will be occupied by the proposed hotel development and car parking. Therefore, relocating to other land on the site is not an alternative for the site. <u>Flood depth and velocity</u> The existing flood depth of 1.0 – 2.3m and velocity of 0 to 1.1m/s are observed within the site. Flood depth and velocity on the adjacent site to the south range from 0 – 1.9m and 0 –

Clause	Requirement	Assessment
	Consistency with the most recent, Council adopted flood study or floodplain risk management study that has been undertaken for the site.	0.5m/s. The results for the post developed conditions produce a similar flood behaviour, suggesting that the proposed development will not increase the potential flood impacts on other development or properties. <u>Isolation in the high hazard floodwaters</u> During the 1% AEP, evacuation to an offsite emergency refuge is possible via Jacaranda Avenue to the east towards the Pacific Highway and therefore, the site does not become isolated during this event. It is expected that the site will be isolated in high hazard floodwaters during the PMF, however, for anyone trapped within the site. On-site refuge is available as an option of last resort within the proposed hotel development. <u>Consistency with the most recent Council adopted flood study or floodplain risk management study.</u> This has been discussed above.

Development type	Required FFL
Development vulnerable to emergency response, and critical infrastructure	Probable maximum flood (PMF) level
Residential accommodation (including dwelling houses)	- Habitable rooms – flood planning level - Non-habitable rooms – adaptable minimum floor level - Flood refuge – probable maximum flood Level (see B5.14 to determine if a flood refuge is required)
Subdivision	Flood planning level
Farm buildings	Onsite waster water level
Commercial premises	Habitable rooms - flood planning level - Non-habitable rooms - onsite waster water level
Industrial premises	Habitable rooms - flood planning level - Non-habitable rooms - onsite waster water level
Garages, open car parking spaces and carports	Current day 1% AEP flood level
Driveways and access	Current day 1% AEP flood level, or the flood immunity of the connecting public road

Figure 5 - Floor levels (Figure BJ Reproduced from The Port Stephens Development Control Plan 2014)

Emergency Response Strategy

Preparation

Education and Awareness

It is proposed to make future staff and visitors aware of the flood hazards through the following means.

- Induction of staff to be aware of flood risks.
- Provision of a Flood Emergency Response Plan (to be prepared prior to occupation and include a summary of this section).
- Signage within the carpark.
- Nomination of Flood Wardens within the premises.

Preparation of Flood Emergency Kit

Staff shall prepare and maintain a Flood Emergency Kit to minimise the likelihood of requiring supplies immediately prior to a flood commencing.

An example of contents for a kit like this can be found at

<https://www.ses.nsw.gov.au/floodsafe/prepare-your-home/emergency-kit/>

Flood and Evacuation Warning Types

Bureau of Meteorology Severe Weather Warning

Severe weather warnings are issued by the Bureau for potentially dangerous weather conditions. A description of the threat will be included in the warning along with the time for next issue. It is noted that a severe weather warning does not imply that flooding will eventuate. Warnings are generally updated every six hours, or as the event dictates.

This type of warning should be accompanied by a predicted rainfall depth and duration. They are also accompanied by observed rainfall values from rainfall that has already occurred across the region.

Bureau of Meteorology Severe Thunderstorm Warning

A severe thunderstorm warning will be issued if there is strong evidence that a severe thunderstorm will develop, or if a severe thunderstorm is reported. Flash flooding may occur during severe thunderstorms. Warnings are generally updated every three hours or shorter as required.

Bureau of Meteorology Flood Watch

A flood watch will be issued if flood producing rain is expected. This provides an early warning that flooding may occur.

Bureau of Meteorology Minor/ Moderate/ Severe Flood Warning

A more detailed flood warning may be issued based on any additional information available. As per Williamstown Salt Ash Floodplain Risk Management Study & Plan, available flood warning times for the Lower Hunter River (Raymond Terrace and downstream areas) exceed 12 hours. The Bureau SLS suggests a target of 18 hours for elevations greater than 3.5m AHD.

SES Advice

This is typically the first alert that will be issued by the SES and indicates a flood or severe weather event may develop. Stay up to date with SES / BoM warnings and monitor conditions in case the situation changes.

