

B Flood Impact Assessment 2016 (Cardno)

Our Ref 59916125 R001:JC

Contact Joshua Coates



29 June 2016

AV Jennings Properties Limited
c/- ADW Johnson Pty Limited
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Tuggerah NSW 2259

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**RE: 15-35 WARNERVALE ROAD, WARNERVALE
FLOOD IMPACT ASSESSMENT**

Web: www.cardno.com.au

Dear Peter,

We are pleased to provide you with our report summarising our flood impact assessment of the proposed development at 15–35 Warnervale Road, Warnervale. This report has been prepared in support of a planning proposal. This study has been undertaken using an updated version of our previous models assembled for the Porters Creek Flood Study (Cardno, 2011) and the Precinct 7A Flood Study (Cardno, 2013), which were prepared for Wyong Shire Council.

1 Introduction

AV Jennings Properties Limited is proposing to subdivide 15–35 Warnervale Road. The development site is located adjacent to a floodplain as identified within the Precinct 7A Flood Study. As part of the development, it is proposed to fill some land that lies within the 1% Annual Exceedance Probability (AEP) flood extent. The land identified to be filled is consistent with that of the precinct 7A study.

Wyong Shire Council requires AV Jennings to provide a flood impact assessment that includes TUFLOW modelling to determine the impact of filling within the 1% AEP flood extent. The modelling is required to compare the existing scenario and potential future conditions. ADW Johnson has provided development details to be assessed.

AV Jennings engaged Cardno to undertake a flood impact assessment for the proposed fill in accordance with Council's requirements. The purpose of this assessment is to ensure that the proposed fill does not have any adverse effect on the flood levels upstream and downstream of the site.

The scope of works was to:

- Update the TUFLOW model of the Porters Creek Flood Study (Cardno 2011) with the supplied ground survey to establish a more accurate base case of existing conditions;
- Run for the 1% AEP and PMF events and compare the flood levels with the previously reported levels in the vicinity of the site;

Australia • Belgium • Canada • Colombia • Ecuador • Germany • Indonesia • Italy • Kenya •
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- Map the flood extent, levels, depth and provisional hazard under existing conditions;
- Modify the existing conditions model to represent the proposed developed conditions and run the 1% AEP and PMF events;
- Map the flood extent, levels, depth and provisional hazard under developed conditions;
- Undertake an assessment of the impacts of the proposed development; and
- Compare the outcomes with Precinct 7A study approved by Wyong Shire Council.

2 Background

2.1 Subject Site

The subject site is located south east of Warnervale Station as shown in **Figure 1**. The proposed development is contained within 15–35 Warnervale Road and 107–171 Virginia Road. The development site is largely outside of the floodplain with only the western and southern boundaries interacting with the floodplain.

A flow path forms upstream of the site and is conveyed to location highlighted as 'ABOX and Channel Upgrade'. This flow is drained by an open channel present along the eastern boundary of the site. This channel conveys flow towards the south before connecting to Porters Creek and ultimately the Wyong River.

2.1 Proposed Development

AV Jennings Properties Limited is proposing to subdivide 15–35 Warnervale Road and 107–171 Virginia Road for the purposes of residential development. The development plan, supplied by ADW Johnson Pty Ltd, are provided in **Attachment B**.

Changes in land form are present just south of Warnervale Road adjacent to the eastern channel, along the eastern and southern corner of the development site and within the south western corner of the development site.

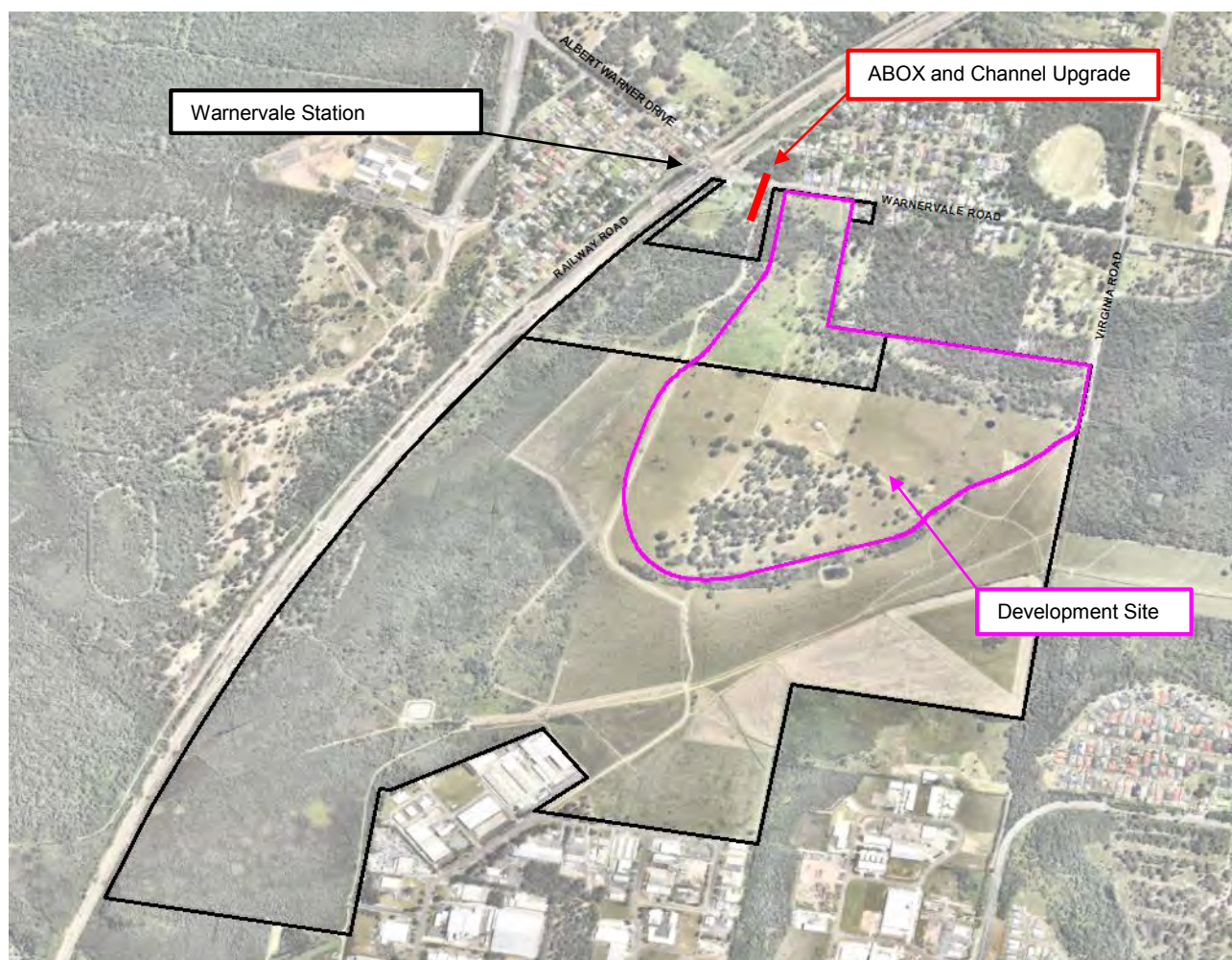


Figure 1: Study area (Aerial Image Source: Nearmap)

3 Previous Studies

Cardno undertook the Porters Creek Flood Study (2011) for Council, which identified the flood behaviour across the Porters Creek catchment, inclusive of the development site. Following this study, Cardno also completed the Precinct 7A Flood Study (2013) for Council. The Precinct 7A investigated future development scenarios including filling and road and culvert upgrades.

