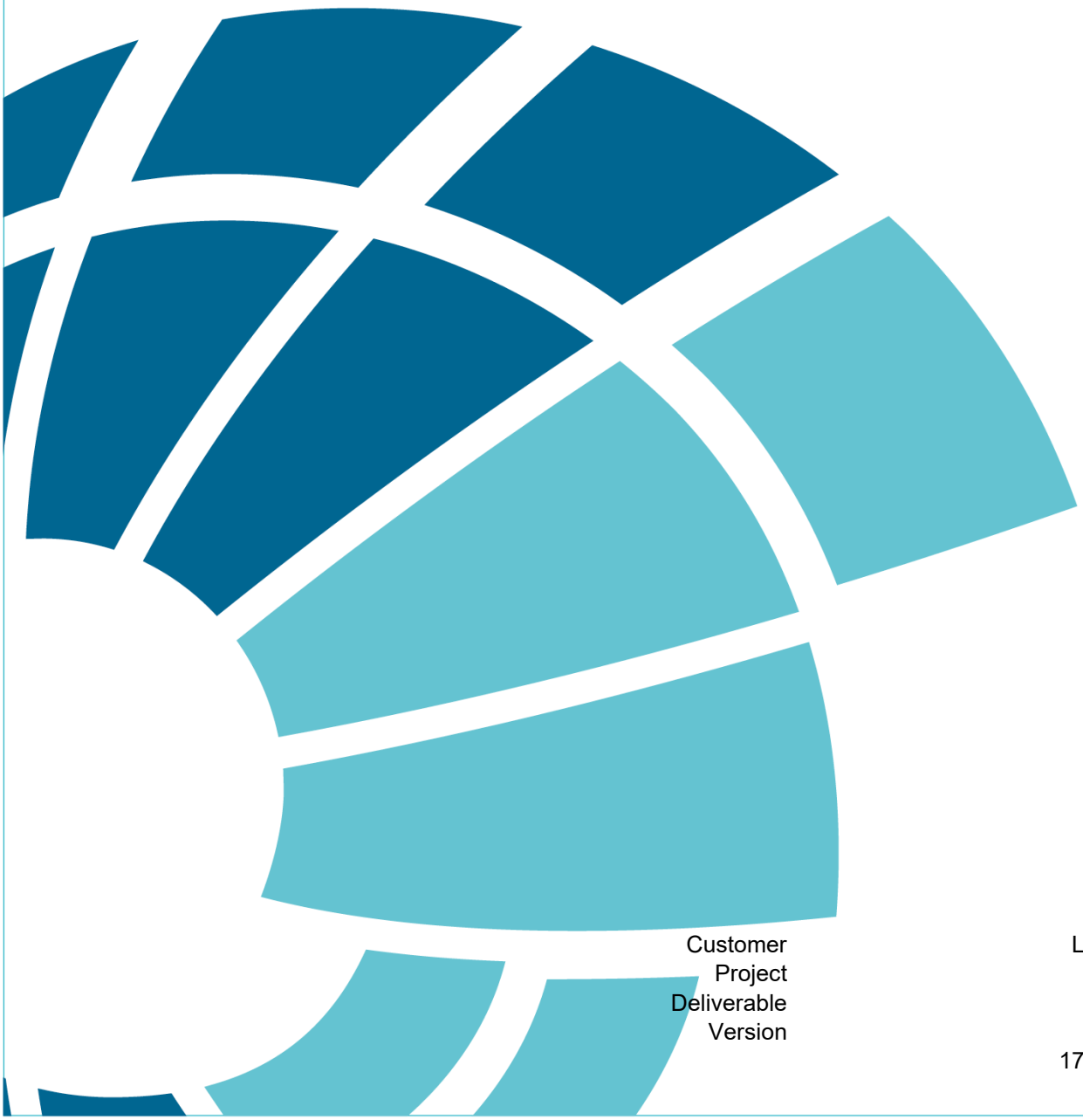
Flood Impact Assessment - Lot 146 South Lake Drive - Lake Wyangan



Customer	LWLE Pty Ltd
Project	A12452.000
Deliverable	001
Version	00
	17 March 2023

Document Control

Document Identification

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Customer	LWLE Pty Ltd
Customer Contact	Andrew Charles Corry on behalf of LWLE Pty Ltd
Classification	BMT (OFFICIAL)
Synopsis	Flood Impact Assessment for proposed development Stages 4 to 6 at Lot146 South Lake Drive – Lake Wyangan

Author	Nicola De Paolis
Reviewed By	Cathie Barton
Project Manager	Nicola De Paolis

Amendment Record

The Amendment Record below records the history and issue status of this document.

Version	Version Date	Distribution	Record
0	17 March 2023	Development Outcomes Pty Ltd	Draft Flood Report –

Contents

Figures

1 Introduction

BMT[1] was engaged by Davis Sanders Homes Pty Ltd in association with Development Outcomes Pty Ltd to conduct a comprehensive flood study investigation for a proposed residential development located at Lot 146 in South Lake Drive, Lake Wyangan – 2680 NSW.

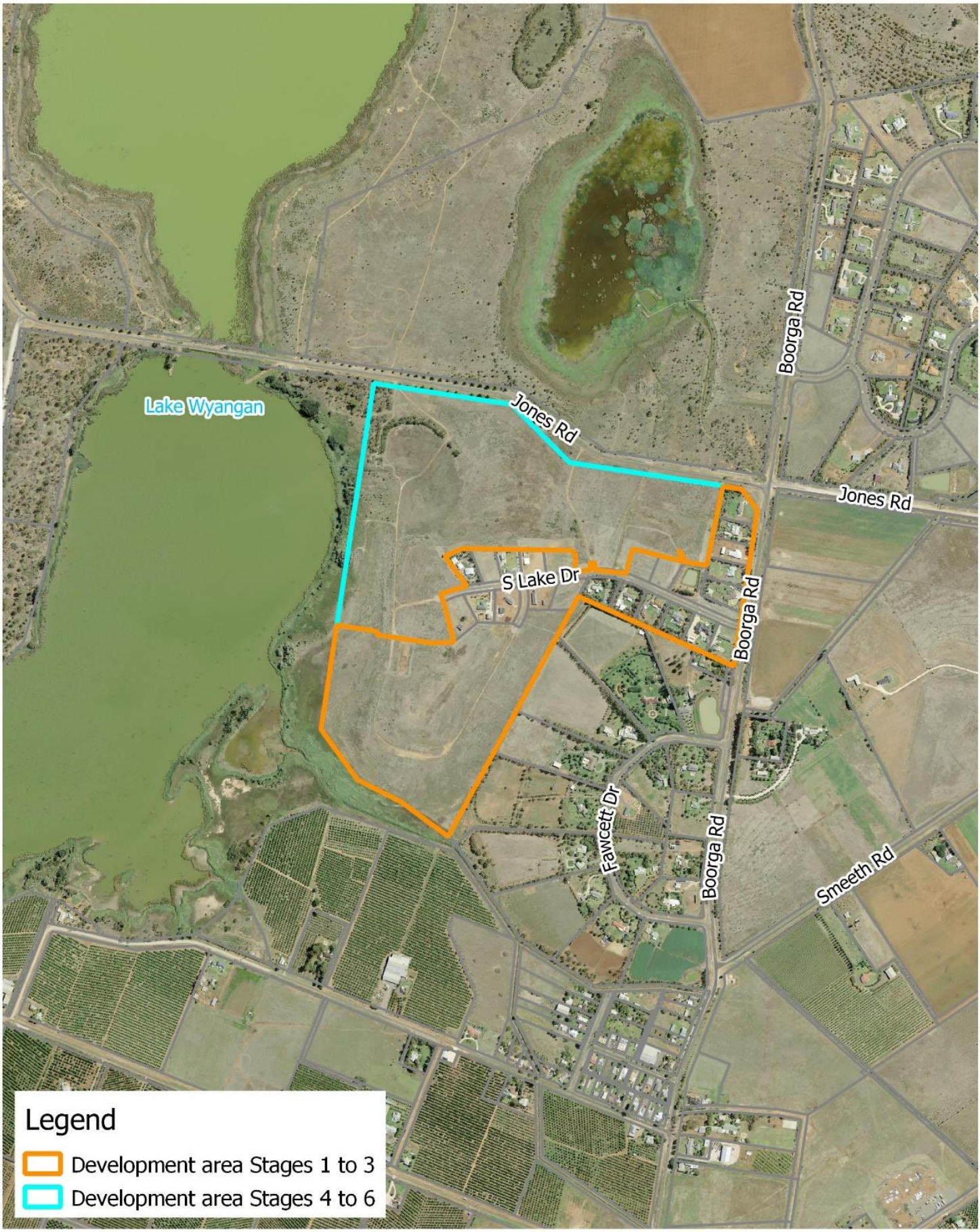
The development, which is shown in Figure 1.1, consists of six (6) Stages, with Stage 1 completed and Stages 2 and 3 currently under construction. Davis Sanders homes Pty Ltd has submitted Development Application (DA) 172/2022, seeking approval for Stages 4, 5 & 6 of the rural lot residential development consisting of Lot 146 DP 1214737.

The Griffith Council flood information certificate for the lot (enclosed in Annex A to this report) indicates that the Site is flood-prone land. As such, any changes to on-Site floodplain conditions have the potential to alter the distribution of floodwaters in the vicinity of the site. To ensure that the proposed development within Stages 4, 5 & 6 does not exacerbate flood risks to the community, BMT was commissioned to undertake a flood impact assessment to determine on-Site flood conditions and any potential flood impacts of the proposed development.

The report documents the methodology and findings of the flood study investigation, including an overview of the proposed development and the existing flood conditions in the area. The study includes detailed modelling of potential flood scenarios and analysis of the impacts on the proposed development and surrounding areas.

BMT's flood study investigation has been conducted in accordance with the relevant legislation and guidelines, and the report is intended to assist Davis Sanders homes Pty Ltd and Development Outcomes in submitting DA 172/2022, making informed decisions about the proposed development, and ensuring the safety and welfare of the local community.

[1] BMT is a leading engineering consultancy firm with extensive experience in flood studies



Title:

Locality Map

Figure: 1.1

Rev: A

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2 Available Flood Studies and Modelling

In 2012 and 2013, the Griffith City Council commissioned the “Lake Wyangan Flood Study’ and ‘Lake Wyangan Floodplain Risk Management Study and Plan” to assess flood behaviour in the Lake Wyangan catchment and facilitate flood management activities.

The catchment spans an area of approximately 825km², encompassing Lake Wyangan, Nericon, and agricultural properties, which ultimately drain to multiple storages, including Tharbogang Swamp, Nericon Swamp, Campbells Swamp, and Lake Wyangan.

Significant infrastructure modifications have altered the catchment's natural drainage, with the majority now draining to Lake Wyangan instead of Tharbogang Swamp. A hydraulic model, developed using TUFLOW 2D software and calibrated against historical flood events, simulates flood conditions in the catchment. The model utilised a rainfall-on-grid approach with ARR2001 intensity-frequency-duration (IFD) design rainfalls as input to determine design flood conditions for the study catchment, with an 18-hour storm duration used for overall critical conditions and a 2-hour storm duration used for sub-catchments.

As a volume-controlled catchment system, the Lake Wyangan catchment's flood levels are directly proportional to the volume of runoff generated during a flood event. High rainfall losses lead to shallow effective rainfall depths, making the flood levels extremely sensitive to initial loss values. During the calibration process, an initial loss value of 60mm was deemed appropriate for the events considered, although this value was reduced to 15mm for design purposes due to the characteristics of the available design rainfall temporal pattern.

3 Flood mechanism at the Site

The main cause of flooding on the Site is a combination of the accumulation of rainfall on the ground, which fills up local depressions once the soil's absorption capacity is exceeded, and the overflow of the Lake Wyangan due to prolonged rainfall. The primary drainage outlet for Lake Wyangan is located to the south of the subject Site and bounds its southern perimeter. This drainageway becomes active when the water level exceeds the lake's overflow height.

The 5%AEP event typically does not result in flooding on the Site (refer to map B-01 in Annex B). This is because overflow from Lake Wyangan is confined to the southern drainageway, and the only area with notable water depths is a ground depression in the northwest of the Site where rainfall accumulates, leading to water depths of up to 0.5 metres.

During the 1%AEP and 0.5%AEP events instead, water spills over from the lake's banks to the north and moves towards the Site's low point in the northwest, resulting in water depths of up to 1.7 metres and 2.2 metres, respectively (refer to maps B-06 and B-11 in Annex B). Despite this, the rest of the Site remains unaffected by flooding during these events.

In the worst-case scenario, the Probable Maximum Flood (PMF) event, the entire Site experiences flooding, with water depths ranging from 3 to 10 metres (refer to map B-16 in Annex B).

The flooding mechanism described is characterised by velocities that are generally very low for all design events up to the 0.5%AEP due to the flat topography of the region (with less than 0.5% slope). Essentially, it can be said that there is no perceptible movement of water. This results in low momentum flows which generally do not pose a significant hazard across the Site, except for the north-west depression where high hazard is associated to high-water depths (refer to maps B-08 and B-13 in Annex B).

In the PMF event instead, the entire Site is classified as having a "high" flood hazard (refer to map B-18 in Annex B).

4 Flood Modelling

4.1 Overview

The TUFLOW model from the 2013 Lake Wyangan Flood Study has been used as the basis for this flood impact modelling assessment. The model has been updated as required to define “Baseline Scenario” (i.e. pre-works) and “Post-Development Scenario” (i.e. post-works) flood conditions for the 5% and 1% Annual Exceedance Probability (AEP) floods and Probable Maximum Flood (PMF).

Furthermore, in order to assess the potential impact of future climate conditions on the existing flood behaviour, the 0.5%AEP flood event was also simulated and utilised as a proxy for the 1% AEP + Climate Change (CC) scenario.

Model updates, detailed in the following sections, focused on inclusion of Digital Elevation Models (DEM) representing final design ground levels and detailing of Site area materials and land use roughness. Manning's roughness coefficients were selected based on industry standards, with a value of 0.02 assigned to roads. Development lot areas were instead assigned a value of 0.25 to account for flow obstruction, which takes into consideration the high obstruction posed by building constructions and a lower value attributed to the surrounding areas. Nonetheless, it should be noted that the impact of roughness on flow behaviour is limited due to the low velocities involved.

As the modelling focuses on large regional flood mechanism, the detail of the stormwater network was not included in the modelling, since limited effect is expected on the regional flooding mechanism.

4.2 Baseline Scenario Model

The 2013 Lake Wyangan TUFLOW model has been updated to form the Baseline Scenario which defines baseline flood conditions against which flood impacts associated with the proposed Stages 4 to 6 works are herein assessed. As originally stated in our Proposal (reference :P.A12452.001_1200_Lake_Wyangan_FIA.pdf), baseline conditions for this assessment incorporate Stages 1 to 3 development data and specifically include:

- Ground surface surveyed elevations (reference: layer “3dFace_ExistingSurface_Survey” contained in DWG file “1200 FloodStudyModel(SuveyControlShiftedTo_MGA).dwg”)
- Design Levels for Stages 2 and 3 currently under construction (reference: layer “3dFace_DesignSurface” contained in DWG file “1200_FloodStudyModel(SuveyControlShiftedTo_MGA).dwg”).
- Refinements to the material layer used to apply Manning’s n roughness values within the Site to represent Base Case conditions on-Site.

It should be noted that the first Stage of the Site's development was completed by different developers several years ago, and as a result, no design level for Stage 1 is available. To address this issue, ground levels as defined in the 2013 Lake Wyangan TUFLOW model are assumed for the area covered by Stage 1. This assumption is unlikely to significantly affect the reliability of the assessments.

