

# Flood Assessment and Stormwater Management Plan

238 Gardner Road, Rochedale

PeakUrban Pty Ltd

16 April 2019





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## EXECUTIVE SUMMARY

Water Technology Pty Ltd (WT) has been commissioned by PEAKURBAN Pty Ltd to investigate stormwater and flood management provisions associated with the proposed development of the property located at 238 Gardner Road, Rochedale Queensland, comprising Lot 8 on RP84459 (referenced as The Site).

This report provides detailed and comprehensive information pertaining to the proposed flood and stormwater management strategies for the proposed development to support the applications over the site. Additionally, a detailed response has been provided addressing matters raised by Council in respect to flooding and stormwater advice received during a pre-lodgement meeting with Council was held on 14 March 2019.

The contents of this report and major findings of the assessment undertaken are summarised as follows: -

- This report has been prepared to demonstrate compliance with the Stormwater and Infrastructure Design Codes.
- Detailed hydrological and hydraulic models were developed for the site and surrounding catchment as described herein.
- The proposed development does not result in adverse flooding impacts external to the site across all standard design events simulated.
- Detailed hydrological and hydraulic analyses support a no detention strategy for the site.
- The results demonstrate that the development footprint is located entirely outside of the worst case 1% AEP regional flood extents, therefore, minimum floor levels can be readily achieved.
- No filling is proposed within the waterway corridor.
- No drainage infrastructure is proposed within the central waterway. The capacity of the waterway corridor is such that future upstream development can be readily accommodated.
- Tree pits are proposed for stormwater treatment at a rate of 1 tree pit per 2 lots, for a total of 8 tree pits. This achieves significant reductions in pollutant loads, however, do not specifically achieve the required pollutant reduction targets. Revegetation of the waterway corridor within the site is proposed as a performance-based outcome. We acknowledge that Council has suggested removal of bioretention basins and utilisation of revegetation as a performance-based outcome for other developments in the vicinity. Details are contained in Section 5 of this report.
- A response to each item raised by Council in the context of flooding and stormwater management has been provided herein.

The flood and stormwater management strategies outlined and presented in this report adequately demonstrate that the development application proposed for the site can be supported. Accordingly, we believe that the development can be supported by BCC subject to reasonable and relevant approval conditions.



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# 1 INTRODUCTION

## 1.1 Purpose and Intent

Water Technology Pty Ltd (WT) has been commissioned by PEAKURBAN Pty Ltd to investigate stormwater and flood management provisions associated with the proposed development of the property located at 238 Gardner Road, Rochedale Queensland, comprising Lot 8 on RP84459 (referenced herein as The Site). The site is located within the Brisbane City Council (BCC) Local Government Area.

A pre-lodgement meeting with Council was held on 14 March 2019. Based on an extract of the minutes provided, the following matters relating to flooding and stormwater were raised: -

- A Lawful Point of Discharge (LPD) is to be demonstrated in accordance with the City Plan 2014, Infrastructure Design Planning Scheme Policy (ID PSP), Section 7.6.
- A hydraulic report prepared by an RPEQ will be required to demonstrate compliance with the outcomes within this Code. The report is to be prepared in accordance with the ID PSP Section 1.
- The proposal is a high-risk site from a water quality perspective. For any subsequent development application, it is necessary to address Section B of the Stormwater Code and prepare a Site Based Stormwater Quality Management Plan in accordance with the Infrastructure Design Code and associated Infrastructure Design Planning Scheme Policy, Section 7.
- The proposed location of the bioretention basins is acceptable (within the fringe area of the waterway). However, the applicant may wish to explore the option of providing rehabilitation in lieu of bioretention subject to demonstrating Water Quality requirements. If bioretention basins are proposed, it is also necessary to consider fire separation requirements to adjacent proposed lots.
- The development is to provide for the orderly development of stormwater infrastructure by providing a drainage connection for the upstream catchment, sized for ultimate catchment conditions.
- Erosion and Sediment control: An erosion and Hazard Assessment Form is required to be lodged with any development application that will results in soil disturbing activity.

This current report has therefore been prepared to detail the technical assessments completed in respect to flooding and stormwater management at the site based on the layouts provided. The report has also been prepared to specifically address the matters raised by Council during pre-lodgement as it relates to stormwater and flooding, and provides detailed and comprehensive information pertaining to the flood and stormwater management strategies proposed at the site.

## 1.2 Site Locality and Description

The subject site is illustrated in Figure 1-1. The site includes two (2) individual land parcels comprising Lot 8 on RP84459, and is approximately 1.3 hectares in total site area. Under the City Plan 2014, both lots are zoned as Emerging Community. The site currently contains one (1) residence and one (1) shed, and is largely cleared of vegetation.

An unnamed watercourse intersects the site and flows in a northerly direction. Elevations at the site range from 56.4 m AHD on the eastern boundary of the site down to 42.4 m AHD in the unnamed watercourse. Run-off from the catchment ultimately flows to Bulimba Creek.

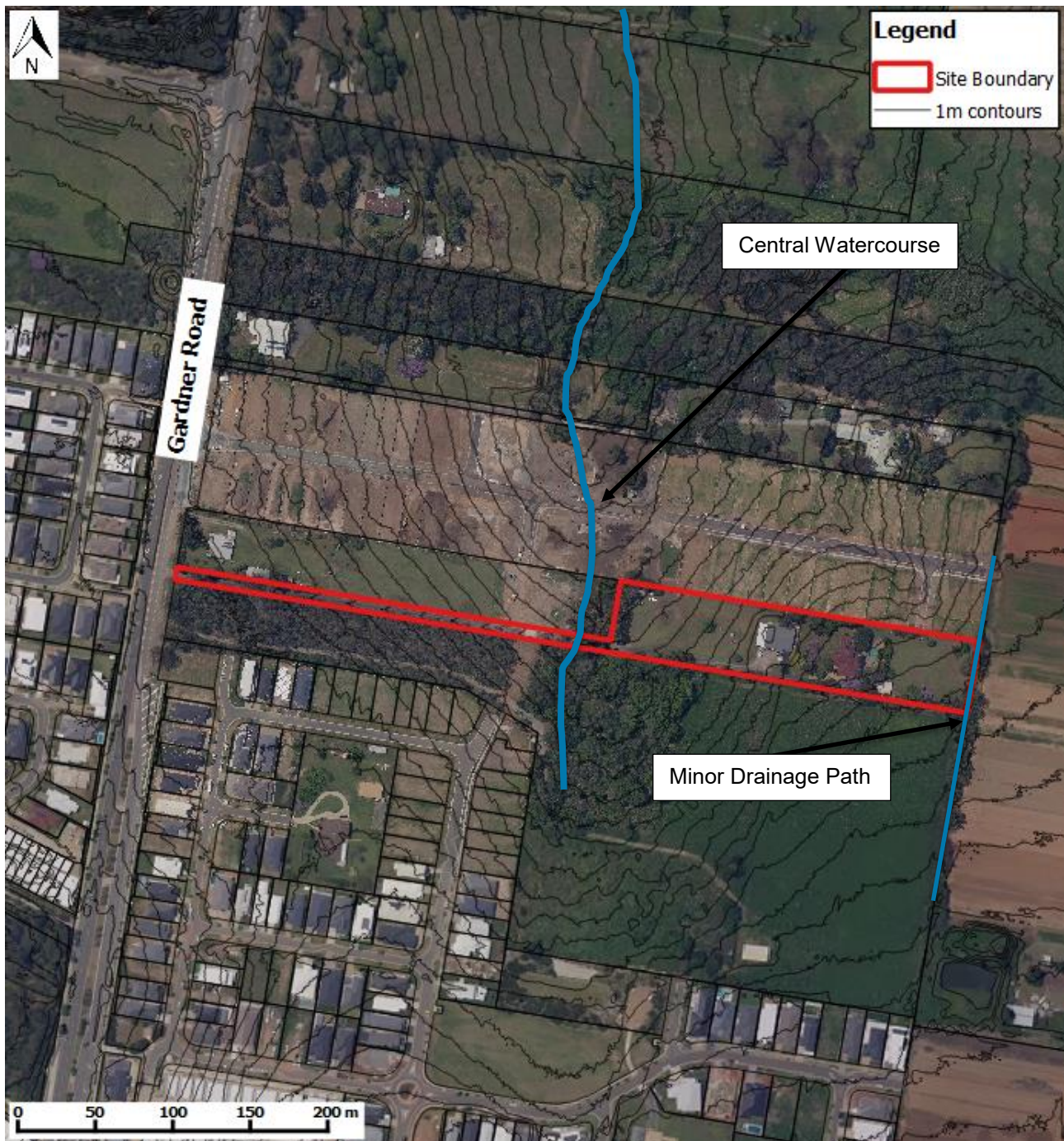


FIGURE 1-1 SITE LOCALITY (AERIAL IMAGE SOURCE: SPOOKFISH, 2019)

### 1.3 Proposed Development

The development proposes a residential aged care facility, serviced apartments, duplex and triplex dwellings, community facilities and associated green space, internal road system and landscaping and drainage. The development will include all associated roads, servicing and related infrastructure provisions necessary to support the intended development outcome. The proposed development layout is illustrated in Figure 1-2 and is additionally also included in Appendix A.

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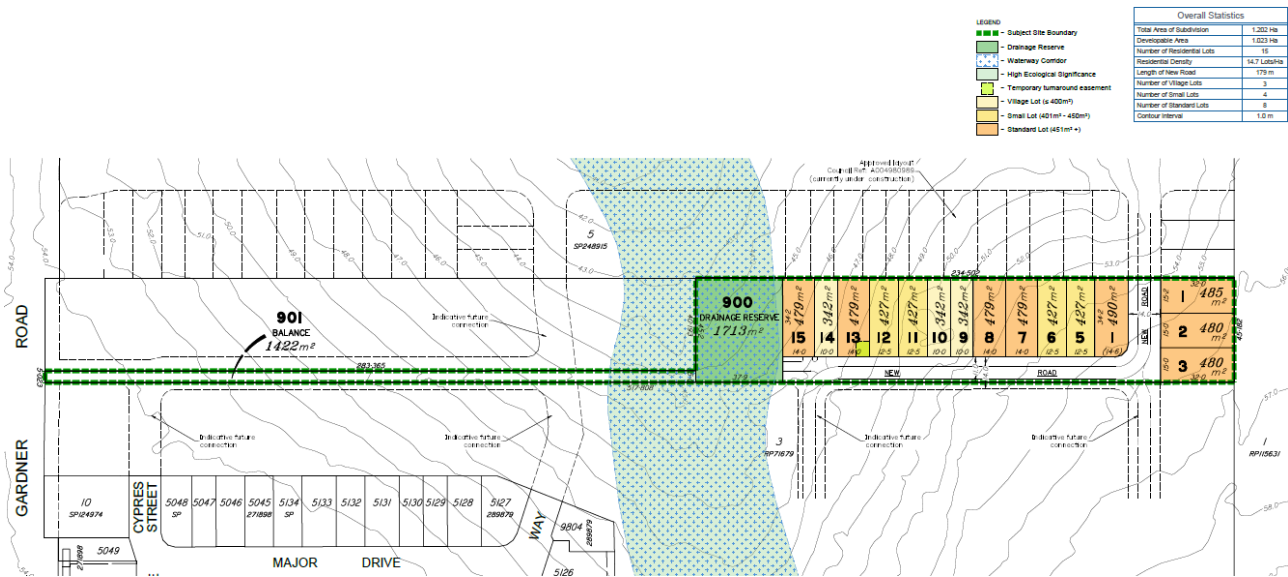


FIGURE 1-2 PROPOSED DEVELOPMENT LAYOUT (SOURCE – DTS QLD)

## 1.4 Relevant Planning Scheme and Overlays

Based on the current City Plan 2014, the site is currently zoned for Emerging Community as illustrated in Figure 1-3. The overland flow path mapping is also shown in Figure 1-3. The mapped overland flow path mostly affects the central corridor of the site and is associated with the drainage path and external catchment which extends to the south of the site. A flow path associated with a minor external catchment traverses the eastern site boundary and is largely associated with a neighbouring farm drain. Flow from this minor external catchment can be readily addressed as part of the civil design and is assessed separately to this report. The central flow path will however be subject to assessment in this report.

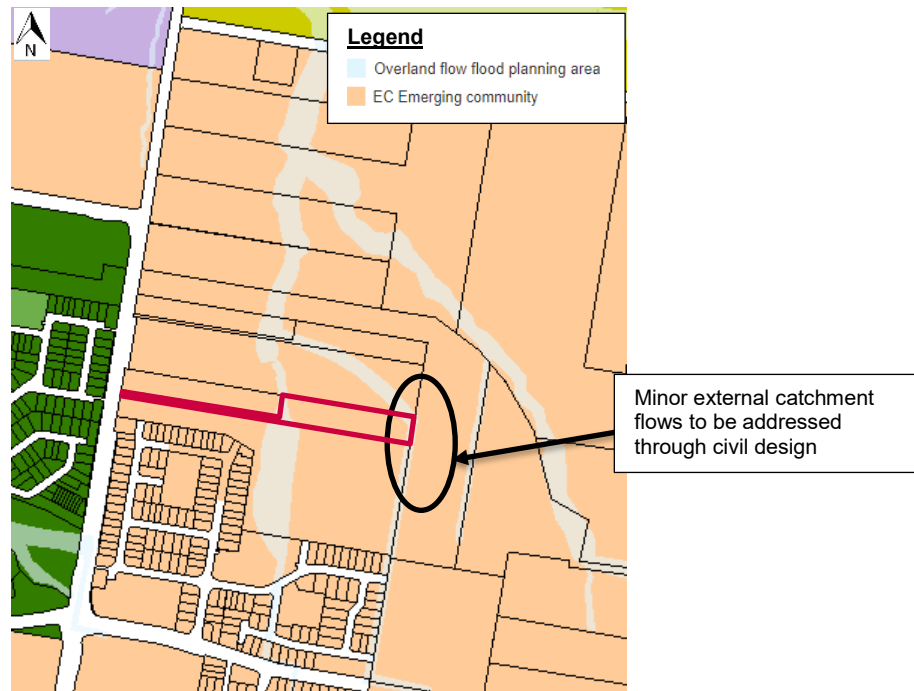


FIGURE 1-3 PLANNING SCHEME (SOURCE: CITY PLAN 2014)

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## 1.5 Available Data

The following data has been sourced and used in this assessment: -

- LiDAR and associated contours - SE Queensland 2014 Project. Spatial Accuracy: Vertical Data:0.3m @ 95% (68% confidence level or 1 sigma), Horizontal Data:0.8m @ 95% (68% confidence level or 1 sigma);
- City Plan 2014 online mapping system;
- Aerial imagery obtained from Spookfish and Google Earth 2019;
- General information and imagery obtained from Queensland Globe 2019;
- Proposed lot layout provided by DTS Qld;
- Rainfall data obtained from the Bureau of Meteorology and ARR Datahub;
- Site photos taken 29 March 2019; and
- Application documents for neighbouring developments, including specifically: -
  - Rochedale Estates Stage 5 – Stormwater Management Plan, prepared by Bradlees, dated January 2015 (Approved 30/06/2015); and
  - Rochedale Estates Stage 6 – Stormwater Management Plan – Revision C, prepared by Bradlees, dated September 2016, BCC Ref No. A004685594, approved 23/03/2017.

Relevant extracts from the above neighbouring development applications within the context of this current investigation have been included in Appendix B, including the development layouts for the upstream and downstream development estates, along with approved earthworks drawings for the downstream estate (Rochedale Estates Stage 6).



## 2 SITE CHARACTERISTICS

### 2.1 Topography and Drainage

Figure 2-1 illustrates the topography at the site and immediate localities based on the 2014 1m LiDAR topographic survey. The site is bound to the north by existing development which has since occurred post the LiDAR capture date. Consequently, it does not represent the topography immediately north of the site. Rather, levels for the waterway, internal road crossing and culverts were obtained from the approved Operational Works drawings (refer Appendix B).

Presently, the neighbouring properties to the immediate south and east are unimproved, used for seasonal horticulture and contain several distinct fields and small farm drains. Further to the south is an existing development estate, which forms part of the upstream catchment for the central waterway that traverses the site.

The elevation of the site ranges from approximately 42 m AHD in the central watercourse to approximately 56 m AHD in the east.

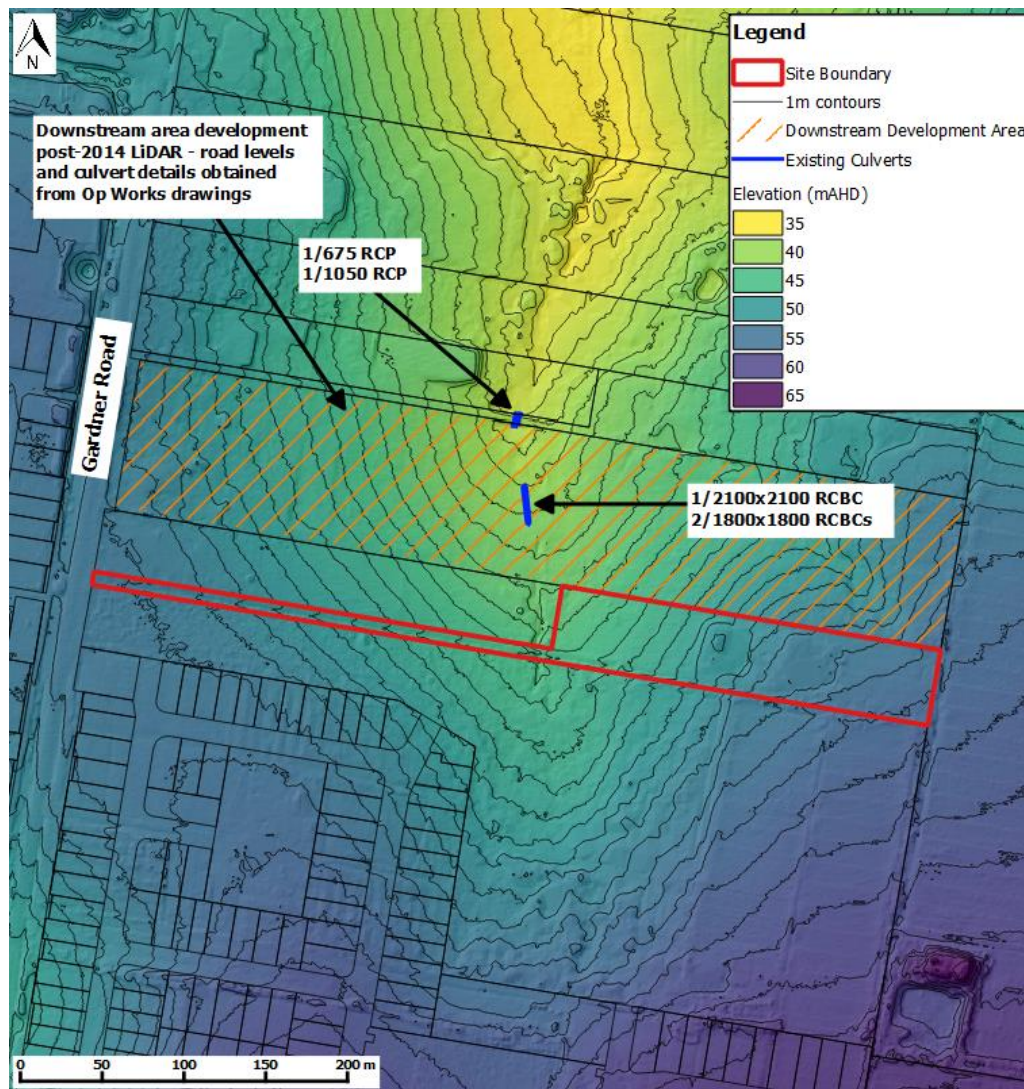


FIGURE 2-1 SITE TOPOGRAPHY AND DRAINAGE

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## 2.2 Site Photos

A site visit was undertaken by Water Technology to develop a greater understanding of the drainage characteristics of the site and surrounding area. Observations during the inspection have been used to inform the development of the site-specific flood model prepared as part of this study. A selection of site photos captured in and around the site in March 2019 are illustrated in Figure 2-2 below.





**Downstream Development Culverts**



**Downstream Development Internal Road**

**FIGURE 2-2 SELECTED SITE PHOTOS (SOURCE – WT, 29/03/2019)**





## 3 HYDROLOGIC MODELLING

### 3.1 Overview

A WBNM hydrologic model has been developed as part of this investigation to inform the flood and stormwater assessment. Hydrology for the 63%, 10%, 2% and 1% Annual Exceedance Probability (AEP) flood events has been derived for the catchment. Flows have been validated against the Rational Method. The WBNM hydrology has been incorporated into the 1D/2D hydraulic model (TUFLOW) which is documented separately in Section 4 of this report.

The WBNM model has been used to assess hydrology at the site for a total of three (3) different scenarios as follows: -

- Existing Case – representing the existing catchment according to current land-use conditions.
- Developed Case – as per the Existing Case but with the proposed development included as an increase in impervious percentage.
- Design Planning Level Immunity Case – assumes an ultimate upstream catchment land use condition based on Council's land-use zoning, with the proposed development included and with consideration of increase in rainfall intensity owing to climate change conditions. This case has been incorporated into the hydraulic model for determining minimum design planning levels at the site and subsequently floor level control which is discussed separately in Section 4.

### 3.2 Existing Case

Existing case catchment boundaries were delineated based on the available LiDAR and modified to incorporate all neighbouring constructed and “as-approved” developments occurring after 2014 and for which are not reflected in the LiDAR data. Extracts of the relevant stormwater management plans for the associated neighbouring developments and approvals are included in Appendix B.

The existing case catchment boundaries are illustrated in Figure 3-1. The catchment and routing parameters for the existing case are provided in Appendix C.

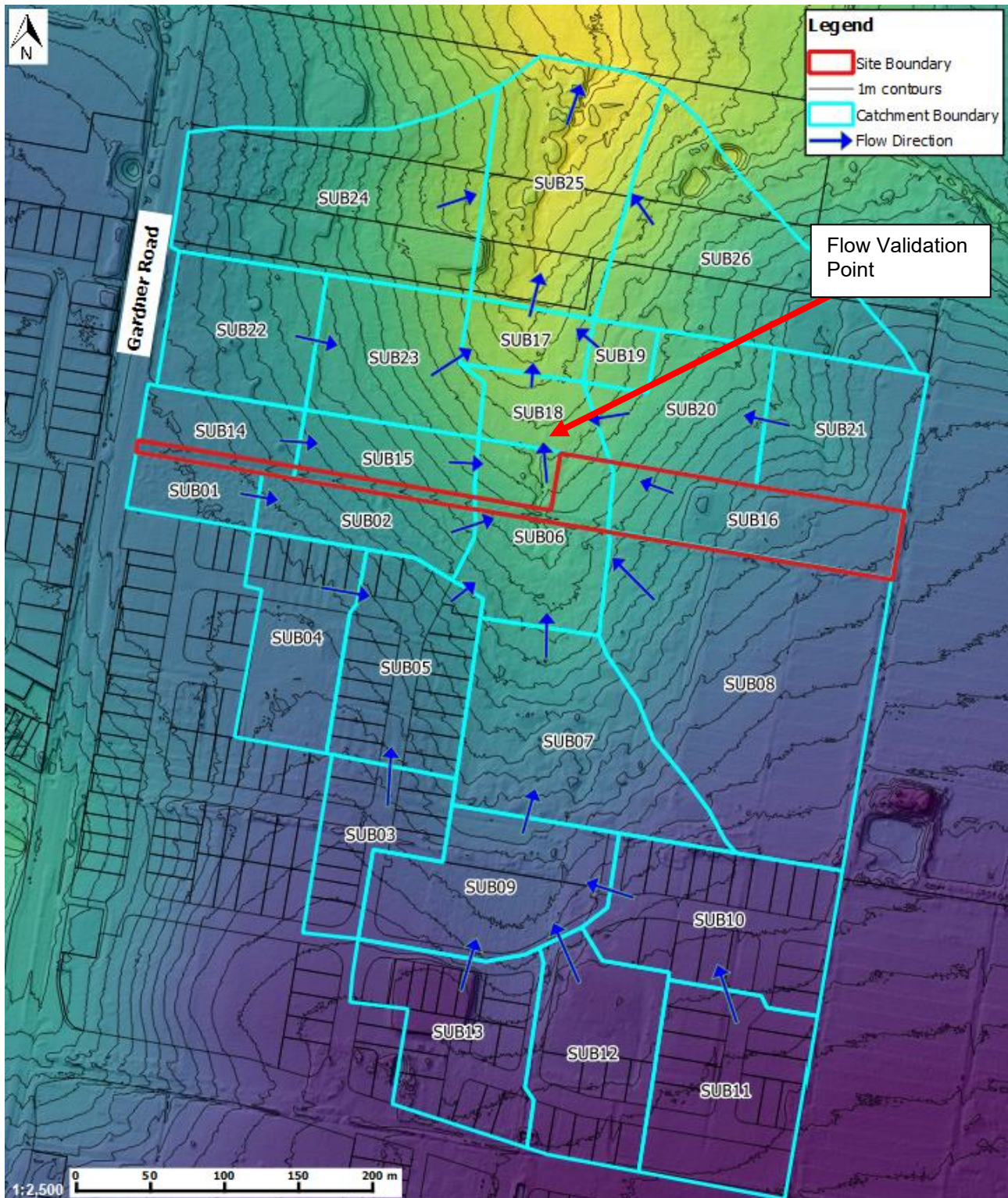


FIGURE 3-1 WBNM SUB-CATCHMENTS – EXISTING CASE

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### 3.2.1 Rainfall

Rainfall Intensity Frequency and Duration values (ARR87 IFDs) were obtained from the Bureau of Meteorology website and are presented in Table 3-1. The standard temporal patterns for Zone 3 (North-East Coast Division) were applied in the WBNM model.

**TABLE 3-1 RAINFALL IFD PARAMETERS**

Location	2Y 1hr (mm)	2Y 12hr (mm)	2Y 72hr (mm)	50Y 1hr (mm)	50Y 12hr (mm)	50Y 72hr (mm)	F2	F50	Skew
Rosedale	48.19	9.12	2.99	89.38	18.37	6.49	4.40	17.24	0.11

### 3.2.2 Losses

Standard design loss rates contained in Table 3-2 were applied to the catchment model. The assumed losses were found to result in flows which could be validated as described and outlined in the following sections of this report and were therefore deemed to be appropriate on this basis.

**TABLE 3-2 ASSUMED LOSSES**

Design Event (AEP)	Pervious Initial Loss (mm)	Continuing Losses (mm/hr)	Impervious Initial Loss (mm)
1%, 2%, 10%, 39%	5.0	1.0	0

## 3.3 Model Validation

In the absence of stream gauges within the catchment areas, the Rational Method was used for model validation to predict existing case flows for the catchment. The validation point chosen is located downstream of the site and corresponds to the downstream end of sub-catchment 6 ("SUB06") as is illustrated in Figure 3-1 previously.