4 Objective

The objective of this letter report is to present the findings of an assessment of the existing scenario with the site survey and proposed development scenario for the development site at 15 – 35 Warnervale Road, Warnervale.

The existing conditions scenario has been modelled to inform the updated flood levels at the site for the 1% AEP and PMF events. The proposed development scenario has been assessed for the same storm events.

5 Hydrology

The hydrology model for the study (Cardno, 2011) was developed using the xprafits modelling software. This model was used to provide the flood hydrographs for the 1% AEP and PMF events.

6 Hydraulic Analysis

Hydraulic modelling was undertaken to define flood behaviour for existing and proposed conditions. It is noted that the design storm for the 1% AEP event includes an increase of 15% rainfall, as per the Porters Creek Floodplain Risk Management Study and Plan.

6.1 Existing Flood Behaviour

The TUFLOW-1D/2D hydraulic model used previously was assembled to assess flood behaviour for 1% AEP and PMF events for existing conditions. The existing conditions flood model was created for the subject site at Warnervale Road through an update of the previous model prepared for the Porters Creek Flood Study (Cardno, 2011) using the following information:

- Site visit conducted on 02/03/2016;
- The flood model assembled on behalf of Wyong Shire Council (already held);
- Existing site survey for 15 – 35 Warnervale Road (**Attachment A**, provided by ADW Johnson);

It is noted that the following upgrades recommended as part of the Precinct 7A developed case model were included in the existing case scenario:

- Upgrades to box culvert at Warnervale Road ('ABOX' – twin box culverts 2.4 m wide by 1.2 m high); and
- Channel upgrade downstream of 'ABOX'.

These upgrades are detailed within the Precinct 7A Flood Study report. The Precinct 7A developed case model also made broad assumptions of flood plain filling and raising of road level in the vicinity of Warnervale Road, although these were superseded by the updated survey provided by ADW Johnson.

The existing model grid cells are 5 m X 5 m. This resolution would not accurately represent channels and, as such, the drainage channel downstream of Warnervale Road is modelled as a 1D channel. This is consistent with the Precinct 7A model.

The 1% AEP and PMF event peak flood extents and peak flood level contours, peak depth and provisional hazard results are shown in **Figures 1 - 6 (Attachment C)**.

6.2 Proposed Development Assessment

An assessment of the proposed scenario was undertaken by amending the existing conditions model with information relevant to the proposed conditions. The development concept plans, supplied by ADW Johnson Pty Ltd for 15-35 Warnervale Road, were used to update the DTM for the proposed development model (**Attachment B**).

The TUFLOW model was run for a number of development scenarios to understand the impacts of flood plain filling on the surrounding areas within the nearby area. The 1% AEP and PMF event peak flood extent and peak water level contours, peak flood depth and provisional hazard results are shown in **Figures 7 – 12 (Attachment C)**.

The proposed development would be contained within land not subject to flooding, although the floodplain filling may impact on flood levels within the floodplain.

6.3 Impact Assessment

The flood impact as a result of the development for the 1% AEP event is shown in **Figure 13** as water level differences between the existing scenario and developed scenario. The area most impacted by floodplain filling is the area downstream of Warnervale Road. Flood level increases of the order of 10-20 mm are observed immediately downstream Warnervale Road, although decreases of 10-20 mm are observed further downstream. This change in flood level is a result of flood plain filling of land bound by the channel and Warnervale Road. The upgrade (raising) of Warnervale Road also has an impact.

It is noted that the flood level increase downstream of Warnervale Road is largely contained with the land zoned as Environmental Conservation, with some isolated increases in land zoned as Private Recreation. Flood level increases upstream of Warnervale Road are contained within land zoned as Public Recreation. This is generally consistent with the outcomes of the flood impacts shown in the Precinct 7A report.

Provisional hazard mapping is shown in **Figure 3** (existing scenario) and **Figure 9** (developed scenario). Negligible change in provisional hazard is observed as a result of the development.

Further downstream, a flood level increase of the order of 5–10 mm is observed throughout the flood plain. This increase extends to the northern boundary of the industrial park and existing development to the south-east of the development site. This increase is within the order of accuracy of the model and can be considered insignificant.

It is further noted that the outcomes of the Precinct 7A model reported flood level increases of up to 40 mm within this area as a result of the assumed ultimate development. With regard to impacts on these properties as a result of the development, a flood levee surrounds the industrial properties and has been constructed at 6.5m AHD. The peak flood level with the Precinct 7A development in place is 6.3m AHD. Therefore, to maintain a freeboard of 300 mm the study recommends to increase the level of the levee by 100 mm.

The flood level increase as a result of this development is less than that calculated in the Precinct 7A study and hence this development does not impact the proposed levee raising.

6.4 Discussion

The Precinct 7A Flood Study produced flood level differences for existing conditions vs developed conditions (reproduced in **Figure 14**). For the location downstream of Warnervale Road, the flood level increases are in the order of 10- 20 mm. The plan extent of flooding for the Precinct 7A model was greater than that of the current, more accurate model (**Figure 15**) and flood level differences are of a similar order of magnitude.

It should be noted that the Precinct 7A model is a precinct planning model, which made general assumptions about future conditions, whereas the updated model provides a more accurate representation of future conditions. For example, broad assumptions on flood plain filling were made within the precinct planning model, whereas the updated model provides an accurate terrain model of the proposed future ground surface levels.

It is considered that the current modelling provides a more accurate assessment of proposed development that was planned during the Precinct 7A modelling. The level of impact, upon comparison with the Precinct 7A model is considered acceptable and is consistent with land use zoning, previous planning and previous impacts predicted.

7 Conclusion

This letter is provided to inform the assessment of the proposed development at 15–35 Warnervale Road. Upon review of the flood modelling results, it is evident that the proposed development causes minor flood level increases, as a result of floodplain filling. These impacts are considered to be acceptable given they are of similar magnitude to that of the flood level increases predicted as part of the Precinct 7A Flood Study. Furthermore, the extent of impact is less than what was predicted previously within the area downstream of Warnervale Road.

Finally, the locations to which flood level increases are evident are within land zoned as Environmental Conservation, Private Recreation and Public Recreation.

Should you have any queries regarding this report or require further information please do not hesitate to contact Joshua Coates on (02) 9496 7874.