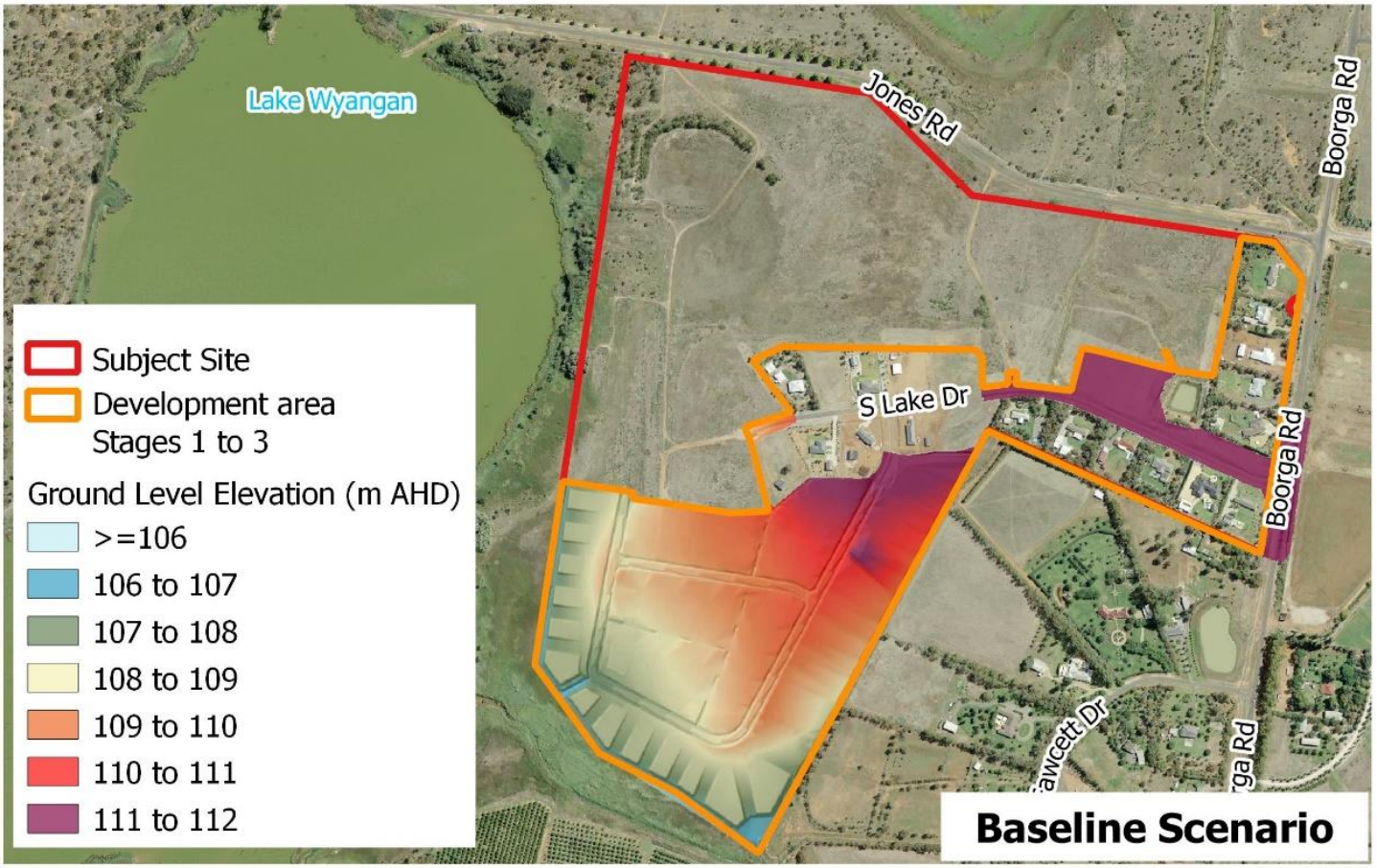
The updated version of the model is referred to as the “Baseline Scenario TUFLOW model”.

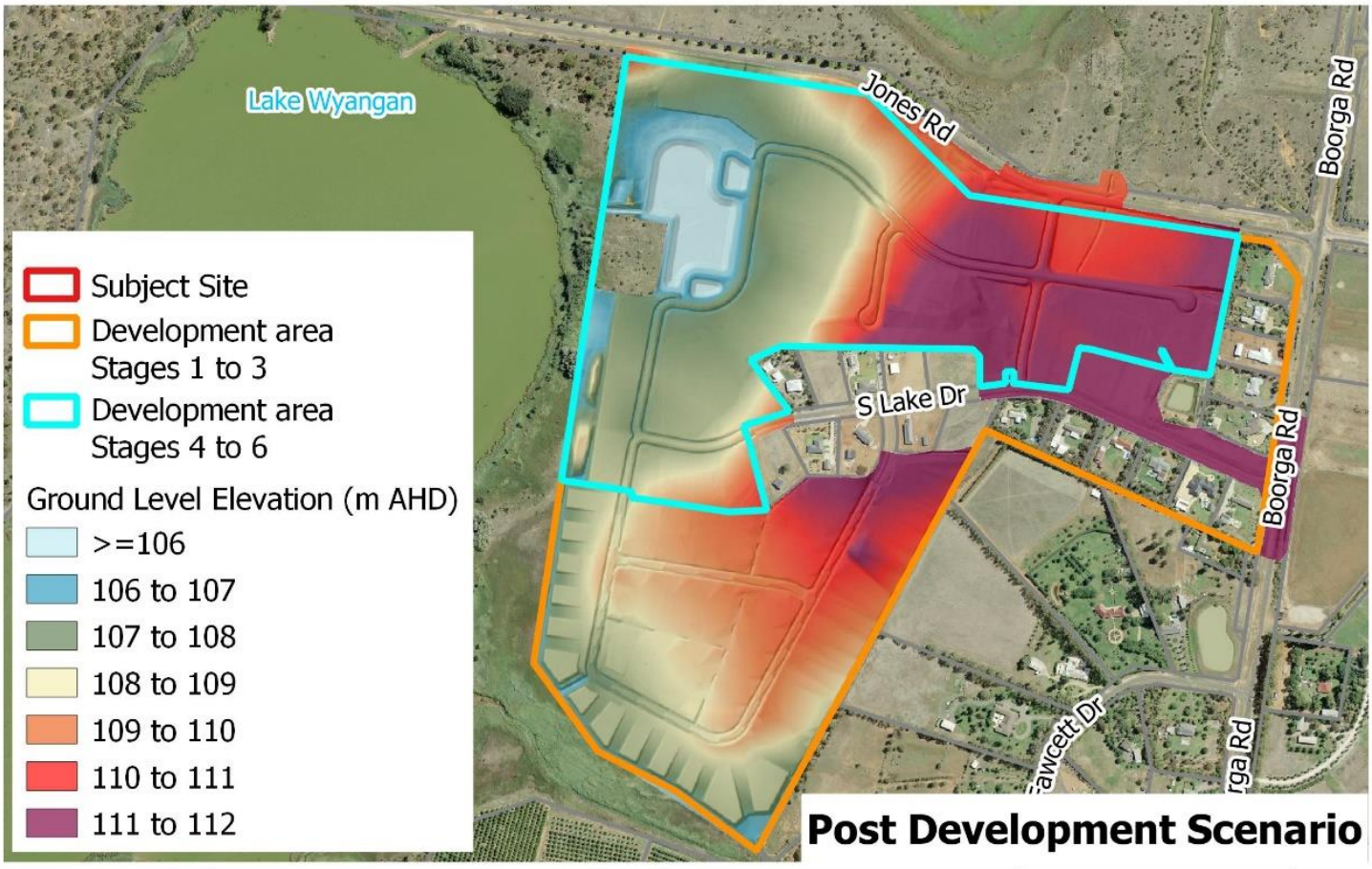
4.3 Post-Development Scenario Model

In February 2023 Development Outcomes supplied BMT with the design terrain data associated with the proposed development Stages 4 to 6. The following modifications were made to the “Baseline Scenario TUFLOW model” to form the “Post-Development Scenario TUFLOW model” for this assessment:

- Inclusion of Design Levels for Stages 4 to 6 (reference: layer “3dFace_DesignSurface” contained in DWG file “1200_FloodStudyModel(SuveyControlShiftedTo_MGA).dwg”)
- Addition of material layers used to apply Manning’s n roughness values within the Site to represent post-development conditions on-Site.

The topography within the Baseline and Post-Development Scenario TUFLOW models is shown in Figure 4.1 while the material layers used to define Baseline and Post-Development conditions are shown in Figure 4.2.





Title:

Site Topography

Figure: **4.1**

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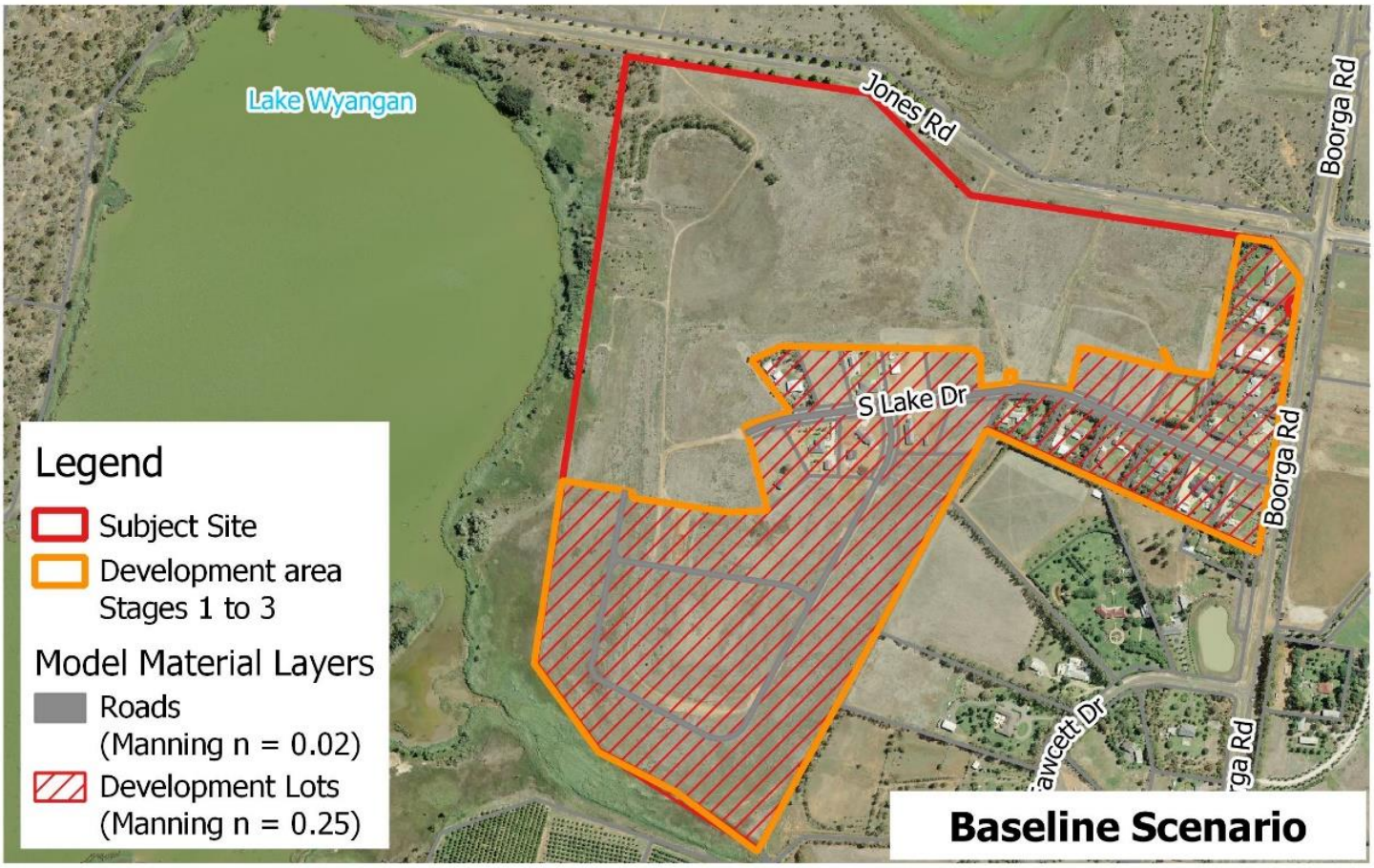

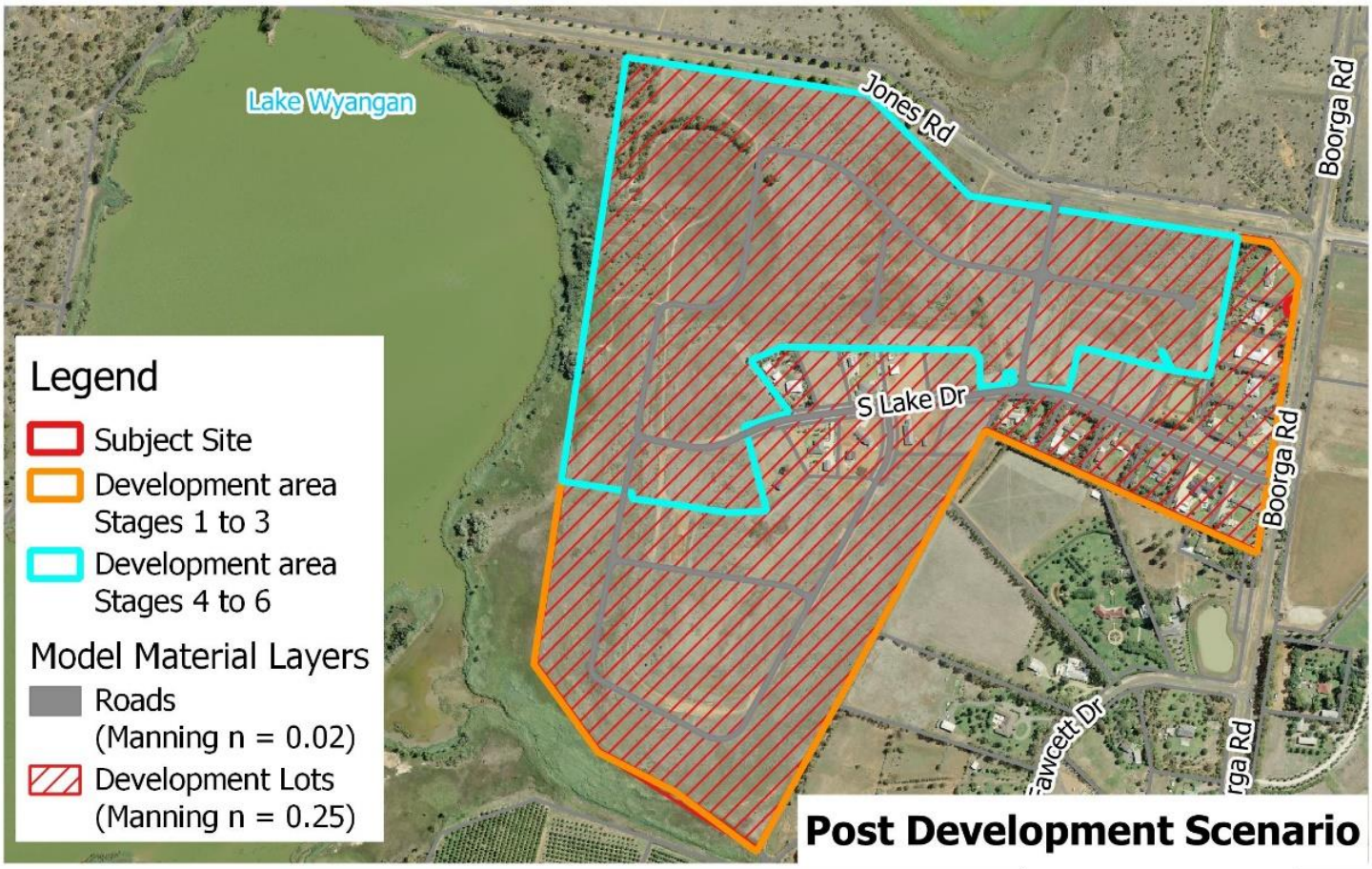

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Model Roughness

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4.4 Model Simulations

Baseline and Post-Development flood conditions were determined by using the Baseline and Post-Development Scenario TUFLOW models to simulate the 5% Annual Exceedance Probability (AEP), 1% AEP, 0.5% AEP and Probable Maximum Flood (PMF) design events for the 2-hours and 18-hours design storms which were selected as critical in the 2012 and 2013 Lake Wyangan studies. The results of these simulations were combined into design flood envelopes for each modelled design event and these enveloped results were used as the basis for flood and impact mapping.

4.5 Modelling Results

The results of the TUFLOW modelling for the modelled events were used to prepare flood depth, velocity and hazard mapping in the vicinity of the Site. This mapping is provided in Annex B and includes:

- Figure B-01 Peak Flood Depth - Baseline Scenario - 5% AEP Flood
- Figure B-02 Peak Flood Depth - Post-Development Scenario - 5% AEP Flood
- Figure B-03 Peak Flood Hazard - Baseline Scenario - 5% AEP Flood
- Figure B-04 Peak Flood Hazard - Post-Development Scenario - 5% AEP Flood
- Figure B-05 Change in Peak Flood Level - 5% AEP Flood
- Figure B-06 Peak Flood Depth - Baseline Scenario - 1% AEP Flood
- Figure B-07 Peak Flood Depth - Post-Development Scenario - 1% AEP Flood
- Figure B-08 Peak Flood Hazard - Baseline Scenario - 1% AEP Flood
- Figure B-09 Peak Flood Hazard - Post-Development Scenario - 1% AEP Flood
- Figure B-10 Change in Peak Flood Level - 1% AEP Flood
- Figure B-11 Peak Flood Depth - Baseline Scenario - 0.5% AEP Flood
- Figure B-12 Peak Flood Depth - Post-Development Scenario - 0.5% AEP Flood
- Figure B-13 Peak Flood Hazard - Baseline Scenario - 0.5% AEP Flood
- Figure B-14 Peak Flood Hazard - Post-Development Scenario - 0.5% AEP Flood
- Figure B-15 Change in Peak Flood Level - 0.5% AEP Flood
- Figure B-16 Peak Flood Depth - Baseline Scenario - PMF
- Figure B-17 Peak Flood Depth - Post-Development Scenario - PMF
- Figure B-18 Peak Flood Hazard - Baseline Scenario - PMF
- Figure B-19 Peak Flood Hazard - Post-Development Scenario – PMF
- Figure B-20 Change in Peak Flood Level – PMF

The change in peak flood level maps provide a visual representation of the differences between the Baseline and Post-Development Scenarios. The difference maps were created by subtracting results for the Baseline Scenario from the results for the Post-Development Scenario and show the location and magnitude of changes in flood level associated with the proposed development.