The time of concentration for the catchment has been calculated based on an assumed average stream velocity of 0.9 m/s, which was found to be consistent with hydraulic modelling results. The  $C_{10}$  values obtained from QUDM (Fourth Ed. 2016) have been based on the fraction impervious determined from aerial imagery and subsequently used in the WBNM model. The Rational Method parameters used for validation purposes are summarised in Table 3-3. A comparison of peak flow estimates for each standard design event analysed is presented in Table 3-4.

**TABLE 3-3 RATIONAL METHOD PARAMETERS**

Parameter	Value
Area (ha)	18
Impervious Fraction (%)	30
$C_{10}$	0.74
Flowpath Length (km)	0.63
Assumed Average Stream Velocity (m/s)	0.9
Time of Concentration (mins)	17

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**TABLE 3-4 MODEL VALIDATION DISCHARGE COMPARISON (EXISTING CASE)**

Design Event	Rational Method (m <sup>3</sup> /s)	WBNM (m <sup>3</sup> /s)	Difference (%)
39% AEP (1 in 2yr)	2.91	3.61	+24
10% AEP (1 in 10yr)	4.81	5.53	+15
2% AEP (1 in 50yr)	7.39	7.47	+1
1% AEP (1 in 100yr)	8.56	8.46	-1

Overall, the peak discharge estimates across all AEP events match well with the Rational Method estimates and were found to be within 10% for the major events analysed. The WBNM model has subsequently been adopted for the purposes of this investigation.

## 3.4 Developed Case

The proposed development has been represented by an increase in impervious percentage to 75% (ie: sub-catchment "SUB16" in the WBNM model). This value is considered appropriate for the intended development outcome, and also accords with the QUDM provisions based on an urban residential high-density land use classification. No modifications were made to the catchment boundaries. The developed case catchment delineation is shown in Figure 3-2 below. The catchment and routing parameters for the developed case are provided in Appendix C.



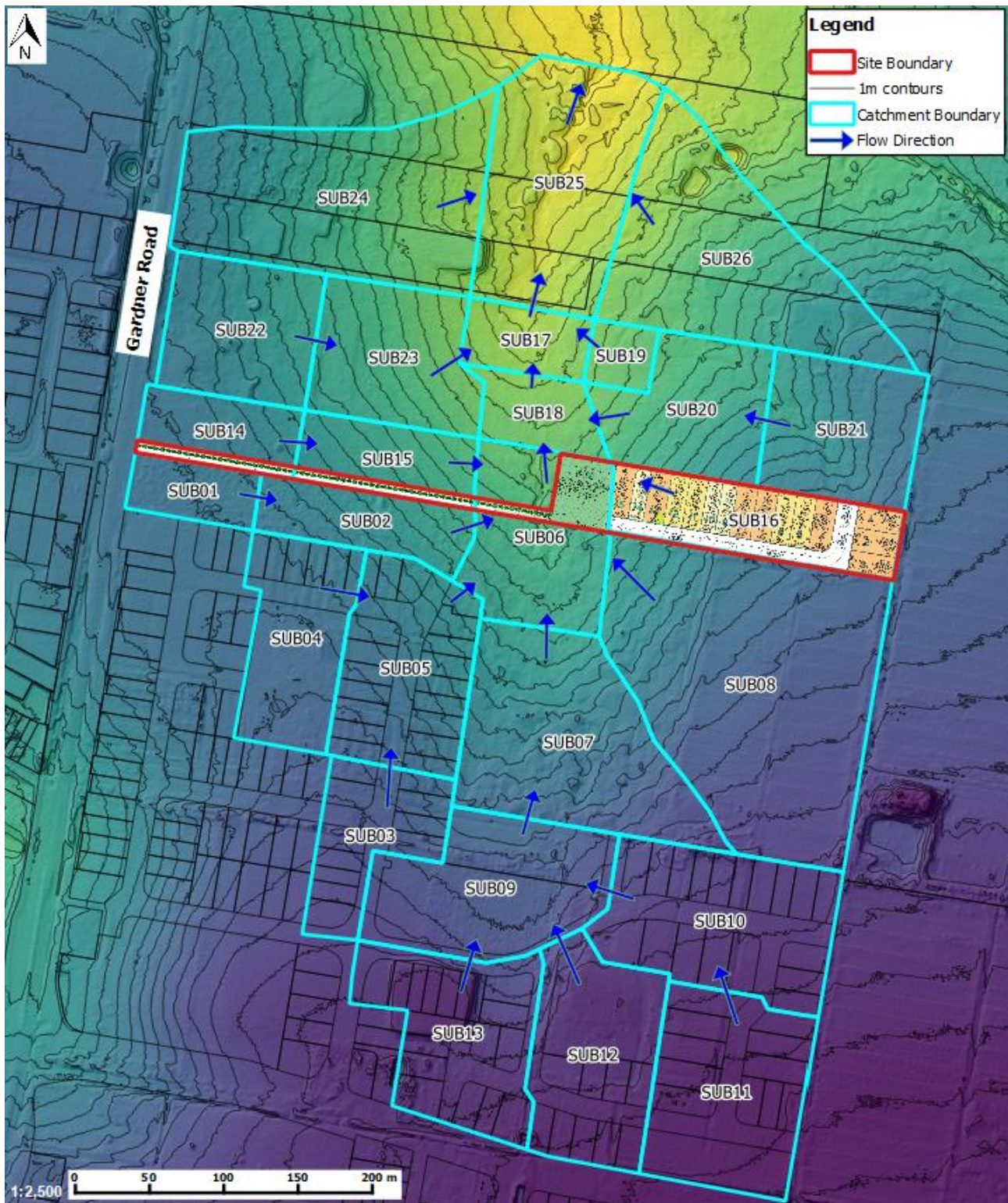


FIGURE 3-2 WBNM SUB-CATCHMENTS – DEVELOPED CASE

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### 3.5 Design Planning Level Flood Immunity Case

The design planning level flood immunity case assumes a fully developed upstream catchment based on future land use planning (ie: all upstream catchments increased to a minimum 75% imperviousness) including provisions for an additional 11.4% increase in rainfall due to climate change (i.e. representing a RCP 6.0 design horizon to 2090). Only the 1% AEP event was considered for the purpose of informing minimum design planning levels and floor level provisions for the proposed development and is discussed further in Section 4.

### 3.6 Critical Durations

It was determined from the existing case WBNM model that the 60-minute storm was the critical event for the site across all AEPs. Consequently, the WBNM hydrology models were analysed for each of the 45-min, 60-minute, and 90-minute storm events, with the resulting discharges incorporated into the hydraulic model to ensure flooding within the study area was appropriately represented across multiple storm durations.

### 3.7 Hydrological Model Results

The WBNM hydrological model was used to determine the changes in peak discharge from the site and the change in total peak discharges from the central waterway traversing the site. Table 3-5 contains a summary of the change in peak discharges from the site in the existing and post-developed cases, including the change in peak discharge resulting from the proposed development. Table 3-6 presents the existing and post developed peak discharges from the central waterway. Note that the no-detention strategy for the site does not materially increase total peak discharges in the central waterway. The slight increase in flow does not adversely affect water levels downstream of the site as demonstrated by the hydraulic assessment described in the following section.

**TABLE 3-5 HYDROLOGICAL MODELLING RESULTS – SITE DISCHARGES ONLY [SUB16 LOCAL]**

Design Event	Existing Case Peak Discharge (m <sup>3</sup> /s)	Developed Case Peak Discharge (m <sup>3</sup> /s)	Change in Peak Discharge Resulting from the Development (m <sup>3</sup> /s)
39% AEP (1 in 2yr)	0.25	0.30	+0.05
10% AEP (1 in 10yr)	0.38	0.43	+0.05
2% AEP (1 in 50yr)	0.49	0.55	+0.06
1% AEP (1 in 100yr)	0.56	0.62	+0.06

**TABLE 3-6 HYDROLOGICAL MODELLING RESULTS – TOTAL CENTRAL WATERWAY DISCHARGES AT VALIDATION POINT (REFER FIGURE 3-1) [SUB06 TOTAL]**

Design Event	Existing Case Peak Discharge (m <sup>3</sup> /s)	Developed Case Peak Discharge (m <sup>3</sup> /s)	Change in Peak Discharge (m <sup>3</sup> /s)
39% AEP (1 in 2yr)	3.58	3.61	+0.03
10% AEP (1 in 10yr)	5.49	5.53	+0.04
2% AEP (1 in 50yr)	7.42	7.47	+0.05
1% AEP (1 in 100yr)	8.40	8.46	+0.06

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## 4 HYDRAULIC MODELLING

### 4.1 Overview

A TUFLOW hydraulic model (build 2018-03-AC) for the catchment was prepared employing the HPC (Highly Parallelised Computations) solution scheme and a GPU solver. TUFLOW is a 1D-2D linked hydraulic model that solves depth-averaged shallow water equations.

The TUFLOW model has been used to simulate a total of three (3) scenarios which includes the following: -

- Existing Case – the base case flooding assessment which represents existing case conditions and is used to inform the base case flood characteristics at the site, in addition to forming the basis upon which the flood impact assessment for the proposed development has been assessed. An additional simulation was performed on the Existing Case model to test the sensitivity of the downstream boundary condition and ensure that the boundary condition did not affect the site or the outcomes of this assessment.
- Developed Case – as per the Existing Case, incorporating the developed case hydrology and proposed development layout and associated drainage.
- Design planning Level Immunity Case – As per the Developed Case model, incorporating the future development scenario hydrology (including climate change provisions – 11.4% increase in rainfall based on RCP 6.0 and 2090 design horizon). Additionally, a high waterway roughness condition ( $n=0.150$ ) has been assumed representing a worst-case waterway vegetation scenario. This analysis has only considered the 1% AEP event and has been used to set minimum floor levels for the proposed development.

An impact assessment has been undertaken comparing for the existing and developed cases. The methodology and results of the hydraulic modelling undertaken are discussed in the sections that follow.

### 4.2 Existing Case Model

#### 4.2.1 Extent and Layout

The model extent was chosen to ensure that the nature of the catchment is fully represented. The TUFLOW model extent and layout are shown in Figure 4-1. The downstream boundary was positioned approximately 300 m downstream of the site to ensure that boundary conditions did not affect the site.

The existing case hydraulic model topography has been established using the available LiDAR. Topographic amendments were made to represent the development estate downstream of the site which has since been constructed as shown in Figure 2-2. This scenario represents the base case flooding assessment which represents the existing case conditions and is used to inform the base case flood characteristics at the site. Additionally, this case has also formed the basis upon which the flood impact assessment for the proposed development has been prepared.

Culverts downstream of the site have been included in the model, however the minor driveway culvert on the upstream side of the site has been disregarded. The driveway formation has however been included in the model by virtue of its representation in the LiDAR.

The hydraulic model was used to simulate the 45-minute, 60-minute and 90-minute storms for each of the 39%, 10%, 2% and 1% AEP design events.



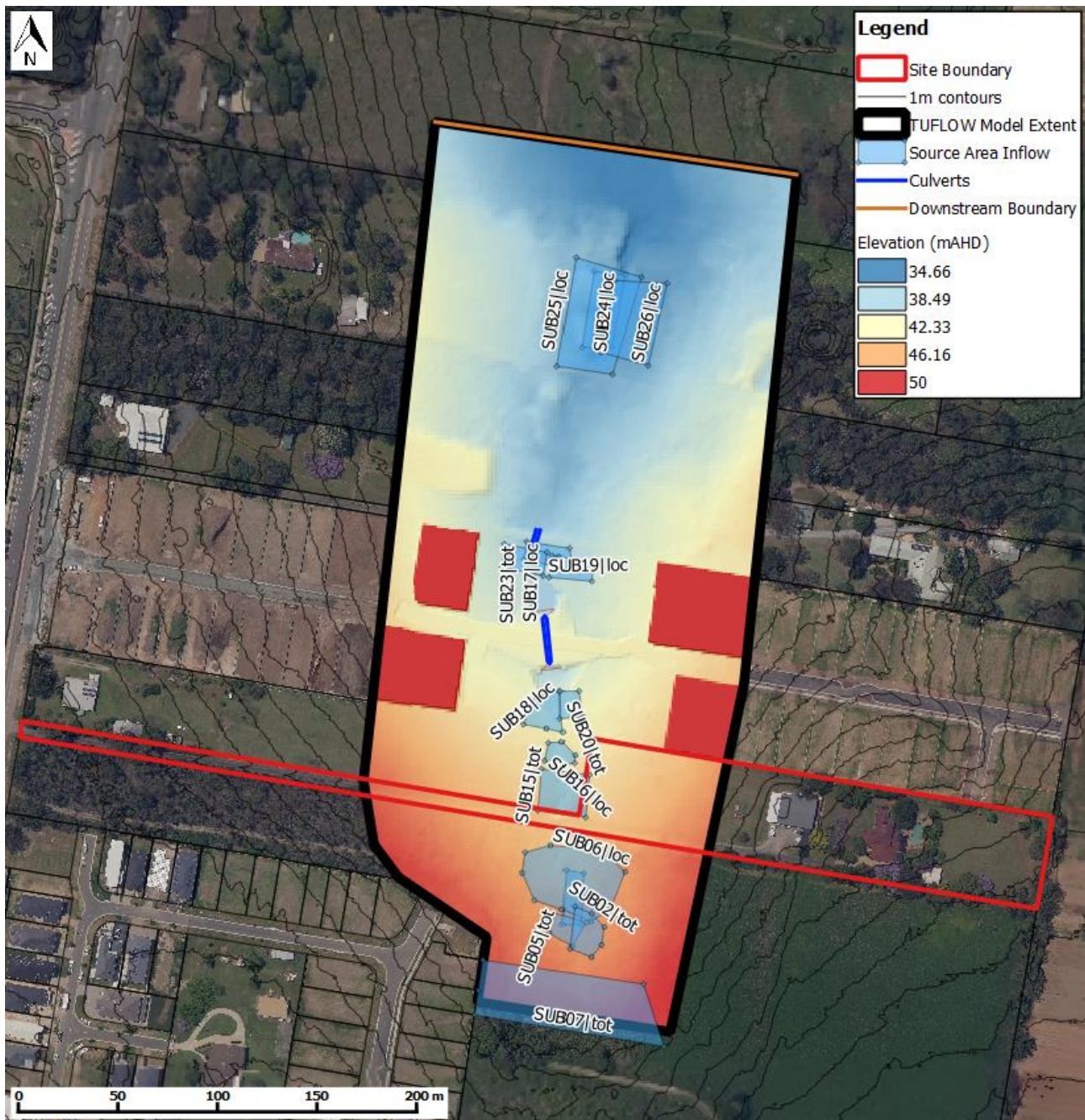


FIGURE 4-1 TUFLOW MODEL LAYOUT – EXISTING CASE





## 4.2.2 Hydraulic Roughness

The hydraulic roughness parameters applied in the existing and developed case models is summarised in Table 4-1 and is illustrated spatially in Figure 4-2. The adopted roughness's were informed by aerial imagery (Spookfish Nov 2018) as well as the site inspection, and are deemed to be appropriate for the assessment.

**TABLE 4-1 ADOPTED ROUGHNESS PARAMETERS**

<b>Roughness Classification</b>	<b>Manning's 'n'</b>
Roads	0.020
Road Verge / Rock Drain	0.040
Light vegetation	0.060
Medium vegetation	0.080

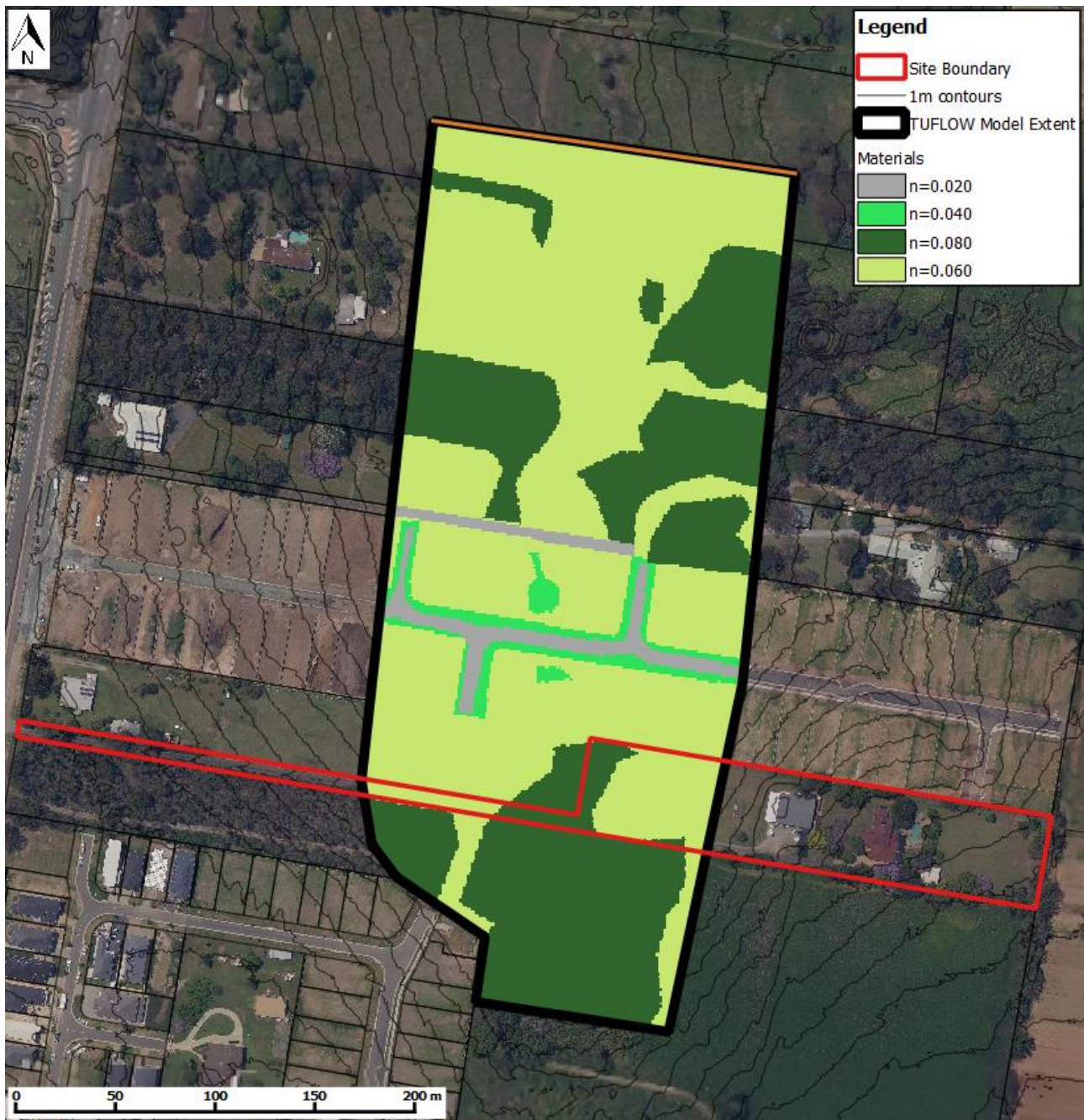


FIGURE 4-2 MANNINGS ROUGHNESS MAP – EXISTING AND DEVELOPED CASES



### 4.2.3 Boundary Conditions

Sensitivity testing involving a comparison between a constant tailwater and a normal slope condition confirmed that the downstream model boundary was placed a sufficient distance from the site and did not affect the outcomes of this assessment. Consequently, a normal slope “HQ” boundary based on the natural topography of 3% was adopted for this assessment. The downstream boundary conditions remained unchanged across all model scenarios. Additionally, the TUFLOW model extends to the confluence of an unnamed watercourse where flooding is dominated by a larger external catchment.

## 4.3 Developed Case

The developed case hydraulic model was prepared based on the existing case model. It was determined that the development footprint was well outside of the 1% AEP flooding extent. As such, there is no encroachment into the waterway and no need to incorporate development fill pads into the model. There is also no internal road crossing contended as part of the proposed development. The developed case model has therefore only incorporated post-development case WBNM discharges. Inflow locations for the site flows were not modified and all external inflows were unchanged.

No other alterations to the existing model were undertaken as part of this assessment and boundary conditions (upstream inflows and downstream boundary) remained unchanged from those represented in the existing case model.

## 4.4 Design Planning Level Flood Immunity Case

A separate model scenario was simulated for the 1% AEP event only to inform the minimum design planning levels and floor level requirements based on a set of conservative assumptions. Specifically, this included: -

- A fully developed upstream catchment (Design Planning Level Flood Immunity Case hydrology);
- Consideration of climate change conditions. Rainfall intensities were increase by 11.4% as projected under RCP 6.0 and a design horizon of 2090 (ARR Datahub 2019); and
- High waterway roughness to represent dense vegetation (based on a Manning’s “n” roughness of 0.15). The roughness map for this case is shown in Figure 4-3.



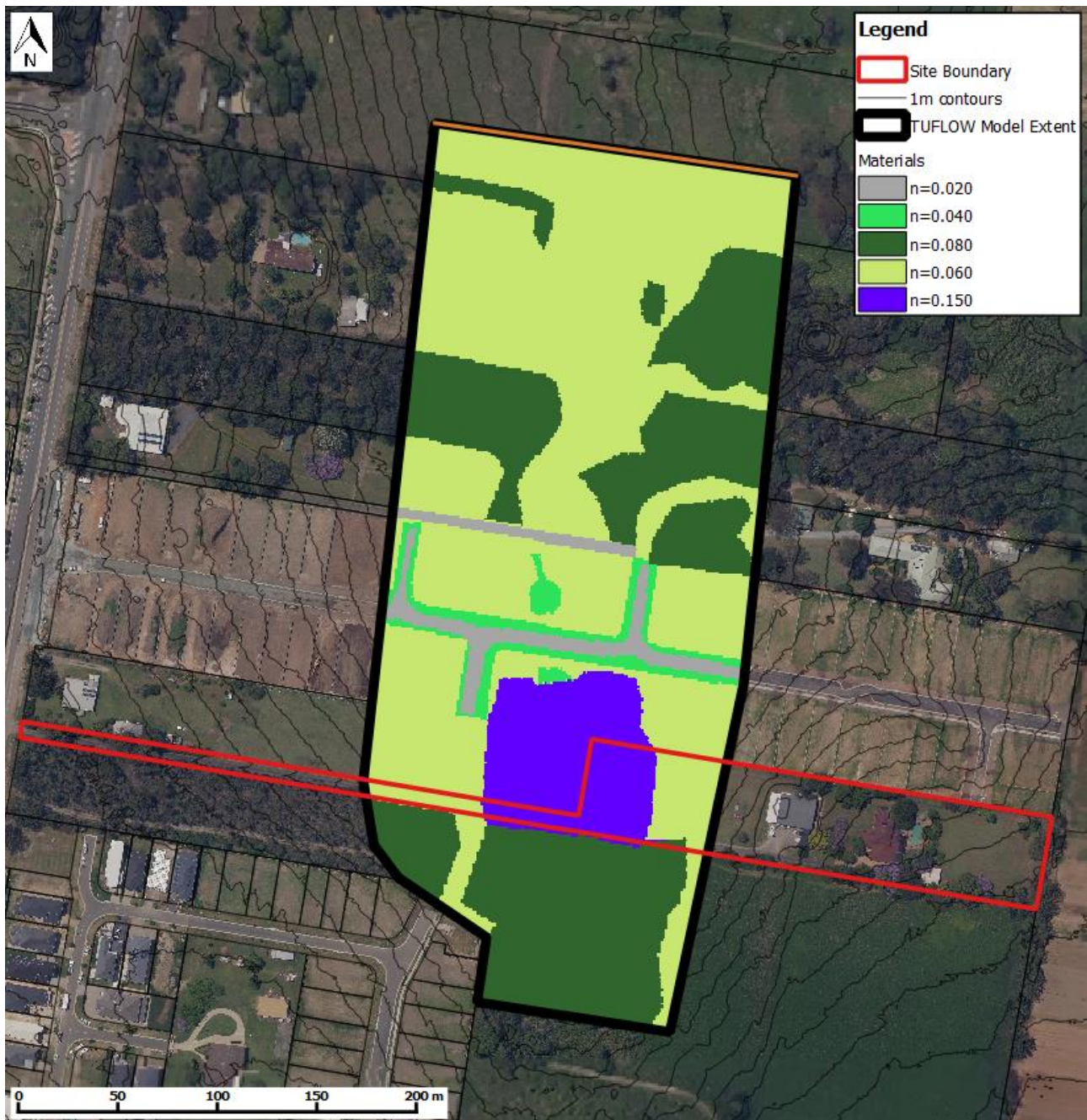


FIGURE 4-3 MANNINGS ROUGHNESS MAP – DESIGN PLANNING LEVEL FLOOD IMMUNITY CASE

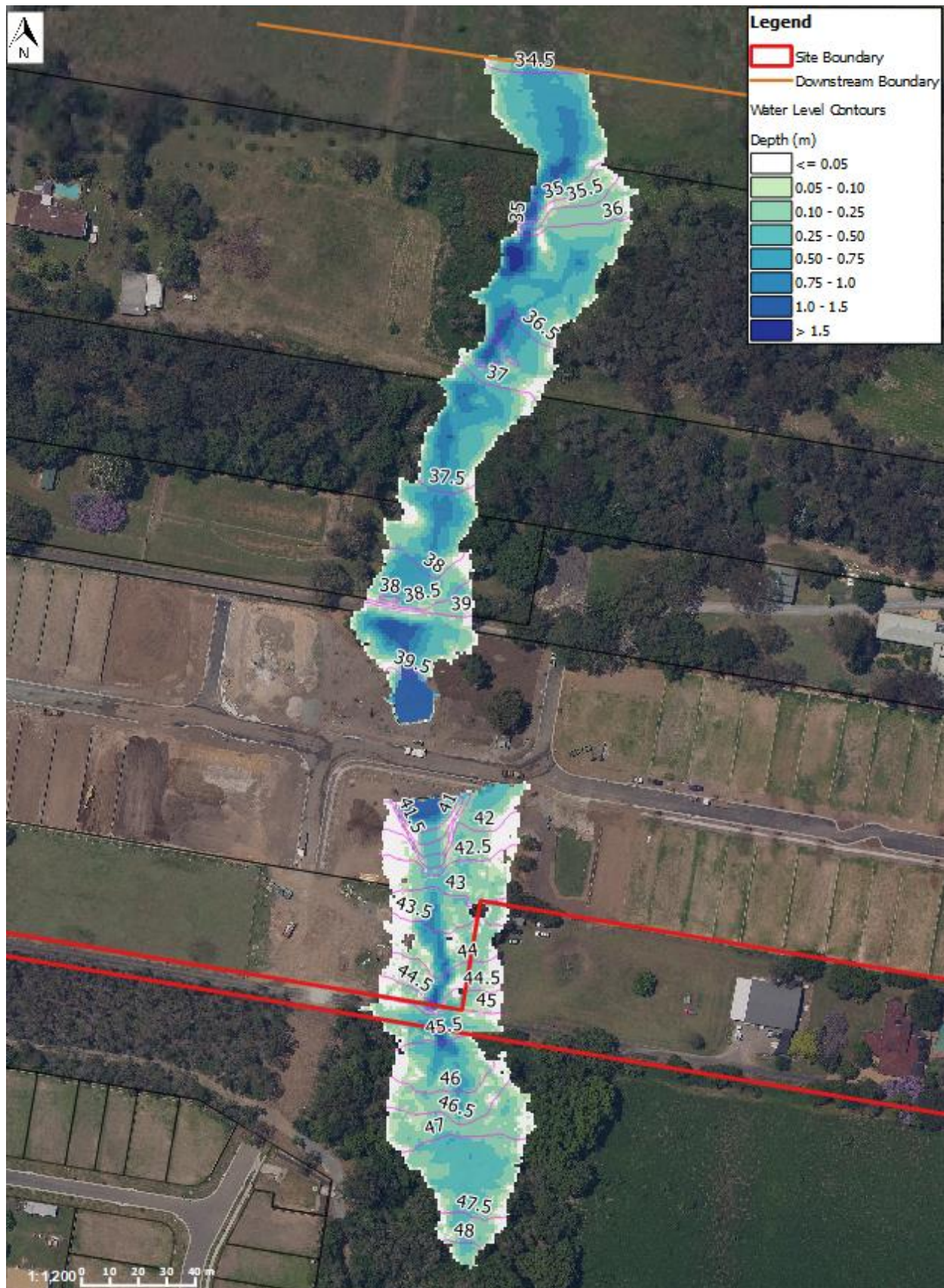


## 4.5 Hydraulic Model Results

### 4.5.1 Existing Case Results

The hydraulic model was simulated for the 39%, 10%, 2% and 1% AEP design events to establish an existing baseline scenario. This baseline assessment has been prepared for the purposes of establishing the site constraints with respect to flooding, as well as establishing the base case results upon which the impacts of development have been assessed. Maximum flood depths, level and velocity maps of existing conditions for all AEP events assessed have been included in Appendix D. The 1% AEP maximum flood depth and level map is illustrated in Figure 4-4. The maximum 1% AEP flood depth and velocity on the site within the central waterway are predicted to be up to 1.3 m and 2 m/s respectively.