Yours faithfully,

Reviewed by



Joshua Coates
Water Engineer
For **Cardno (NSW/ACT) Pty Ltd**



Fiona Coe
Senior Engineer
For **Cardno (NSW/ACT) Pty Ltd**

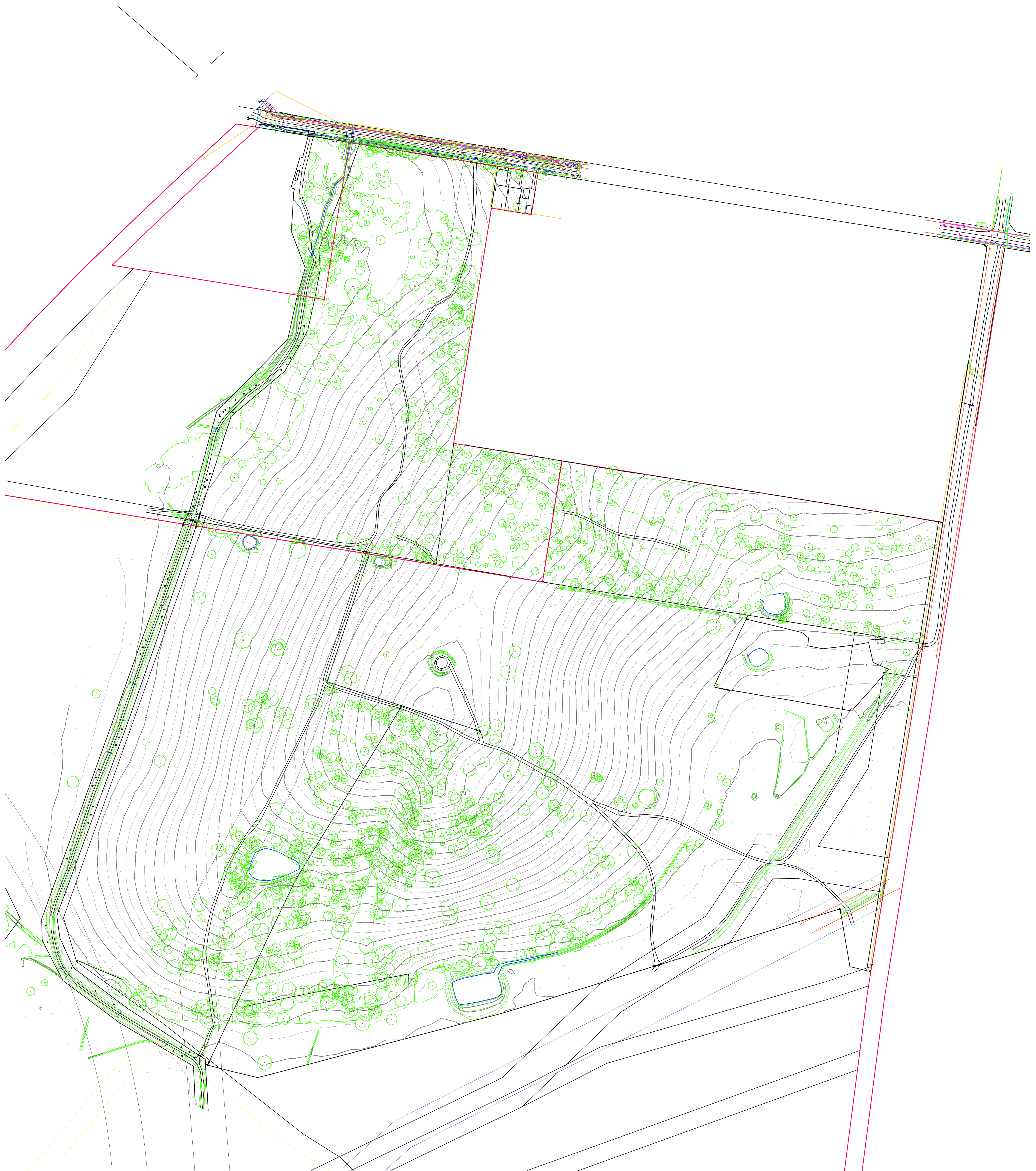
Attachments

Attachment A – Site Survey

Attachment B – Proposed Development at 15-35 Warnervale Road

Attachment C – Figures

**ATTACHMENT A
SITE SURVEY**



**ATTACHMENT B
PROPOSED DEVELOPMENT**



Developed Scenario

59916125
15 - 35 WARNERVALE RD FIA

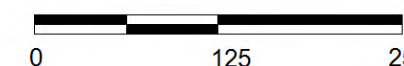
Legend

- Fill Area
- Major Contour
- Minor Contour
- Property Boundary



SCALE 1:5,000 Scale at A3

Metres



Map Produced by Cardno NSW/ACT (Water and environment)
Date: 15 March 2016
Coordinate System: GDA94 Zone 56
Project: 59916125
Map: 59916125.wor 01

ATTACHMENT C

Figure	Scenario	Event	Description
Figure 1	Existing	1% AEP	Flood Extent + Water Level Contours
Figure 2	Existing	1% AEP	Flood Depth
Figure 3	Existing	1% AEP	Provisional Hazard
Figure 4	Existing	PMF	Flood Extent + Water Level Contours
Figure 5	Existing	PMF	Flood Depth
Figure 6	Existing	PMF	Provisional Hazard
Figure 7	Developed	1% AEP	Flood Extent + Water Level Contours
Figure 8	Developed	1% AEP	Flood Depth
Figure 9	Developed	1% AEP	Provisional Hazard
Figure 10	Developed	PMF	Flood Extent + Water Level Contours
Figure 11	Developed	PMF	Flood Depth
Figure 12	Developed	PMF	Provisional Hazard
Figure 13	Developed - Existing	1% AEP	Flood Level Differences (Floodplain)
Figure 14	P7A developed - existing	1% AEP	Flood Level Differences (Warnervale Rd)
Figure 15	Developed - Existing	1% AEP	Flood Level Differences (Warnervale Rd)