The low flood velocities involved and the minimal reduction in the storage when compared to the accumulation volumes of the lake mean that there are no significant or extensive changes predicted in

flood levels resulting from the fill proposed as part of the development stages 4 to 6 in any modelled events, up to and including the PMF event.

It is worth noting that certain maps indicate an increase in water levels in specific regions. However, this increase is limited to the areas where the digital elevation model of the proposed development stages 4 to 6 has been incorporated into the model. The rise in water level, known as "afflux," is a consequence of the combination of the rainfall-on-grid modelling approach and the elevated ground level of the proposed development. Therefore, it is important to clarify that the rise in water level is not caused by water displacement resulting from the development, but rather it is a direct result of the rainfall-on-grid modelling approach combined with raised ground level.

Overall, the proposed development has minimal impacts on flood behaviour, and it will not lead to any flood impacts on other private properties or public roads. There will also not be an increased requirement for government spending on flood mitigation measures.

5 Conclusions

BMT carried out a flood impact investigation to evaluate the potential impact of a proposed residential development located at Lot 146 in South Lake Drive, Lake Wyangan – 2680 NSW. The primary objective of the study was to ensure that the proposed development in Stages 4, 5 & 6 areas does not exacerbate flood risks to the surrounding community.

The investigation was conducted in accordance with relevant legislation and guidelines, and an existing TUFLOW model was utilised, which was previously developed as part of the 2012 “Lake Wyangan Flood Study” and the 2013 “Lake Wyangan Floodplain Risk Management Study and Plan”. The model was updated to include a "Baseline Scenario" that accounts for design data across Stages 1 to 3 of the development and a "Post-Development Scenario" that incorporates the design associated with the proposed development Stages 4 to 6.

Based on the modelling results, the proposed development in Stages 4, 5 & 6 areas will not cause any significant or extensive changes in flood levels, for events up to and including the Probable Maximum Flood (PMF) event. Therefore, the development will have a negligible impact on flood behaviour, and it will not result in any adverse flood impacts on adjacent private properties or public roads.

The calculated hazard at the Site is generally low for all events up to the 0.5% Annual Exceedance Probability (AEP) event due to the low velocities involved. A small area of high hazard exists in the low-lying area in the northwest of the Site. The hazard levels become a concern only during the PMF event, when high depths of water across the Site translate into high hazard levels.

A detailed representation of flooding at the site is provided in the flood maps and levels at the Site enclosed in annex B and C of this report.

6 References

BMT (2012). Lake Wyangan Flood Study, prepared for Griffith City Council.

BMT (2013). Lake Wyangan Floodplain Risk Management Study and Plan, prepared for Griffith City Council

Annex A Griffith City Council Flood Information Certificate

FLOOD REPORT

LOT / DP No:	**Lot 146 DP 1214737** **(DA 172/2022)**
STREET / ROAD	**South Lake Drive**
SUBURB / LOCALITY	LAKE WYANGAN

According to **Lake Wyangan FRMS&P 2013 (BMT WBM):**

- This is **Flood Prone Land.**

- Estimated **1% AEP** Flood Level and the associated Hazard Category is for this location varies (see 100 Year Level on page 4):

Location	Level (m AHD)	Hazard Category
1	107.61	High
2	111.05	Low
3	N/A	N/A
4	107.61	High
5	107.61	Transition
6	N/A	N/A
7	107.61	Low

- Estimated **PMF** Level and the associated Hazard Category for this location varies (see PMF Level on page 6):

Location	Level (m AHD)	Hazard Category
1	116.15	High
2	116.15	High
3	116.15	High
4	116.15	High
5	116.15	High
6	116.15	High
7	116.15	High

NB: Floor levels are subject to Council's Flood Management Policy.
The floor level for habitable room areas is to be **500mm** above the 1% AEP flood level.

Location	Level (m AHD)
1	108.11
2	111.55
3	N/A
4	108.11
5	108.11
6	N/A
7	108.11

Or **410mm** above the existing natural ground level, whichever is higher.

Council does not have sufficient accurate ground level information.
A registered surveyor may be able to assist in determining the required floor height. The applicant is advised to obtain a survey plan of the allotment.

Shamsul Haque
Civil Designer
14/09/2022

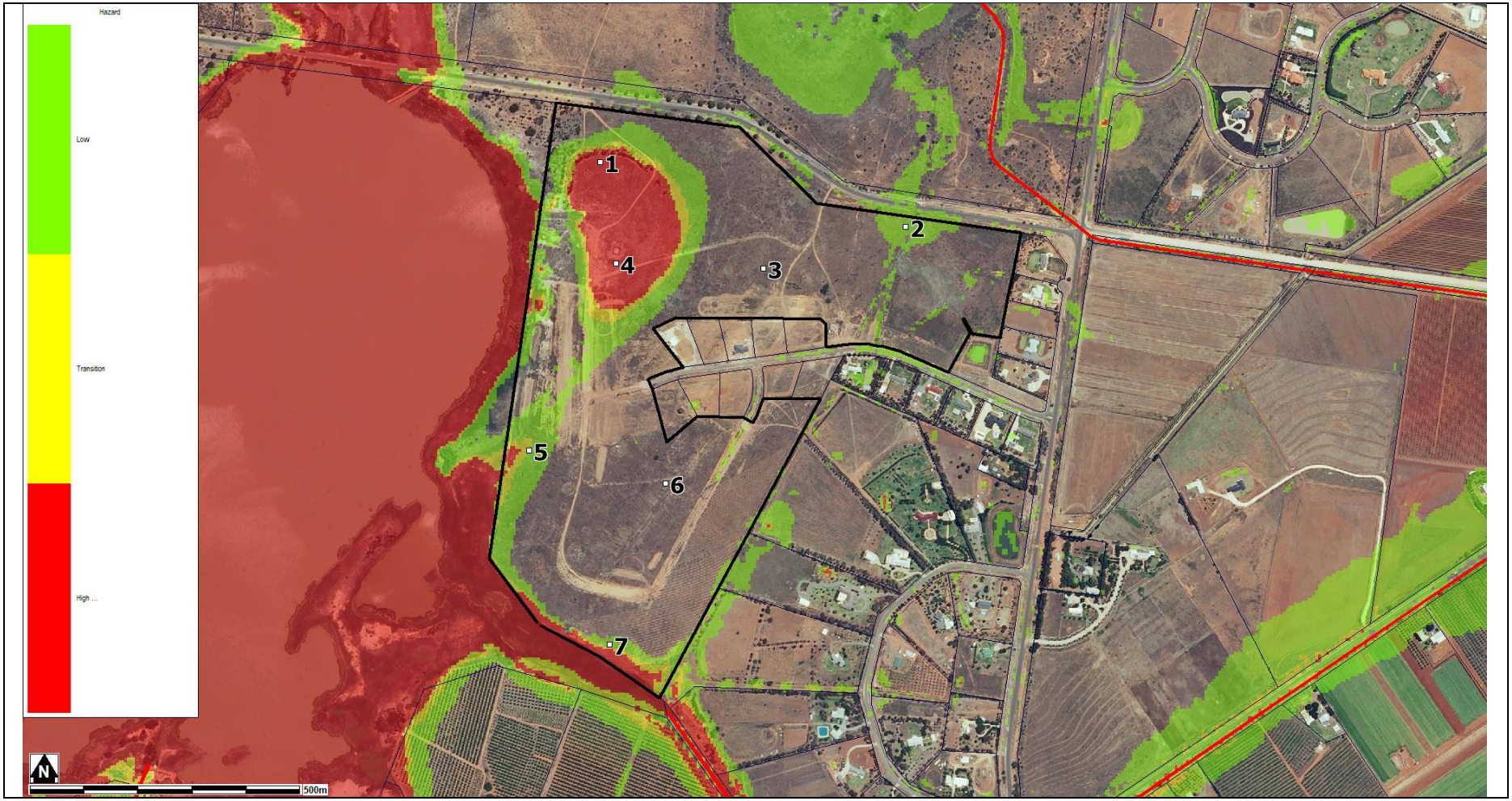
MAP – Lot 253 DP 1119328, South Lake Drive, LAKE WYANGAN

14/09/2022

1% AEP Level – Lot 253 DP 1119328, South Lake Drive, LAKE WYANGAN

14/09/2022

1% AEP Hazard – Lot 253 DP 1119328, South Lake Drive, LAKE WYANGAN



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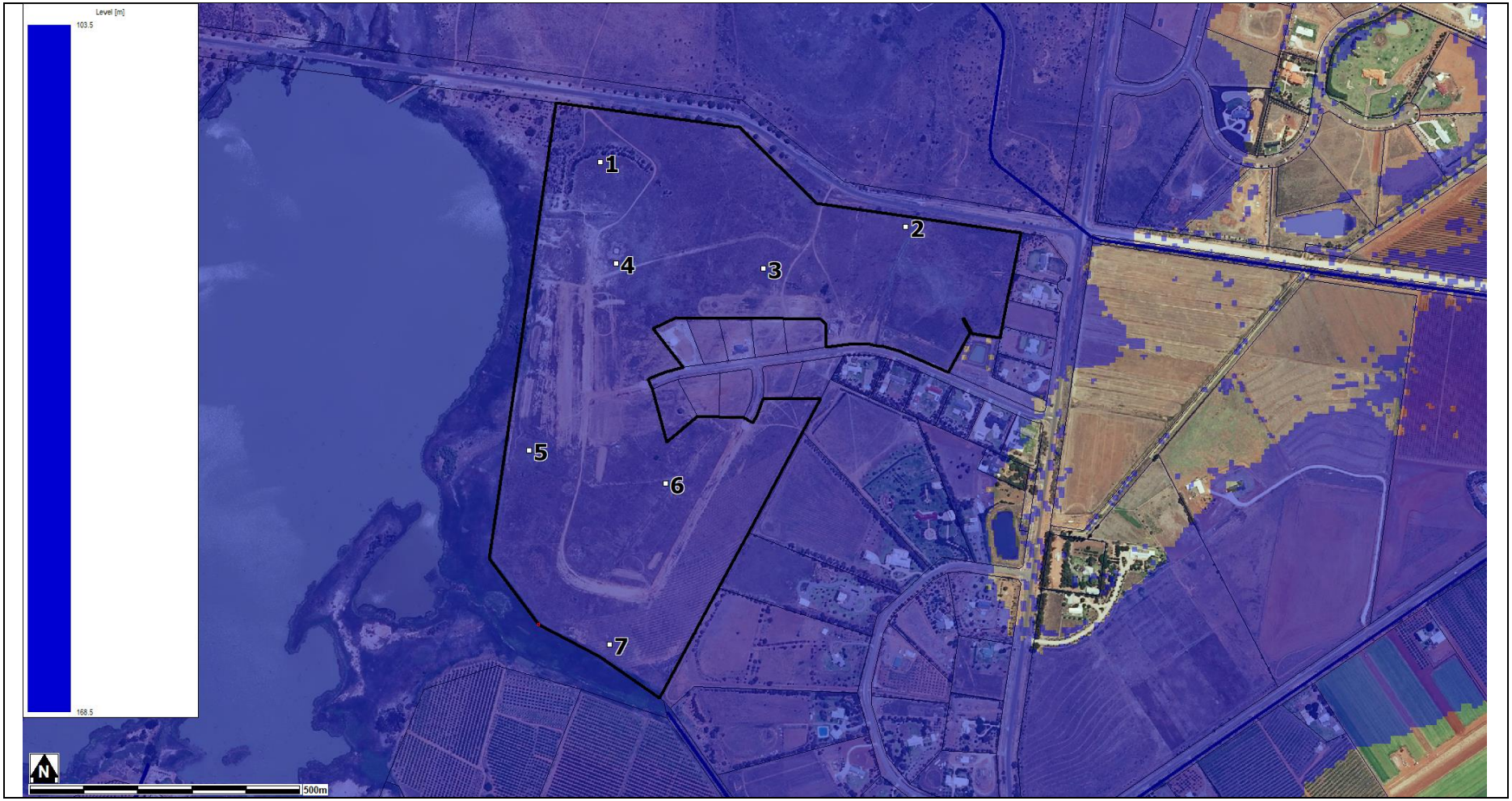
PMF Level(116.15) – Lot 253 DP 1119328, South Lake Drive, LAKE WYANGAN



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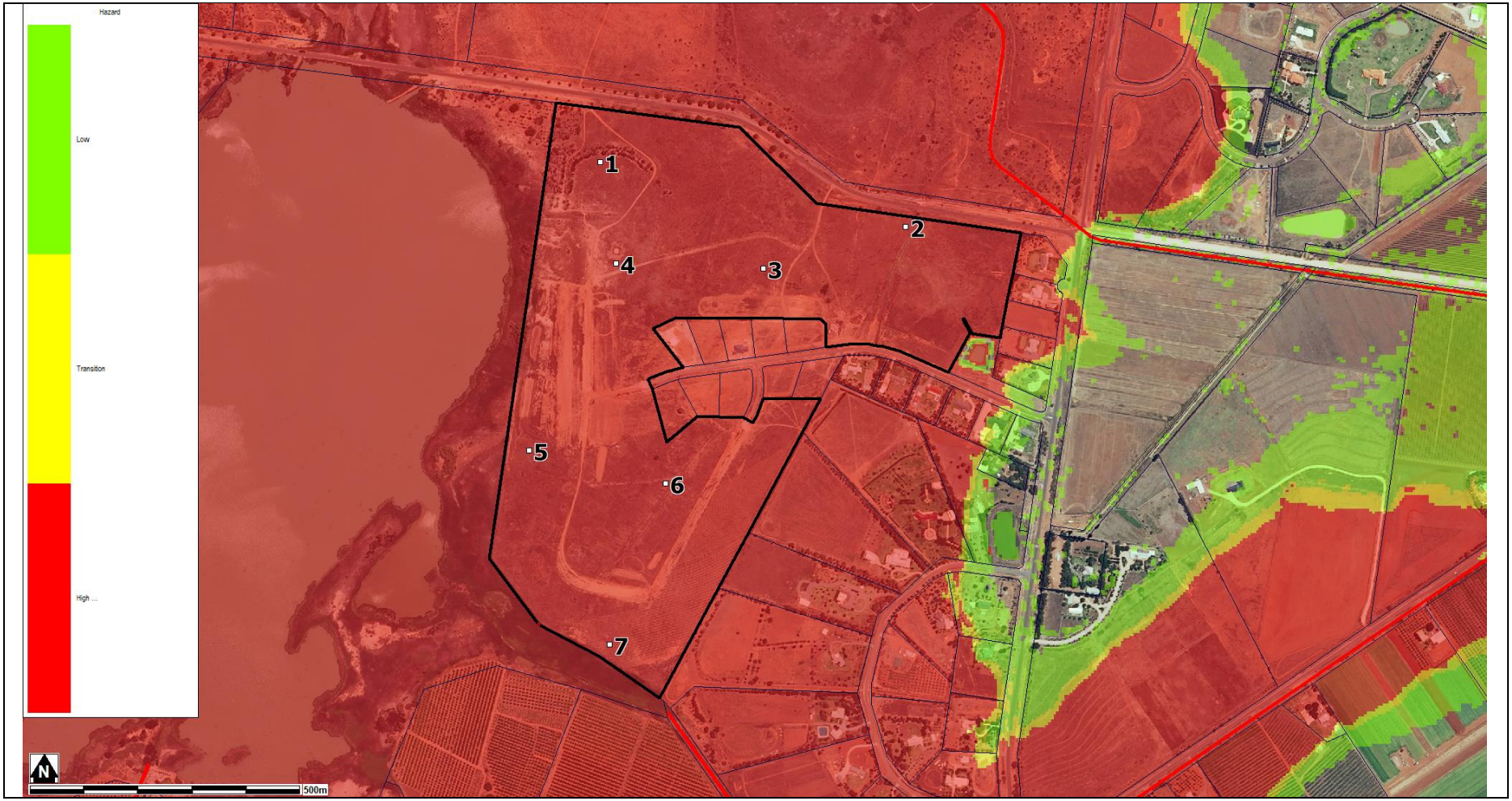
PMF Hazard (High) – Lot 253 DP 1119328, South Lake Drive, LAKE WYANGAN