**FIGURE 4-4 1% AEP MAXIMUM FLOOD DEPTH AND LEVEL – EXISTING CASE**

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## 4.5.2 Developed Case Results

The developed case flood model was simulated for the 39%, 10%, 2% and 1% AEP design events. Maximum flood depths, level and velocity maps of the post development conditions for all AEP events analysed have been included in Appendix D. Flood impact mapping is contained in Appendix E.

Maximum depths and velocities across all AEP events analysed remain unchanged from the existing case. Figure 4-5 presents the 1% AEP maximum flood depth and water level contours. Figure 4-6 shows the 1% AEP flood impact map for the site, noting that impacts have been filtered to 5 mm. Minor impacts up to 8 mm are noted at the downstream culverts and are associated with a small increase in run-off volume from the site. It is understood that these culverts have been sized to accommodate future upstream development therefore these impacts are considered to be of little consequence, are also fully contained within the flood extent and do not affect the downstream development.

## 4.5.3 Design Planning Level Flood Immunity Case Results

The maximum flood level and depth for the design planning and immunity case is illustrated in Figure 4-7. The results demonstrate that the development footprint is located entirely outside of the worst case 1% AEP flood extent. As such, design planning levels and minimum floor levels can readily be achieved for the development. A digital copy of the flood results has also been provided to the civil designers separately to this report.



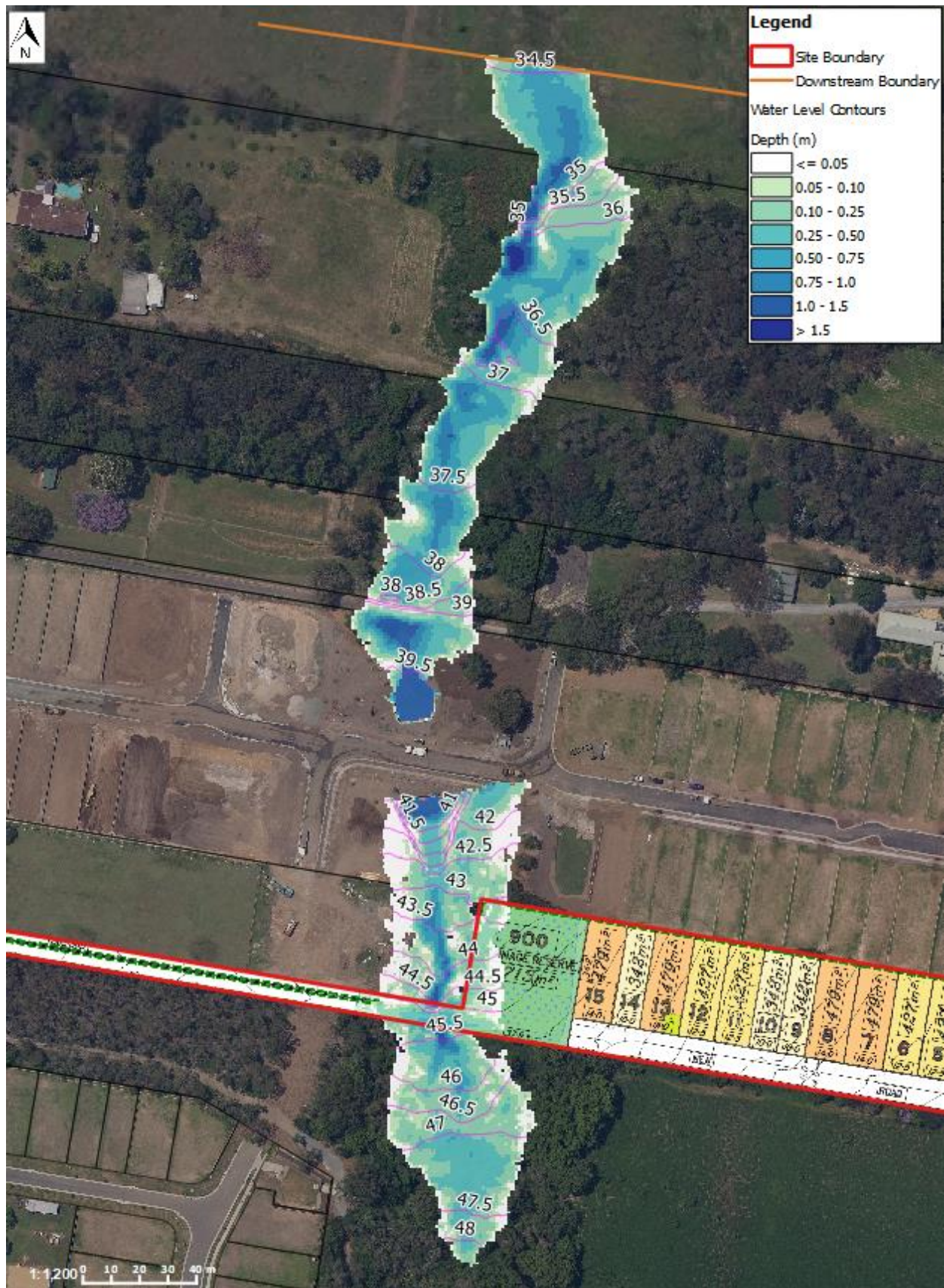
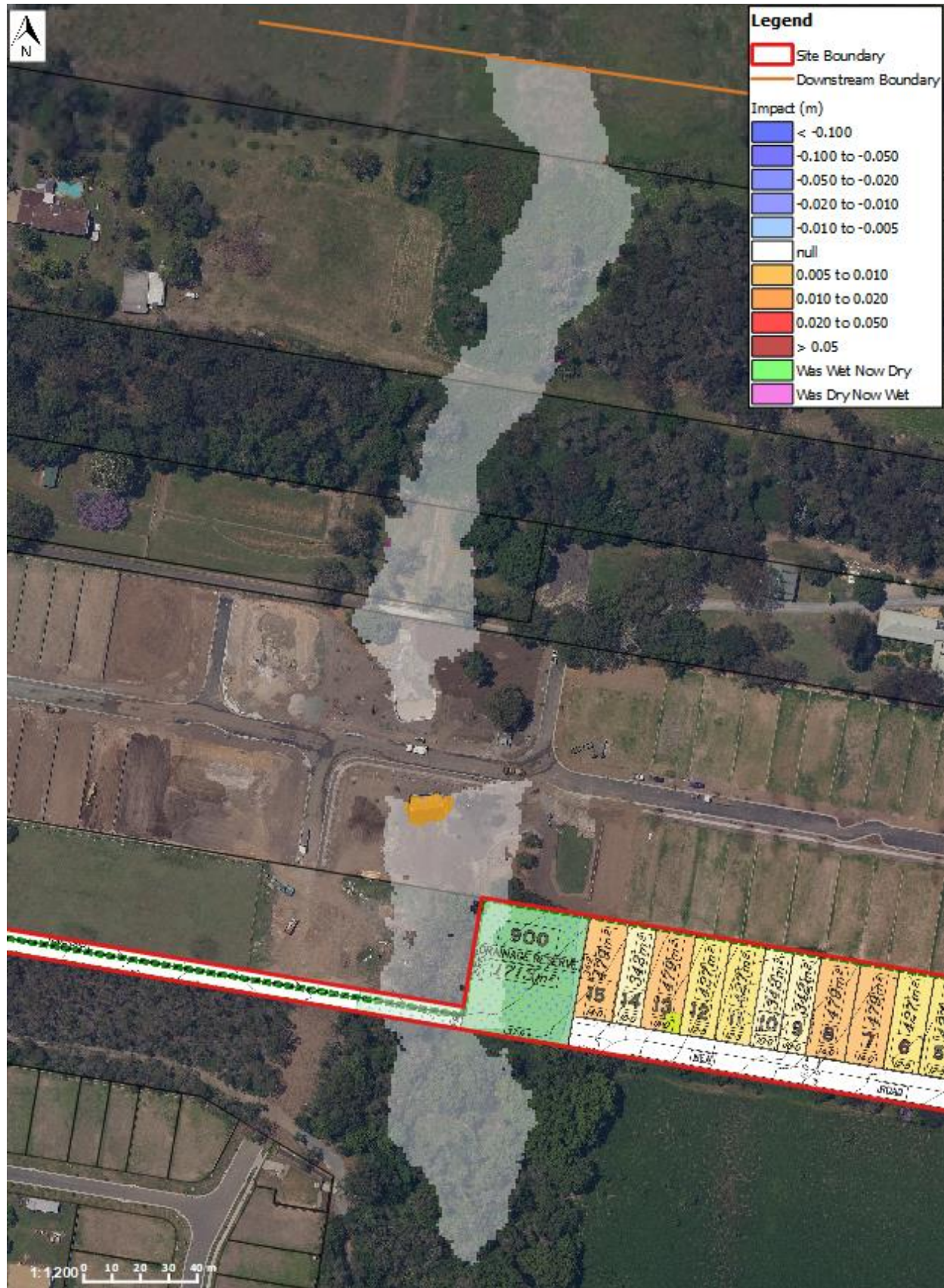


FIGURE 4-5 1% AEP MAXIMUM FLOOD DEPTH AND LEVEL – DEVELOPED CASE

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**FIGURE 4-6 1% AEP FLOOD LEVEL IMPACT – EXISTING VS DEVELOPED CASE**

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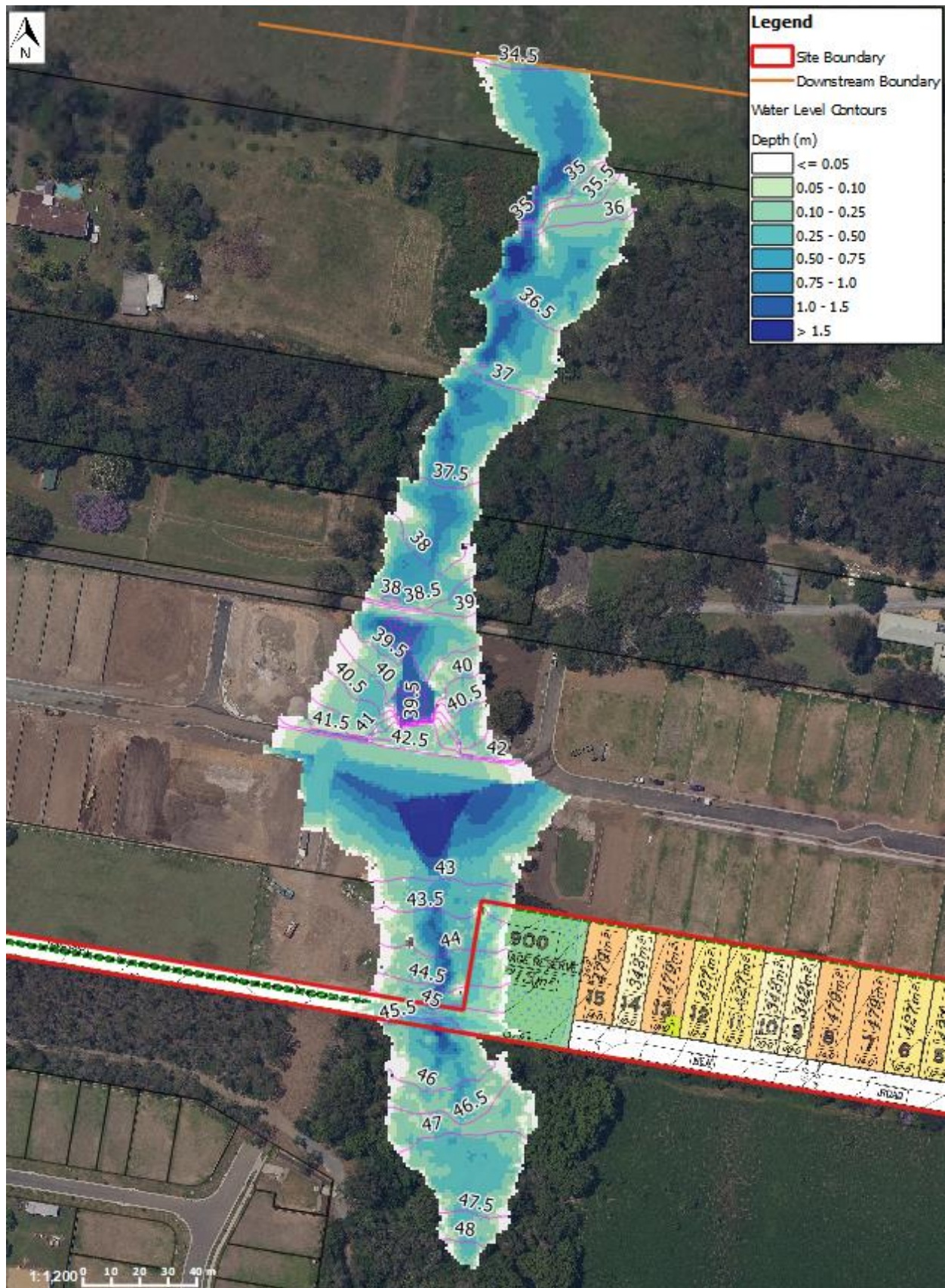


FIGURE 4-7 1% AEP MAXIMUM FLOOD DEPTH AND LEVEL – IMMUNITY CASE

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## 4.6 Results Summary

The following is a brief summary provided in relation to the results of this assessment: -

- The proposed development will not result in offsite adverse flooding impacts.
- Analysis has demonstrated that the proposed no on-site detention strategy is appropriate and increased flows from the post-developed site do not result in a material increase in maximum flood level downstream of the site across all events modelled.
- The hydraulic analysis supports a no detention strategy for the site by virtue of inclusion of developed case hydrology that does not result in flooding impacts external to the site.
- The results demonstrate that the development footprint is outside of the worst case 1% AEP flood extents, therefore, minimum floor levels can be readily achieved.
- Flood velocities on or external to the site are not increased.
- Potential increases in water surface levels associated with the proposed revegetation works have been investigated using the hydraulic model, and no adverse impacts to the proposed lots were observed.



## 5 STORMWATER QUALITY

### 5.1 Overview

This section of the report outlines the assessment of stormwater quality at the site which includes Water Sensitive Urban Design (WSUD) measures proposed to mitigate impacts to the water quality of runoff leaving the developed site and comply with recommended Water Quality Objectives (WQOs) (see Section 5.3). These WSUD measures are proposed for the operational (post-construction) phase of the development and are therefore long-term water quality management measures.

The water quality strategy proposed for the site includes:

- Provision of tree pits (as per BCC standard detail) at a rate of 1 tree pit per 2 lots; and
- Further water quality outcomes through revegetation of the waterway corridor through the site.

### 5.2 Water Quality Concerns

Typical pollutants from this development are listed in Table 5-1 below: -

**TABLE 5-1 TYPICAL POLLUTANTS FROM SITE (OPERATIONAL PHASE)**

Pollutant Type	Pollutant sources
Gross Pollutants	Litter such as food, drink and materials packaging and wrappers, leaf matter and grass clippings.
Sediment	Sediment brought in by vehicles, erosion, atmospheric deposition, organic matter, spills and accidents.
Hydrocarbons	Fuel and oil spills from cars and trucks, asphalt pavements.
Nutrients	fertiliser, decaying organic matter, animal faeces, detergents, atmospheric deposition.

### 5.3 Water Quality Standards and Guidelines

The standards and guidelines referenced for the MUSIC analysis are listed below: -

- “State Planning Policy” (SPP), Department of State Development, Infrastructure and Planning, 2017;
- “South East Queensland Regional Plan 2009 - 2031 - Implementation Guideline No. 7”, November 2009 by Department of Infrastructure and Planning;
- “MUSIC Modelling Guidelines – Version 1.0 – 2010” produced under the Water by Design Program by the South East Queensland Healthy Waterways Partnership 2010;
- The City Plan 2014 and Stormwater Code (BCC);
- “Urban Stormwater Quality Planning Guidelines”, Department of Environment and Resource Management, 2009;
- “Urban Stormwater – Queensland best practice environmental management guidelines – Technical Note: Derivation of Design Objectives”, Environmental Protection Agency, January 2009; and
- “Urban Stormwater Quality Planning Guidelines 2010” Department of Heritage Protection, 2010.

The stormwater quality pollutant load reduction requirements, as specified in Table B in Appendix 3 of the State Planning Policy (DSDIP 2016) are listed in Table 5-2. These reduction targets are calculated as





reductions in total pollutant load to be achieved as compared to the theoretical runoff of untreated stormwater from the proposed development.

**TABLE 5-2 POST CONSTRUCTION PHASE STORMWATER MANAGEMENT DESIGN OBJECTIVES (SPP)**

Pollutant	Water Quality Objectives
Total Suspended Solids (TSS)	80% reduction in average annual load of pollutants
Total Phosphorus (TP)	60% reduction in average annual load of pollutants
Total Nitrogen (TN)	45% reduction in average annual load of pollutants
Gross Pollutants (GP)	90% reduction in average annual load of pollutants

## 5.4 MUSIC Model Setup

Water quality modelling of the proposed development has been undertaken using the Model for Urban Stormwater Conceptualisation (MUSIC). The MUSIC model enables the user to estimate the pollutant export from the proposed development site and quantify the effectiveness of the proposed stormwater quality treatment train. MUSIC provides quantitative modelling for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN) and Gross Pollutants (GP).

The MUSIC model was set up in accordance with Water by Design MUSIC Modelling Guidelines (2010) which has been produced under the Water by Design Program by the South-East Queensland Healthy Waterways Partnership. In addition, Healthy Waterways recommends using MUSIC version 6 to ensure compliance with stormwater pollutant loads reduction objectives, with the following parameters adopted when modelling bioretention filter media: -

- Minimum 30 mg/kg Orthophosphate (OP); and
- Minimum 400 mg/kg Total Nitrogen (TN).

The modelling adopted the split catchment approach accordance with the typical impervious fractions indicated in Table 5-3 and in general accordance with the MUSIC Modelling Guidelines (2010) (Table 3.3).

**TABLE 5-3 SPLIT CATCHMENT ASSUMPTIONS – PROPOSED DEVELOPMENT**

Development Type	Impervious Fraction (%)		
	Road	Roof	Ground Level
15 Dwelling/ha	25	32.5	42.5

### 5.4.1 Catchment Areas

A split catchment approach has been undertaken using the “typical” surface-type splits as documented by Water by Design (2010) and a lot density of approximately 15 dwellings per hectare, which is consistent with the density proposed as part of the current proposed layout.

The catchment area utilised for sizing bioretention devices at the site is shown in Figure 5-1 below. Note that the entire developable area has been accumulated into a single catchment, and represented in MUSIC as per Table 5-4. If required, individual treatment devices can be sized by proportioning the required filter media size according to the contributing catchment.



Overall Statistics	
Total Area of Subdivision	1.202 Ha
Developable Area	1.023 Ha
Number of Residential Lots	15
Residential Density	14.7 Lots/Ha
Length of New Road	179 m
Number of Village Lots	3
Number of Small Lots	4
Number of Standard Lots	8
Contour Interval	1.0 m

FIGURE 5-1 DEVELOPMENT STATISTICS (SOURCE: DTS 2019)

TABLE 5-4 CATCHMENT BREAKDOWN – PROPOSED DEVELOPMENT

Sub-Catchment	Total Area (ha)	Road Area (ha)	Lot Roof Area (ha)	Ground Level (ha)
Development Footprint	1.023	0.26	0.33	0.44

## 5.4.2 Pollutant Export Parameters

As recommended in Water by Design (2010), the pollutant export parameter for urban residential and commercial areas using the split catchment land-use has been adopted for this analysis. These parameters are summarised in Table 5-5.

TABLE 5-5 POLLUTANT EXPORT PARAMETERS (SPLIT CATCHMENT APPROACH) - WATER BY DESIGN (2010).

Flow Type	Surface Type	TSS log <sup>10</sup> values		TP log <sup>10</sup> values		TN log <sup>10</sup> values	
	Urban Residential	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Baseflow Parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
	Roads	1.00	0.34	-0.97	0.31	0.20	0.20
	Ground level	1.00	0.34	-0.97	0.31	0.20	0.20
Streamflow Parameters	Roof	1.30	0.39	-0.89	0.31	0.26	0.23
	Roads	2.43	0.39	-0.30	0.31	0.26	0.23
	Ground level	2.18	0.39	-0.47	0.31	0.26	0.23

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### 5.4.3 Rainfall and Evapotranspiration Data

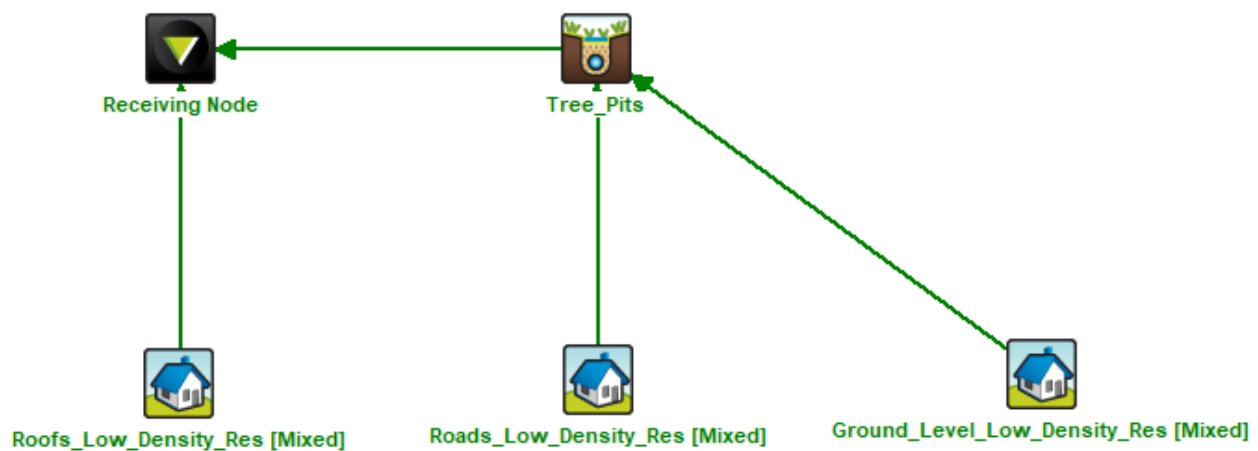
The rainfall and evapotranspiration data were sourced from the Bureau of Meteorology (BoM) for Brisbane Aero (Station Number 40223) and covered the period from the 1<sup>st</sup> January 1980 to the 31<sup>st</sup> December 1989 with 6-minute rainfall data resolution, as recommended by the MUSIC Modelling Guidelines (2010). Table 5-6 summarises the monthly evapotranspiration data adopted for the MUSIC analysis.

**TABLE 5-6 EVAPOTRANSPIRATION DATA (PET) OBSERVED AT BRISBANE AERO**

Month	Evapotranspiration (mm)
January	193
February	151
March	150
April	109
May	75
June	63
July	65
August	84
September	112
October	148
November	175
December	199

### 5.4.4 Treatment Nodes

Figure 5-2 provides an illustration of the MUSIC model schematic for the development. The roof water / inter-allotment drainage network will not be routed to the street due to topographical constraints. Further details regarding the treatment nodes are provided in the following sections.



**FIGURE 5-2 MUSIC MODEL SCHEMATIC**



#### 5.4.4.1 Rainwater Tank

Rainwater tanks have not been used in the analysis.

#### 5.4.4.2 Gross Pollutant Trap (GPT)

GPT devices have not been used in the analysis.

#### 5.4.4.3 Sediment Forebay

A sediment forebay has not been included in the MUSIC analysis.

#### 5.4.4.4 Tree Pits

One (1) tree pit, which has been modelled as a bioretention basin for the MUSIC analysis, has been included in the WSUD treatment train and is representative of a decentralised WSUD measure proposed for the development. The basin node receives stormwater from all impervious paved and roof surfaces on the site.

The tree pits have been assumed to be as per BCC's standard drawing BSD-9034 and BSD-9035, with a total surface area of approximately 3m<sup>2</sup> each. The tree pits have been accumulated into a single bioretention node for the purposes of MUSIC analysis. It has been assumed that tree pits will be provided at a rate of 1 tree pit per 2 lots, for a total of 8 tree pits.

The basin parameters, as modelled, are provided in Table 5-7.

**TABLE 5-7 MUSIC BIORETENTION SYSTEM DETAILS**

Parameter	Conceptual Design Value
Low Flow By-pass (m <sup>3</sup> /s)	0
High Flow By-pass (m <sup>3</sup> /s)	100
Extended Detention Depth (m)	0.2
Surface Area (m <sup>2</sup> )	24
Filter Area (m <sup>2</sup> )	24
Saturated Hydraulic Conductivity (mm/hr)	200
Filter Depth (m)	0.6
TN Content of Filter Media (mg/kg)	400
Orthophosphate Content of Filter Media (mg/kg)	30
Exfiltration Rate (mm/hr)	0
Is the Base Lined (Y/N)	Yes
Vegetation Properties	Vegetated with Effective Nutrient Removal Plants
Overflow Weir Width (metres)	2.4
Underdrain Present (Y/N)	Yes
Submerged Zone with Carbon Present (Y/N)	No

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## 5.5 MUSIC Results and Discussion

The MUSIC modelling results indicate that the proposed WSUD devices, comprising tree pits at a rate of 1 per 2 lots, achieve significant reductions in pollutant loads, however do not specifically achieve the required pollutant reduction targets as illustrated in Table 5-8. For this reason, additional measures are proposed to offset the shortfall in treatment standard for the development which are discussed in Section 5.6.