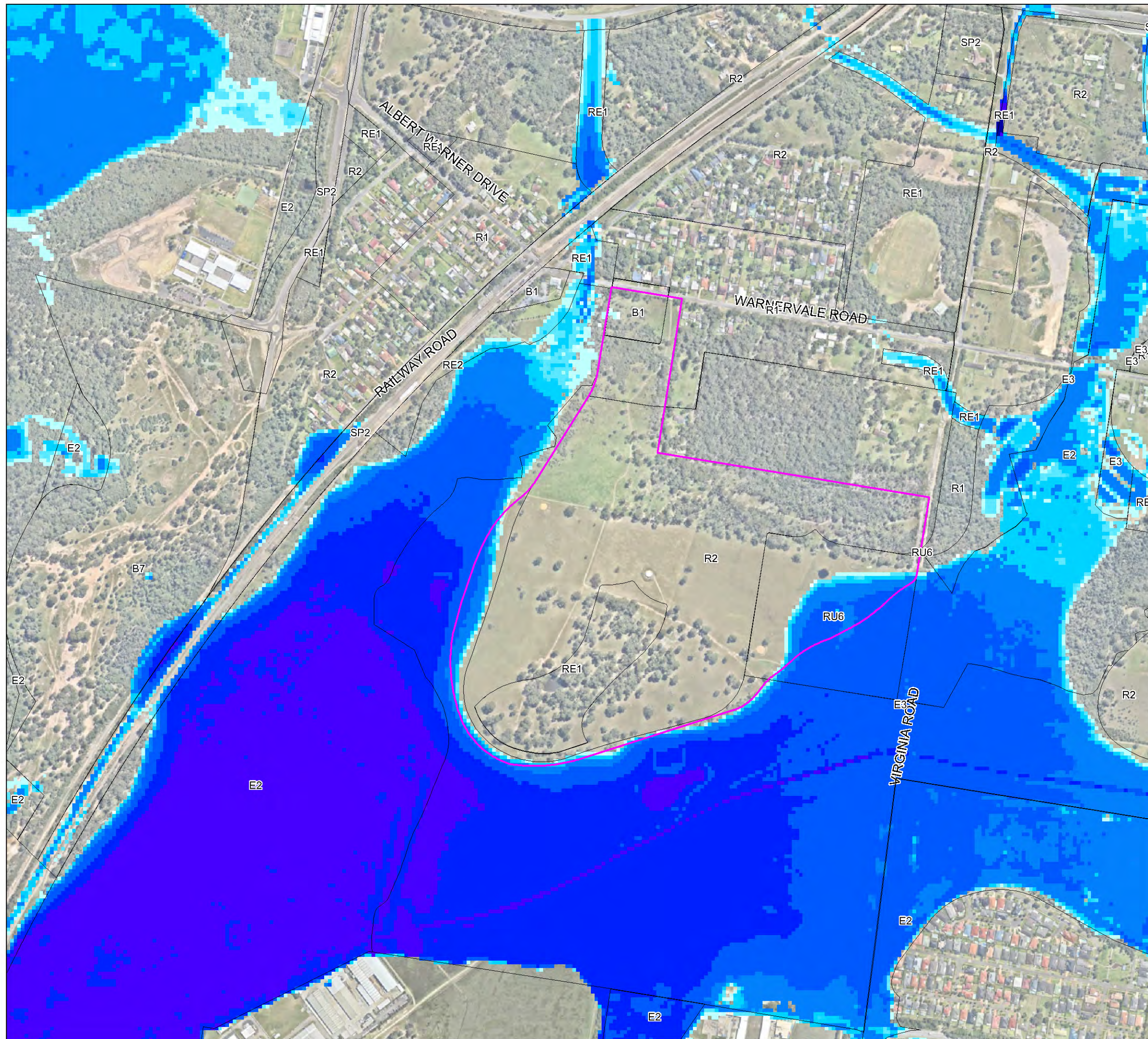


Figure 2
Peak Flood Depth
Existing Scenario
1% AEP Event

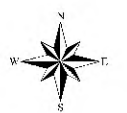
59916125
15 - 35 WARNERVALE RD FIA

LEGEND -
PEAK DEPTH (m)

	0.01-0.09m
	0.10-0.20m
	0.20-0.50m
	0.50-1.00m
	1.0-2.0m
	2.0-3.0m
	3.0-5.0m
	> 5.0m

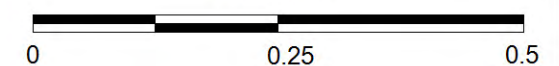
Development Boundary

Land Use Zones



SCALE 1:7,500 Scale at A3

Kilometres



Map Produced by Cardno NSW/ACT (Water and environment)
Date: 15 March 2016
Coordinate System: GDA94 Zone 56
Project: 59916125
Map: Figure_2_Existing_100yr_Peak_Flood_Depth.WOR

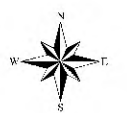


Figure 3
Provisional Hazard
Existing Scenario
1% AEP Event

59916125
15 - 35 WARNERVALE RD FIA

LEGEND
PROVISIONAL HAZARD

-  High
-  Transitional Zone
-  Low
-  Development Boundary
-  Land Use Zones
-  0.2 m Water Level Contour
-  1 Pct AEP Flood Extent



SCALE 1:7,500 Scale at A3

Kilometres



Map Produced by Cardno NSW/ACT (Water and environment)
Date: 15 March 2016
Coordinate System: GDA94 Zone 56
Project: 59916125
Map: Figure_3_Existing_100yr_Provision_Hazard.WOR



Figure 4
Peak Flood Extent
Flood Level Contours
Existing Scenario
PMF Event

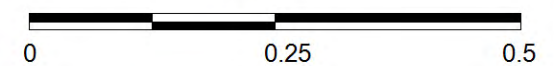
59916125
15 - 35 WARNERVALE RD FIA

- Development Boundary
- Land Use Zones
- 0.2 m Water Level Contour
- 1 Pct AEP Flood Extent



SCALE 1:7,500 Scale at A3

Kilometres



Map Produced by Cardno NSW/ACT (Water and environment)
Date: 15 March 2016
Coordinate System: GDA94 Zone 56
Project: 59916125
Map: Figure_4_Existing_PMF_Extent_Flood_Level.WOR



Figure 5
Peak Flood Depth
Existing Scenario
PMF Event

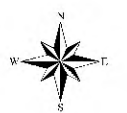
59916125
15 - 35 WARNERVALE RD FIA

LEGEND -
PEAK DEPTH (m)

	0.01-0.09m
	0.10-0.20m
	0.20-0.50m
	0.50-1.00m
	1.0-2.0m
	2.0-3.0m
	3.0-5.0m
	> 5.0m

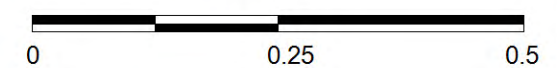
Development Boundary

Land Use Zones



SCALE 1:7,500 Scale at A3

Kilometres



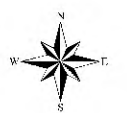
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Project: 59916125
Map: Figure_5_Existing_PMF_Peak_Flood_Depth.WOR

Figure 6 Provisional Hazard Existing Scenario PMF Event

59916125
15 - 35 WARNERVALE RD FIA

LEGEND PROVISIONAL HAZARD

- High
- Transitional Zone
- Low
- Development Boundary
- Land Use Zones
- 0.2 m Water Level Contour
- 1 Pct AEP Flood Extent



SCALE 1:7,500 Scale at A3

Kilometres



Map Produced by Cardno NSW/ACT (Water and environment)
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Coordinate System: GDA94 Zone 56
Project: 59916125
Map: Figure_6_Existing_PMF_Provision_Hazard.WOR