SES Watch and Act

This is issued as the emergency develops and suggests conditions are changing and preparation is advised.

SES Emergency Warnings

Emergency warnings issued by the SES indicate the highest level of warning.

Flood and Evacuation Warning Dissemination

Media Outlets Including Radio, Television, and Online

Weather forecasts are available on all commercial television and radio stations.

ABC radio frequencies in this area include ABC Newcastle 1233 AM.

Online services include the ABC News App, ABC website (www.abc.net.au), BoM website (www.bom.gov.au), and Hazard Watch (described below)

Hazard Watch and Hazards Near Me App

The NSW SES and NSW Government have recently created the Hazard Watch online portal where the user can review predicted and current flood emergencies. This can be accessed from <https://www.hazardwatch.gov.au/>. The application provides SES and BoM warnings for NSW and should be used by the Flood Wardens as an additional resource to monitor flood events. An app is also available for download.

Nomination of Flood Response Personnel

Summarised in Table 6 below are the developments nominated emergency personnel, their location, and responsibilities in managing flood response.

Table 6 - Flood Response Personnel

Location		Responsibilities
Chief Flood Warden	On-site	- Obtain and maintain First Aid Certificate. - Monitor weather situation. - Disseminate warnings to visitors. - Liaison with SES or Emergency Services personnel if they attend site.
Flood Wardens	On-Site	Perform duties of Chief Flood Warden if delegated or Chief Flood Warden off-site.

Response

Severe Weather Predicted

Media reports will provide advance warning of an extreme event. Typically reports are made for oncoming east coast lows and severe weather conditions.

These reports may also be accompanied by a BoM Flood Watch, an SES Advice, or both.

People with existing medical conditions that are likely to require imminent attention – such as pregnant mothers who are approaching full term or have a high-risk pregnancy – may choose self-directed evacuation prior to rainfall commencing to be close to a hospital or in an area not subject to extreme weather predictions.

TRIGGERS

- Media report of upcoming extreme weather.
- BoM Flood Watch.
- SES Advice.

ACTIONS

- Disseminate flood warning and weather situation to staff and visitors.
- Individuals with health concerns requiring imminent attention to consider self-directed evacuation to near hospitals or areas away from predicted weather.

RESPONSIBLE

- Individuals.

Flooding or Severe Weather Imminent

If flooding likely to inundate the site is imminent, staff and visitors shall evacuate early. Evacuation is the preferred emergency response measure. Flood free land is available 300 metres to the southeast in Adelaide Street.

Warnings include a BoM Severe Weather Warning / BoM Severe Thunderstorm Warning / BoM Flood Warning / SES Watch and Act.

Warnings should be disseminated through text alerts to all staff and visitors.

No attempt should be made to walk or drive through floodwater.

TRIGGERS

- BoM Severe Weather Warning.
- BoM Severe Weather Warning.
- BoM Severe Thunderstorm Warning.
- BoM Flood Warning.
- SES Watch and Act.

ACTIONS

- Disseminate flood warning and weather situation to staff and visitors.
- Evacuate early to high ground.
- Avoid floodwater.

RESPONSIBLE

- Chief Flood Warden.
- Flood Wardens.

Flooding Occurring

If flooding is occurring, and evacuation is no longer possible. Staff and visitors should move to the upper levels and seek refuge as an option of last resort.

Warnings include BoM Minor / Moderate / Major Flood Warning. SES Watch and Act / SES Emergency Warning.

TRIGGERS

- BoM Minor Flood Warning.
- BoM Moderate Flood Warning.
- BoM Major Flood Warning.
- SES Watch and Act.
- SES Emergency Warning.

ACTIONS

- Seek refuge within hotel.
- Avoid floodwater.

RESPONSIBLE

- Chief Flood Warden.
- Flood Wardens.

Emergency Services Attending Site

If emergency services attend site, patrons/guests are required to follow their instructions.

TRIGGERS

- Emergency services attending site.

ACTIONS

- Follow their instruction.

RESPONSIBLE

- Chief Flood Warden.
- Flood Wardens.

Recovery

Once the SES has issued an All Clear, affected buildings and infrastructure should be inspected and remediated, if necessary, prior to use.