**TABLE 5-8 MUSIC RESULTS AND POLLUTANT REDUCTION TARGETS**

Parameter	Reduction Requirement	Achieved Outcome	Target Met
Total Suspended Solids	80%	55.8%	no
Total Phosphorus	60%	42.1%	no
Total Nitrogen	45%	18.7%	no
Gross Pollutants	90%	52.4%	no

## 5.6 Performance Based Outcome

As indicated by the above MUSIC analysis, the provision of tree pits at the rate of 1 tree pit for every 2 dwellings is not sufficient bioretention treatment area to demonstrate compliance with the SPP pollutant reduction targets. Therefore, a performance-based outcome is proposed, which includes revegetation and rehabilitation of some of the mapped waterway corridor and associated drainage reserve through the centre of the site as indicated in Figure 5-3. The extent of mapped waterway corridor is approximately 2,000m<sup>2</sup>, much of which is presently cleared of significant vegetation as has been illustrated previously in Figure 2-2. The revegetation associated with habitat tree offsets could be considered in conjunction with revegetation for water quality offsets.

We note that detailing and assessment of these revegetation works require detailed planning which is beyond the scope of this SMP and are yet to be determined with specific ecological and landscaping input. However, in principal, the revegetation of some of this area should be sufficient to provide additional water quality outcomes to achieve a performance-based outcome against the Planning Scheme while also enhancing the local environmental outcomes more generally in a broader site context.

We further note that a similar approach has been applied for the development currently under assessment at 220 Gardner Road (Council reference A005055466). In this instance, it appears that bioretention basins have not been preferred, with all stormwater quality offsets to be achieved via revegetation.

An alternative arrangement to the above, being tree pits dispersed throughout the development, would be to accumulate the total proposed treatment area into a single 'end of line' bioretention basin in the area between the boulevard road and waterway corridor. This approach would reduce the number of devices required from 8 to 1, which reduces construction costs as well as ongoing maintenance costs on Council. It is the intention that this 'end of line' bioretention basin would be sized at approximately 24m<sup>2</sup>, with the shortfall in treatment efficiency obtained via revegetation of the waterway corridor.



FIGURE 5-3 POTENTIAL LOCATION OF ONSITE REVEGETATION



## 6 PRE-LODGE MENT ADVICE

A pre-lodgement meeting with Council was held on 14 March 2019. A response to the relevant stormwater management items raised at the meeting is provided in Table 6-1.

**TABLE 6-1 RESPONSES TO PRE-LODGE MENT ADVICE**

Item	Response
A Lawful Point of Discharge (LPD) is to be demonstrated in accordance with the City Plan 2014, Infrastructure Design Planning Scheme Policy (ID PSP), Section 7.6. A hydraulic report prepared by an RPEQ will be required to demonstrate compliance with the outcomes within this Code. The report is to be prepared in accordance with the ID PSP Section 1.	<p>This report has been prepared to demonstrate compliance with the Stormwater Code. The detailed hydrologic and hydraulic assessments as detailed herein demonstrate that the proposed development does not cause adverse flooding impacts external to the site.</p> <p>Note that internal drainage will be designed by others in accordance with QUDM. RPEQ certification will be provided following the finalisation of drainage and water quality arrangements.</p>
The proposal is a high-risk site from a water quality perspective. For any subsequent development application, it is necessary to address Section B of the Stormwater Code and prepare a Site Based Stormwater Quality Management Plan in accordance with the Infrastructure Design Code and associated Infrastructure Design Planning Scheme Policy, Section 7.	A performance-based outcome involving tree pits and onsite revegetation of the waterway corridor has been proposed as part of this assessment. Details are contained in Section 5 of this report. Water quality requirements can be readily conditioned. We note that a similar approach has been applied for the development currently under assessment at 220 Gardner Road (Council reference A005055466). In this instance, it appears that bioretention basins have not been preferred, with all stormwater quality offsets to be achieved via revegetation.
The proposed location of the bioretention basins is acceptable (within the fringe area of the waterway). However, the applicant may wish to explore the option of providing rehabilitation in lieu of bioretention subject to demonstrating Water Quality requirements. If bioretention basins are proposed, it is also necessary to consider fire separation requirements to adjacent proposed lots.	A performance-based outcome involving tree pits and onsite revegetation of the waterway corridor is proposed in lieu of providing on-site bioretention. Refer to the above response and Section 5 of this report for details.
The development is to provide for the orderly development of stormwater infrastructure by providing a drainage connection for the upstream catchment, sized for ultimate catchment conditions.	No drainage infrastructure is proposed within the central waterway. The capacity of the waterway corridor is such that future upstream development can be readily accommodated.
Erosion and Sediment control: An erosion and Hazard Assessment Form is required to be lodged with any development application that will result in soil disturbing activity.	To be completed by others.

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## 7 CONCLUSION

Water Technology Pty Ltd (WT) has been commissioned by PEAKURBAN Pty Ltd to investigate stormwater and flood management provisions associated with the proposed development of the property located at 238 Gardner Road, Rochedale Queensland, comprising Lot 8 on RP84459. The site is located within the Brisbane City Council (BCC) Local Government Area.

This report provides detailed and comprehensive information pertaining to the proposed flood and stormwater management strategies for the proposed development to support the applications over the site. Additionally, a detailed response has been provided addressing matters raised by Council in respect to flooding and stormwater advice received during a pre-lodgement meeting with Council was held on 14 March 2019.

The contents of this report and major findings of the assessment undertaken are summarised as follows: -

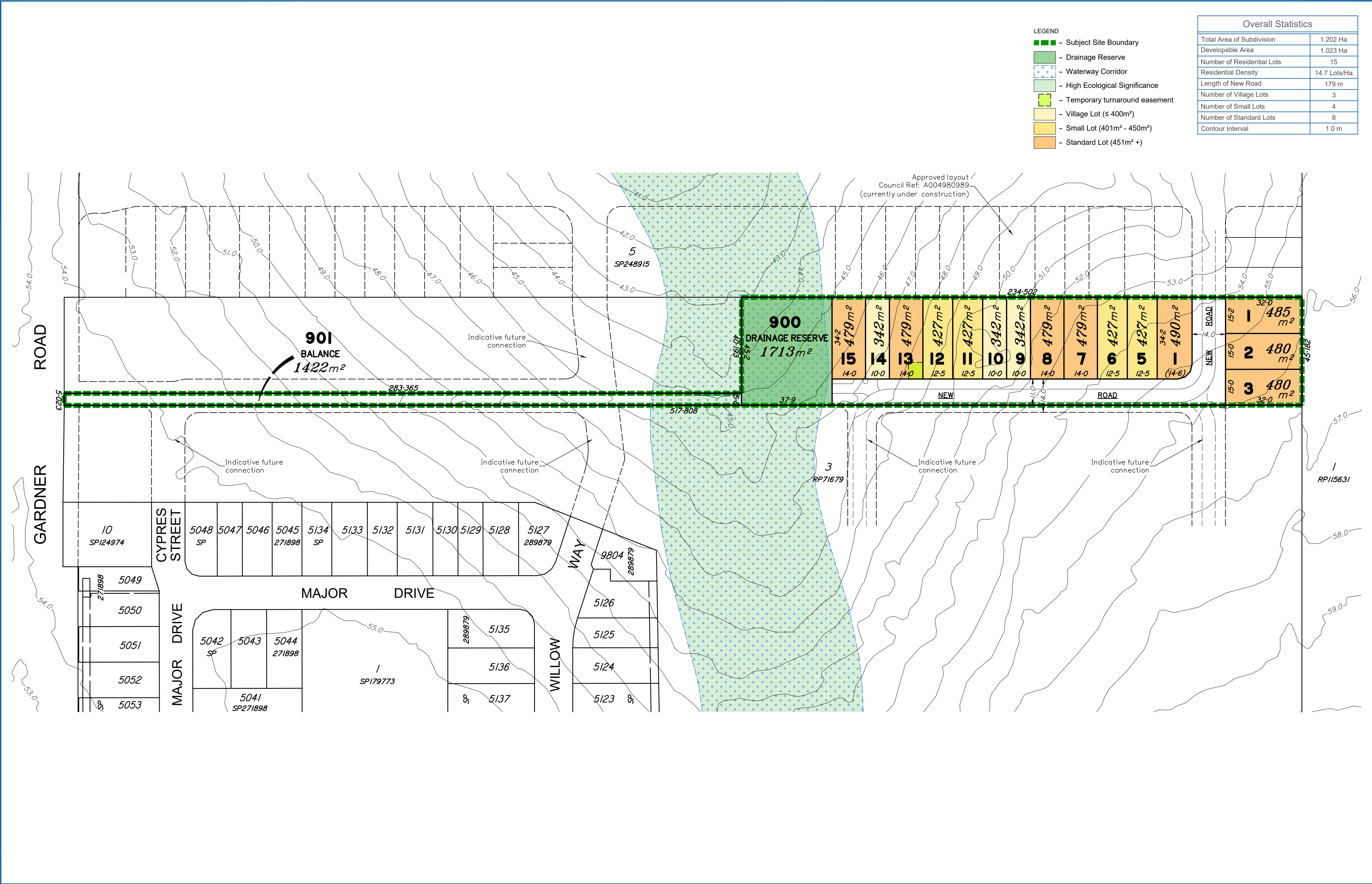
- Detailed hydrological and hydraulic models were developed for the site and surrounding catchment as described herein.
- The proposed development does not result in adverse flooding impacts external to the site across all standard design events simulated without provision of onsite stormwater detention.
- Detailed hydrological and hydraulic analyses support a no detention strategy for the site.
- The results demonstrate that the development footprint is located entirely outside of the worst case 1% AEP regional flood extents, therefore, minimum floor levels can be readily achieved.
- No filling is proposed within the waterway corridor.
- No drainage infrastructure is proposed within the central waterway. The capacity of the waterway corridor is such that future upstream development can be readily accommodated.
- A performance-based outcome involving tree pits and onsite revegetation of the waterway corridor has been proposed as part of this assessment. Details are contained in Section 5 of this report.
- Potential increases in water surface levels associated with the proposed revegetation works have been investigated using the hydraulic model, and no adverse impacts to the proposed lots was observed.
- A response to each item raised by Council in the context of flooding and stormwater management has been provided as part of this report.

The flood and stormwater management strategies outlined and presented in this report adequately demonstrate that the development application proposed for the site can be supported. Accordingly, we believe that the development can be supported by BCC subject to reasonable and relevant approval conditions.



## APPENDIX A PROPOSED SITE LAYOUT









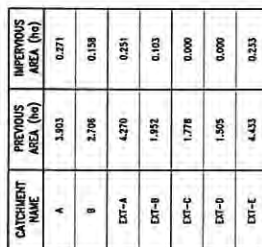
## APPENDIX B NEIGHBOURING DEVELOPMENT REPORT EXTRACTS



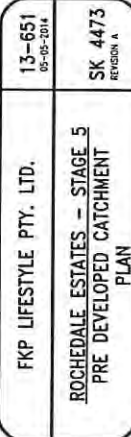








EXISTING SURFACE CONTOURS  
CATCHMENT BOUNDARY  
EXTERNAL BOUNDARY  
STORMWATER  
EXISTING STORMWATER

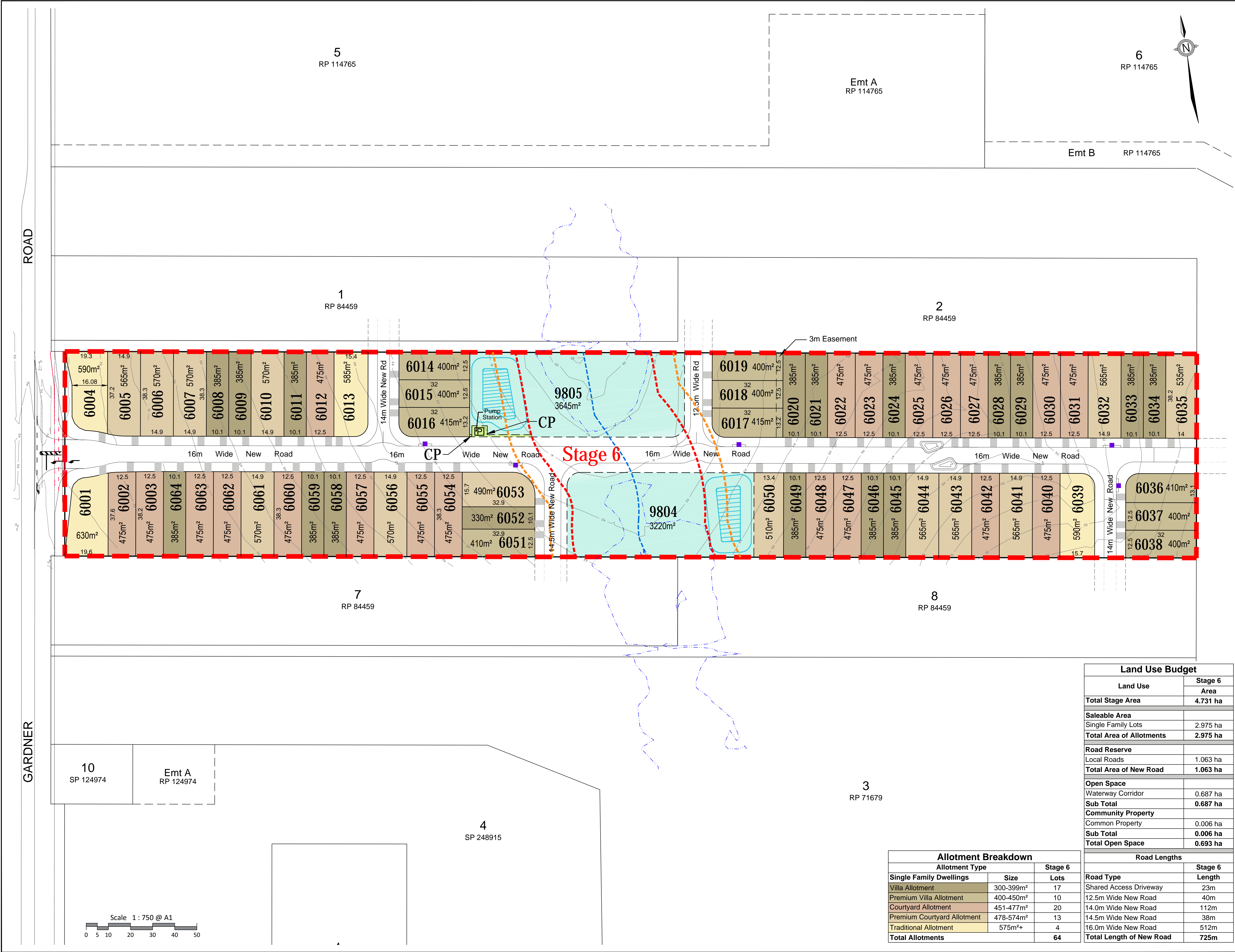


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 Website: [www.gclaw.com](http://www.gclaw.com), Website: [www.gclaw.com](http://www.gclaw.com)









REVISION

A: 22/02/16: Update entry road and lots

B: 04/03/16: Update east-west road to 14m and lots

C: 18/03/16: Update layout

D: 19/07/16: Update East-West road to 16m

E: 16/08/16: Add bin Pads & Add Q100

F: 29/08/16: Amend PCP

G: 01/09/16: Amend Layout for RFI

Note:

All dimensions and areas are approximate only, and are subject to survey and Council approval.

Dimensions have been rounded to the nearest 0.1 metres.

Areas have been rounded down to the nearest 5m².

The boundaries shown on this plan should not be used for final detailed engineers design.

Source Information:

Site boundaries: RPS Survey.

Adjoining information: DCDB.

Contours: RPS Survey.

Flooding (Q100): Bradless

Legend

Stage Boundary

Waterway Centre Line

60m Core Waterway

80m Fringe Waterway

Flood Extent Q100

Waterway Corridor

Common Property

Proposed Biopod (Subject to Detail Design)

Bin Pad Location for Lots 6001-6003, 6014-6016, 6017-6019, 6032-6035, 6036-6038, 6051-6053

CLIENT

AVEO

PROJECT

Rochedale Estates

Proposed Subdivision

Stage 6

Cancelling

Lot 5 on SP 248915

Date.01 September 2016

Comp By..WNN/KCH

Checked By..FK

DWG Name..6103-1018 Stage 6

Job Ref..6103

Local Authority..Brisbane City Council

Locality..Rochedale

Scale1 : 750

SheetA1

Plan Ref\* %\$' î %\$%

RevG

RPS

RPS Australia East Pty Ltd  
ACN 140 292 762  
ABN 44 140 292 762

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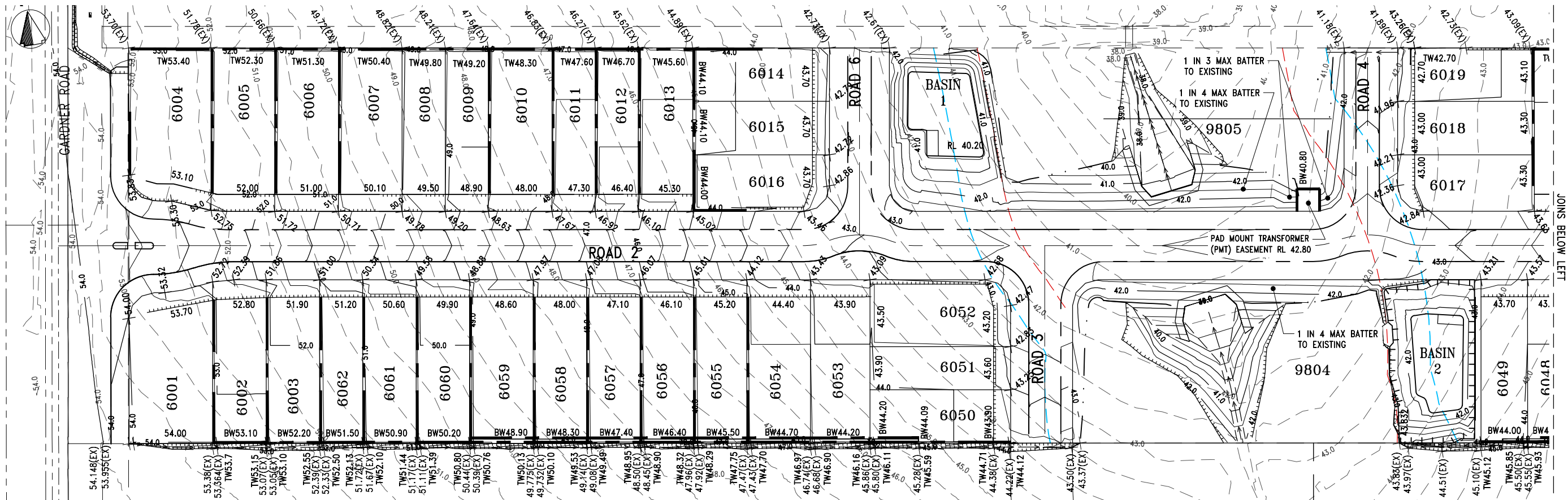
Allotment Breakdown		
Allotment Type		Stage 6
Single Family Dwellings	Size	Lots
Villa Allotment	300-399m²	17
Premium Villa Allotment	400-450m²	10
Courtyard Allotment	451-477m²	20
Premium Courtyard Allotment	478-574m²	13
Traditional Allotment	575m²+	4
Total Allotments		64

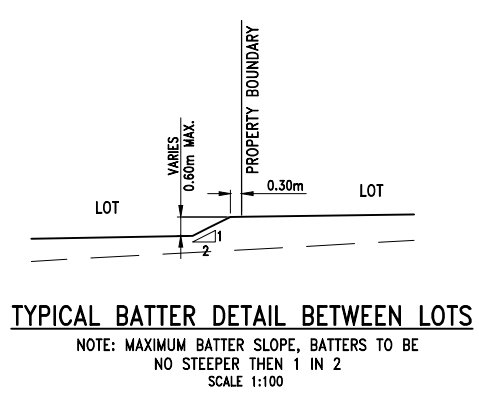
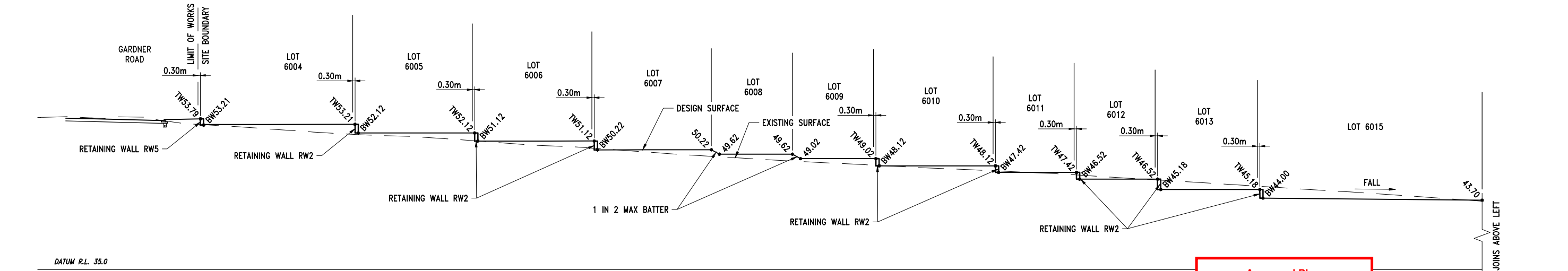
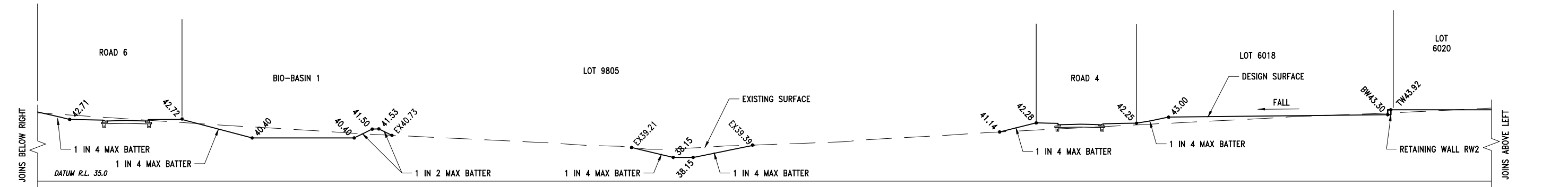
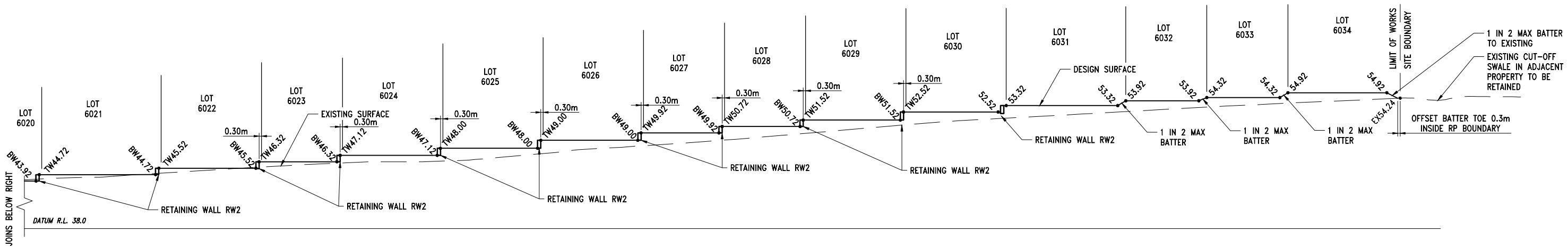
Land Use Budget	
Land Use	Stage 6 Area
Total Stage Area	4.731 ha
Saleable Area	
Single Family Lots	2.975 ha
Total Area of Allotments	2.975 ha
Road Reserve	
Local Roads	1.063 ha
Total Area of New Road	1.063 ha
Open Space	
Waterway Corridor	0.687 ha
Sub Total	0.687 ha
Community Property	
Common Property	0.006 ha
Sub Total	0.006 ha
Total Open Space	0.693 ha
Road Lengths	
Road Type	Stage 6 Length
Shared Access Driveway	23m
12.5m Wide New Road	40m
14.0m Wide New Road	112m
14.5m Wide New Road	38m
16.0m Wide New Road	512m
Total Length of New Road	725m



DESIGNED AB	DRAWN ZC	APPROVED JH	DATE 08.06.17	SCALE @ A1 1:500	SHEET 1 of 1
PROJECT No 13-649		DRAWING No 05		REV D	







SECTION A  
SCALE 1:250

**Neighbouring Property Consent**

This approval does not authorise or give permission to enter onto, under or over any neighbouring private properties to survey or carryout any works without any prior consultation or without the prior consent of the relevant land or property owner(s).

[This includes for any works for: built to boundary walls; any construction (retaining walls) within neighbouring buildings structural zones; boundary fences; temporary rock anchoring; or crane oversail.]

**Approved Plan**  
Brisbane City Council  
06/03/2018

**APPROVED PLAN ONLY REFERS TO:**

- ☒ Earthworks
- ☐ Stormwater
- ☐ Roadworks
- ☐ Traffic Functional Layout
- ☐ Traffic Signals
- ☐ Construction Management Plan
- ☐ WSUD Device(s)
- ☐ Signs and Linemarking

Other:

**Conditional Approval Only**  
(Vegetation Management Plan)

Plans marked "Approved" are conditional to their compliance with the approved Vegetation Management Plan. Works cannot commence prior to obtaining the Council approved "Vegetation Management Plan".

LOCAL AUTHORITY: BRISBANE CITY COUNCIL  
BCC FILE REF NO: A004359770  
RP DESCRIPTION: LOT 5 SP248915  
PARISH/COUNTY: TINGALPA/CHANDLER  
ORIGIN: PSM TBA  
HORIZONTAL DATUM: AHD(0)

REV		DESCRIPTION		BY	SIDR	DATE
A		ORIGINAL ISSUE	ZC	AB		08.06.17
B		REGRADE LOTS 6019 - 6034.	RCM	AB		12.01.18

50510m

1 : 250 (FULL SIZE A1)  
1 : 500 (REDUCED SIZE A3)

SURVEYOR

JASON HARLEY  
RPEQ 5665

For  
RPEQ 12172

Approved by for and on behalf of Bradlees

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Gold Coast Office Level 1, 34 Thomas Drive, Chevron Island QLD 4217

Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5451 1994

Bradlees

Part of the Meinhardt Group

CLIENT

FKP LIFESTYLE PTY. LTD.