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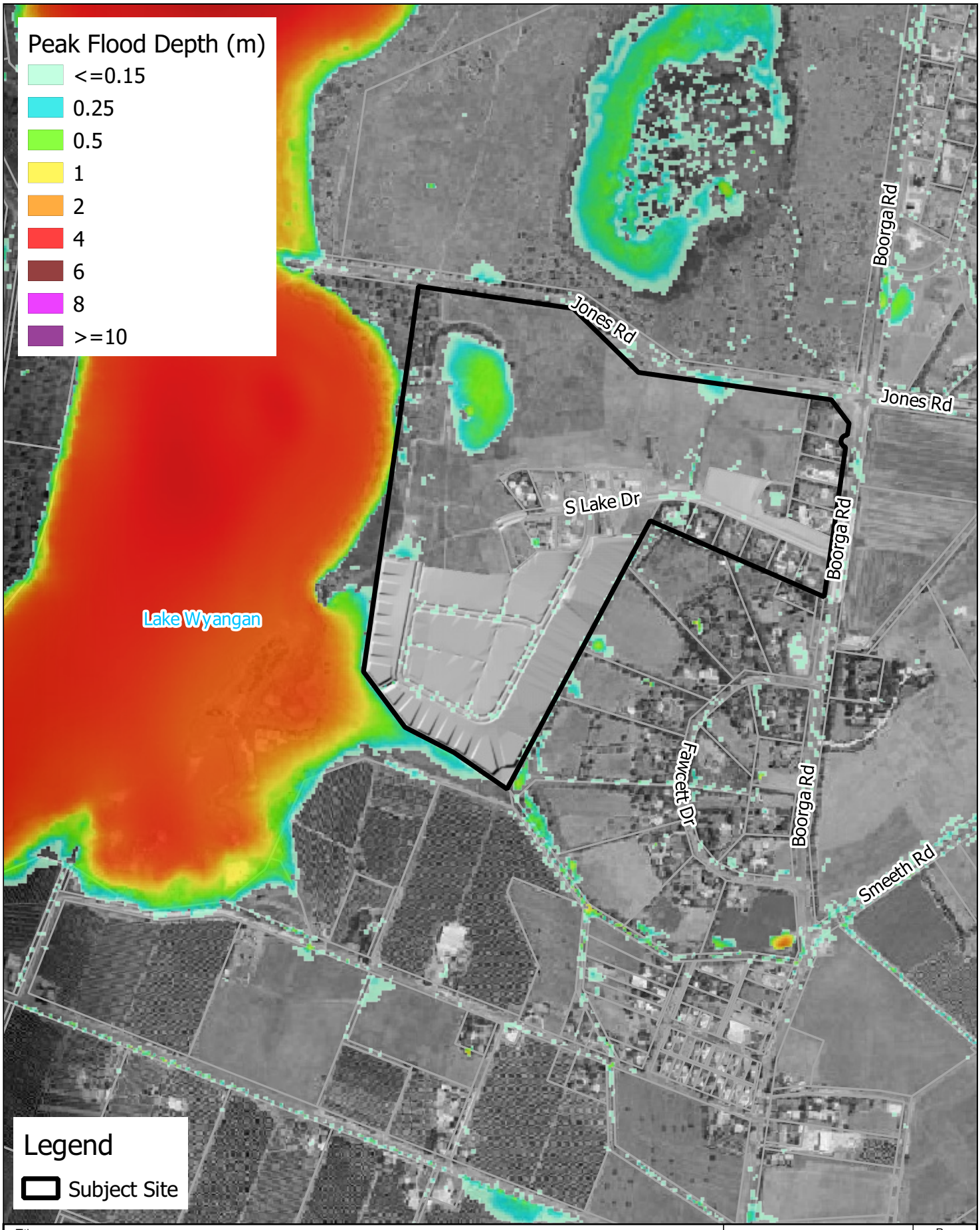
Annex B Flood Maps



Title:

Peak Flood Depth - Baseline Scenario - 5% AEP Flood

Figure: **B-01**

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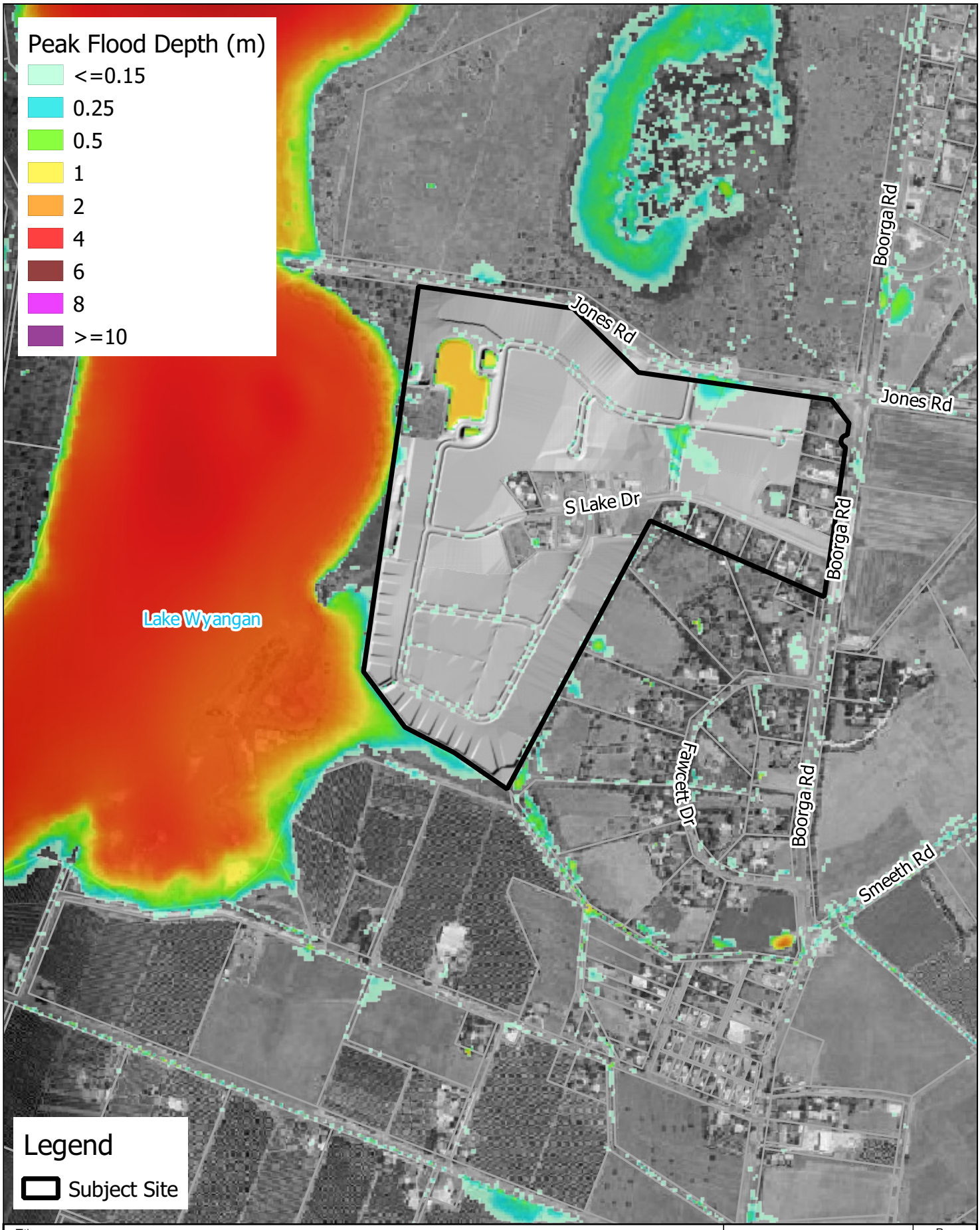

Title:

Peak Flood Depth - Post-development Scenario - 5% AEP Flood

Figure: B-02

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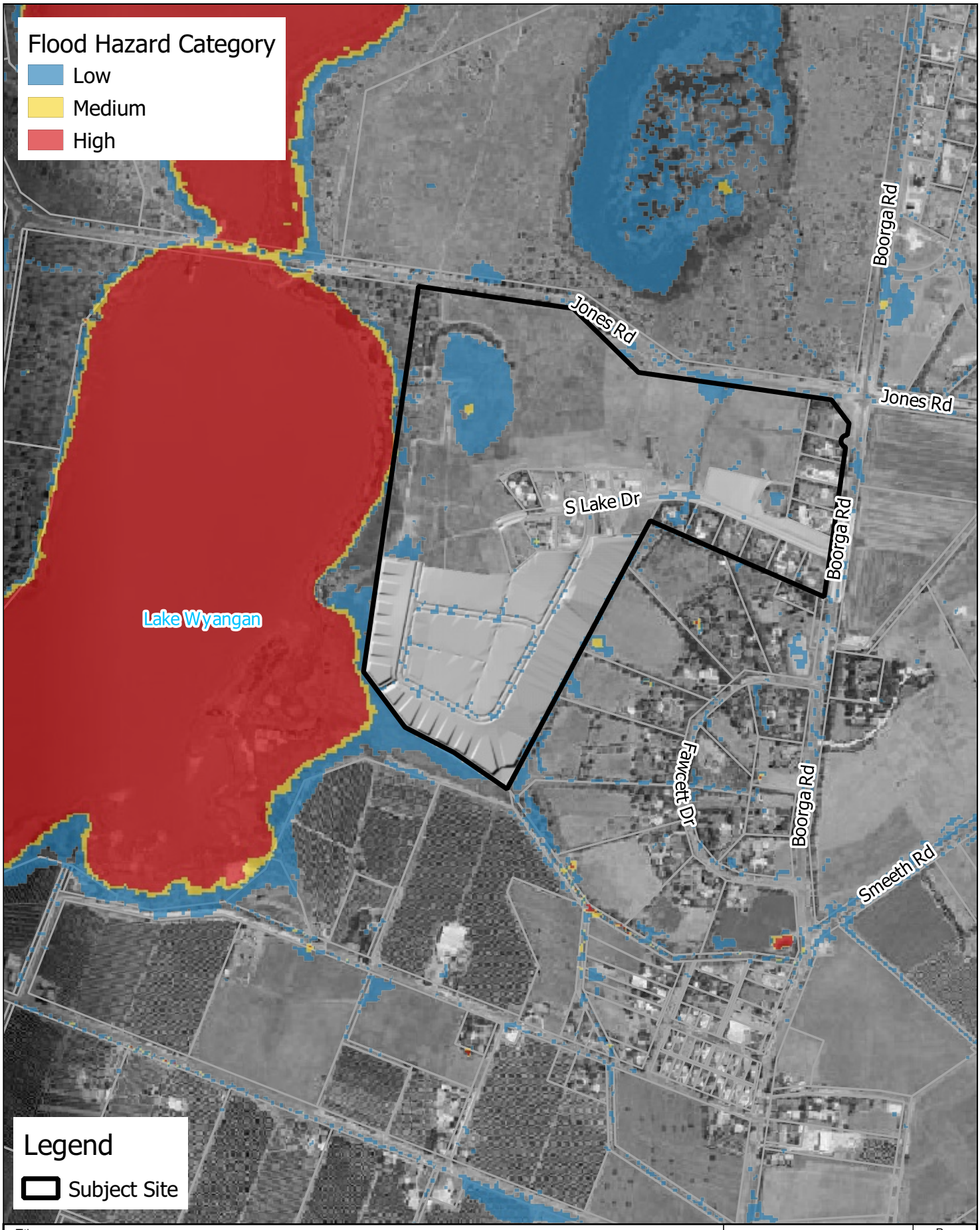

Title:

Peak Flood Hazard - Baseline Scenario - 5% AEP Flood

Figure: **B-03**

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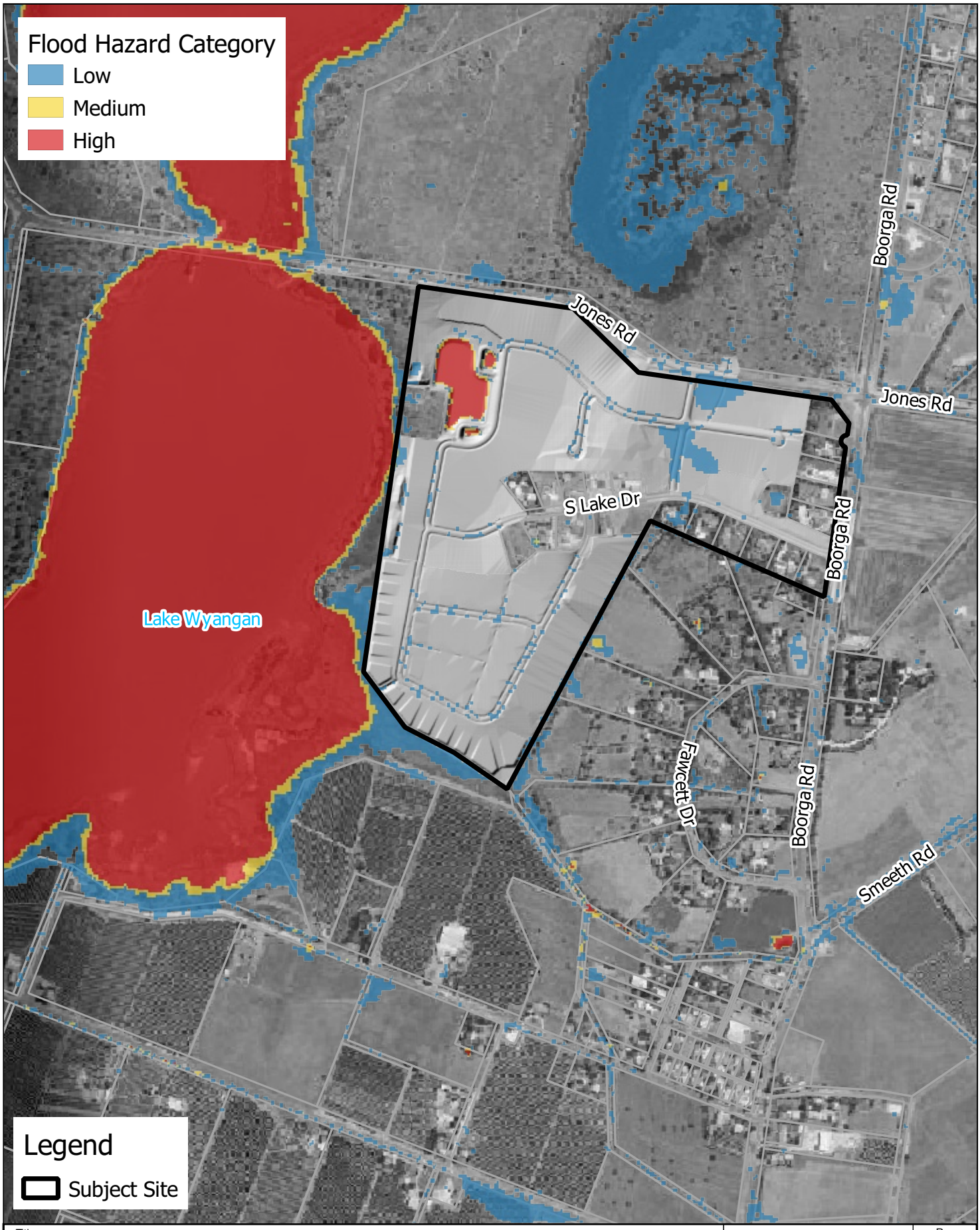

Title:

Peak Flood Hazard - Post-development Scenario - 5% AEP Flood

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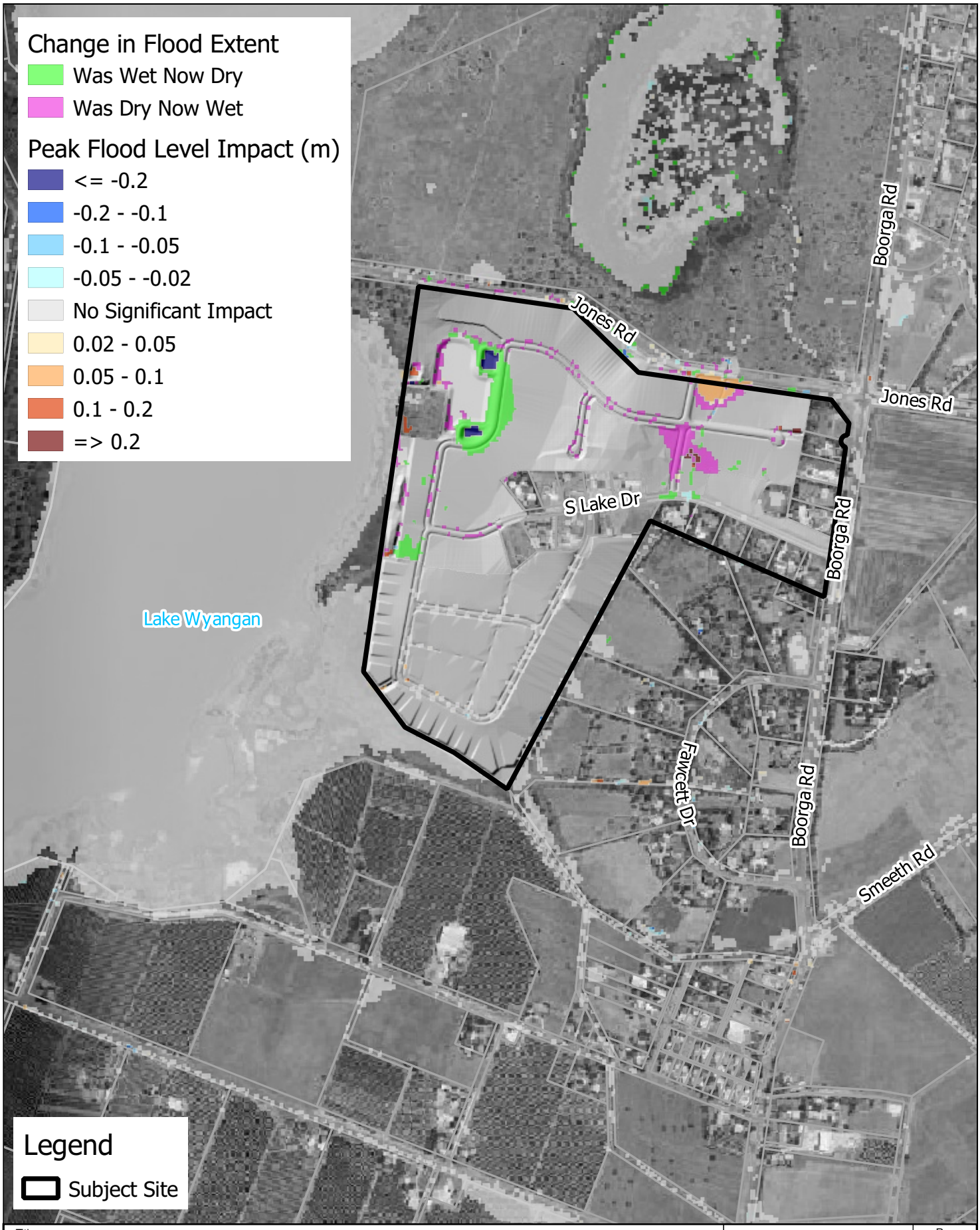