The NSW Government provides information on a number of recovery services at <https://www.nsw.gov.au/emergency/floods/recover/immediately-after>

Formalisation

This Flood Emergency Response Strategy should be formalised as a Flood Emergency Response Plan and implemented once the hotel becomes operational. This Flood Emergency Response Plan should be amended in the following situations.

- When there is a change to the flood information for the Hunter River, Williams River, and local upstream catchment.
- After a flood event to assess the efficacy and make improvements, if required.
- At a minimum of every three years.

Conclusion

Northrop Consulting Engineers were engaged by Raymond Terrace Bowling Club to prepare a flood assessment for the proposed development at 2 Jacaranda Ave, Raymond Terrace.

This study has reviewed the existing flood extents across the subject site, the flood impact of the proposed development as well as the development compliance with respect to Council's flood related Development Controls. The model parameters and assumptions made during the development this study have also been discussed.

It was concluded that the proposed development is not expected to result in a significant adverse impact in adjacent properties. The development is located in a floodway and therefore, a performance-based assessment is sought to determine the suitability of the development.

Furthermore, it was determined that risks to property and life can be appropriately managed through design of the proposed development, and emergency response strategy proposed.

Limitation Statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by Raymond Terrace Bowling Club. The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report.

Except where expressly permitted in writing or required by law, no third party may use or rely on this report unless otherwise agreed in writing by Northrop.

Where this report indicates that information has been provided to Northrop by third parties, Northrop has made no independent verification of this information except as expressly stated in the report. Northrop is not liable for any inaccuracies in or omissions to that information.

The report was prepared on the dates shown and is based on the conditions and information received at the time of preparation.

This report should be read in full, with reference made to all sources. No responsibility is accepted for use of any part of this report in any other context or for any other purpose. Northrop does not purport to give legal advice or financial advice. Appropriate specialist advice should be obtained where required.

To the extent permitted by law, Northrop expressly excludes any liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this report.

Document Register

Rev	Status	Prepared	Approved	Date
A	For Client Review	N Parana Manage	A Brien	4 August 2023
B	For Approval	N Parana Manage	A Brien	4 December 2023
C	For Approval	N Parana Manage	A Brien	15 December 2023
D	For Approval	A Brien	A Brien	3 July 2024
E	For Approval	E Holswich	A Brien	6 August 2024

Appendix A

FLOOD CERTIFICATE

File No: PSC2013-05401
Issue date: 20-Dec-22
Property ID: 7919

INFOTRACK PTY LIMITED
135 King St
Sydney NSW 2000

Certificate number: 83-2022-1148-1

Property details: 2 Jacaranda Avenue RAYMOND TERRACE LOT: 1 SEC: 23 DP: 758871

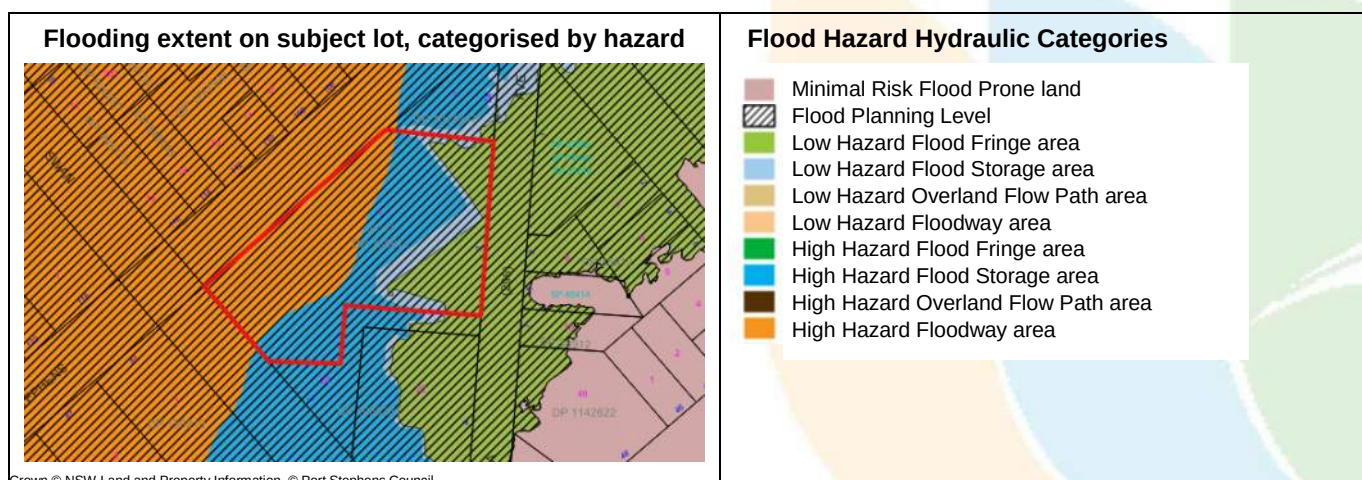
Thank you for your recent flood enquiry regarding the above property. This certificate confirms that this property **is** located in a **flood prone** area. This **is** a "flood control lot" for the purposes of the *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008*.