TITLE

EARTHWORKS SECTIONS - SHEET 1 OF 3

PROJECT

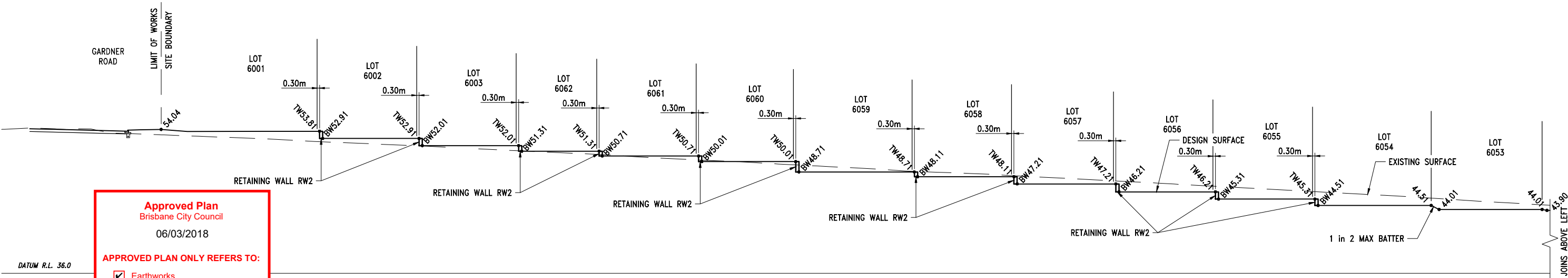
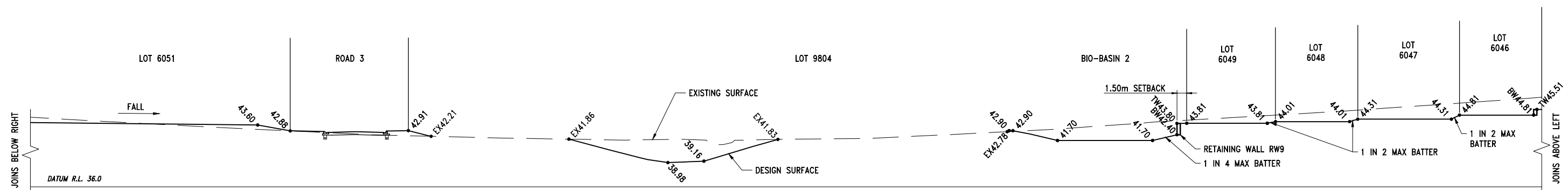
ROCHEDALE ESTATE - STAGE 6  
232 GARDNER ROAD, ROCHEDALE QLD 4123  
BRISBANE CITY COUNCIL

STATUS

FOR CONSTRUCTION

DESIGNED	DRAWN	APPROVED	DATE	SCALE @ A1	SHEET
AB	ZC	JH	08.06.17	1:250	1 OF 3

PROJECT No	DRAWING No	REV
13-649	07	B



Other:

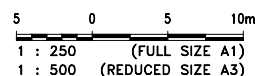
SECTION B  
SCALE 1:500

Plans marked "Approved" are conditional to their compliance with the approved Vegetation Management Plan. Works cannot commence prior to obtaining the Council approved "Vegetation Management Plan".

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*[This includes for any works for: built to boundary walls; any construction (retaining walls) within neighbouring buildings structural zones, boundary fences; temporary rock anchoring; or crane oversail.]*

LOCAL AUTHORITY:	BRISBANE CITY COUNCIL
BCC FILE REF NO:	A004359770
RP DESCRIPTION:	LOT 5 SP248915
PARISH/COUNTY:	TINGALPA/CHANDLER
ORIGIN:	PSM TBA
HORIZONTAL DATUM:	AHD(D)

[illegible]

**SURVEYOR**

JASON HARLEY  
RPEQ 5665

For  RPEQ 12172

Approved by, for and on behalf of Bradlees

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**ABN 29 064 159 191**

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Gold Coast Office Level 1, 34 Thomas Drive, Chevron Island QLD 4217  
Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5451 1994



	CLIENT
--	--------

FKP LIFESTYLE PTY. LTD.

TITLE	EARTHWORKS SECTIONS - SHEET 2 OF 3
-------	---------------------------------------

PROJECT  
ROCHEDALE ESTATE - STAGE 6  
232 GARDNER ROAD, ROCHEDALE QLD 4123  
BRISBANE CITY COUNCIL


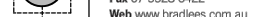

FOR CONSTRUCTION

DESIGNED AB	DRAWN ZC	APPROVED JH	DATE 08.06.17	SCALE @ A1 1:250	SHEET 2 OF 3
PROJECT No 13-649		DRAWING No 08		REV B	





LOCAL AUTHORITY:	BRISBANE CITY COUNCIL
BCC FILE REF NO:	A004359770
RP DESCRIPTION:	LOT 5 SP248915
PARISH/COUNTY:	TINGALPA/CHANDLER
ORIGIN:	PSM TBA
HORIZONTAL DATUM:	AHD(D)

REV		DESCRIPTION		BY	SIDR	DATE	0.1 0 0.1 0.2 0.3 0.4 0.5m		SURVEYOR		JASON HARLEY RPEQ 5665		 Bradford Lees Pty Ltd ABN 29 064 159 191 Ph 07 5528 6411 Fax 07 5528 6422 Web www.bradlees.com.au Email mail.au@bradleesreinhardt.com Postal PO Box 2293, Southport QLD 4215 Gold Coast Office Level 1, 34 Thomas Drive, Chevron Island QLD 4217 Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5451 1994		CLIENT		PROJECT	
A			ORIGINAL ISSUE	ZC	AB	08.06.17	1 : 10 (FULL SIZE A1)		 For RPEQ 12172 Approved by, for and on behalf of Bradlees		 SQC QUALITY ASSURED COMPANY AS/NZS ISO 9001:2008 REG. NO. 233		FKP LIFESTYLE PTY. LTD.		ROCHEDALE ESTATE - STAGE 6			
B			SECTION 1 UPDATED	AB	AB	08.07.17	1 : 20 (REDUCED SIZE A3)						EARTHWORKS SECTIONS - SHEET 3 OF 3		232 GARDNER ROAD, ROCHEDALE QLD 4123			
C			GRADE LOTS 6017 - 6034 TO ROAD 02	RM	NG	16.01.18	5 0 5 10m								BRISBANE CITY COUNCIL			
							1 : 250 (FULL SIZE A1)								STATUS			
							1 : 500 (REDUCED SIZE A3)								DESIGNED AB			
															DRAWN ZC			
															APPROVED JH			
															DATE 08.06.17			
															SCALE @ A1 1:250			
															SHEET 3 OF 3			
															PROJECT NO. 13-649			
															DRAWING NO. 09			
															REV C			

NOTE:

FOR RW2 TYPE RETAINING WALL REFER TO DWG 48 FOR DETAILS.

LEGEND

- NOMINAL KERB LINE / INVERT OF KERB
- RETAINING WALL
- PROPOSED BLOCK WALL
- RETAINING WALL WITH ACOUSTIC FENCE
- SW --- STORMWATER DRAIN LINE
- STAGE BOUNDARY
- ZERO LOT BOUNDARY
- KERB ADAPTORS
- EXISTING RETAINING WALL
- FUTURE RETAINING WALL
- WALL DRAIN LINE

NOTE

WHERE LOTS ARE RETAINED, CONTRACTOR TO INSTALL #300 PVC SLEEVES FOR FENCE POSTS AT 2.4m CTRS AND AT CORNER OF EACH LOT. DEPTH 600mm MIN FOR 1.8m HIGH FENCE, DEPTH 1/3 HEIGHT OF FENCE IF HIGHER. CONFIRM PRIOR TO CONSTRUCTION WITH SUPERINTENDANT.

Conditional Approval Only  
(Vegetation Management Plan)

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[This includes for any works for: built to boundary walls; any construction (retaining walls) within neighbouring buildings structural zones, boundary fences; temporary rock anchoring; or crane oversail.]

Approved Plan  
Brisbane City Council  
06/03/2018

APPROVED PLAN ONLY REFERS TO:

- ☒ Earthworks
- ☐ Stormwater
- ☐ Roadworks
- ☐ Traffic Functional Layout
- ☐ Traffic Signals
- ☐ Construction Management Plan
- ☐ WSUD Device(s)
- ☐ Signs and Linemarking

Other:

FIRE ANT NOTE:

UNDER QUEENSLAND LEGISLATION, FIRE ANTS ARE A NOTIFIABLE PEST AND SUSPECTED SIGHTING MUST BE REPORTED TO BIOSECURITY QUEENSLAND. MOVEMENT OF FIRE ANTS IS PROHIBITED UNLESS APPROVED OTHERWISE BY THE DEPARTMENT OF PRIMARY INDUSTRIES. THE CONTRACTOR SHALL ACQUIRE THE NECESSARY PERMITS TO COMPLETE THE WORKS.



LOCAL AUTHORITY: BRISBANE CITY COUNCIL  
BCC FILE REF NO: A004359770  
RP DESCRIPTION: LOT 5 SP248915  
PARISH/COUNTY: TINGALPA/CHANDLER  
ORIGIN: PSM TBA  
HORIZONTAL DATUM: AHD(0)

REV	DESCRIPTION	BY	SIDR	DATE
A	ORIGINAL ISSUE	ZC	AB	08.06.17
B	RESPONSE TO COUNCIL RFI	MT	RM	12.01.18

5 0 5 10 15 20 25m

1 : 500 (FULL SIZE A1)

1 : 1000 (REDUCED SIZE A3)

SURVEYOR



JASON HARLEY  
RPEQ 5665

For RPEQ 12172

Approved by, for and on behalf of Bradlees

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Gold Coast Office Level 1, 34 Thomas Drive, Chevron Island QLD 4217

Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5451 1994

CLIENT

FKP LIFESTYLE PTY. LTD.

TITLE

RETAINING WALL LAYOUT

PROJECT

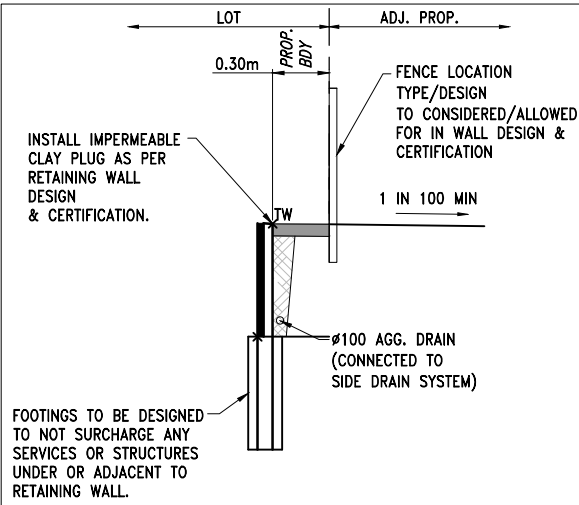
ROCHEDALE ESTATE - STAGE 6  
232 GARDNER ROAD, ROCHEDALE QLD 4123  
BRISBANE CITY COUNCIL

STATUS

ISSUE FOR APPROVAL

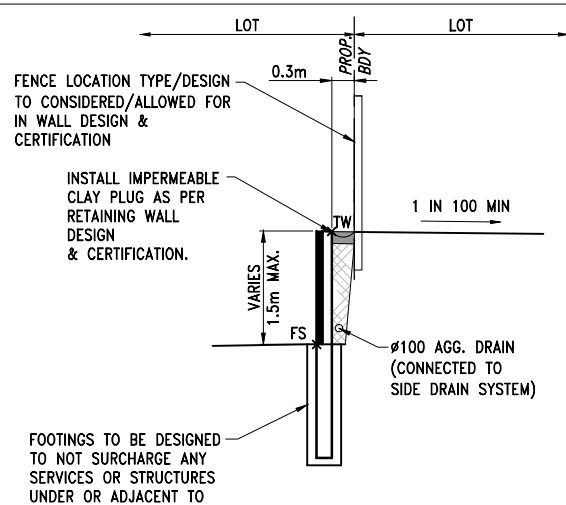
DESIGNED AB DRAWN ZC APPROVED JH DATE 08.06.17 SCALE @ A1 1:500 SHEET 1 OF 1

PROJECT No 13-649 DRAWING No 47 REV B



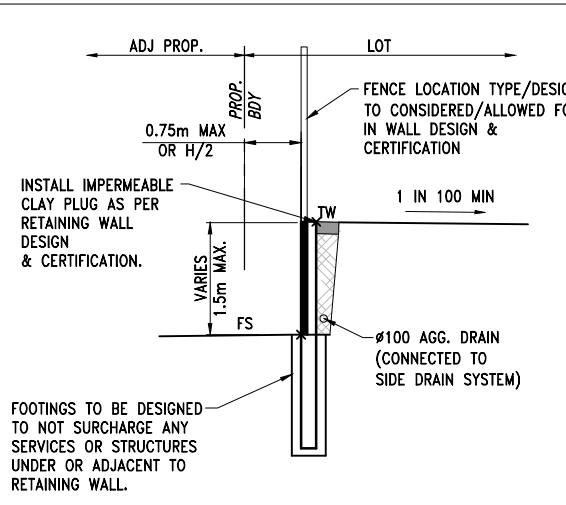
**RW1 SINGLE TIER SLEEPER RETAINING WALL**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.



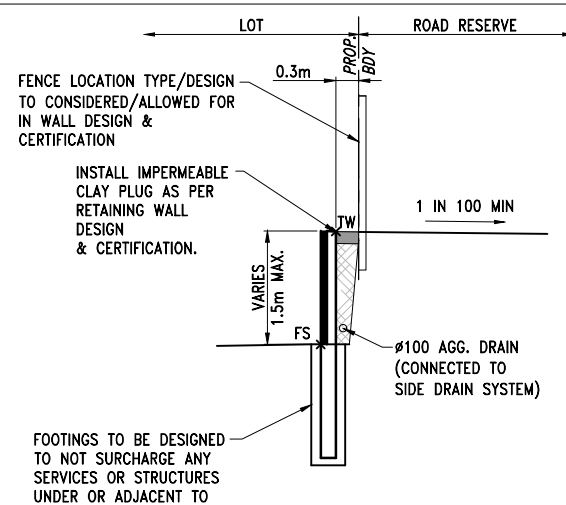
**RW2 SLEEPER RETAINING WALL**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.



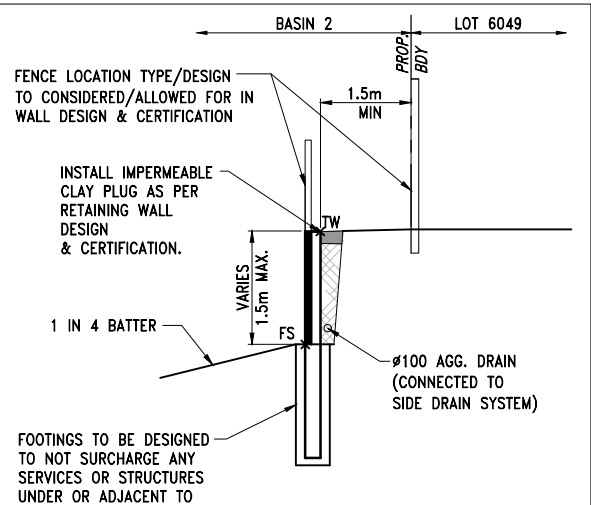
**RW3 SINGLE TIER SLEEPER RETAINING WALL**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.



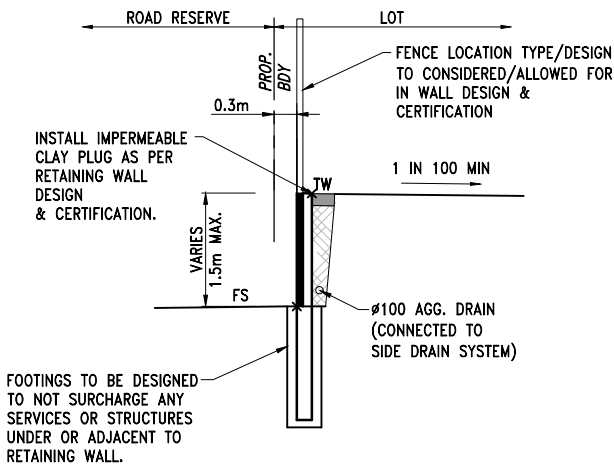
**RW4 SINGLE TIER SLEEPER RETAINING WALL**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.



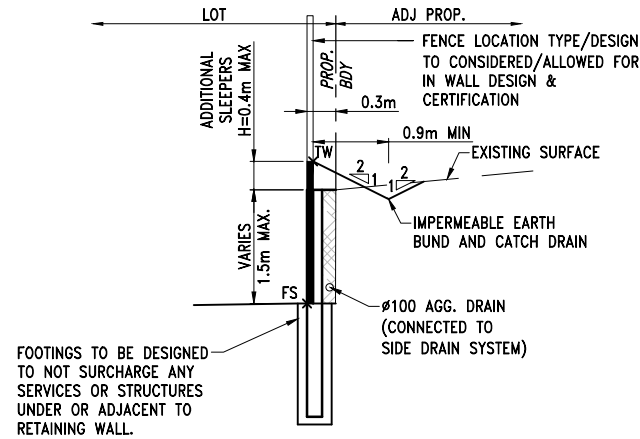
**RW9 SINGLE TIER SLEEPER RETAINING WALL**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.



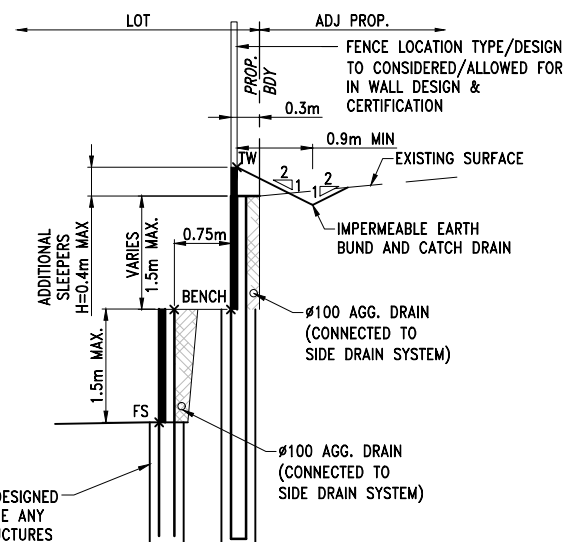
**RW5 SLEEPER RETAINING WALL**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.



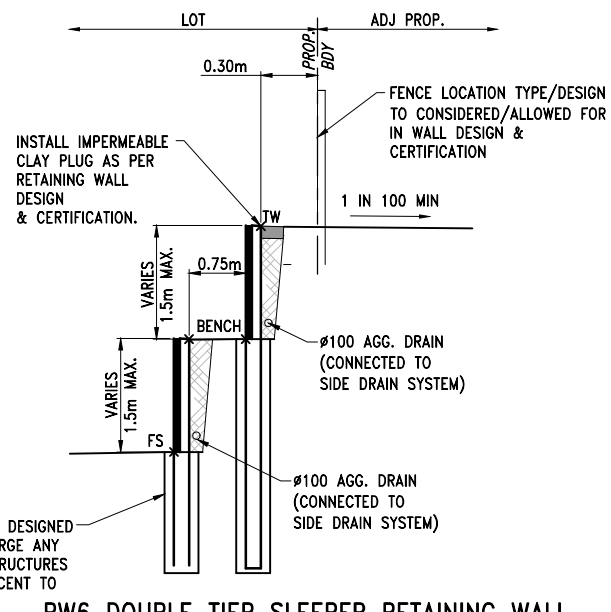
**RW7 SLEEPER RETAINING WALL**  
**WITH EARTH BUND & CATCH DRAIN**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.



**RW8 SLEEPER RETAINING WALL**  
**WITH EARTH BUND & CATCH DRAIN**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.



**RW6 DOUBLE TIER SLEEPER RETAINING WALL**  
**TYPICAL SECTION**

NOT TO SCALE  
SLEEPER WALL DESIGN AND CONSTRUCTION TO BE  
CERTIFIED BY A STRUCTURAL ENGINEER.

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#### Conditional Approval Only (Vegetation Management Plan)

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#### NOTES:

1. WALL ALIGNMENT IS TO BE PEGGED FOR INSPECTION BY SUPERINTENDENT PRIOR TO CONSTRUCTION.
2. WALLS TO BE A VERTICAL FACE TO A MAXIMUM HEIGHT OF 1.5m. TYPE, FINISH AND COLOUR TO BE APPROVED BY SUPERINTENDENT.
3. CONTRACTOR IS RESPONSIBLE FOR PROVIDING STRUCTURAL DESIGN, CONSTRUCTION SUPERVISION AND STRUCTURAL CERTIFICATION BY A SUITABLY QUALIFIED AND EXPERIENCED, REGISTERED STRUCTURAL ENGINEER (RPEQ) FOR ALL WALLS 1.0m HIGH OR GREATER.
4. WALL TO BE DESIGNED FOR A MINIMUM SERVICE LIFE OF 100 YEARS.
5. THE STANDARD BUILDING REGULATION 1993 REQUIRES THAT A BUILDING APPLICATION BE LODGED FOR EARTH RETAINING STRUCTURES >1000mm HIGH.
6. ALL WALLS TO BE DESIGNED BASED ON A GEOTECHNICAL ASSESSMENT OF INSITU SOILS BY A SUITABLY QUALIFIED ENGINEER
7. ALL COUNCIL RETAINING WALLS TO BE CONSTRUCTED IN THE ROAD RESERVE WHERE POSSIBLE.
8. PRIVATE WALLS INCLUDING FOOTING TO BE CONTAINED WHOLLY WITHIN PRIVATE PROPERTY.
9. SUBSOIL DRAINAGE BEHIND ALL WALLS TO INCLUDE DISCHARGE PIPE INTO THE NEAREST STORMWATER STRUCTURE (OR DEDICATED KERB ADAPTOR) AND MUST BE FREE DRAINING. ALL WALL DRAINAGE LINES DISCHARGING THROUGH LOTS OR ROAD VERGE TO BE SOLID uPVC (NO SLOTS) AND MUST BE FREE DRAINING.
10. WALLS ARE TO BE DESIGNED IN ACCORDANCE WITH B.C.C. PSP6 CHAPTER 8 SECTION 8.5.
11. FOOTINGS TO BE CONTAINED WHOLLY WITHIN LOT IN WHICH WALL IS LOCATED.

LOCAL AUTHORITY: BRISBANE CITY COUNCIL  
BCC FILE REF NO: A004359770  
RP DESCRIPTION: LOT 5 SP248915  
PARISH/COUNTY: TINGALPA/CHANDLER  
ORIGIN: PSM TBA  
HORIZONTAL DATUM: AHD(0)

- Approved Plan**  
Brisbane City Council  
06/03/2018
- APPROVED PLAN ONLY REFERS TO:**
- ☒ Earthworks
  - ☐ Stormwater
  - ☐ Roadworks
  - ☐ Traffic Functional Layout
  - ☐ Traffic Signals
  - ☐ Construction Management Plan
  - ☐ WSUD Device(s)
  - ☐ Signs and Linemarking

Other:

REV	DESCRIPTION	BY	SIDR	DATE
A	ORIGINAL ISSUE	ZC	AS	08.06.17
B	RESPONSE TO COUNCIL RF1	MT	RM	12.01.18

SURVEYOR



JASON HARLEY  
RPEQ 5665

For **RPEQ 12172**

Approved by, for and on behalf of Bradlees

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Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5451 1994



CLIENT

FKP LIFESTYLE PTY. LTD.

TITLE

RETAINING WALL DETAILS

PROJECT

ROCHEDALE ESTATE - STAGE 6  
232 GARDNER ROAD, ROCHEDALE QLD 4123  
BRISBANE CITY COUNCIL

STATUS

ISSUE FOR APPROVAL

DESIGNED AB DRAWN ZC APPROVED JH DATE 08.06.17 SCALE @ A1 SHEET 1 OF 1

PROJECT No 13-649 DRAWING No 48 REV B



LIMIT OF WORKS  
1545.47  
1540.000

1520.000

1500.000

1480.000

1460.000

LIMIT OF WORKS  
1450.15

## LEGEND

- 12 FINISHED SURFACE CONTOURS
- NOMINAL KERB LINE / INVERT OF KERB
- 4/1 STORMWATER DRAIN MANHOLE 4 ON LINE 1
- PROPOSED RETAINING WALLS
- S SEWER MAIN
- RM SEWER RISING MAIN
- W WATER MAIN
- WATER CONDUITS (Ø100 CLASS 12 uPVC)
- PROPOSED SWALE DRAIN
- 1.2m WIDE STD B.C.C. CONCRETE FOOTPATH
- PROPOSED BINPADS
- EXISTING SWALE DRAIN
- STAGE BOUNDARY
- ZERO LOT BOUNDARY
- DRIVEWAYS (AND BINPADS SHOWN SIMILAR) TO BE CONSTRUCTED BY CIVIL CONTRACTOR
- KERB ADAPTORS INCL. uPVC PIPES (1 PER LOT) REFER NOTE 6
- KERB ADAPTORS (1 PER LOT) REFER NOTE 6
- INDICATIVE DRIVEWAY LOCATIONS CONSIDERED DURING DESIGN (NOT TO BE BUILT BY CIVILS)
- ROCK ARMOURING TO STORMWATER OUTLET

Approved Plan  
Brisbane City Council

09/03/2018

### APPROVED PLAN ONLY REFERS TO:

- ☐ Earthworks
- ☒ Stormwater
- ☒ Roadworks
- ☐ Traffic Functional Layout
- ☐ Traffic Signals
- ☐ Construction Management Plan
- ☐ WSUD Device(s)
- ☐ Signs and Linemarking

Other:

### ROADWORKS & DRAINAGE NOTES

1. READ IN CONJUNCTION WITH DRAWING 11 GENERAL NOTES.
2. SOAKED CBR TESTS ARE TO BE CARRIED OUT AND RESULTS FORWARDED TO SUPERINTENDENT FOR DETERMINATION OF PAVEMENT DESIGN AND THICKNESS.
3. CBR TEST RESULTS AND PAVEMENT DESIGNS ARE TO BE APPROVED BY B.C.C.
4. SIDE DRAINS ARE TO BE CONSTRUCTED UNDER ALL KERB UNLESS NOTED OTHERWISE AND IN ACCORDANCE WITH B.C.C. STD DRAWING BSD-2041.
5. PRAM RAMPS ARE TO BE CONSTRUCTED AT ALL INTERSECTIONS AND CROSSING POINTS IN ACCORDANCE WITH B.C.C. STD DRAWING BSD-5231.
6. ADAPTOR (1 PER LOT) SHALL BE PROVIDED AT EACH ALLOTMENT WHERE INTER-ALLOTMENT DRAINAGE PITS HAVE NOT BEEN PROVIDED, INCLUDING TWO CAPPED Ø90 OR Ø100 SN10 uPVC PIPES FOR FULL FOOTPATH WIDTH UNDER CONCRETE PATH WHERE APPLICABLE IN ACCORDANCE WITH B.C.C. STD DRAWING BSD-8114. THEY ARE TO BE LOCATED MIN 300mm UPSTREAM FROM THE LOW SIDE BOUNDARY.
7. PROVIDE SIDE DRAINS AND FLUSHING POINTS IN ACCORDANCE WITH B.C.C. STANDARD DRAWING BSD-2041. FLUSHING POINTS TO BE SPACED AT 50m CENTRES MAXIMUM.
8. FOR DRIVEWAYS INDICATED ON THE LOWER SIDE BOUNDARY OF ZERO LOTS, KERB ADAPTORS ARE TO BE INSTALLED UPSTREAM OF THE DRIVEWAY. KERB ADAPTORS ARE NOT TO BE INSTALLED WITHIN 5.0m UPSTREAM OF ANY CATCHPIT. FOR SUCH CASES PROVIDE A DIRECT CONNECTION TO GULLY PIT.
9. THE LOCATION OF ALL STORMWATER OUTLETS ARE INDICATIVE ONLY AND MUST BE VERIFIED IN THE FIELD AND CONFIRMED BY THE SUPERINTENDENT PRIOR TO CONSTRUCTION OF DISCHARGE LINE AND OUTLET.
10. STEP IRONS ARE TO BE FITTED TO ALL STORMWATER STRUCTURES DEEPER THAN 1.35m IN ACCORDANCE WITH B.C.C. STD DRAWING BSD-8021.
11. ALL SIGNS, LINEMARKING & PAVEMENT MARKERS TO BE ACCORDANCE WITH MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD).
12. FOR EXCAVATION, BEDDING AND BACKFILLING OF STORMWATER DRAINAGE PIPES REFER TO B.C.C. STD DRAWING BSD-8011.
13. ALL STORMWATER STRUCTURES & PITS TO BE CONSTRUCTED IN ACCORDANCE B.C.C. STANDARDS.
14. CONTRACTOR TO LIAISE WITH RELEVANT AUTHORITIES FOR THE RELOCATION/PROTECTION OF EXISTING SERVICES. INCLUDING THE PROVISION FOR EXISTING POWER POLES TO BE HELD DURING TRENCH EXCAVATION, OBTAINING THE NECESSARY APPROVALS FROM ASSOCIATED AUTHORITIES AND APPLICATION FEES.