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Change in Peak Flood Level - 5% AEP Flood

Figure: **B-05**

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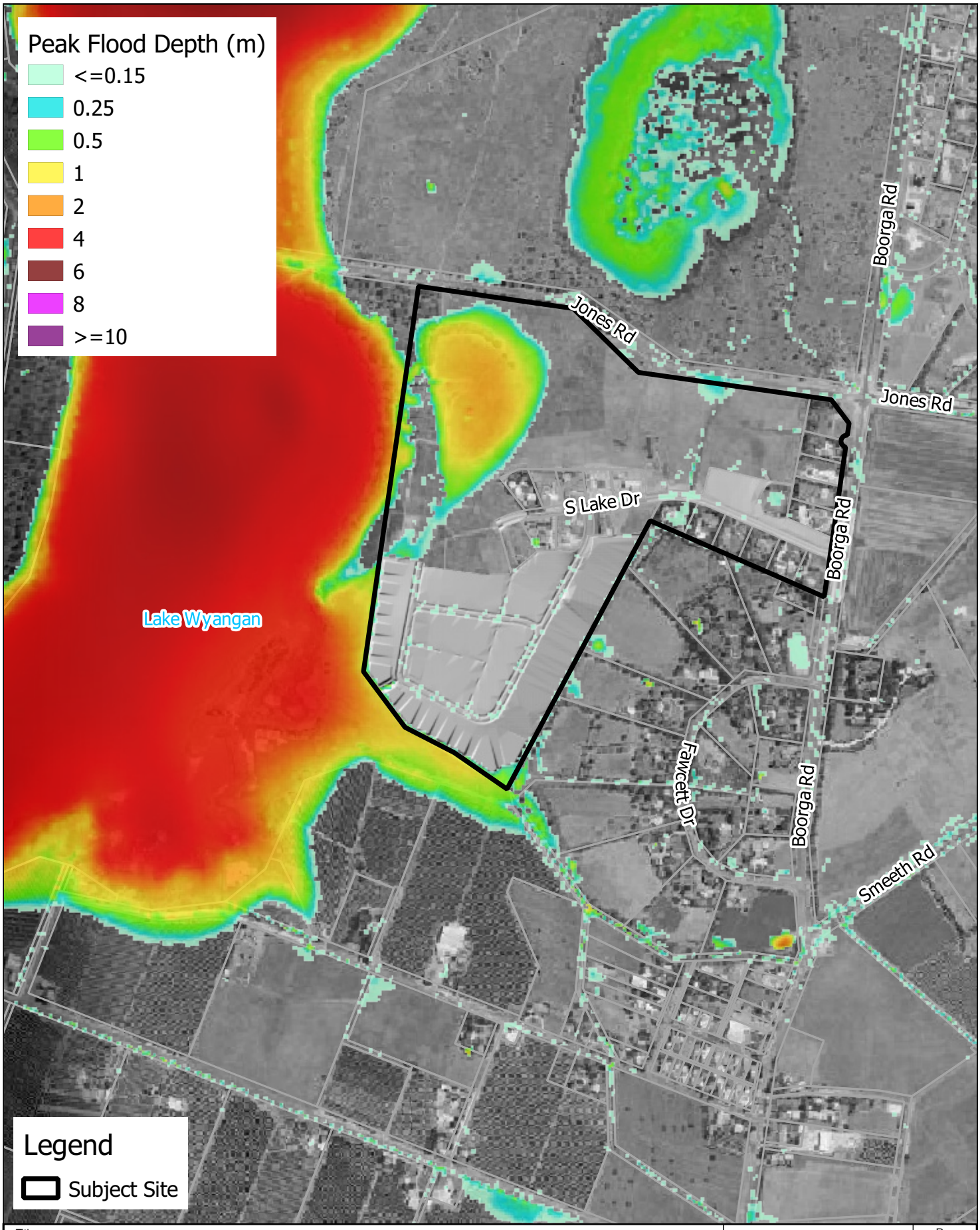

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Peak Flood Depth - Baseline Scenario - 1% AEP Flood

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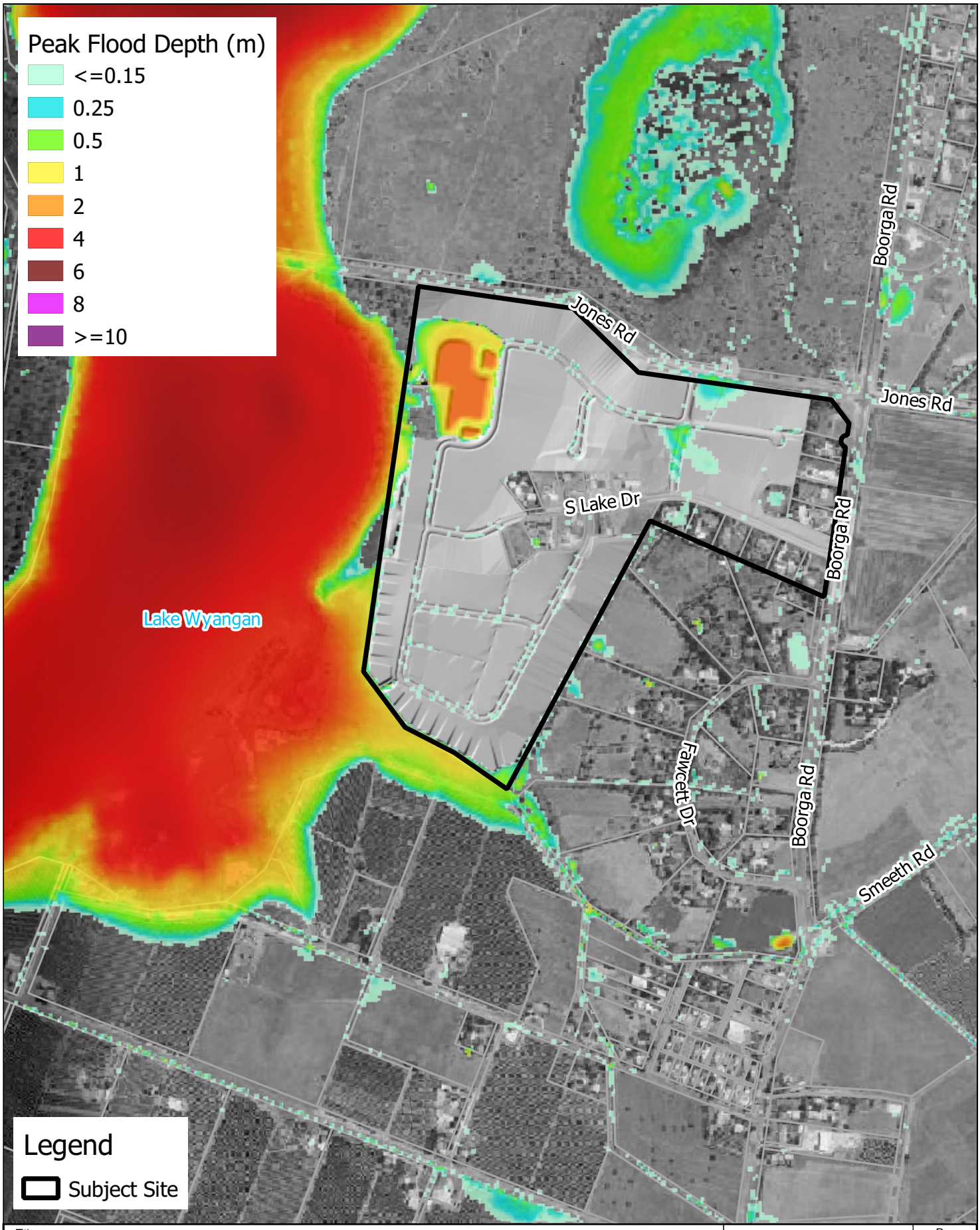

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Peak Flood Depth - Post-development Scenario - 1% AEP Flood

Figure: B-07

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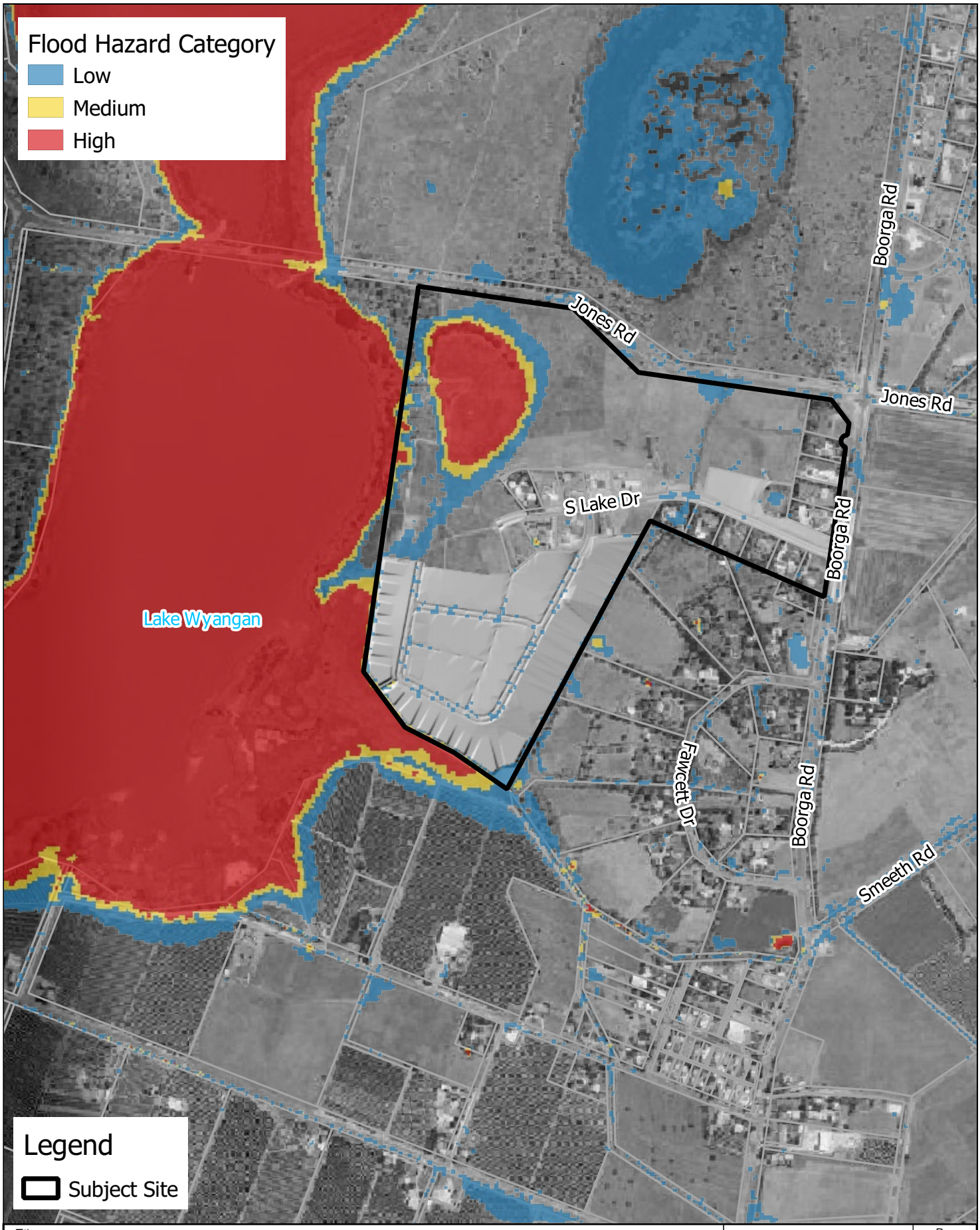

Title:

Peak Flood Hazard - Baseline Scenario - 1% AEP Flood

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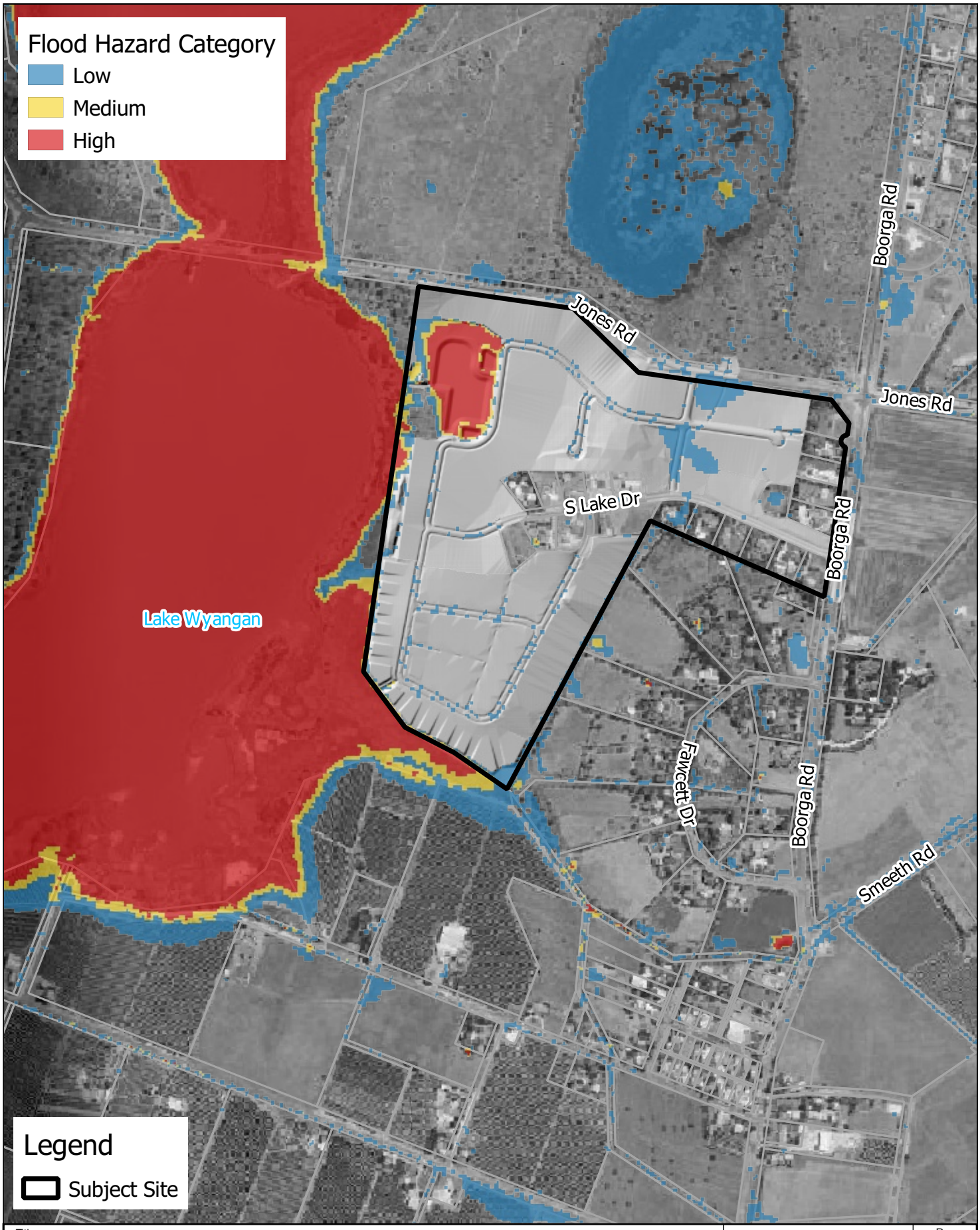