Flood Planning Level **5.8 metres AHD** (This level defines the minimum floor level for habitable rooms and land that is subject to flood-related development controls (refer to Port Stephens DCP Section B5).)
(velocity = 0.3m/s)

Highest Hazard Category **High Hazard Floodway area**

Flood levels that may be useful are:

Probable maximum flood level	8.7 metres AHD (velocity = 0.3 m/s)	(The highest flood level that could conceivably occur at this location. If required, onsite flood refuges are built at or above this level, refer to the Port Stephens Development Control Plan B5.2)
Surveyed floor level	3.29 metres AHD	(Council may have a floor level at the entrance to the residence on this site that was surveyed May 2012 as part of the preparation of a Floodplain Risk Management Study for this area.)
Current day 1% AEP flood level	4.8 metres AHD	(This level is useful for insurance purposes, refer to your insurance policy and the Insurance Contracts Regulation 1985 (Cwealth).)
Adaptable minimum floor level	5.8 metres AHD	(The 1% AEP flood level plus freeboard, 50 years from now, refer to the Port Stephens Development Control Plan B5.2.)
Minimum onsite wastewater level	3.5 metres AHD	(The 5% AEP level 50 years from now, refer to the Port Stephens On-site Sewage Management Development Assessment Framework and AS/NZS 1547:2012 5.5 land application system design.)



Information derived from Port Stephens Council 2017 *Williamtown / Salt Ash River Floodplain Risk Management Study and Plan*, BMT WBM, Newcastle and Port Stephens Council 2012, *Williamtown / Salt Ash Flood Study Review*, BMT WBM

PORT STEPHENS COUNCIL

116 Adelaide Street
Raymond Terrace NSW 2324

PO Box 42
Raymond Terrace NSW 2324

Phone: 02 4980 0255
Email: council@portstephens.nsw.gov.au

www.portstephens.nsw.gov.au
ABN 16 744 377 876

IMPORTANT INFORMATION

This Certificate is provided in good faith and in accordance with the provisions of section 733 of the Local Government Act 1993. This certificate provides an estimate of real flood characteristics. Any particular flood may be different to the conditions that were assumed to determine the information shown in this certificate.

The provided flood information has been compiled from information provided by external consultants and flood studies completed by Council in accordance with the NSW Floodplain Development Manual. The information has not been independently verified or checked beyond the agreed scope of work and Council does not accept liability in connection with unverified information.

Council acknowledges that its flood information may be incomplete and varying in accuracy, however it is the best information available to Council at the time of issue.

The information is provided to give the applicant an understanding as to the extent of flooding affecting the property as well as assist in the preparation of a Floodplain Risk Management Report. The information is subject to change if more accurate data becomes available to Council. Accordingly the information in this certificate is not warranted after the day of issue.

Council is not responsible for updating flood data when site conditions have change from the time of the original flood study and does not accept responsibility arising from any change in site conditions.

Where the relevant information is available, Council's Flood Planning Levels include the estimated impact of climate change.

Council recommends that the information contained in this Certificate be interpreted by a suitably qualified professional. It is the responsibility of the applicant to obtain survey level data (in metres AHD) for the site.