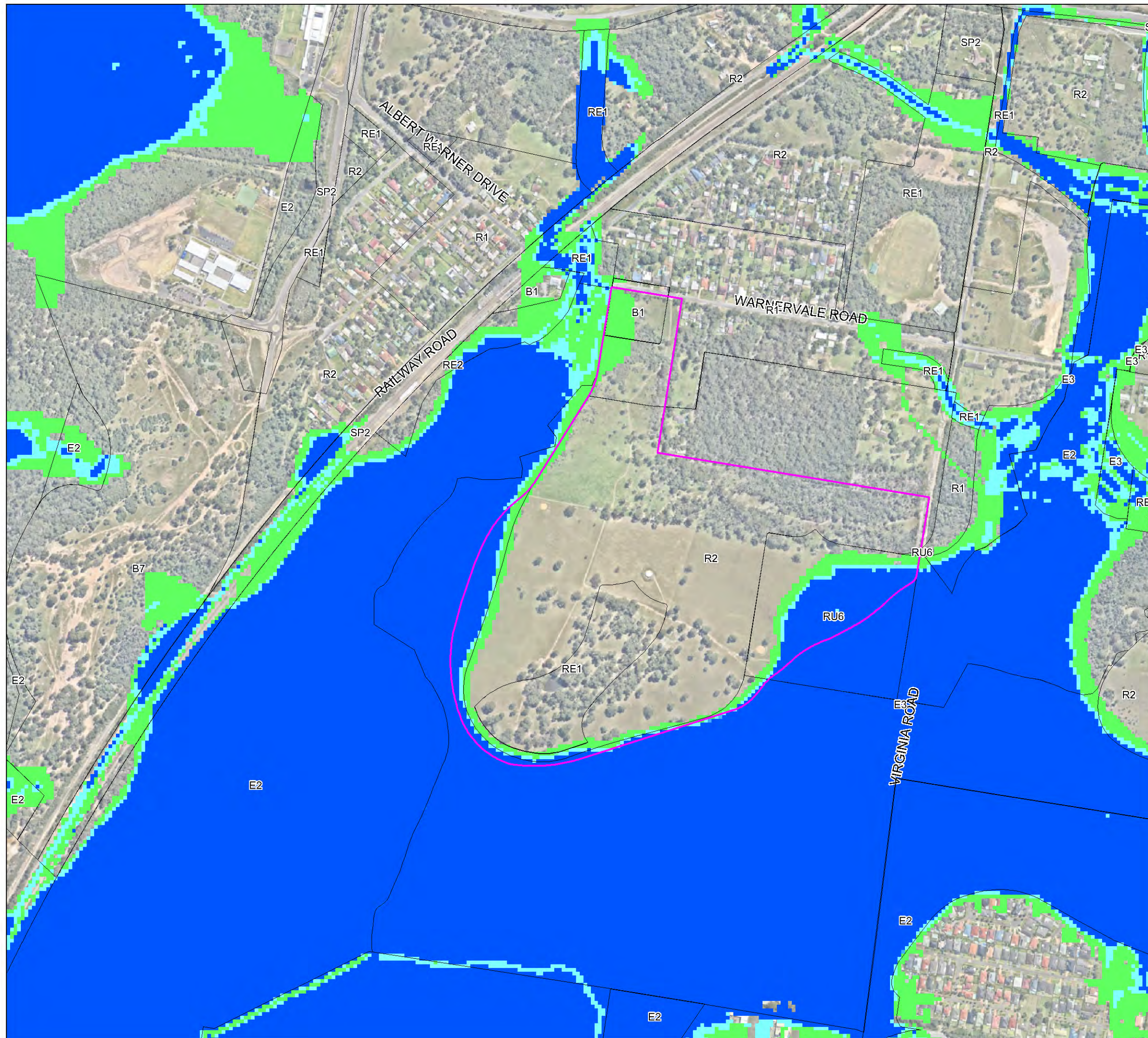
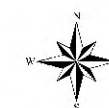




Figure 7
Peak Flood Extent
Flood Level Contours
Developed Scenario
1% AEP Event

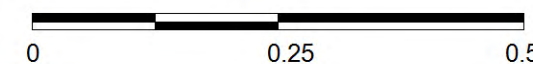
59916125
15 - 35 WARNERVALE RD FIA

- Development Boundary
- Land Use Zones
- 0.2 m Water Level Contour
- 1 Pct AEP Flood Extent



SCALE 1:7,500 Scale at A3

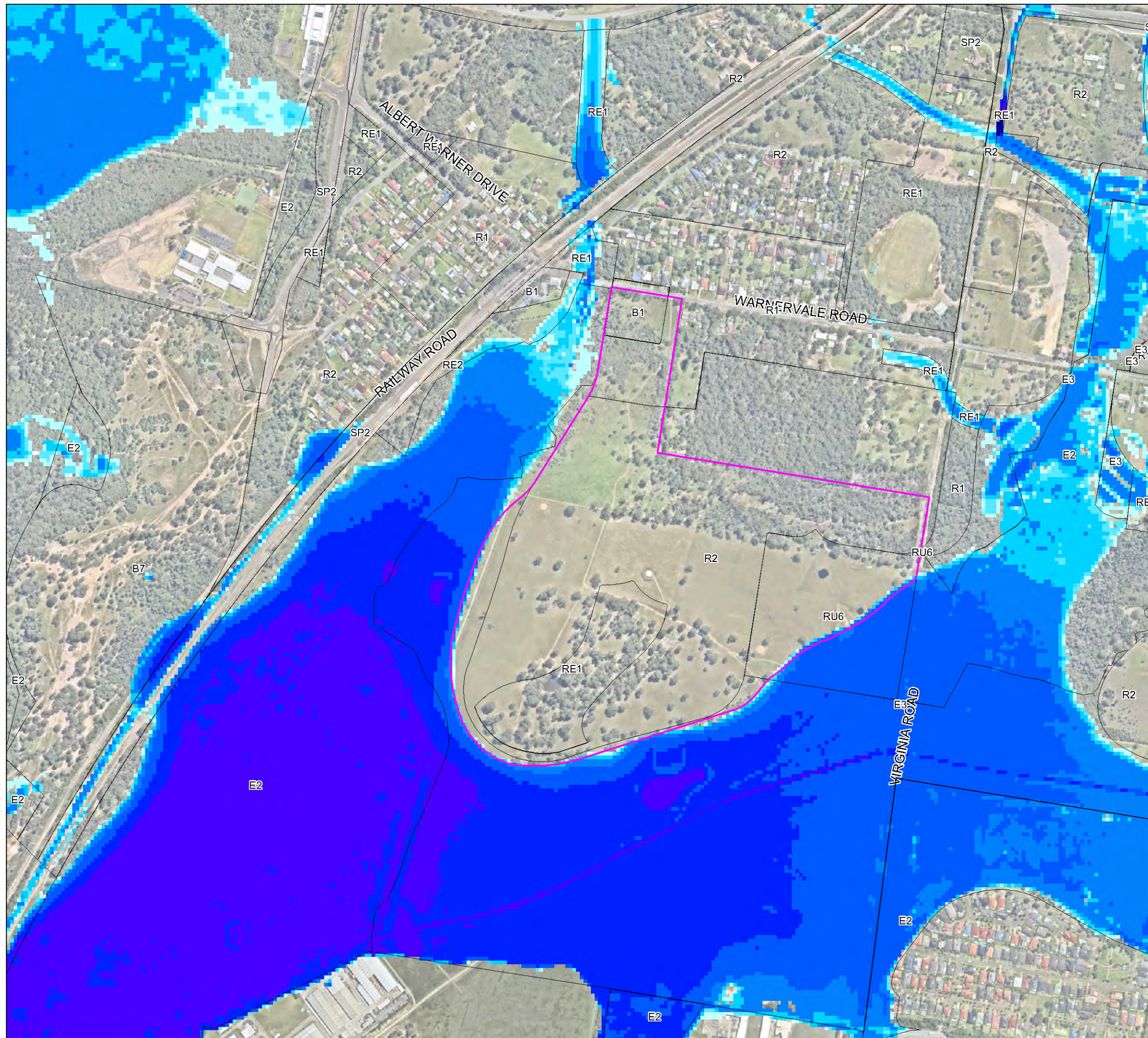
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Map Produced by Cardno NSW/ACT (Water and environment)
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 Project: 59916125
 Map: Figure_7_Developed_100yr_Extent_Flood_level.WOR