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Figure: B-09

Rev: A

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0 200 400 m

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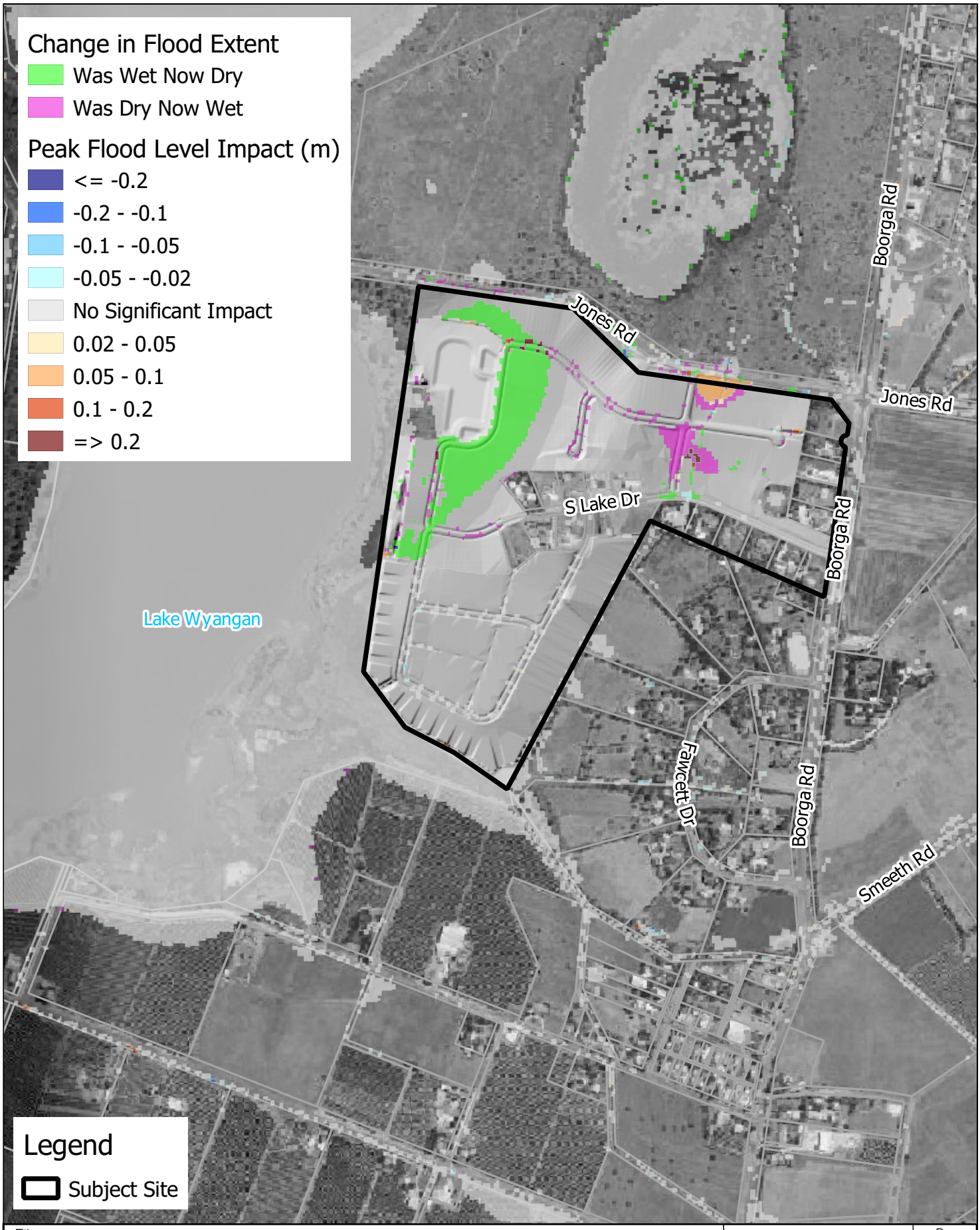

Title:

Change in Peak Flood Level - 1% AEP Flood

Figure: **B-10**

Rev: **A**

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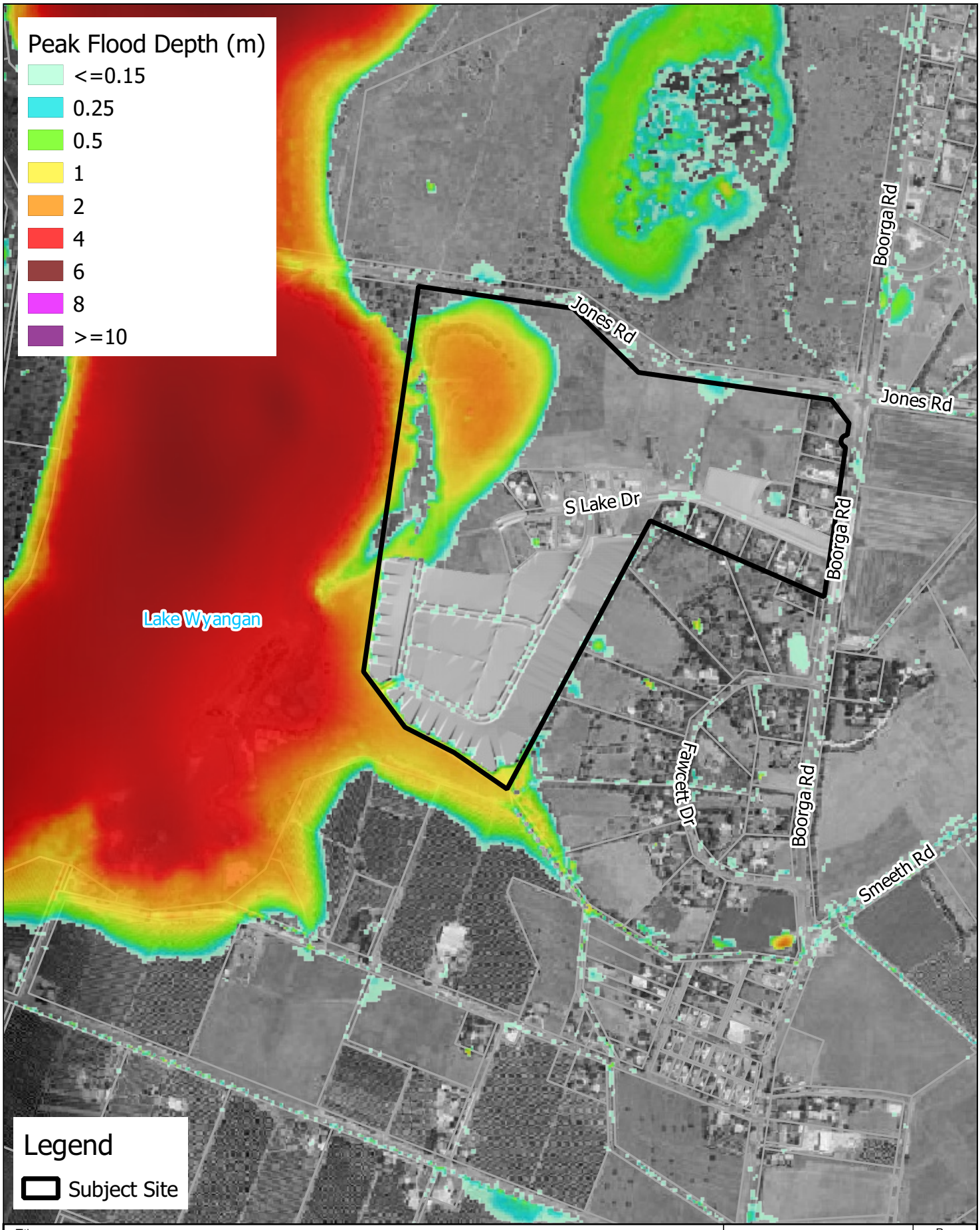

Title:

Peak Flood Depth - Baseline Scenario - 0.5% AEP Flood

Figure: **B-11**

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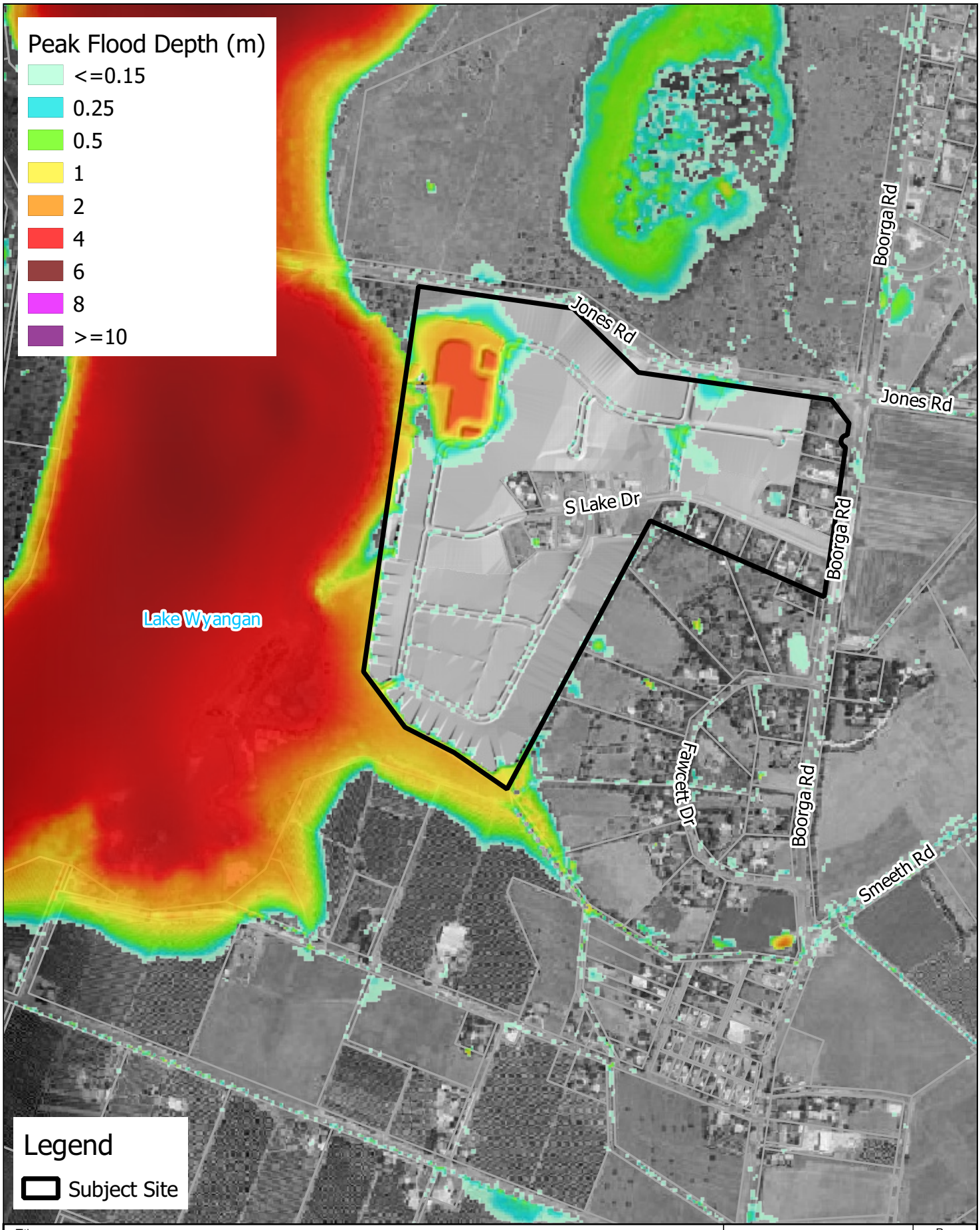

Title:

Peak Flood Depth - Post-development Scenario - 0.5% AEP Flood

Figure: B-12

Rev: A

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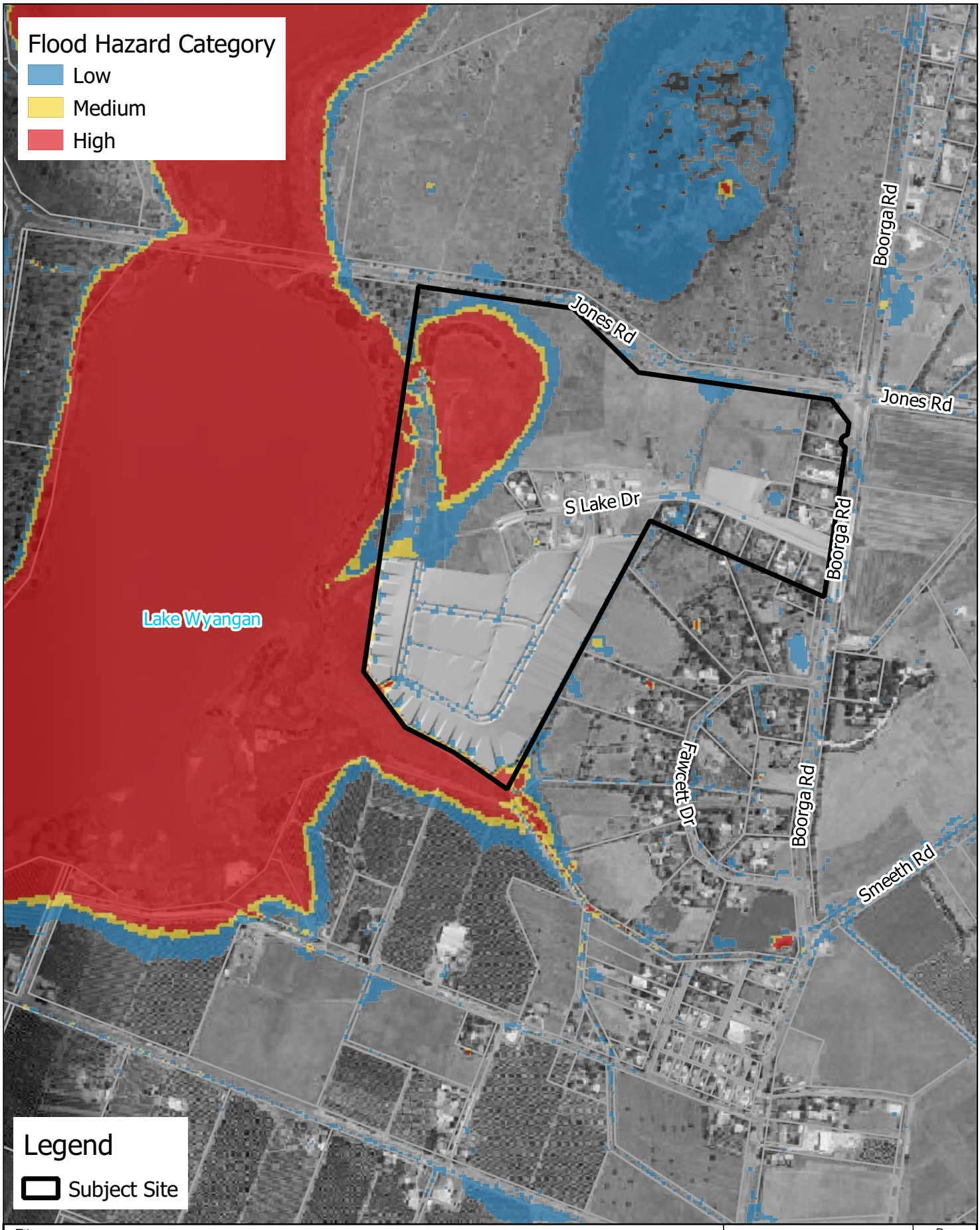

Title:

Peak Flood Hazard - Baseline Scenario - 0.5% AEP Flood

Figure: **B-13**

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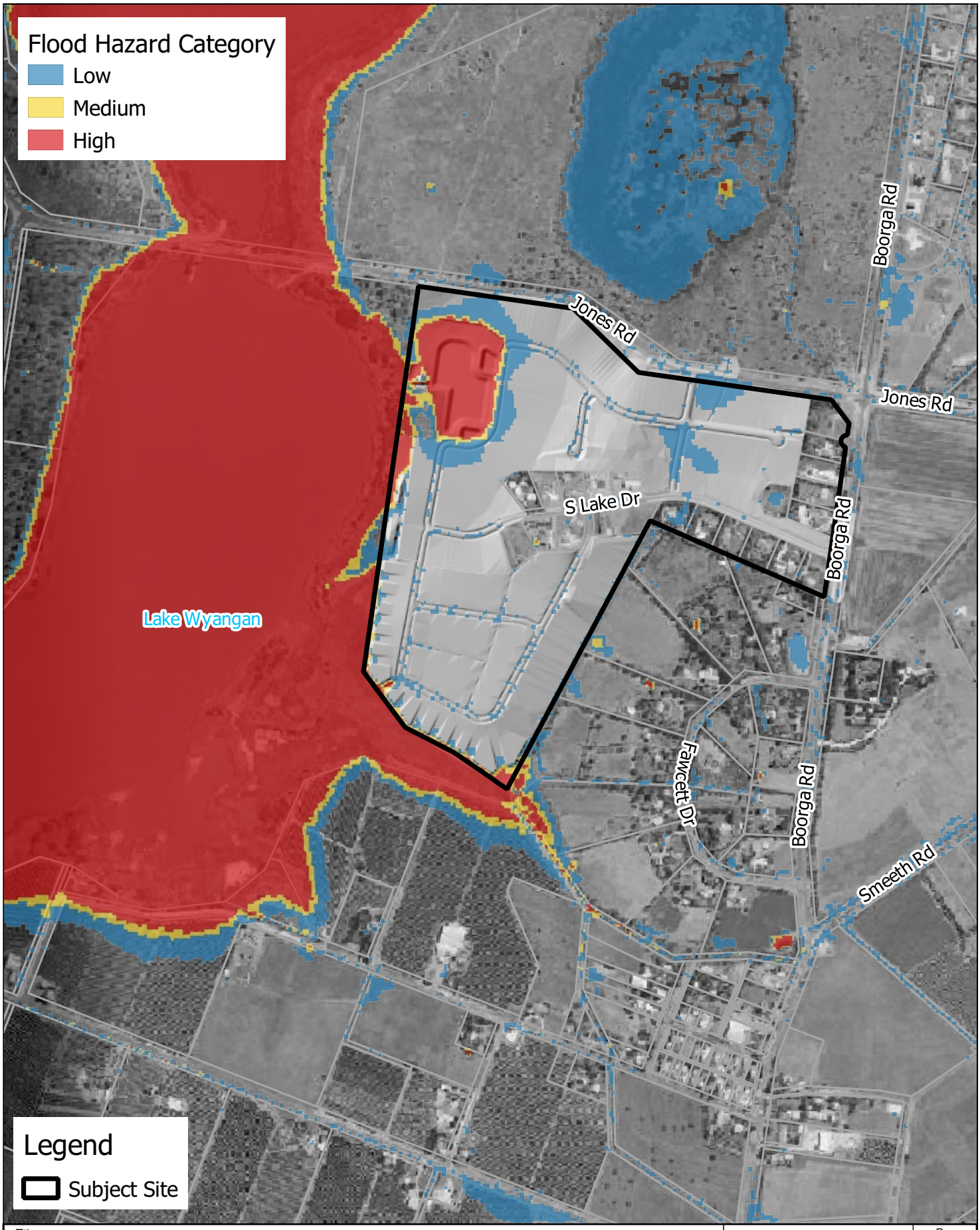