Council disclaims responsibilities to any other person other than the person nominated on the Flood Certificate arising from or in connection with the information provided.

The floor level survey for the property (if available) is based on the conditions on the date of the survey. Any changes to buildings since the survey may alter the appropriate floor level. Refer to the Port Stephens LEP 2013 Section 5.21 and Port Stephens Development Control Plan Section B5 for details on development controls on flood prone land.

For information, the insurance industry uses its own estimates of flood risk and its own definitions for flooding, which may differ when compared with Council's information and the NSW Floodplain Development Manual. You should contact your insurance company to find out if a flood certificate may influence your insurance premium.

The information provided may contain personal information as defined under the Privacy and Personal Information Protection Act 1998. The purpose of collecting this information is to enable Council to consider matters under related legislation, issue related documentation where required and other associated matters as provided by law and will be utilised by Council officers in assessing the proposal and other associated activities. The information may also be made available to other persons in accordance with the relevant Acts and regulations, such as the Government Information (Public Access) Act 2009 and will be stored in Council's record system.

DEFINITIONS

"Flood Planning Level" defines the area of land below the 1% AEP flood event in the year 2100 plus freeboard and is the area of land subject to flood-related development controls (refer to Port Stephens Development Control Plan Section B5). The Flood Planning Level defines the minimum floor level for habitable rooms.

"Freeboard" is a safety margin applied to the estimation of flood levels to compensate for uncertainties due to factors such as wave action, localised hydraulic behaviour (eg flow path blockages caused by natural and urban debris such as trees, 'wheelie' bins, cars, containers) and changes in rainfall patterns and ocean water levels as a result of the changing climate (refer Flood Manual Section 4).

"Habitable room" in a residential situation is a living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom; in an industrial or commercial situation is an area used for offices or to store valuable possessions susceptible to flood damage (refer Flood Manual Section 4).

"Adaptable minimum floor level" is the reduced flood planning level allowed in Council's Development Control Plan where the proposed development facilitates ongoing flood adaptation (for example, where the design facilitates building raising in the future, such as a pier and beam housing design).

"Probable maximum flood level" is the flood level that arises from the largest flood that could conceivably occur at a particular location (the "PMF" or extreme design event). This level does not include any freeboard and provides an upper limit of flooding and associated consequences for the problem being investigated. It is used for emergency response planning purposes to address the safety of people and defines the floodplain and identifies "Flood Prone" land.

"AEP" (Annual Exceedance Probability) is the chance of a flood of a given or larger size occurring in any one year (for example, the 1% AEP event has a 1% chance of occurring every year; the 5% AEP event has a 5% chance of occurring every year).

"Surveyed floor level" is the surveyed level at the entrance to the residence, usually measured as part of the floodplain risk management plan undertaken for the area.

"AHD" (Australian Height Datum) a common national survey level datum, approximately corresponding to mean sea level set in the mid to late 1960s.

Hazard Categories

"High hazard" flood area is the area of flood which poses a possible danger to personal safety, where the evacuation of trucks would be difficult, where able-bodied adults would have difficulty wading to safety or where there is a potential for significant damage to buildings (refer Flood Manual Appendix L).

"Low hazard" flood area is the area of flood where, should it be necessary, a truck could evacuate people and their possessions or an able-bodied adult would have little difficulty in wading to safety (refer Flood Manual Appendix L).

Hydraulic Categories

"Floodways" are those areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that, even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas (refer Flood Manual Section 4).

"Overland flow path" is land inundated by local runoff on its way to a waterway, rather than overbank flow from a stream, river, estuary, lake or dam (refer Flood Manual Section 4).

"Flood Storage" areas are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The loss of storage areas may increase the severity of flood impacts by reducing natural flood attenuation (refer Flood Manual Section 4).

"Flood Fringe" is the remaining land in the Flood Planning Area after the Floodway area and Flood Storage area have been defined (refer Flood Manual Section 4).

"Minimal Risk Flood Prone Land" is land on the floodplain that is above the Flood Planning Level. This means that there are no flood-related development controls that apply to residential development, but critical emergency response and recovery facilities, such as evacuation centres and vulnerable development types, such as aged care and child care facilities, may not be appropriate in this location.