Figure 8
Peak Flood Depth
Developed Scenario
1% AEP Event

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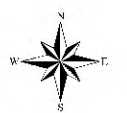


LEGEND -
PEAK DEPTH (m)

	0.01-0.09m
	0.10-0.20m
	0.20-0.50m
	0.50-1.00m
	1.0-2.0m
	2.0-3.0m
	3.0-5.0m
	> 5.0m

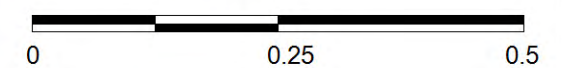
Development Boundary

Land Use Zones



SCALE 1:7,500 Scale at A3

Kilometres



Map Produced by Cardno NSW/ACT (Water and environment)
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 Project: 59916125
 Map: Figure_8_Developed_100yr_Peak_Flood_Depth.WOR

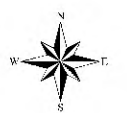


Figure 9
Provisional Hazard
Developed Scenario
1% AEP Event

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15 - 35 WARNERVALE RD FIA

LEGEND
PROVISIONAL HAZARD

-  High
-  Transitional Zone
-  Low
-  Development Boundary
-  Land Use Zones
-  0.2 m Water Level Contour
-  1 Pct AEP Flood Extent



SCALE 1:7,500 Scale at A3

Kilometres



Map Produced by Cardno NSW/ACT (Water and environment)
Date: 15 March 2016
Coordinate System: GDA94 Zone 56
Project: 59916125
Map: Figure_9_Developed_100yr_Provision_Hazard.WOR



Figure 11 Peak Flood Depth Developed Scenario PMF Event

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15 - 35 WARNERVALE RD FIA

LEGEND - PEAK DEPTH (m)

	0.01-0.09m
	0.10-0.20m
	0.20-0.50m
	0.50-1.00m
	1.0-2.0m
	2.0-3.0m
	3.0-5.0m
	> 5.0m

 Development Boundary

 Land Use Zones



SCALE 1:7,500 Scale at A3

Kilometres



Map Produced by Cardno NSW/ACT (Water and environment)
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Project: 59916125
Map: Figure_11_Developed_PMF_Peak_Flood_Depth.WOR

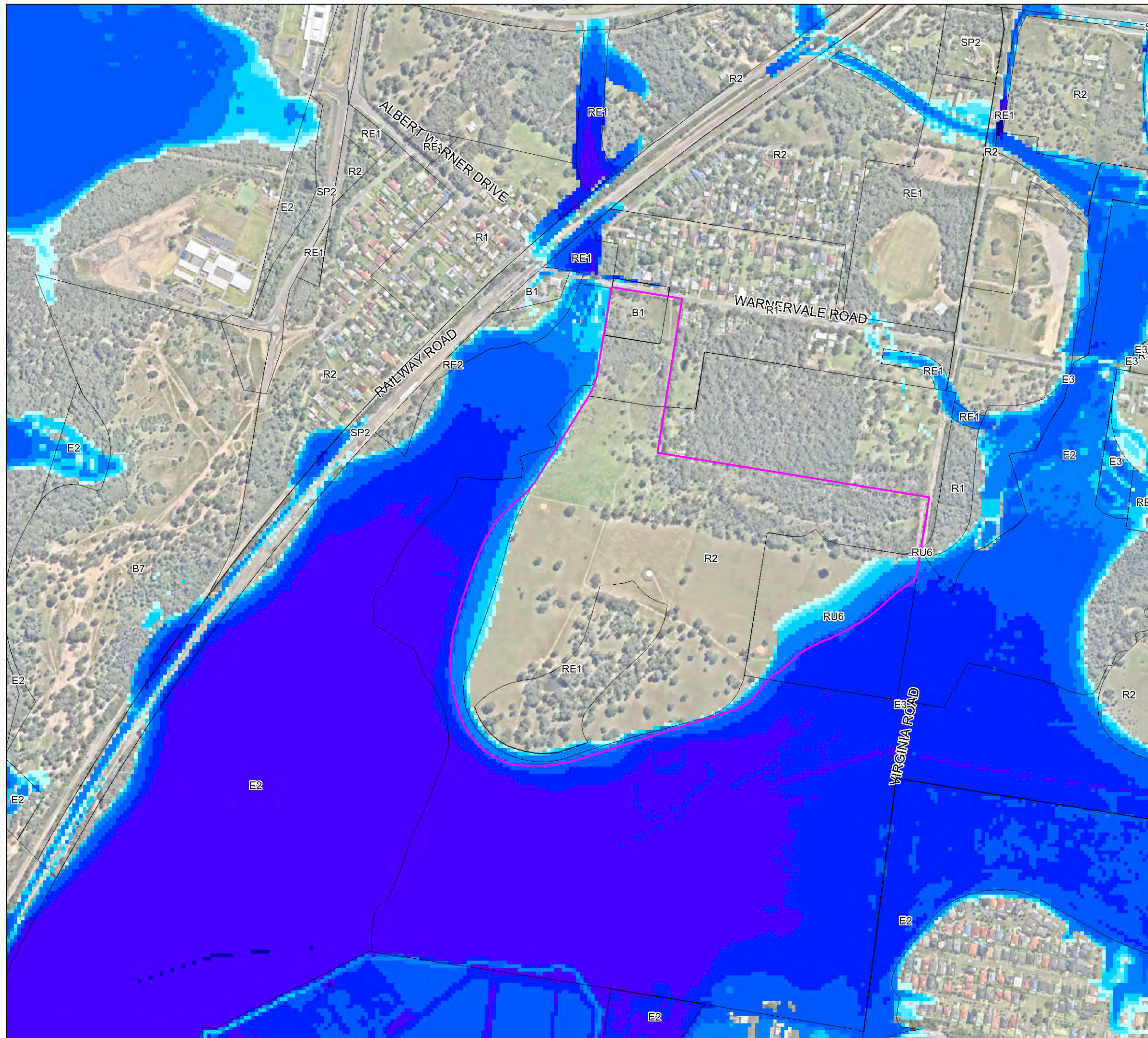


Figure 12 Provisional Hazard Developed Scenario PMF Event

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LEGEND PROVISIONAL HAZARD

- High
- Transitional Zone
- Low
- Development Boundary
- Land Use Zones
- 0.2 m Water Level Contour