Title:

Peak Flood Hazard - Post-development Scenario - 0.5% AEP Flood

Figure: B-14

Rev: A

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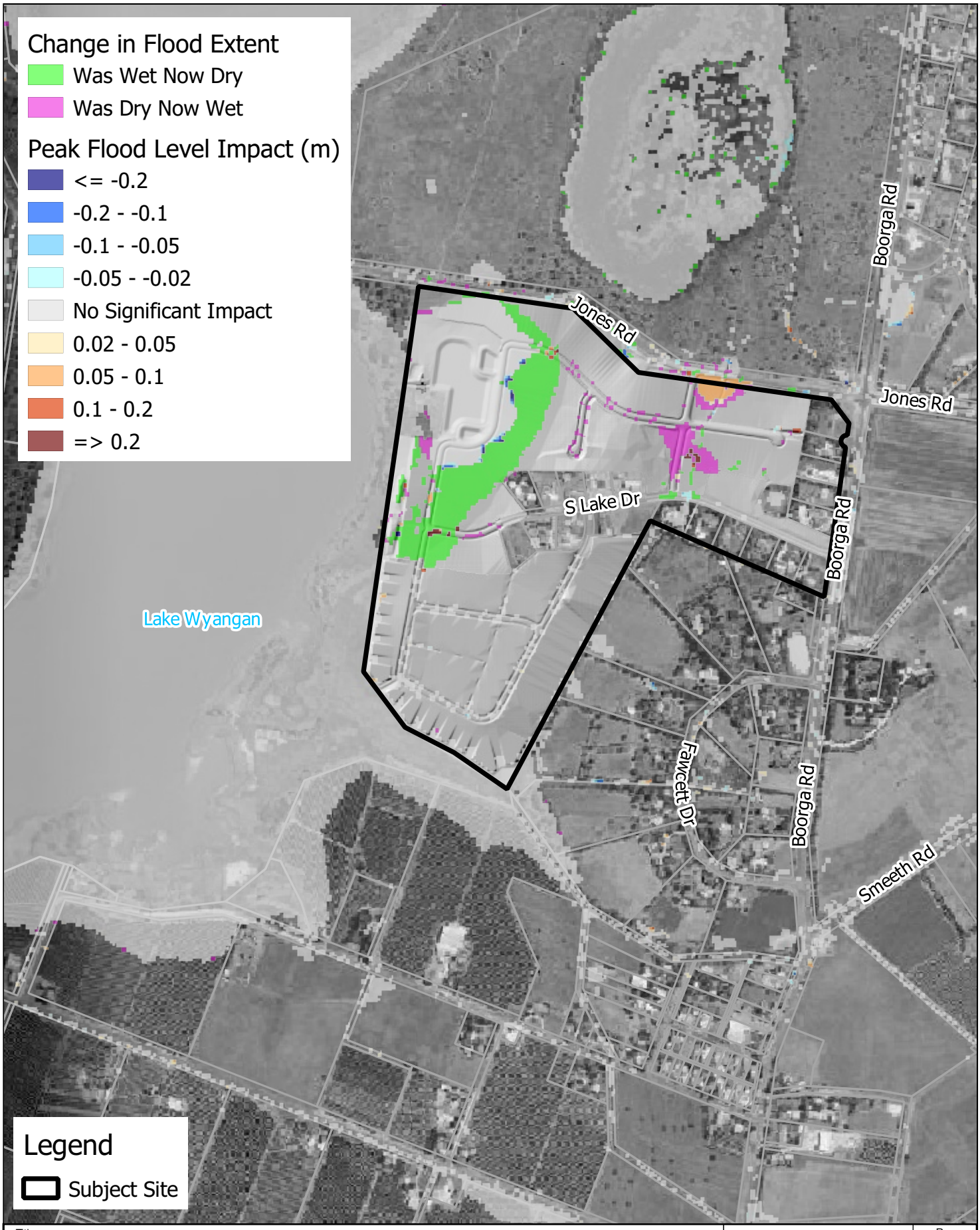

Title:

Change in Peak Flood Level - 0.5% AEP Flood

Figure: B-15

Rev: A

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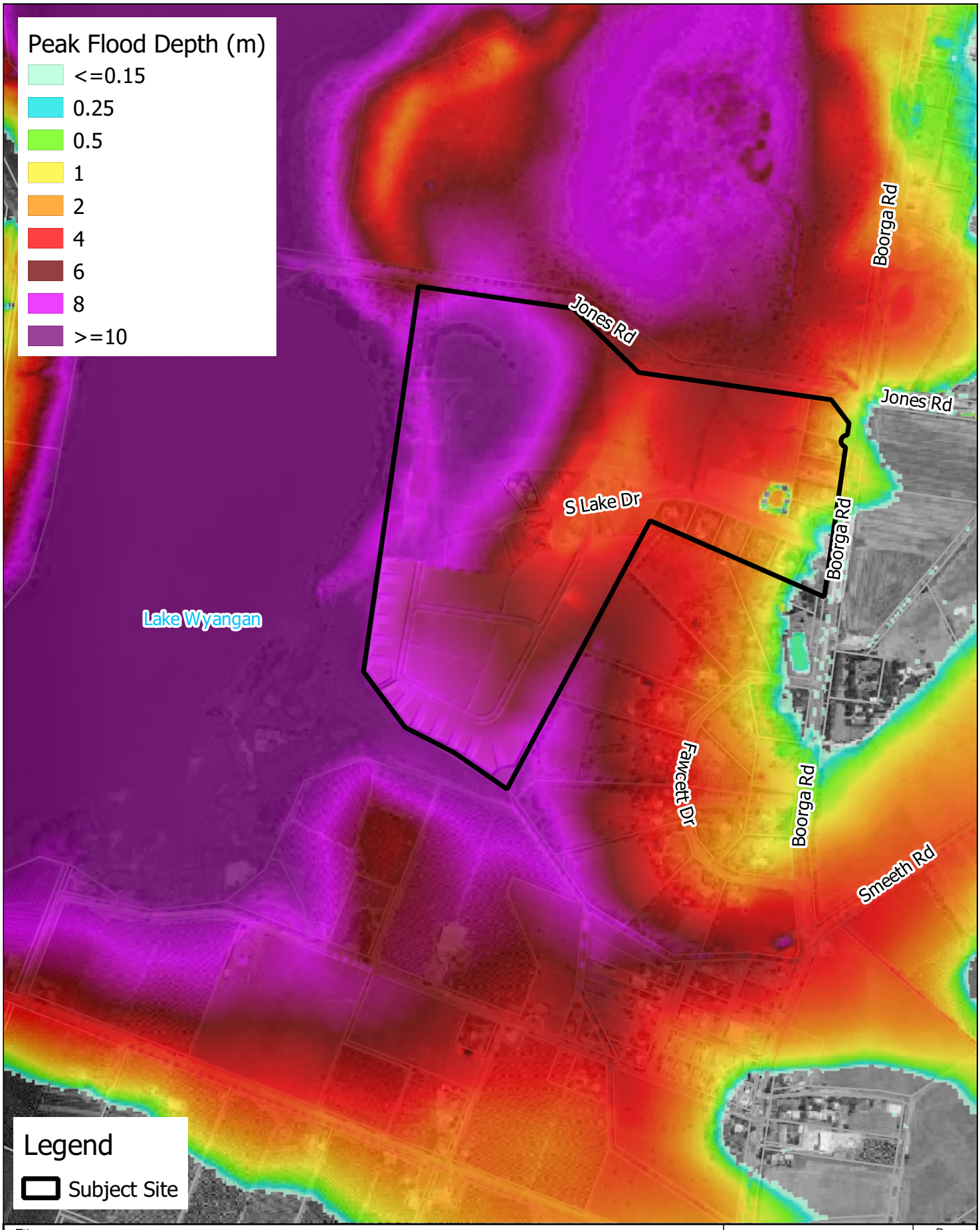

Title:

Peak Flood Depth - Baseline Scenario - PMF

Figure: **B-16**

Rev: **A**

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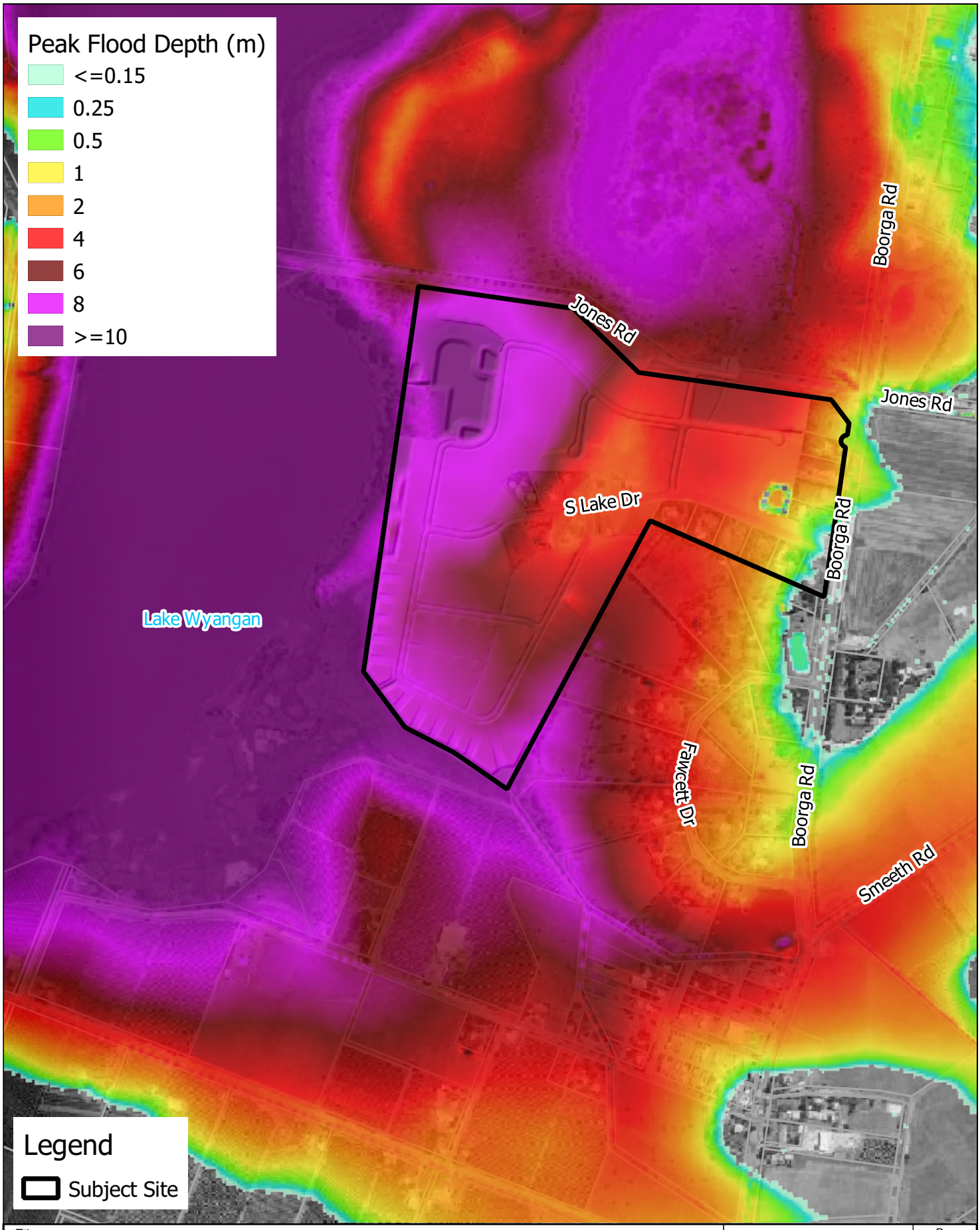

Title:

Peak Flood Depth - Post-development Scenario - PMF

Figure: **B-17**

Rev: **A**

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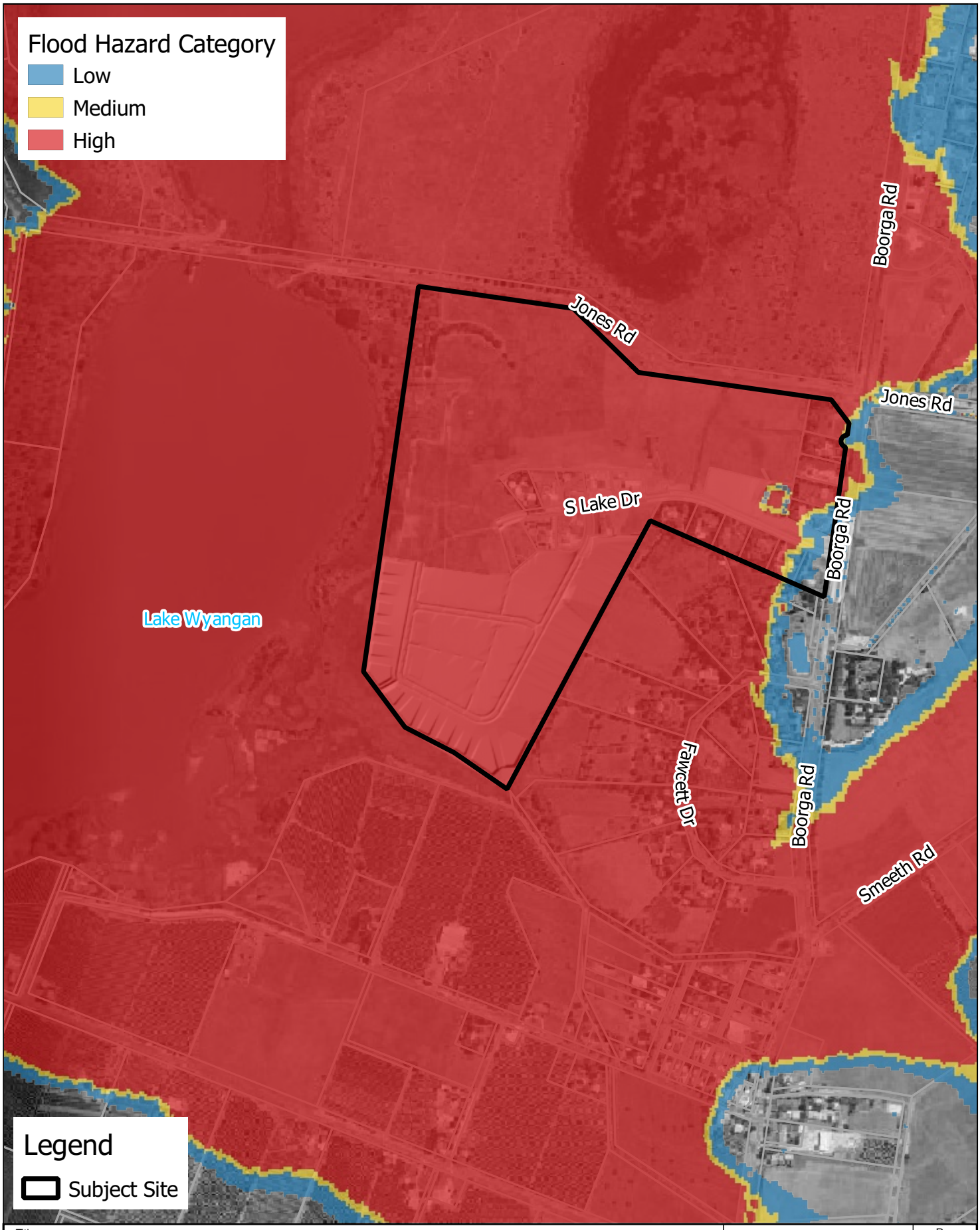