REFER TO EARTHWORKS  
PLANS FOR DETAILS OF SWALE  
DRAIN, TO BE CONSTRUCTED  
TO THE SATISFACTION OF THE  
OWNER OF THE LAND

### FIRE ANT NOTE:

UNDER QUEENSLAND LEGISLATION, FIRE ANTS ARE A NOTIFIABLE PEST AND SUSPECTED SIGHTING MUST BE REPORTED TO BIOSECURITY QUEENSLAND. MOVEMENT OF FIRE ANTS IS PROHIBITED UNLESS APPROVED OTHERWISE BY THE DEPARTMENT OF PRIMARY INDUSTRIES. THE CONTRACTOR SHALL ACQUIRE THE NECESSARY PERMITS TO COMPLETE THE WORKS.



LOCAL AUTHORITY: BRISBANE CITY COUNCIL  
BCC FILE REF NO: A004359770  
RP DESCRIPTION: LOT 5 SP248915  
PARISH/COUNTY: TINGALPA/CHANDLER  
ORIGIN: PSM TBA  
HORIZONTAL DATUM: AHD(0)

REV	DESCRIPTION	BY	SIDR	DATE
A	ORIGINAL ISSUE	ZC	AG	29.06.17
B	DRAINAGE LAYOUT, LEGEND & NOTES AMENDED	MT	NG	29.01.18
C	RESPONSE TO COUNCIL RFI	MT	NG	37.02.18
D	EARTHWORKS AROUND PMT AMENDED	MT	RM	19.02.18

5 0 5 10 15 20 25m

1 : 500 (FULL SIZE A1)  
1 : 1000 (REDUCED SIZE A3)

SURVEYOR



NUWAN GUNAWARDANA  
RPEQ 12172

Approved by, for and on behalf of Bradlees

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Gold Coast Office Level 1, 34 Thomas Drive, Chevron Island QLD 4217

Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5451 1994



CLIENT

FKP LIFESTYLE PTY. LTD.

TITLE

ROADWORKS AND DRAINAGE  
LAYOUT

PROJECT

ROCHEDALE ESTATE - STAGE 6  
232 GARDNER ROAD, ROCHEDALE QLD 4123  
BRISBANE CITY COUNCIL

STATUS

ISSUE FOR APPROVAL

DESIGNED

DRAWN

APPROVED

DATE

SCALE @ A1

SHEET

AB

ZC

JH

08.06.17

1:500

1 OF 1

PROJECT No

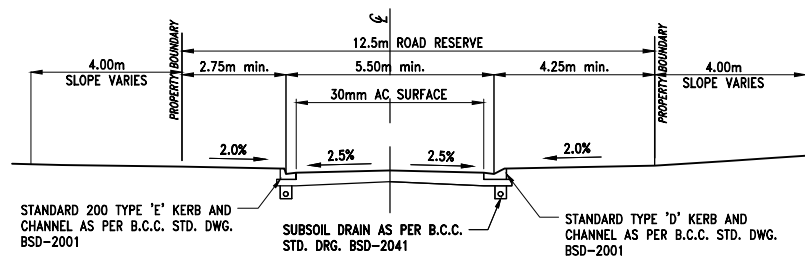
DRAWING No

REV

13-649

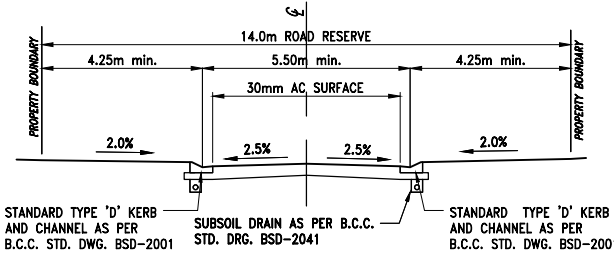
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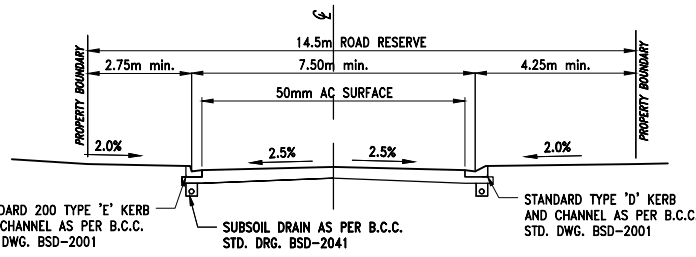
TYPICAL SECTION LOCAL ROAD

ROAD 4  
SCALE 1:100m



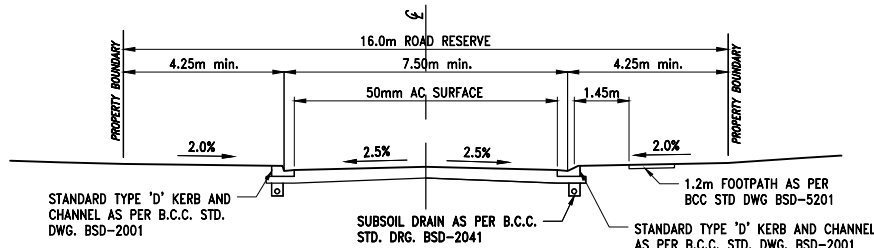
TYPICAL SECTION LOCAL ROAD

ROAD 5



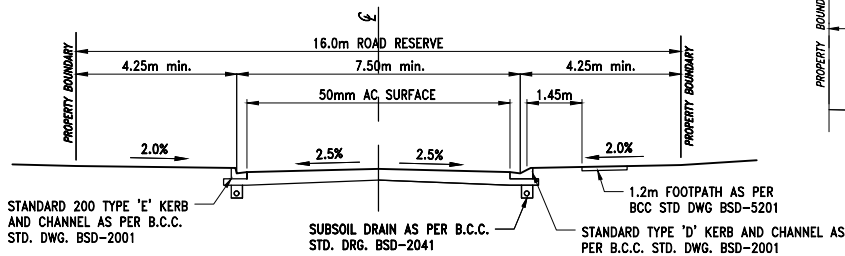
TYPICAL SECTION NEIGHBOURHOOD ROAD

ROAD 3  
SCALE 1:100m



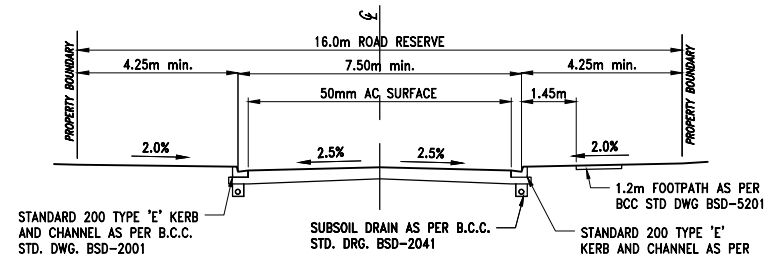
TYPICAL SECTION NEIGHBOURHOOD ROAD

ROAD 2  
CH.0.000 - CH.190.00, CH.334.00 - CH.526.00  
SCALE 1:100m



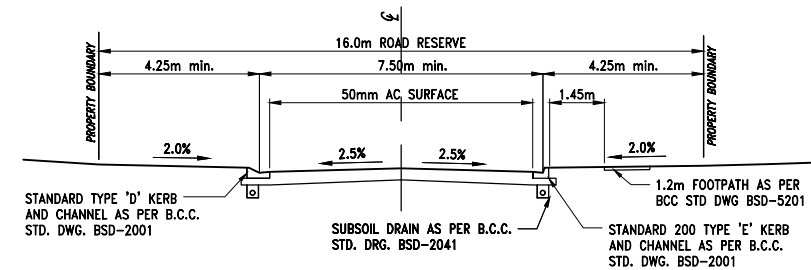
TYPICAL SECTION NEIGHBOURHOOD ROAD

ROAD 2  
CH.190.00 - CH.225.00  
SCALE 1:100m



TYPICAL SECTION NEIGHBOURHOOD ROAD

ROAD 2  
CH.225.00 - CH.310.00  
SCALE 1:100m



TYPICAL SECTION NEIGHBOURHOOD ROAD

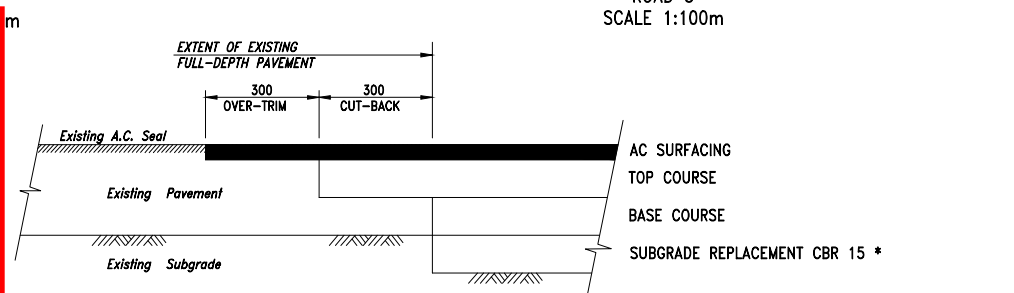
ROAD 2  
CH.310.00 - CH.334.00  
SCALE 1:100m

Approved Plan  
Brisbane City Council  
09/03/2018

APPROVED PLAN ONLY REFERS TO:

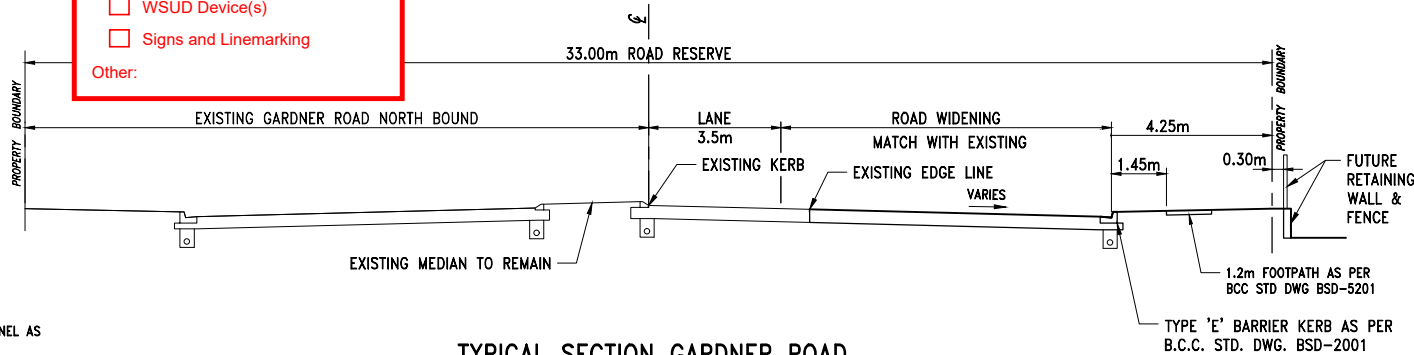
- ☐ Earthworks
- ☒ Stormwater
- ☒ Roadworks
- ☐ Traffic Functional Layout
- ☐ Traffic Signals
- ☐ Construction Management Plan
- ☐ WSUD Device(s)
- ☐ Signs and Linemarking

Other:



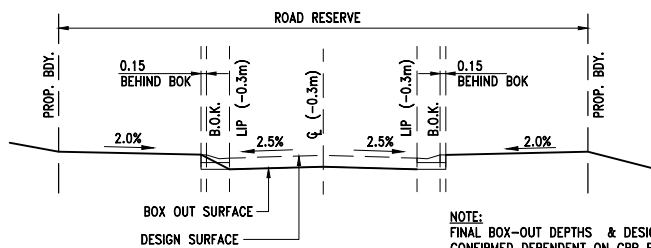
PAVEMENT CUT-BACK DETAILS

SCALE 1 : 100



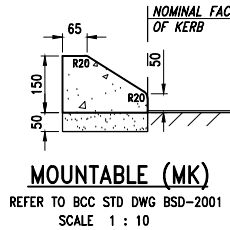
TYPICAL SECTION GARDNER ROAD

SCALE 1:100



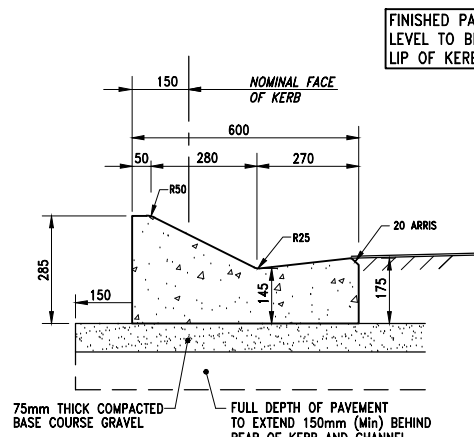
TYPICAL ROAD BOX-OUT SECTION

FOR ALL ROADS WITH TWO-WAY CROSSFALL  
SCALE 1 : 100



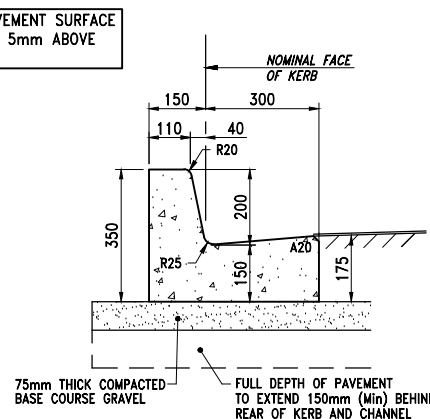
MOUNTABLE (MK)

REFER TO BCC STD DWG BSD-2001  
SCALE 1 : 10



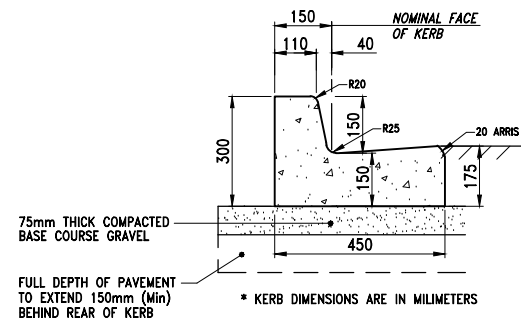
TYPICAL SECTION  
KERB AND CHANNEL TYPE 'D'

REFER TO BCC STD DWG BSD-2001  
SCALE 1 : 10



TYPICAL SECTION  
KERB AND CHANNEL 200 TYPE 'E'

REFER TO BCC STD DWG BSD-2001  
SCALE 1 : 10



TYPICAL SECTION  
KERB AND CHANNEL STANDARD TYPE 'E'

REFER TO BCC STD DWG BSD-2001  
SCALE 1 : 10

## PAVEMENT NOTES

- THE COMPACTED DEPTHS OF PAVEMENT SHOWN ON THE DRAWINGS ARE INDICATIVE DESIGN DEPTHS ONLY AND MAY BE VARIED AFTER SUBGRADE TESTS ARE TAKEN. PAVEMENT DEPTHS SHALL BE SUBJECT TO APPROVAL BY B.C.C.
- PAVEMENT MATERIAL SHALL CONFORM TO B.C.C SPECIFICATIONS.

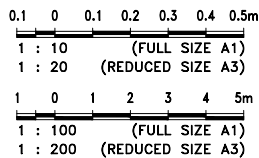
## NOTES

- BATTER SLOPES AND PAVEMENT CROSS FALLS SHOWN ON THIS DRAWING ARE TYPICAL ONLY. FOR VARIATION FROM THE STANDARD PROFILES REFER RELEVANT ROADWORKS DRAWINGS.
- KERB PROFILES ARE TO BE IN ACCORDANCE WITH B.C.C. STANDARD DRAWING BSD-2001.
- SUB SURFACE DRAINAGE SHALL BE ADJACENT TO ALL KERB AND CHANNEL AND KERB LOCATIONS UNLESS DIRECTED OTHERWISE. REFER TO B.C.C. STANDARD DRAWING BSD-2041.
- REFER TO B.C.C. STANDARD DRAWING BSD-5201 TO 5204 FOR CONCRETE FOOTPATH DETAILS.
- VERGE PROFILE TO BE IN ACCORDANCE WITH B.C.C. STANDARD DRAWINGS BSD-1021 & BSD-1022.

## GENERAL NOTES

- ALL DIMENSIONS ON THE JOB ARE IN METRES UNLESS SHOWN OTHERWISE.
- THE CONTRACTOR IS TO MAKE THEMSELVES FULLY AWARE OF ALL EXISTING SERVICES PRIOR TO WORKS COMMENCING. PARTICULAR ATTENTION IS DRAWN TO THE EXISTING PRESSURISED GAS MAIN & LIVE OVERHEAD ELECTRICAL DISTRIBUTION IN THE VICINITY OF THE PROPOSED WORKS.
- ALL WORKS ARE TO BE CARRIED OUT TO B.C.C. STANDARDS UNLESS OTHERWISE DIRECTED (IN WRITING).
- NOTWITHSTANDING THE LIMITS OF CUTTING AND FILLING SHOWN ON THE DRAWINGS, THE ACTUAL LIMITS SHALL BE DETERMINED ON SITE BY THE SUPERINTENDENT DURING CONSTRUCTION. SIMILARLY, FINISHED SURFACE CONTOURS FOR ALLOTMENTS MAY BE ADJUSTED BY A WRITTEN DIRECTION OF THE SUPERINTENDENT DURING CONSTRUCTION (REFER JOB SPECIFICATION).
- THE CONTRACTOR SHALL INITIALLY EXCAVATE THE PAVEMENT BOX TO THE MIN. DEPTHS NOMINATED ON THE PAVEMENT DESIGN BOX ON LONGITUDINAL SECTION OF ROAD. HE SHALL THEN NOTIFY THE SUPERINTENDENT WHO WILL FIX THE PAVEMENT THICKNESS TO BE CONSTRUCTED FOLLOWING THE RESULTS OF SUBGRADE TESTING.
- ALL DRAINAGE PIPES SHALL BE CLASS 3 R.C. PIPES UNLESS SHOWN OTHERWISE.
- UNLESS SHOWN OTHERWISE, THE INVERT LEVELS SHOWN ON DRAINAGE LONGITUDINAL SECTIONS ARE LEVELS CALCULATED AT THE CENTRES OF MANHOLES. TO OBTAIN LEVELS ON DRAINLINES AT THE INSIDE FACE OF MANHOLES, THE CONTRACTOR SHALL MAKE ALLOWANCE FOR THE DIFFERENCE IN LEVEL CALCULATED AT SLOPE SHOWN ON DRAINLINE LONGITUDINAL SECTION FOR THE APPROPRIATE DISTANCE.
- THE LEVELS AND SLOPES SHOWN ON MANHOLE COVERS ARE APPROXIMATE ONLY. THE CONTRACTOR SHALL FINISH MANHOLE COVERS AND SURROUNDS TO SUIT THE SLOPE AND LEVEL OF THE FINISHED SURFACE LEVEL AT THAT LOCATION UNLESS OTHERWISE DIRECTED BY THE SUPERINTENDENT.
- ALL SETTING OUT IS TO NOMINAL KERB LINE AND LEVELS ARE TO LIP OF CHANNEL OR FACE OF BARRIER KERB UNLESS SHOWN OTHERWISE.
- WHERE WORK UNDER THIS CONTRACT ABUTS EXISTING ROADS THE KERB CONNECTIONS SHALL BE NEAT AND THE CONTRACTOR SHALL SAW CUT THE EXISTING PAVEMENT PRIOR TO THE LAYING OF ASPHALT.
- KERB AND CHANNEL SHALL BE CONSTRUCTED TO THE TYPES SHOWN ON THE TYPICAL SECTIONS AND ALL KERB SHALL BE AS SHOWN ON THE JOB DRAWINGS AND IN ACCORDANCE WITH B.C.C. STANDARD DRAWINGS.
- THE CIVIL CONTRACTOR SHALL LIAISE WITH ELECTRICAL SUBCONTRACTOR TO ENSURE THAT STREET LIGHTS ARE LOCATED CLEAR OF WATER AND SEWER SERVICES.
- ANY WORK CONSTRUCTED OUTSIDE TOLERANCES WILL BE RECTIFIED AT CONTRACTORS EXPENSE IF ORDERED.
- ALL BATTERS BETWEEN 1:4 AND 1:6 ARE TO BE FULLY TURFED TO PREVENT SCOUR AND EROSION. ANY BATTERS BETWEEN 1:4 AND 1:3 TO BE HEAVILY LANDSCAPED. BATTERS STEEPER THAN 1:3 ARE UNDESIRABLE U.N.O.
- THE LOCATION OF ALL STORMWATER OUTLETS ARE INDICATIVE ONLY AND MUST BE VERIFIED IN THE FIELD AND CONFIRMED BY THE SUPERINTENDENT PRIOR TO CONSTRUCTION OF DISCHARGE LINE AND OUTLET.
- REFER TO B.C.C. STANDARD DRAWING BSD-5206 & 5208 FOR RELEVANT CONCRETE JOINTING DETAILS.

REV	DESCRIPTION	BY	SIR	DATE
A	ORIGINAL ISSUE	ZC	AB	08.06.17
B	SECTIONS & NOTES AMENDED	MT	NG	29.01.18



SURVEYOR

NUWAN GUNAWARDANA  
RPEQ 12172

Approved by for and on behalf of Bradlees

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Postal PO Box 2293, Southport QLD 4215  
Gold Coast Office Level 1, 34 Thomas Drive, Chevron Island QLD 4217  
Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5451 1994

CLIENT

FKP LIFESTYLE PTY. LTD.