SCALE 1:7,500 Scale at A3

Kilometres

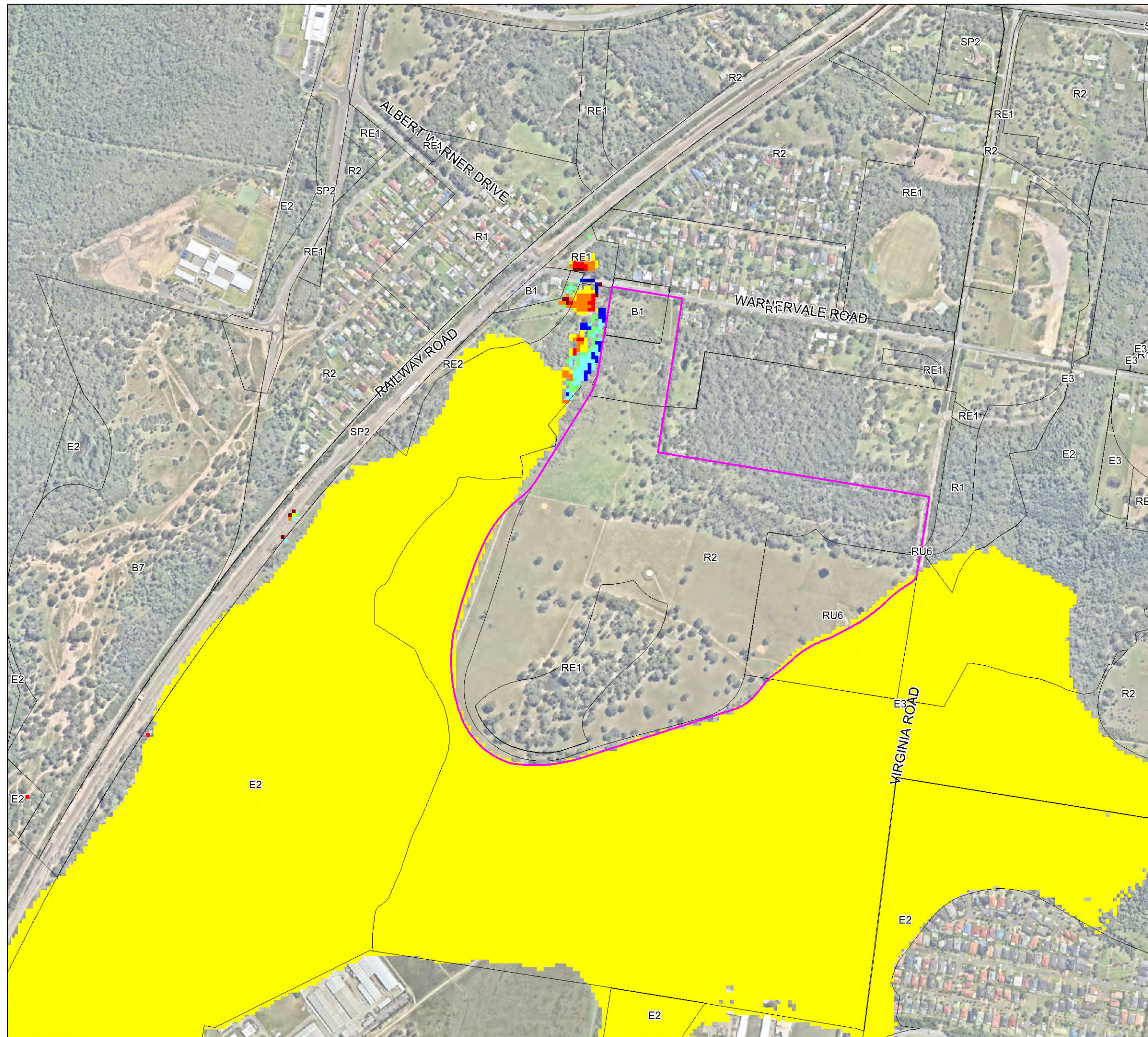


Map Produced by Cardno NSW/ACT (Water and environment)
Date: 15 March 2016
Coordinate System: GDA94 Zone 56
Project: 59916125
Map: Figure_12_Developed_PMF_Provision_Hazard.WOR



Figure 13
Water Level Difference
Developed Scenario
- Existing Scenario
1% AEP Event

59916125
15 - 35 WARNERVALE RD FIA



Peak Water Level Difference
 millimetres



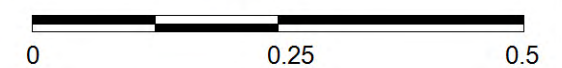
Development Boundary

Land Use Zones



SCALE 1:7,500 Scale at A3

Kilometres



Map Produced by Cardno NSW/ACT (Water and environment)
 Date: 15 March 2016
 Coordinate System: GDA94 Zone 56
 Project: 59916125
 Map: Figure_15_100y_waterleveldiff_P7Adev-P7Aexisting.WOR

Figure 14
Water Level Difference
Precinct 7A Developed
- Precinct 7A Existing
1% AEP Event

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Peak Water Level Difference
 millimetres



 Development Boundary

 Land Use Zones



SCALE 1:1,500 Scale at A3

Metres



Map Produced by Cardno NSW/ACT (Water and environment)
 Date: 15 March 2016
 Coordinate System: GDA94 Zone 56
 Project: 59916125
 Map: Figure_15_100y_waterleveldiff_P7Adev-P7Aexisting.WOR