Title:

Peak Flood Hazard - Baseline Scenario - PMF

Figure: **B-18**

Rev: **A**

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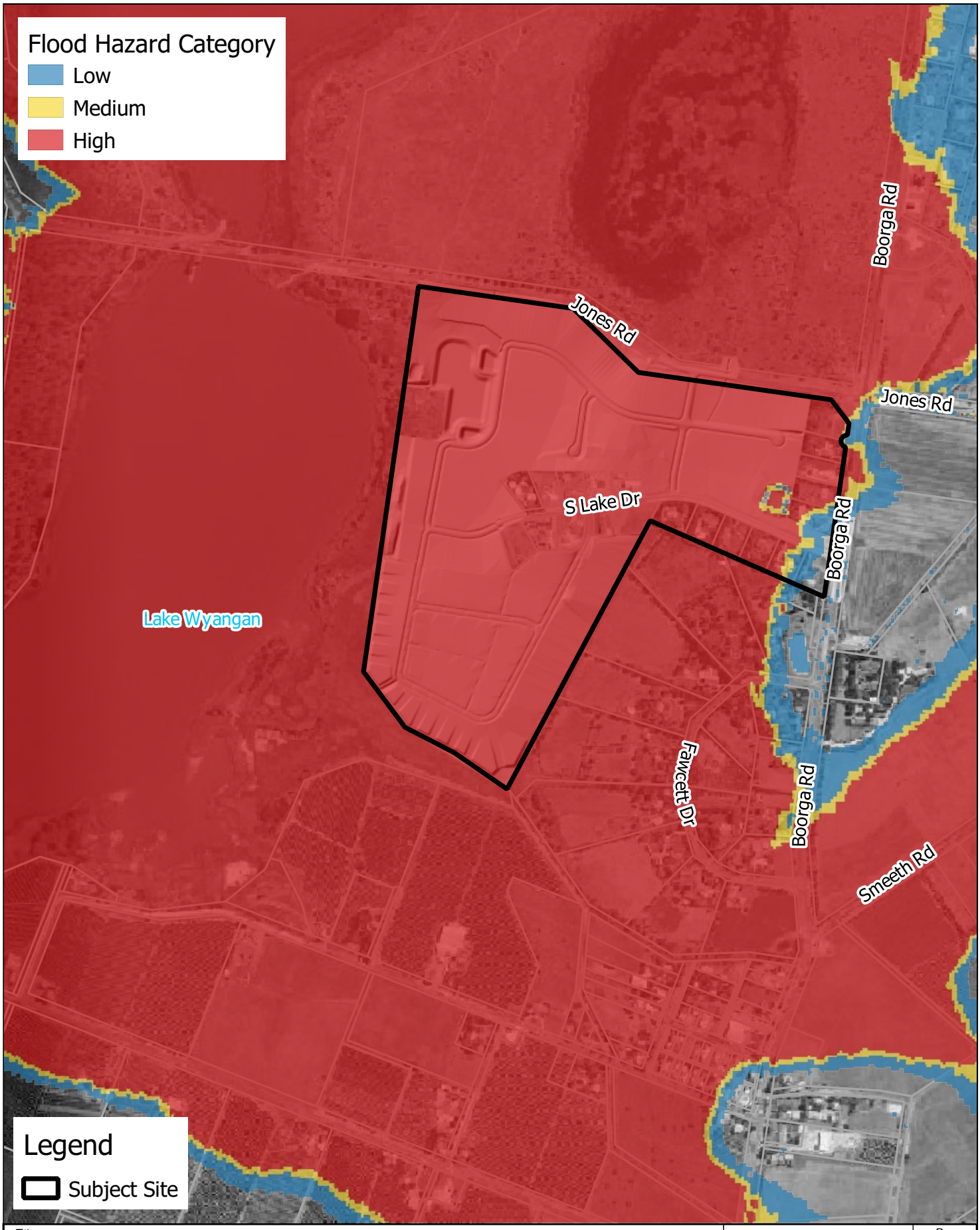

Title:

Peak Flood Hazard - Post-development Scenario - PMF

Figure: **B-19**

Rev: **A**

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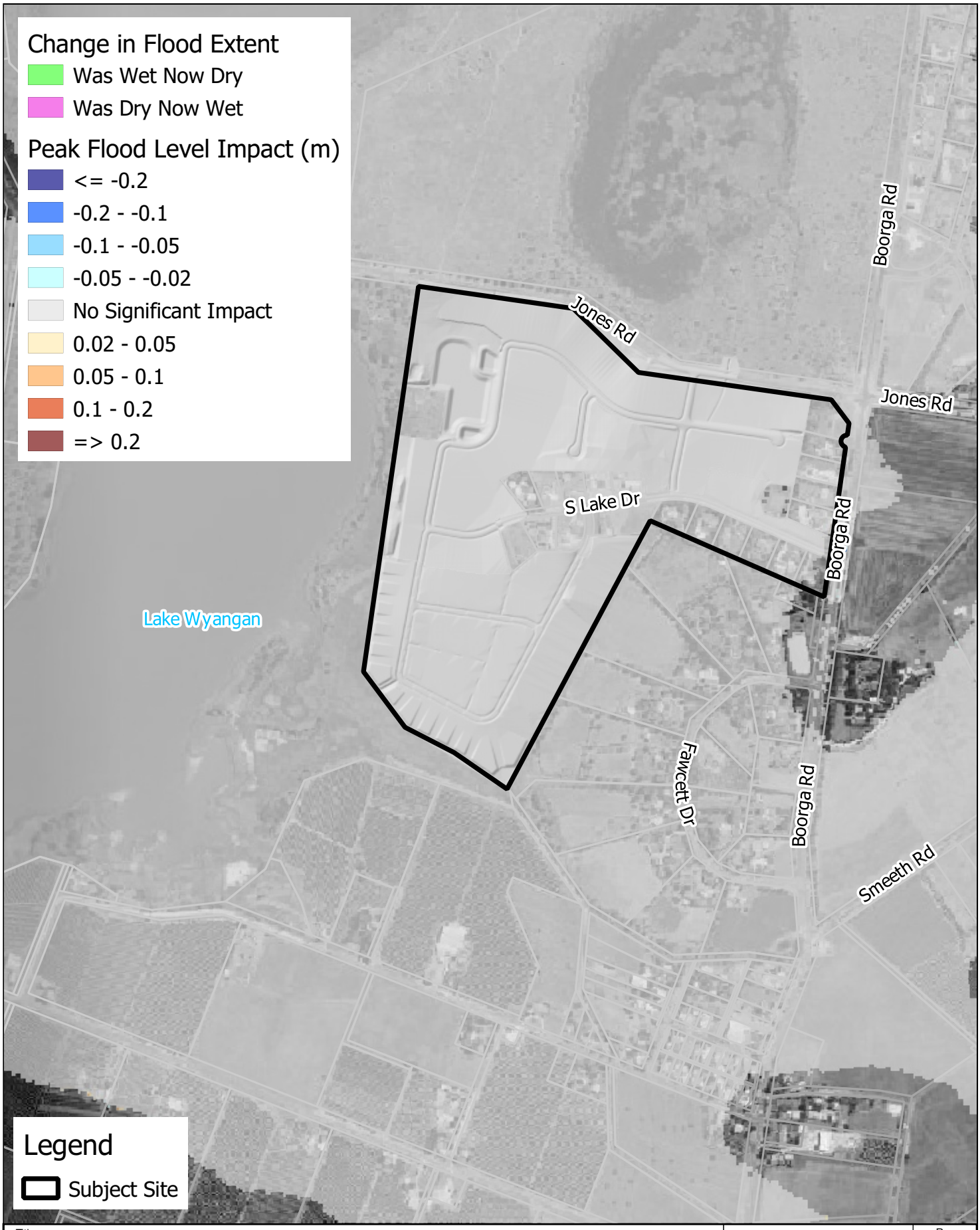

Title:

Change in Peak Flood Level - PMF

Figure: **B-20**

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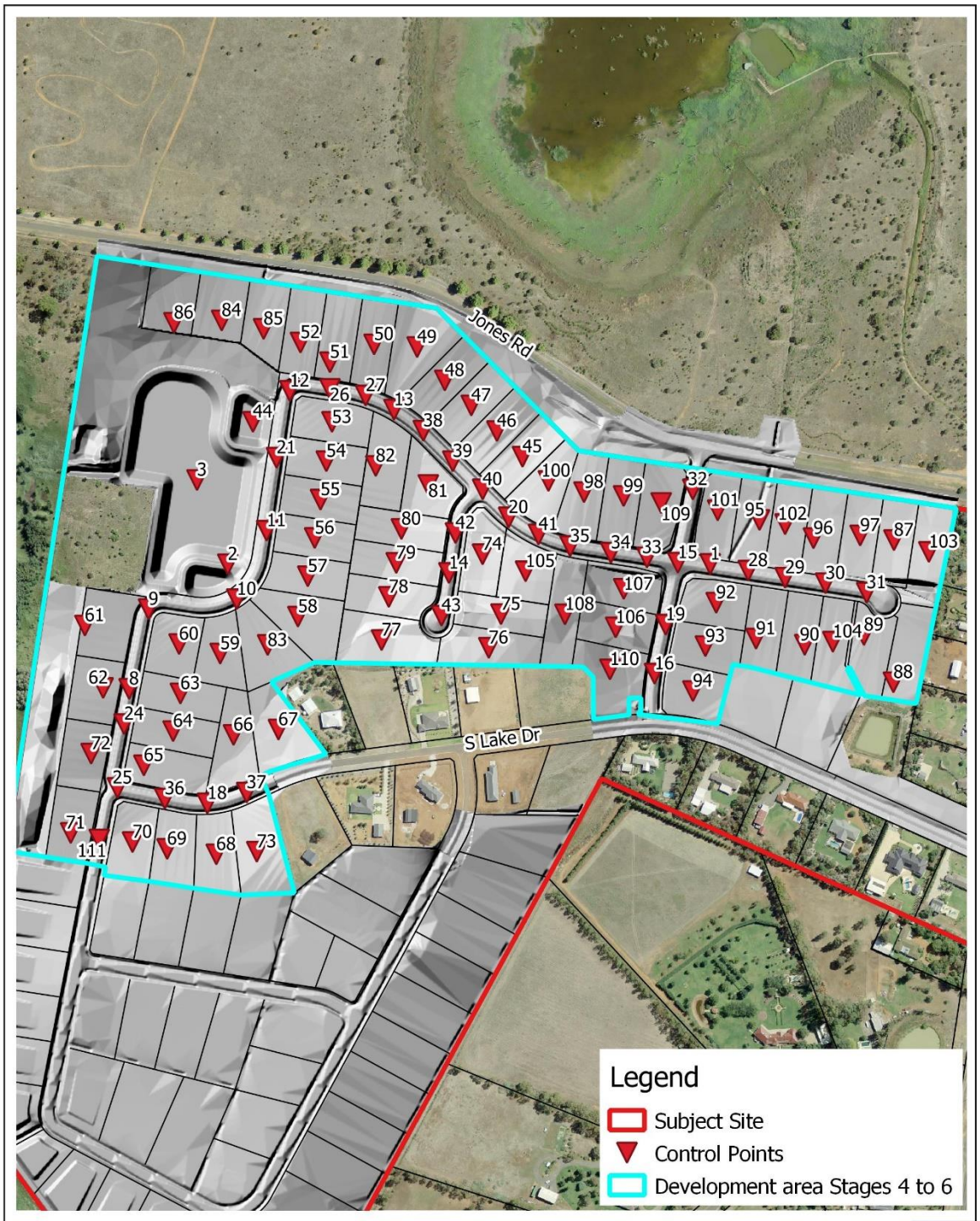
Annex C Design Flood Levels

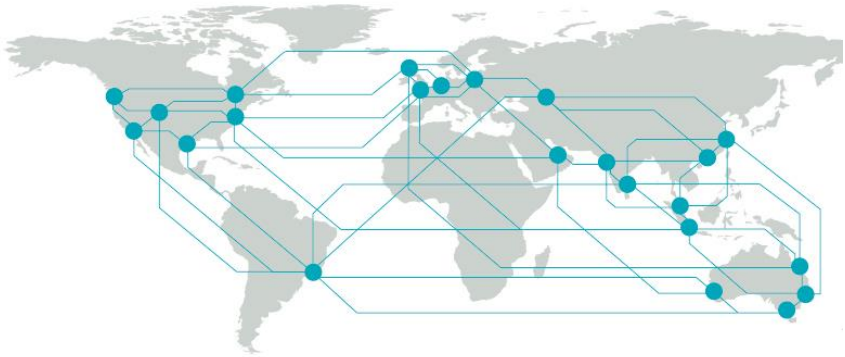


Water Level (m AHD)				
Control Point ID	20 Year	100 Year	200 Year	PMF
1	NF	NF	NF	116.1427
2	NF	107.633	108.138	116.1427
3	106.435	107.633	108.138	116.1427
8	NF	NF	NF	116.1427
9	NF	NF	108.138	116.1427
10	NF	NF	108.135	116.1427
11	NF	NF	108.138	116.1427
12	NF	NF	108.138	116.1427
13	108.321	108.321	108.32	116.1427
14	NF	NF	NF	116.1427
15	111.992	111.992	111.992	116.1427
16	111.992	111.992	111.992	116.1427
18	NF	NF	NF	116.1427
19	111.992	111.992	111.992	116.1427
20	111.309	111.307	111.294	116.1427
21	NF	NF	108.138	116.1427
24	NF	NF	NF	116.1427
25	NF	NF	NF	116.1427
26	107.935	107.935	108.138	116.1427
27	NF	NF	NF	116.1427
28	NF	NF	NF	116.1427
29	NF	NF	NF	116.1427
30	NF	NF	NF	116.1427
31	NF	NF	NF	116.1427
32	NF	NF	NF	116.1427
33	NF	NF	NF	116.1427
34	112.249	112.253	112.255	116.1427
35	NF	NF	NF	116.1427
36	NF	NF	NF	116.1427
37	NF	NF	NF	116.1427
38	NF	NF	NF	116.1427
39	NF	NF	NF	116.1427
40	NF	NF	NF	116.1427
41	NF	NF	NF	116.1427
42	NF	NF	NF	116.1427
43	NF	NF	NF	116.1427
44	106.045	107.633	108.138	116.1427
45	NF	NF	NF	116.1427
46	NF	NF	NF	116.1427
47	NF	NF	NF	116.1427
48	NF	NF	NF	116.1427
49	NF	NF	NF	116.1427
50	NF	NF	NF	116.1427
51	NF	NF	NF	116.1427
52	NF	NF	108.138	116.1427
53	NF	NF	NF	116.1427
54	NF	NF	NF	116.1427

Water Level (m AHD)				
Control Point ID	20 Year	100 Year	200 Year	PMF
55	NF	NF	NF	116.1427
56	NF	NF	NF	116.1427
57	NF	NF	NF	116.1427
58	NF	NF	NF	116.1427
59	NF	NF	NF	116.1427
60	NF	NF	108.137	116.1427
61	NF	NF	NF	116.1427
62	NF	NF	NF	116.1427
63	NF	NF	NF	116.1427
64	NF	NF	NF	116.1427
65	NF	NF	NF	116.1427
66	NF	NF	NF	116.1427
67	NF	NF	NF	116.1427
68	NF	NF	NF	116.1427
69	NF	NF	NF	116.1427
70	NF	NF	NF	116.1427
71	NF	NF	NF	116.1427
72	NF	NF	NF	116.1427
73	NF	NF	NF	116.1427
74	NF	NF	NF	116.1427
75	NF	NF	NF	116.1427
76	NF	NF	NF	116.1427
77	NF	NF	NF	116.1427
78	NF	NF	NF	116.1427
79	NF	NF	NF	116.1427
80	NF	NF	NF	116.1427
81	NF	NF	NF	116.1427
82	NF	NF	NF	116.1427
83	NF	NF	NF	116.1427
84	NF	NF	108.138	116.1427
85	NF	NF	108.138	116.1427
86	NF	NF	108.138	116.1427
87	NF	NF	NF	116.1427
88	NF	NF	NF	116.1427
89	NF	NF	NF	116.1427
90	NF	NF	NF	116.1427
91	NF	NF	NF	116.1427
92	NF	NF	NF	116.1427
93	111.992	111.992	111.992	116.1427
94	NF	NF	NF	116.1427
95	110.941	110.941	110.941	116.1427
96	NF	NF	NF	116.1427
97	NF	NF	NF	116.1427
98	NF	NF	NF	116.1427
99	NF	NF	NF	116.1427
100	NF	NF	NF	116.1427
101	110.941	110.941	110.941	116.1427

Water Level (m AHD)				
Control Point ID	20 Year	100 Year	200 Year	PMF
102	NF	NF	NF	116.1427
103	NF	NF	NF	116.1427
104	NF	NF	NF	116.1427
105	NF	NF	NF	116.1427
106	NF	NF	NF	116.1427
107	111.992	111.992	111.992	116.1427
108	NF	NF	NF	116.1427
109	NF	NF	NF	116.1427
110	NF	NF	NF	116.1427
111	NF	NF	NF	116.1427

Note: "NF" = "Not Flooded"



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