TITLE

TYPICAL SECTIONS & KERB  
DETAILS

PROJECT	STATUS	DESIGNED	DRAWN	APPROVED	DATE	SCALE @ A1	SHEET
ROCHEDALE ESTATE - STAGE 6 232 GARDNER ROAD, ROCHEDALE QLD 4123 BRISBANE CITY COUNCIL	ISSUE FOR APPROVAL	AB	ZC	JH	08.06.17	1 : 10	1 OF 1
PROJECT No	DRAWING No	REV					
13-649	11						B

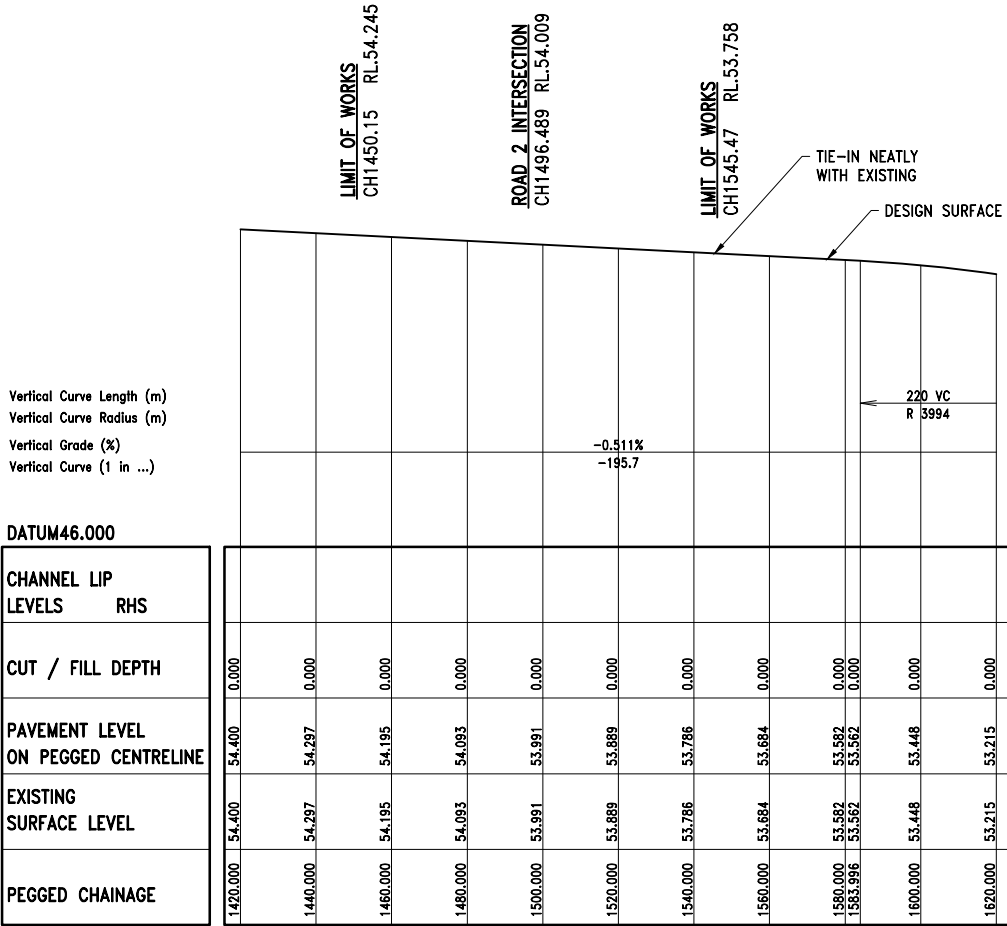


NOMINAL PAVEMENT DESIGN

AC SURFACING TO MATCH THE EXISTING

\* ALL PAVEMENT DEPTH SUBJECT TO CBR TESTING AND  
BRISBANE CITY COUNCIL APPROVAL

GARDNER ROAD – ALIGNMENT TABLE					
PT	CHAINAGE	EASTING	NORTHING	LEVEL	BEARING
	1420.000	1570.720	8146.941	54.400	9°32'44.54"
	1440.000	1574.037	8166.664	54.297	9°32'44.54"
	1460.000	1577.353	8186.387	54.195	9°32'44.54"
	1480.000	1580.670	8206.110	54.093	9°32'44.54"
	1500.000	1583.987	8225.833	53.991	9°32'44.54"
	1520.000	1587.303	8245.556	53.889	9°32'44.54"
	1540.000	1590.620	8265.279	53.786	9°32'44.54"
	1560.000	1593.937	8285.002	53.684	9°32'44.54"
	1580.000	1597.253	8304.725	53.582	9°32'44.54"
	1600.000	1600.570	8324.449	53.448	9°32'44.54"
	1620.000	1603.887	8344.172	53.215	9°32'44.54"



Approved Plan  
Brisbane City Council

09/03/2018

APPROVED PLAN ONLY REFERS TO:

- ☐ Earthworks
- ☒ Stormwater
- ☒ Roadworks
- ☐ Traffic Functional Layout
- ☐ Traffic Signals
- ☐ Construction Management Plan
- ☐ WSUD Device(s)
- ☐ Signs and Linemarking

Other:

GARDNER ROAD

SCALE: HORIZONTAL – 1:1000  
VERTICAL – 1:100

LOCAL AUTHORITY: BRISBANE CITY COUNCIL  
BCC FILE REF NO: A004359770  
RP DESCRIPTION: LOT 5 SP248915  
PARISH/COUNTY: TINGALPA/CHANDLER  
ORIGIN: PSM TBA  
HORIZONTAL DATUM: AHD(D)

REV		DESCRIPTION		BY	SIDR	DATE											CLIENT		PROJECT																																															
A	6	ORIGINAL ISSUE PAVEMENT DESIGN AMENDED		ZC MT	AB NG	08.06.17 29.01.18											FKP LIFESTYLE PTY. LTD.		ROCHEDALE ESTATE - STAGE 6 232 GARDNER ROAD, ROCHEDALE QLD 4123 BRISBANE CITY COUNCIL																																															
							<p>SURVEYOR</p> <p>NUWAN GUNAWARDANA RPEQ 12172</p> <p></p> <p>Approved by: for and on behalf of Bradlees</p> <p>This drawing has been produced for the exclusive use of the client (nominated on this document). No third party is to rely on this document without written permission from Bradlees. This drawing is not to be constructed from unless 'Issued for construction' is displayed and only where signed by an RPEQ.</p> <p>© Copyright</p>																																																											
							<p>QUALITY ASSURED COMPANY AS/NZS ISO 9001:2008 REG. NO. 233</p>																																																											
							<p>Bradford Lees Pty Ltd ABN 29 064 199 191</p> <p>Ph 07 5528 6411 Fax 07 5528 6422 Web www.bradlees.com.au Email mail.au@bradleesmeinhardt.com Postal PO Box 2293, Southport QLD 4215 Gold Coast Office Level 1, 34 Thomas Drive, Chevron Island QLD 4217 Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5461 1994</p> <p></p>																																																											
							TITLE GARNER ROAD LONGITUDINAL SECTION										STATUS ISSUE FOR APPROVAL																																																	
							DESIGNED AB										DRAWN ZC										APPROVED JH										DATE 08.06.17										SCALE @ A1 1 OF 1										SHEET B									
							PROJECT NO. 13-649										DRAWING NO. 12										REV B																																							





GARDNER ROAD INTERSECTION  
CH0.000 RL.54.009

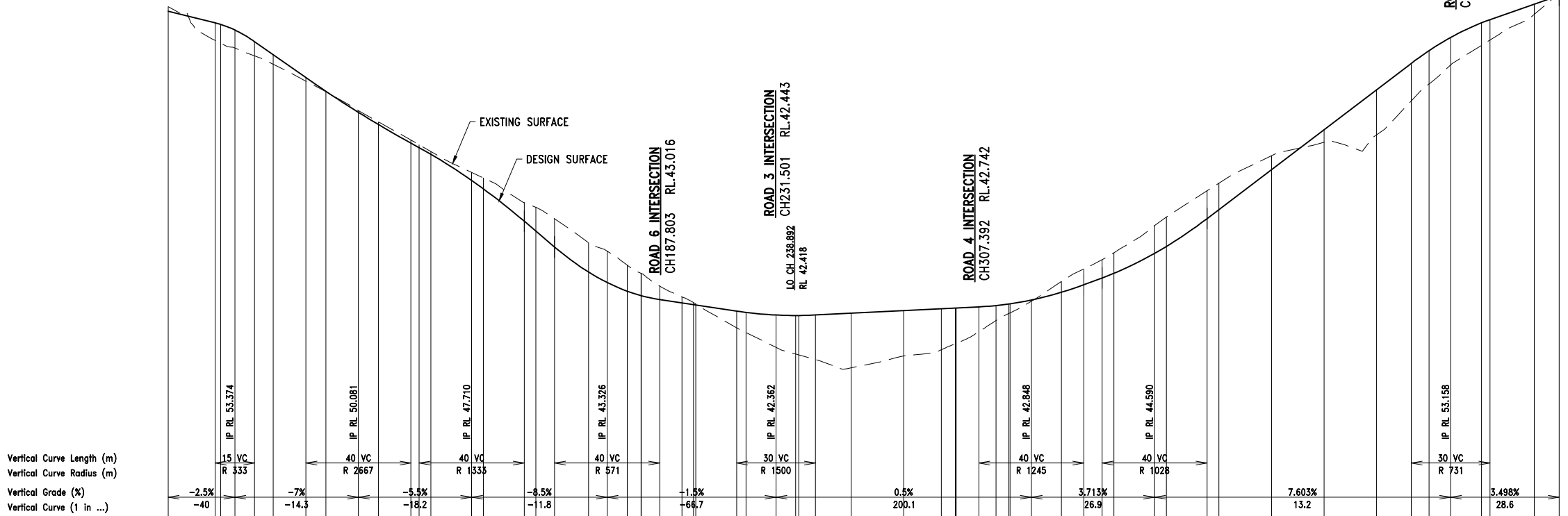
NOMINAL PAVEMENT DESIGN

50mm AC SURFACING  
100mm BASE COURSE (CLASS 1 - CBR80)  
100mm SUB BASE COURSE (CLASS 2 - CBR 45)  
SUBGRADE REPLACEMENT AS REQUIRED (CBR 15)

\* ALL PAVEMENT DEPTH SUBJECT TO CBR TESTING AND  
BRISBANE CITY COUNCIL APPROVAL

ROAD 5 INTERSECTION  
CH490.528 RL.53.132

LIMIT OF ROADWORKS  
CH526.000 RL.54.481



DATUM 33.000

PEGGED CHAINAGE	EXISTING SURFACE LEVEL	PAVEMENT LEVEL ON PEGGED CENTRELINE	CUT / FILL DEPTH	CHANNEL LIP LEVELS	
				LHS	RHS
0.000	54.173	54.009	-0.164		
17.879	52.890	53.562	0.672		
20.000	52.784	53.502	0.718		
25.379	52.606	53.290	0.684	53.149	53.136
32.879	52.308	52.849	0.541	52.749	52.739
40.000	51.983	52.351	0.368	52.268	52.268
52.418	51.344	51.481	0.137	51.399	51.399
60.000	50.952	50.961	0.010	50.879	50.879
72.418	50.225	50.156	-0.068	50.074	50.074
80.000	49.793	49.693	-0.100	49.611	49.611
92.418	49.087	48.981	-0.116	48.899	48.899
95.534	48.918	48.812	-0.106	48.778	48.778
100.000	48.661	48.557	-0.105	48.724	48.724
115.534	47.866	47.560	-0.306	47.477	47.477
120.000	47.857	47.240	-0.617	47.157	47.157
135.534	46.715	46.010	-0.705	45.928	45.928
140.000	46.540	45.630	-0.910	45.548	45.548
147.106	46.100	45.026	-1.074	44.944	44.944
160.000	45.194	44.076	-1.118	43.993	43.993
167.106	44.871	43.676	-1.195	43.595	43.595
174.729	44.339	43.346	-0.993	43.264	43.264
180.000	44.025	43.177	-0.848	43.095	43.095
180.056	44.023	43.176	-0.847	43.093	43.093
187.106	43.539	43.026	-0.512	42.944	42.944
195.552	43.126	42.900	-0.226	42.817	42.817
200.000	42.110	42.833	0.723	42.751	42.751
200.678	42.858	42.820	-0.036	42.734	42.737
216.390	41.950	42.587	0.637	42.501	42.505
220.000	41.764	42.537	0.773	42.451	
231.390	41.208	42.437	1.231	42.352	
238.892	40.949	42.418	1.470	42.332	
240.000	40.918	42.419	1.501	42.333	42.591
246.390	40.740	42.437	1.697	42.351	42.619
260.000	40.427	42.505	2.078	42.419	42.662
280.000	40.377	42.605	1.728	42.519	42.712
294.318	41.112	42.677	1.565	42.591	42.771
299.644	41.343	42.703	1.360	42.619	42.817
300.000	41.350	42.705	1.348	42.619	42.819
308.578	41.800	42.748	0.948	42.662	42.862
315.140	42.230	42.798	0.569	42.712	42.878
320.000	42.495	42.858	0.362	42.782	42.923
320.467	42.518	42.864	0.346	42.778	
328.578	42.361	43.009	0.048	42.927	
340.000	43.709	43.302	-0.407	43.219	43.219
348.578	44.193	43.591	-0.602	43.508	43.508
355.481	44.540	43.847	-0.693	43.765	43.765
360.000	44.807	44.025	-0.782	43.942	43.942
375.481	45.639	44.784	-1.055	44.702	44.702
380.000	46.166	45.050	-1.116	44.967	44.967
395.481	47.172	46.110	-1.062	46.028	46.028
400.000	47.460	46.454	-1.006	46.371	46.371
420.000	48.301	47.975	-0.526		
440.000	49.913	49.495	0.482	49.413	49.413
460.000	49.298	51.016	1.718	50.934	50.934
473.172	50.885	52.018	1.432	51.935	51.935
480.000	51.234	52.505	1.271	52.422	52.422
488.172	51.553	53.004	1.051	52.921	52.921
500.000	52.710	53.565	0.854	53.482	53.482
503.172	52.908	53.683	0.774	53.6	53.6
520.000	53.883	54.271	0.389	54.189	54.189
529.529		54.605			

Horizontal Curve Radius (m)

ROAD 2

SCALE: HORIZONTAL - 1:1000  
VERTICAL - 1:100

Approved Plan  
Brisbane City Council

09/03/2018

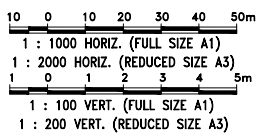
APPROVED PLAN ONLY REFERS TO:

- ☐ Earthworks
- ☒ Stormwater
- ☒ Roadworks
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- ☐ Traffic Signals
- ☐ Construction Management Plan
- ☐ WSUD Device(s)
- ☐ Signs and Linemarking

Other:

LOCAL AUTHORITY: BRISBANE CITY COUNCIL  
BCC FILE REF NO: A004359770  
RP DESCRIPTION: LOT 5 SP248915  
PARISH/COUNTY: TINGALPA/CHANDLER  
ORIGIN: PSM TBA  
HORIZONTAL DATUM: AHD(0)

REV	DESCRIPTION	BY	SIDR	DATE
A	ORIGINAL ISSUE	ZC	AB	08.06.17



SURVEYOR  
NUWAN GUNAWARDANA  
RPEQ 12172  
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Gold Coast Office Level 1, 34 Thomas Drive, Chevron Island QLD 4217  
Brisbane Ph 07 3018 5034 Sunshine Coast Ph 07 5451 1994



CLIENT  
FKP LIFESTYLE PTY. LTD.  
TITLE  
ROAD 2 LONGITUDINAL SECTION

PROJECT	ROCHEDALE ESTATE - STAGE 6 232 GARDNER ROAD, ROCHEDALE QLD 4123 BRISBANE CITY COUNCIL
STATUS	ISSUE FOR APPROVAL
DESIGNED	AB
DRAWN	ZC
APPROVED	JH
DATE	08.06.17
SCALE @ A1	1 : 1000
SHEET	1 OF 1
PROJECT No	13-649
DRAWING No	14
REV	A



## APPENDIX C

### WBNM MODEL CATCHMENT DETAILS







#### Appendix C1 – Existing Catchment Details

Catchment ID	Downstream ID	Area (ha)	Impervious Fraction (%)	Catchment Lag Parameters	Flowpath Parameter
SUB26	SUB25	1.843	5	1.6/0.1	1
SUB24	SUB25	2.098	5	1.6/0.1	1
SUB22	SUB23	0.936	75	1.6/0.1	1
SUB23	SUB17	0.994	75	1.6/0.1	1
SUB19	SUB17	0.191	75	1.6/0.1	1
SUB21	SUB20	0.956	75	1.6/0.1	1
SUB20	SUB18	0.912	75	1.6/0.1	1
SUB16	SUB06	0.908	20	1.6/0.1	1
SUB14	SUB15	0.506	15	1.6/0.1	1
SUB15	SUB06	0.573	0	1.6/0.1	1
SUB08	SUB06	3.065	0	1.6/0.1	1
SUB13	SUB09	1.181	70	1.6/0.1	1
SUB12	SUB09	1.158	50	1.6/0.1	1
SUB11	SUB10	1.305	60	1.6/0.1	1
SUB10	SUB09	1.422	75	1.6/0.1	1
SUB09	SUB07	1.297	5	1.6/0.1	1
SUB07	SUB06	1.738	3	1.6/0.1	1
SUB04	SUB05	0.932	50	1.6/0.1	1
SUB03	SUB05	0.729	75	1.6/0.1	1
SUB05	SUB06	1.182	75	1.6/0.1	1
SUB01	SUB02	0.332	0	1.6/0.1	1
SUB02	SUB06	0.587	0	1.6/0.1	1
SUB06	SUB18	1.093	0	1.6/0.1	1
SUB18	SUB17	0.39	5	1.6/0.1	1
SUB17	SUB25	0.374	5	1.6/0.1	1
SUB25	SINK	1.606	0	1.6/0.1	1

#### Appendix C2 – Developed Catchment Details

Catchment ID	Downstream ID	Area (ha)	Impervious Fraction (%)	Catchment Lag Parameters	Flowpath Parameter
SUB26	SUB25	1.843	5	1.6/0.1	1
SUB24	SUB25	2.098	5	1.6/0.1	1
SUB22	SUB23	0.936	75	1.6/0.1	1
SUB23	SUB17	0.994	75	1.6/0.1	1
SUB19	SUB17	0.191	75	1.6/0.1	1
SUB21	SUB20	0.956	75	1.6/0.1	1
SUB20	SUB18	0.912	75	1.6/0.1	1
SUB16	SUB06	0.908	75	1.6/0.1	1
SUB14	SUB15	0.506	15	1.6/0.1	1
SUB15	SUB06	0.573	0	1.6/0.1	1



Catchment ID	Downstream ID	Area (ha)	Impervious Fraction (%)	Catchment Lag Parameters	Flowpath Parameter
SUB08	SUB06	3.065	0	1.6/0.1	1
SUB13	SUB09	1.181	70	1.6/0.1	1
SUB12	SUB09	1.158	50	1.6/0.1	1
SUB11	SUB10	1.305	60	1.6/0.1	1
SUB10	SUB09	1.422	75	1.6/0.1	0.5
SUB09	SUB07	1.297	5	1.6/0.1	0.5
SUB07	SUB06	1.738	3	1.6/0.1	1
SUB04	SUB05	0.932	50	1.6/0.1	1
SUB03	SUB05	0.729	75	1.6/0.1	1
SUB05	SUB06	1.182	75	1.6/0.1	1
SUB01	SUB02	0.332	0	1.6/0.1	0.5
SUB02	SUB06	0.587	0	1.6/0.1	0.5
SUB06	SUB18	1.093	0	1.6/0.1	1
SUB18	SUB17	0.39	5	1.6/0.1	1
SUB17	SUB25	0.374	5	1.6/0.1	1
SUB25	SINK	1.606	0	1.6/0.1	1

#### Appendix C3 – Design Planning Level Immunity Case Catchment Details

Catchment ID	Downstream ID	Area (ha)	Impervious Fraction (%)	Catchment Lag Parameters	Flowpath Parameter
SUB26	SUB25	1.843	5	1.6/0.1	1
SUB24	SUB25	2.098	5	1.6/0.1	1
SUB22	SUB23	0.936	75	1.6/0.1	1
SUB23	SUB17	0.994	75	1.6/0.1	1
SUB19	SUB17	0.191	75	1.6/0.1	1
SUB21	SUB20	0.956	75	1.6/0.1	1
SUB20	SUB18	0.912	75	1.6/0.1	1
SUB16	SUB06	0.908	75	1.6/0.1	1
SUB14	SUB15	0.506	75	1.6/0.1	1
SUB15	SUB06	0.573	75	1.6/0.1	1
SUB08	SUB06	3.065	75	1.6/0.1	1
SUB13	SUB09	1.181	70	1.6/0.1	1
SUB12	SUB09	1.158	50	1.6/0.1	1
SUB11	SUB10	1.305	60	1.6/0.1	1
SUB10	SUB09	1.422	75	1.6/0.1	1
SUB09	SUB07	1.297	5	1.6/0.1	1
SUB07	SUB06	1.738	50	1.6/0.1	1
SUB04	SUB05	0.932	50	1.6/0.1	1
SUB03	SUB05	0.729	75	1.6/0.1	1
SUB05	SUB06	1.182	75	1.6/0.1	1
SUB01	SUB02	0.332	75	1.6/0.1	1
SUB02	SUB06	0.587	75	1.6/0.1	1



Catchment ID	Downstream ID	Area (ha)	Impervious Fraction (%)	Catchment Lag Parameters	Flowpath Parameter
SUB06	SUB18	1.093	0	1.6/0.1	1
SUB18	SUB17	0.39	5	1.6/0.1	1
SUB17	SUB25	0.374	5	1.6/0.1	1
SUB25	SINK	1.606	0	1.6/0.1	1





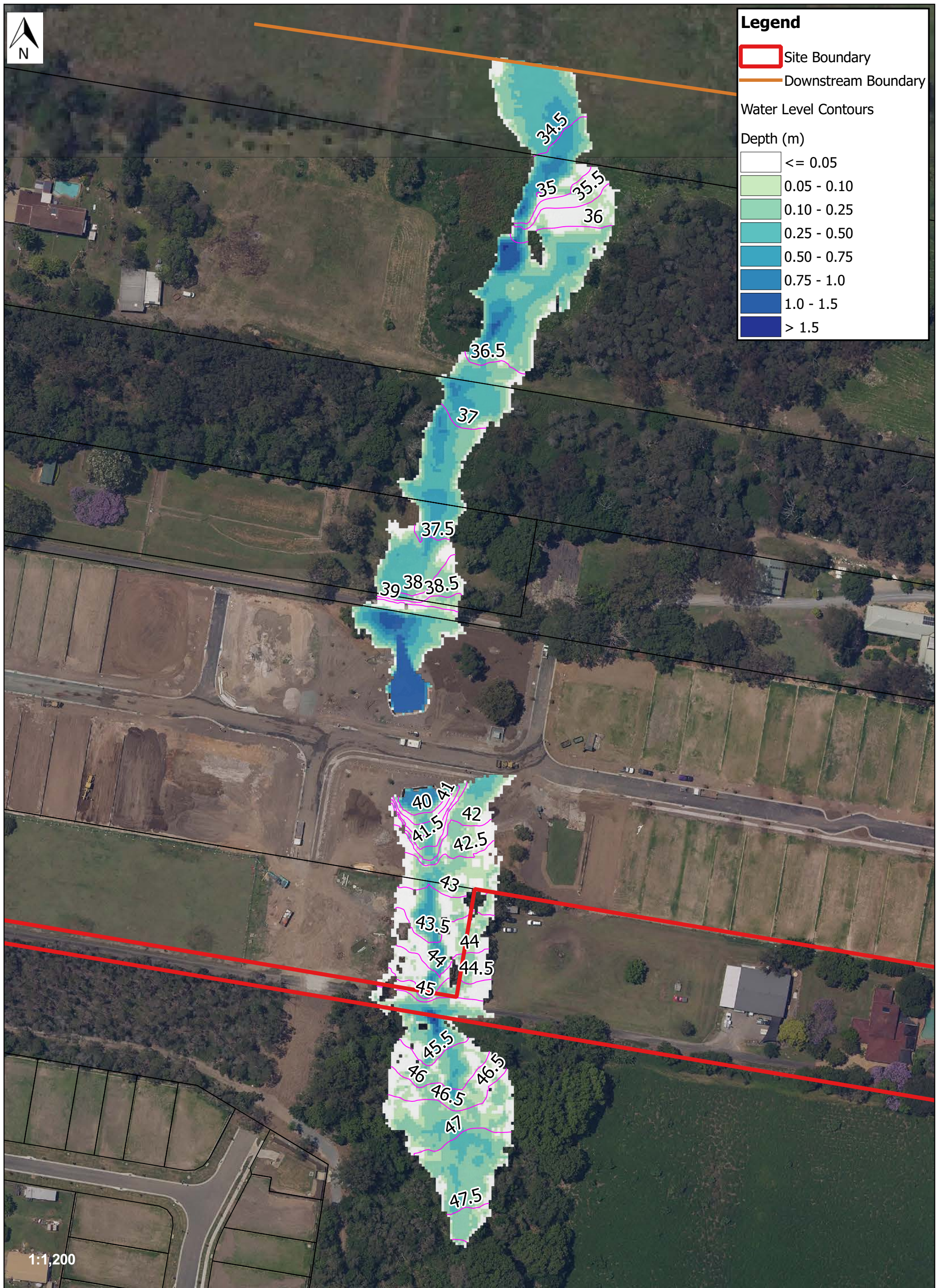
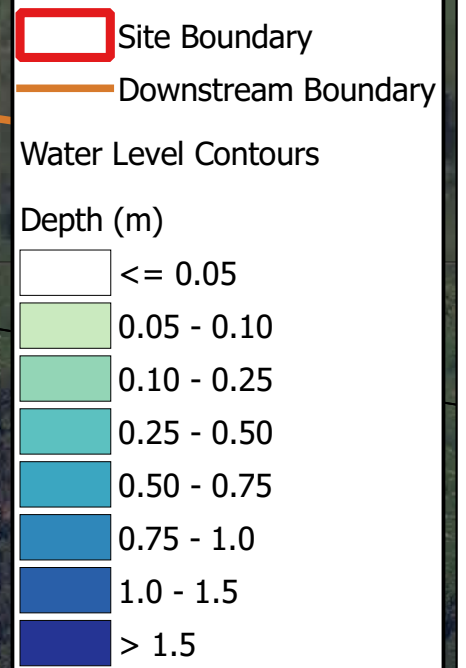
## APPENDIX D EXISTING AND DEVELOPED CASE FLOOD MAPPING







### Legend



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

39% AEP Maximum Flood Depth and Level - Existing Case

238 Gardner Road Rochdale

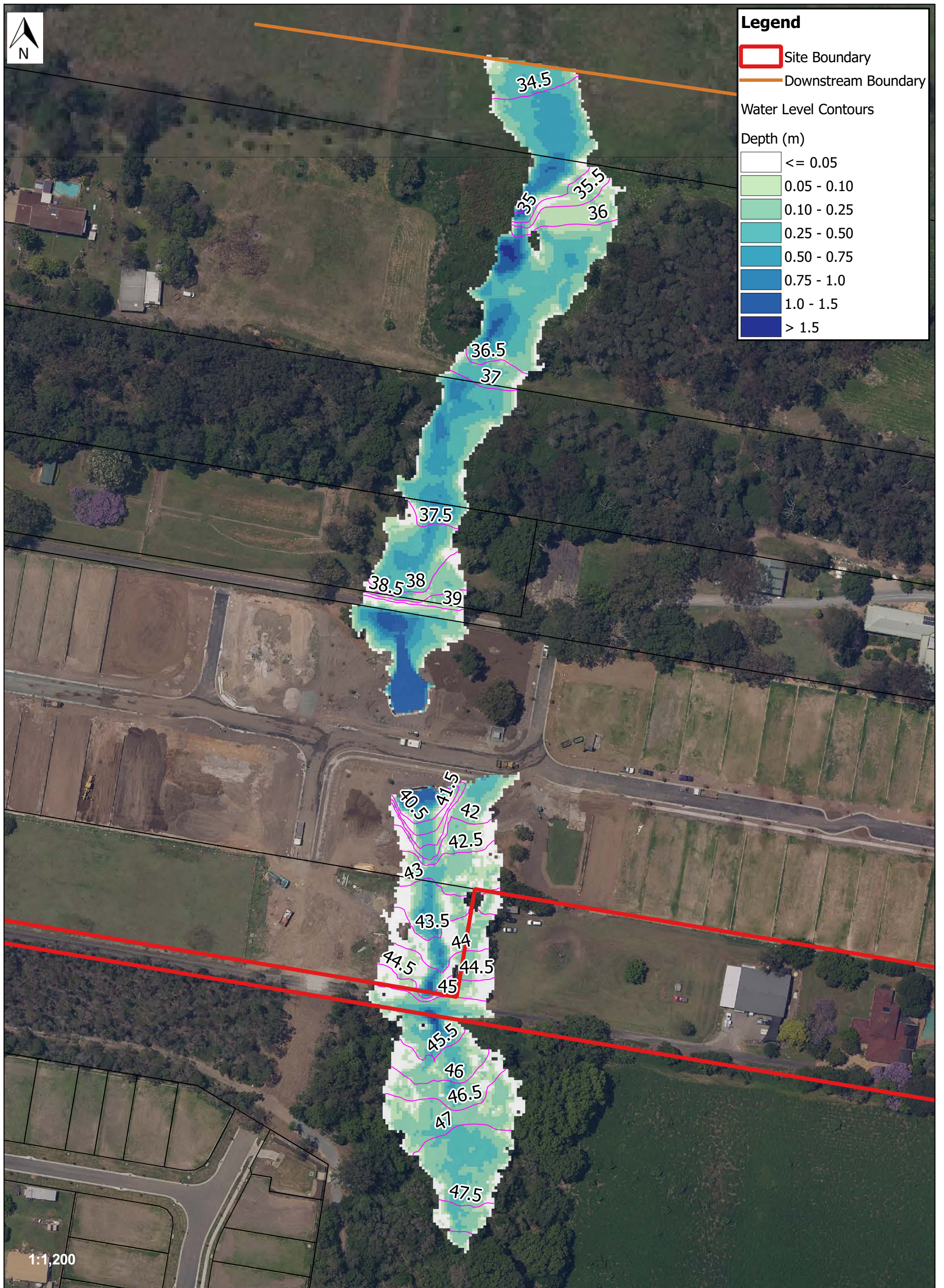
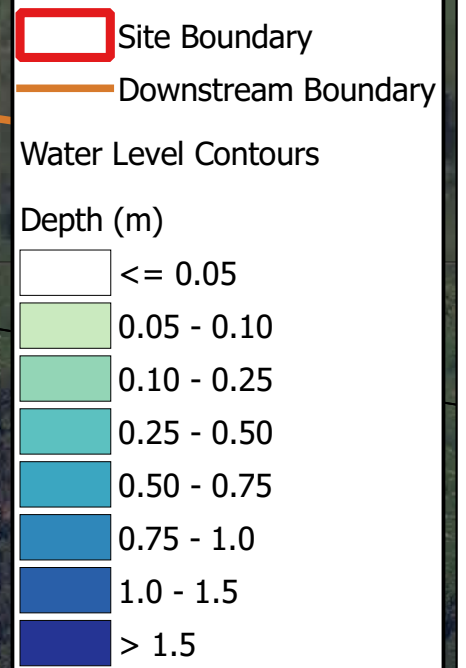