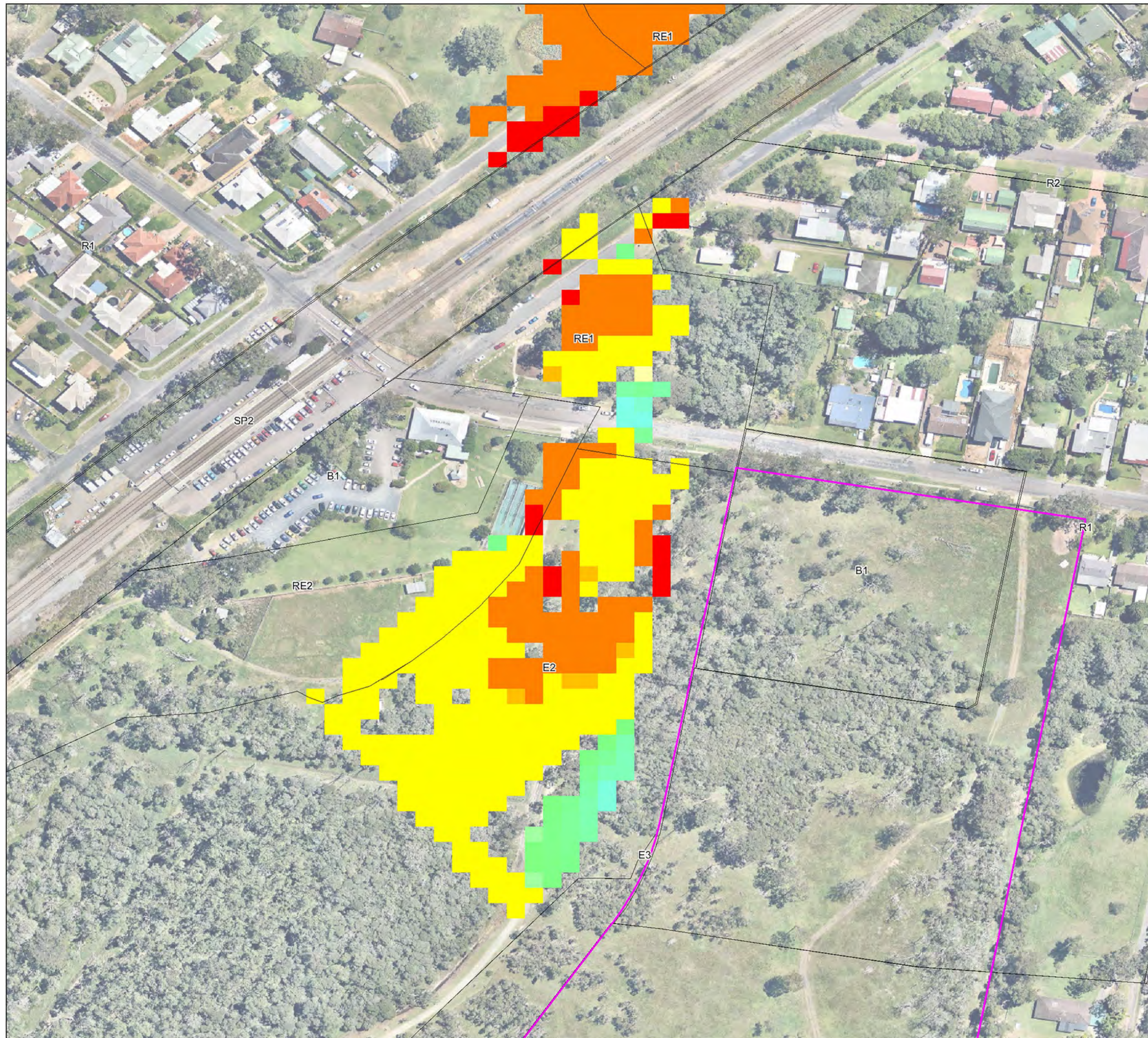


Figure 15 Water Level Difference Developed Scenario - Existing Scenario 1% AEP Event

59916125
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Peak Water Level Difference
millimetres



 Development Boundary

 Land Use Zones

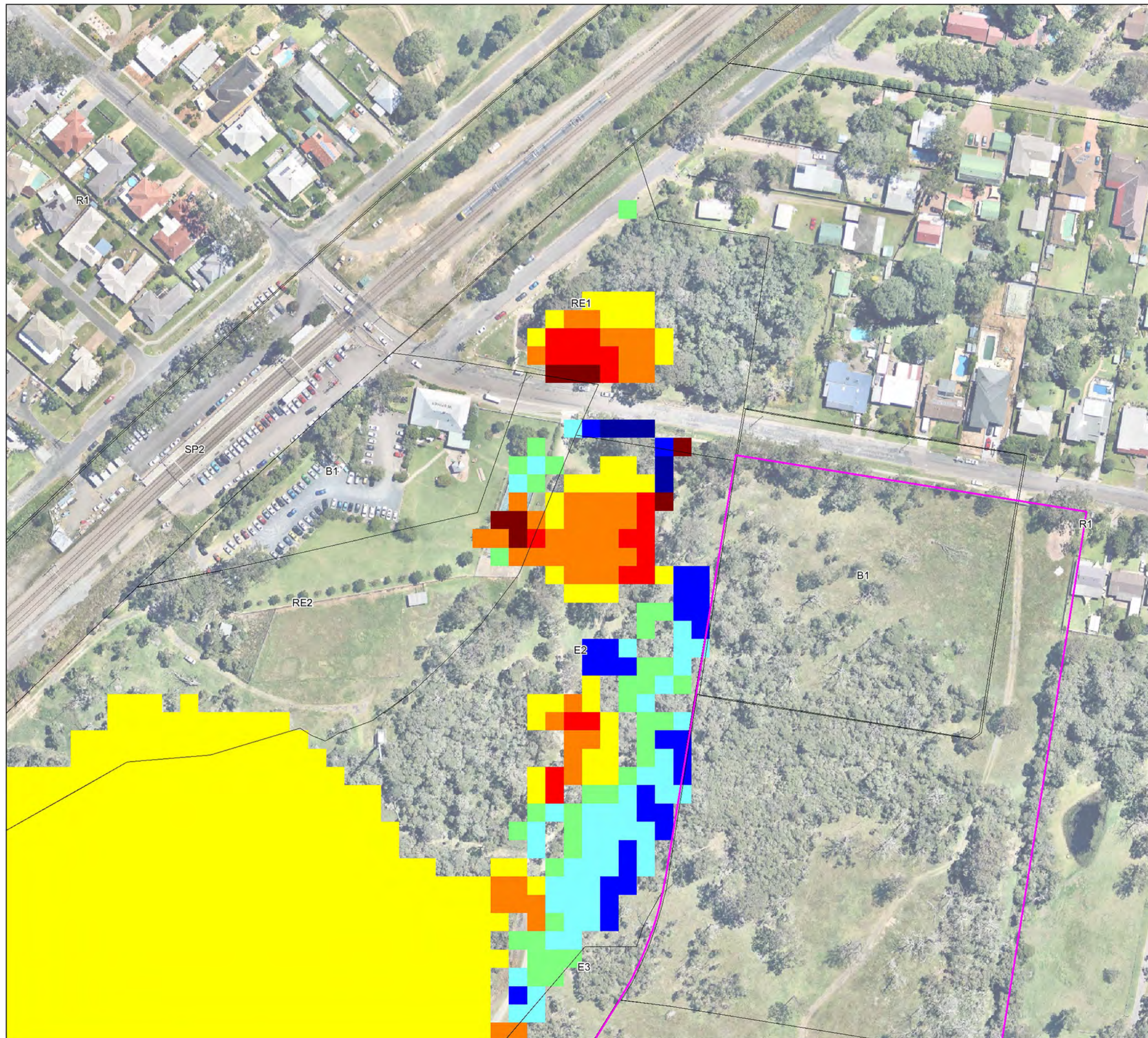


SCALE 1:1,500 Scale at A3

Metres



Map Produced by Cardno NSW/ACT (Water and environment)
Date: 15 March 2016
Coordinate System: GDA94 Zone 56
Project: 59916125
Map: 59916125.wor 01



C Aboriginal Heritage 2016 (Extent)