2019-04-12T12:41:49





### Legend



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

10% AEP Maximum Flood Depth and Level - Existing Case

238 Gardner Road Rochdale



2019-04-12T12:41:53





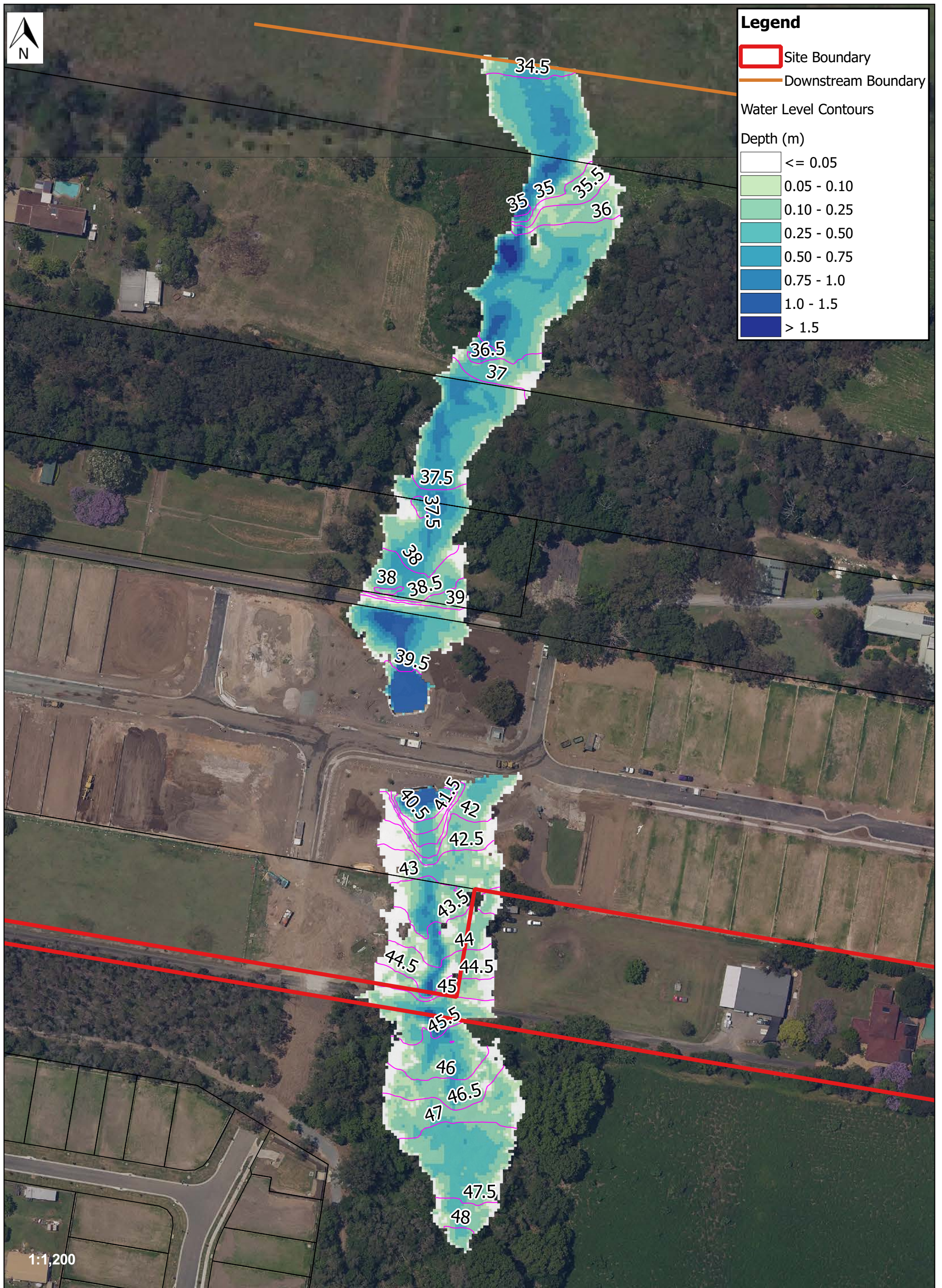
### Legend

- Site Boundary
- Downstream Boundary

### Water Level Contours

#### Depth (m)

- $\leq 0.05$
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- $> 1.5$



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

2% AEP Maximum Flood Depth and Level - Existing Case

238 Gardner Road Rochdale



2019-04-12T12:41:57





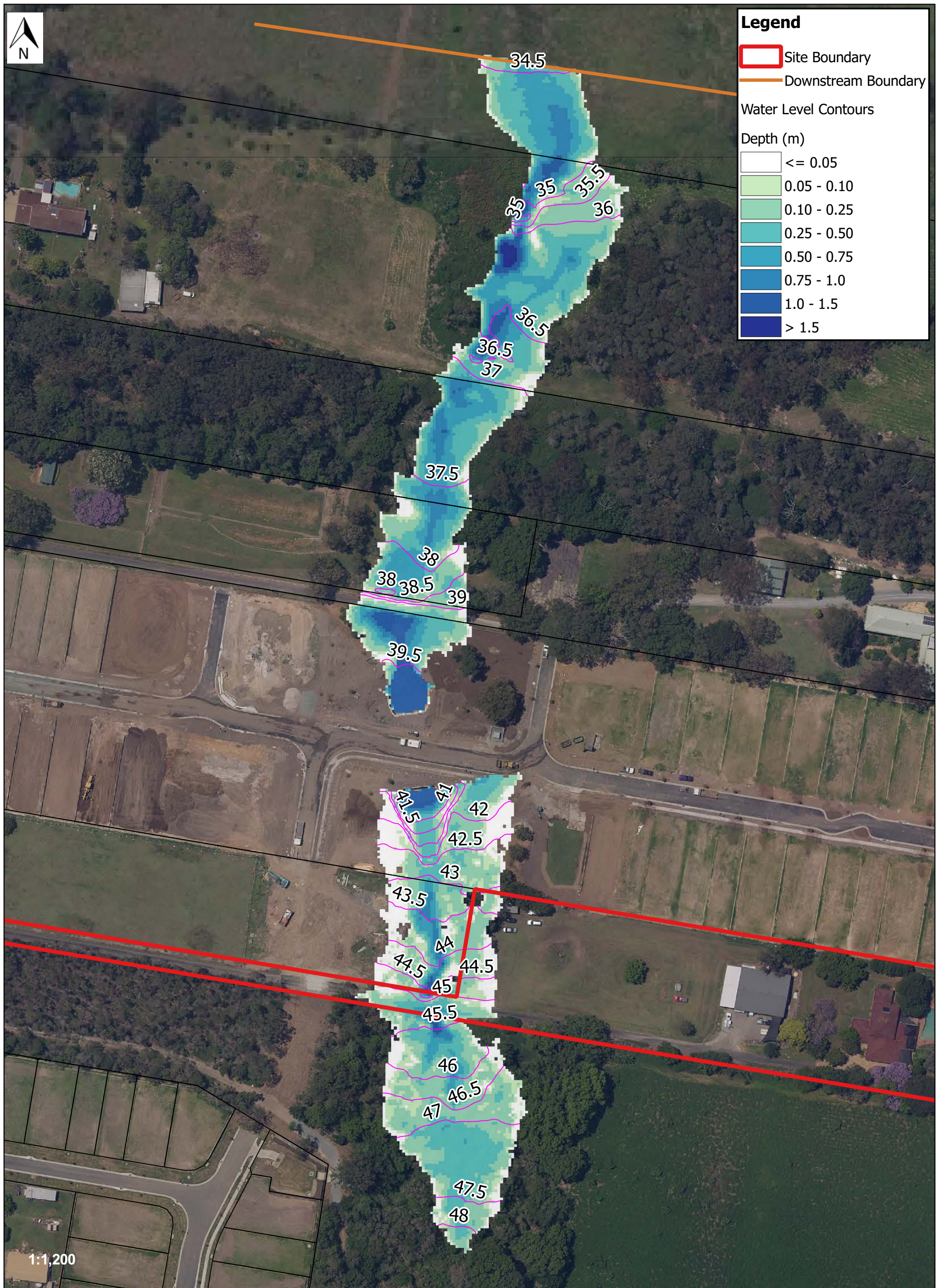
### Legend

- Site Boundary
- Downstream Boundary

### Water Level Contours

#### Depth (m)

- $\leq 0.05$
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- $> 1.5$



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

1% AEP Maximum Flood Depth and Level - Existing Case

238 Gardner Road Rochdale





2019-04-12T12:42:01











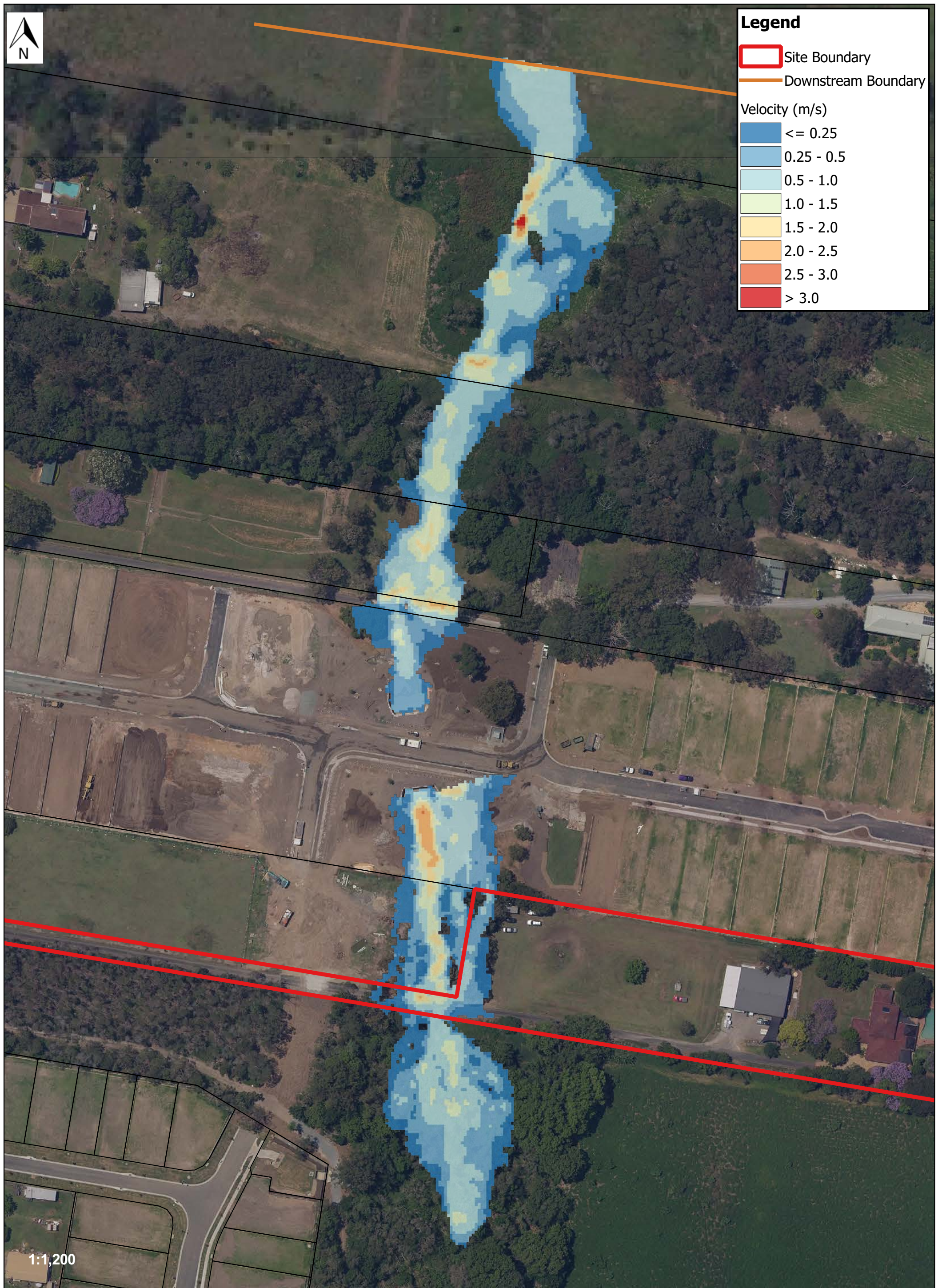


### Legend

-  Site Boundary
-  Downstream Boundary

### Velocity (m/s)

-   $\leq 0.25$
-  0.25 - 0.5
-  0.5 - 1.0
-  1.0 - 1.5
-  1.5 - 2.0
-  2.0 - 2.5
-  2.5 - 3.0
-   $> 3.0$



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

39% AEP Maximum Flood Velocity - Existing Case

238 Gardner Road Rochdale





2019-04-12T12:42:45













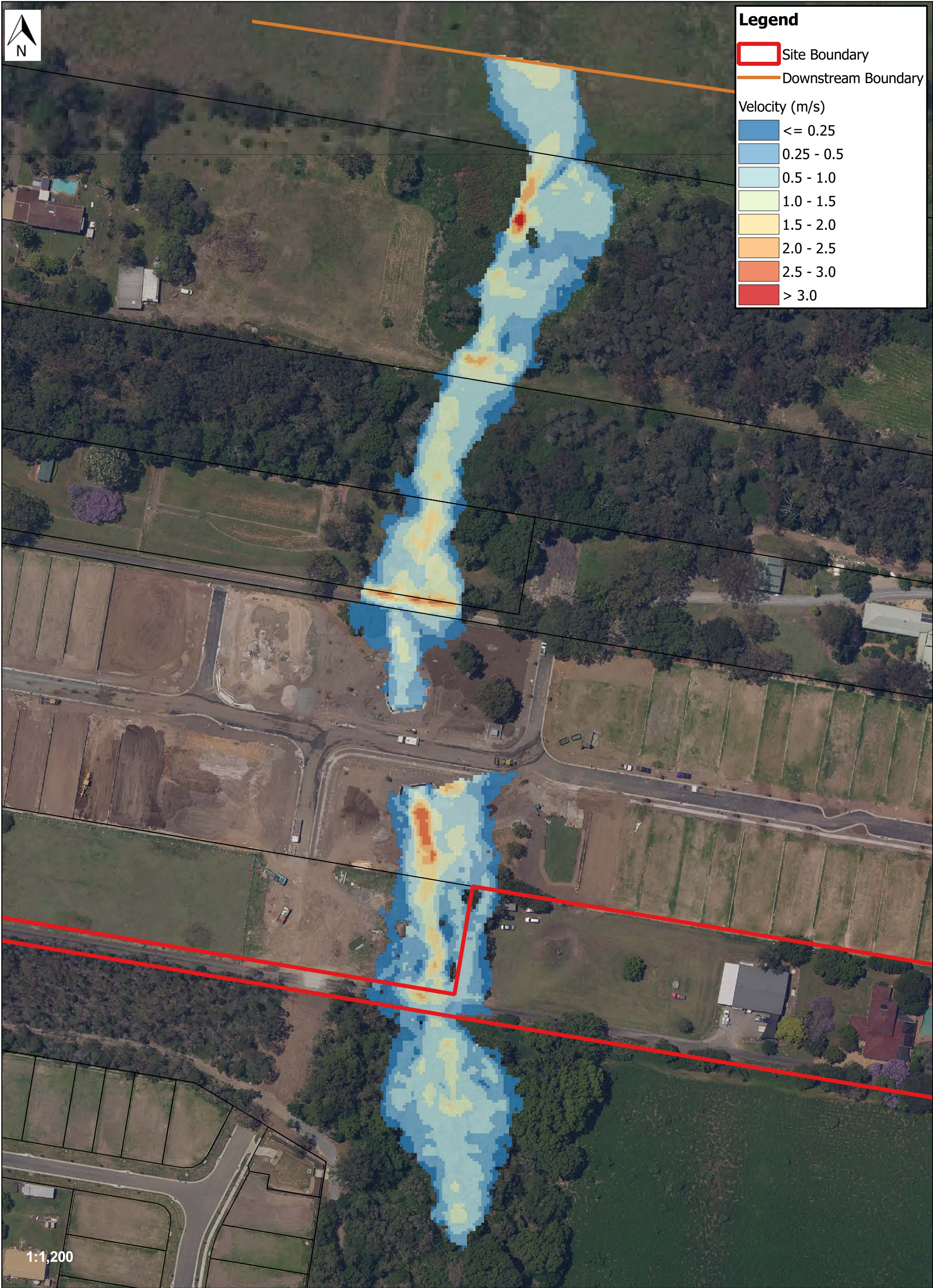
**Legend**

 Site Boundary

 Downstream Boundary

**Velocity (m/s)**

	<= 0.25
	0.25 - 0.5
	0.5 - 1.0
	1.0 - 1.5
	1.5 - 2.0
	2.0 - 2.5
	2.5 - 3.0
	> 3.0



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019



238 Gardner Road Rochdale  
10% AEP Maximum Flood Velocity - Existing Case





2019-04-12T12:42:49











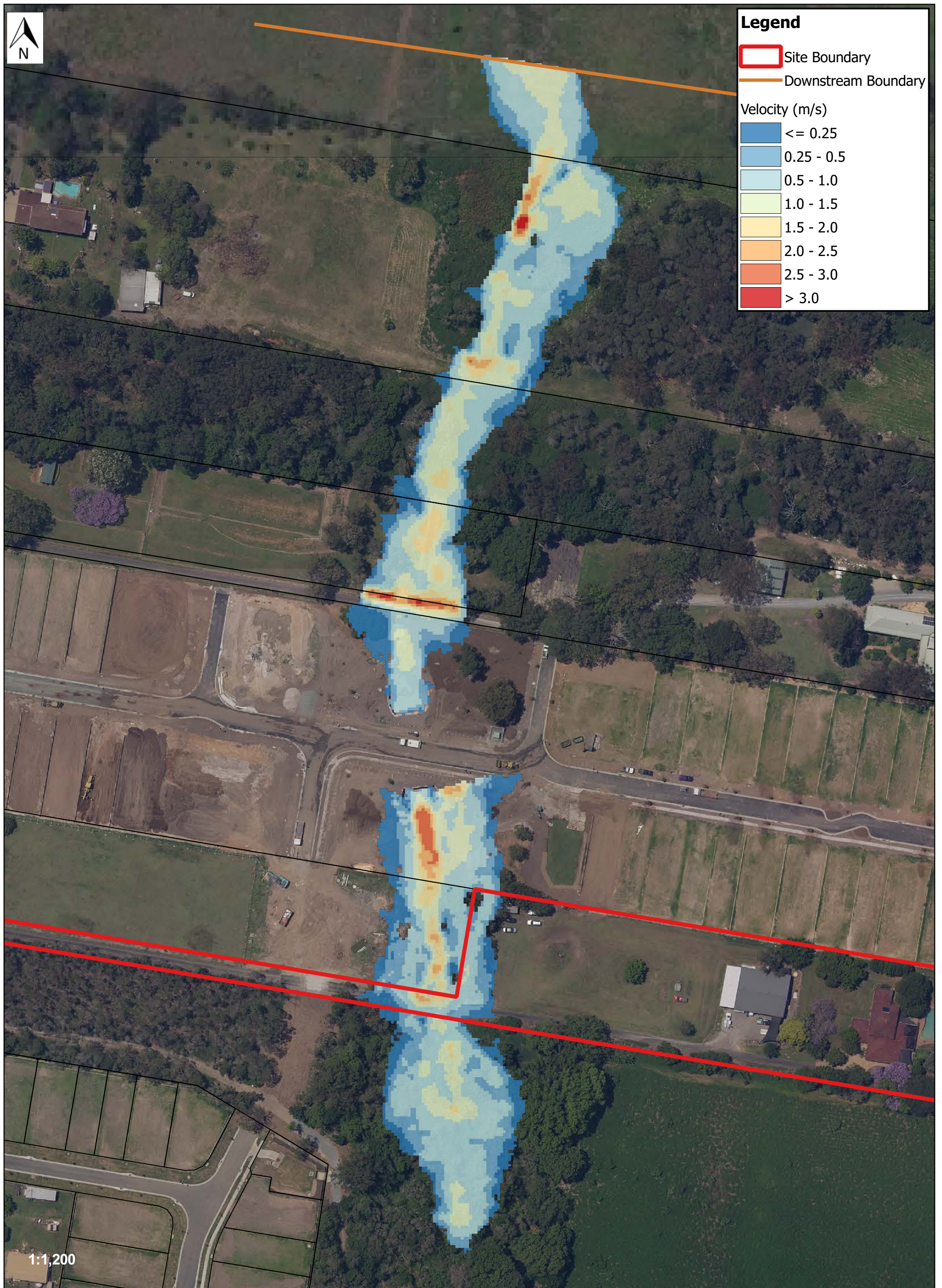


### Legend

-  Site Boundary
-  Downstream Boundary

### Velocity (m/s)

-   $\leq 0.25$
-  0.25 - 0.5
-  0.5 - 1.0
-  1.0 - 1.5
-  1.5 - 2.0
-  2.0 - 2.5
-  2.5 - 3.0
-   $> 3.0$



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

238 Gardner Road Rochdale  
2% AEP Maximum Flood Velocity - Existing Case

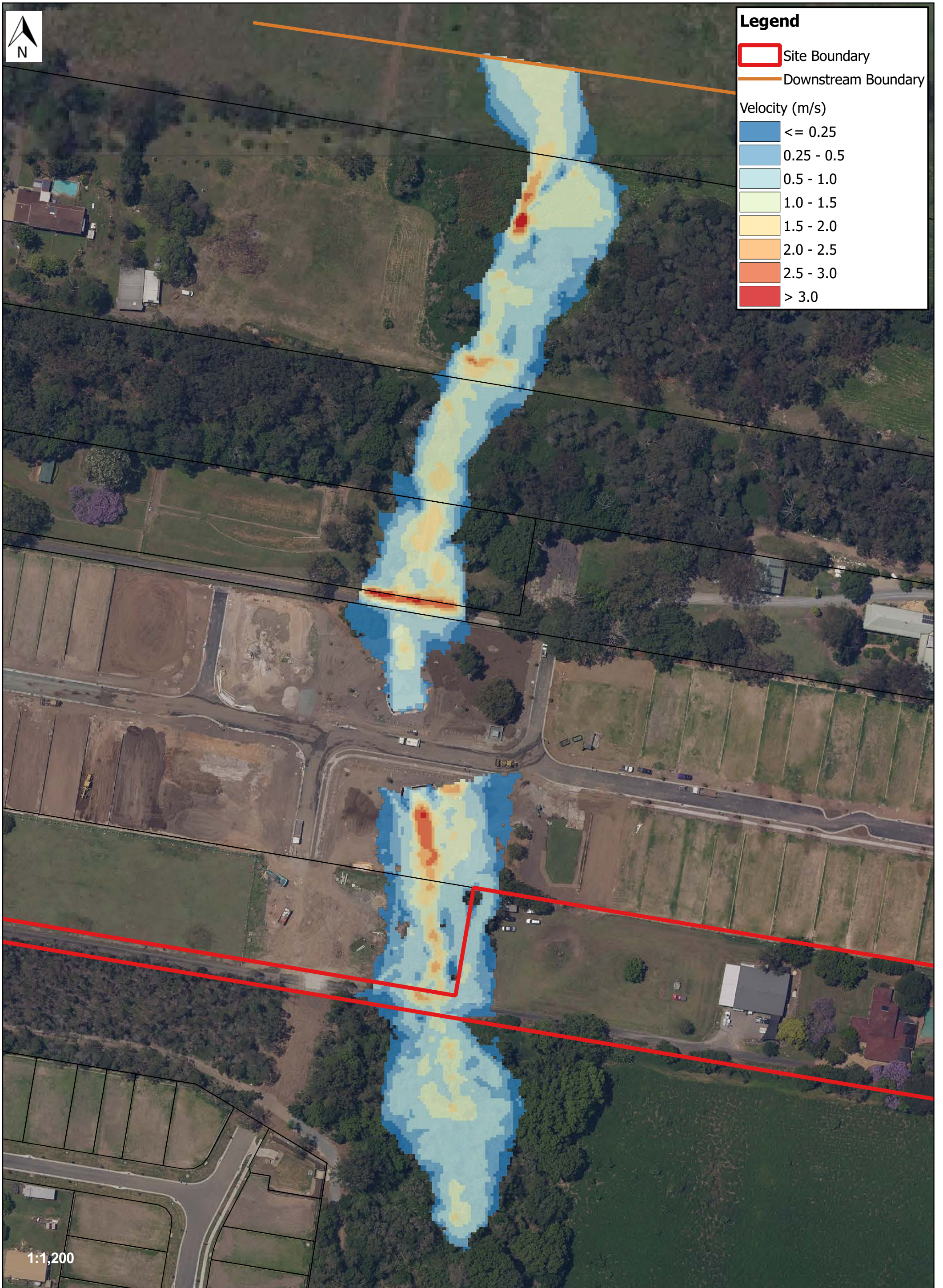
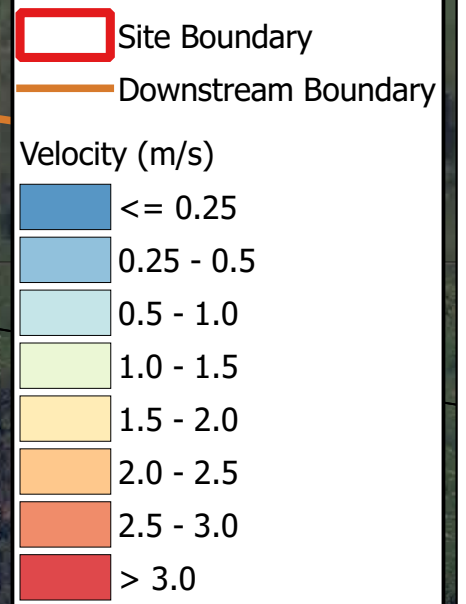


2019-04-12T12:42:52





### Legend



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

1% AEP Maximum Flood Velocity - Existing Case

238 Gardner Road Rochdale



2019-04-12T12:42:56

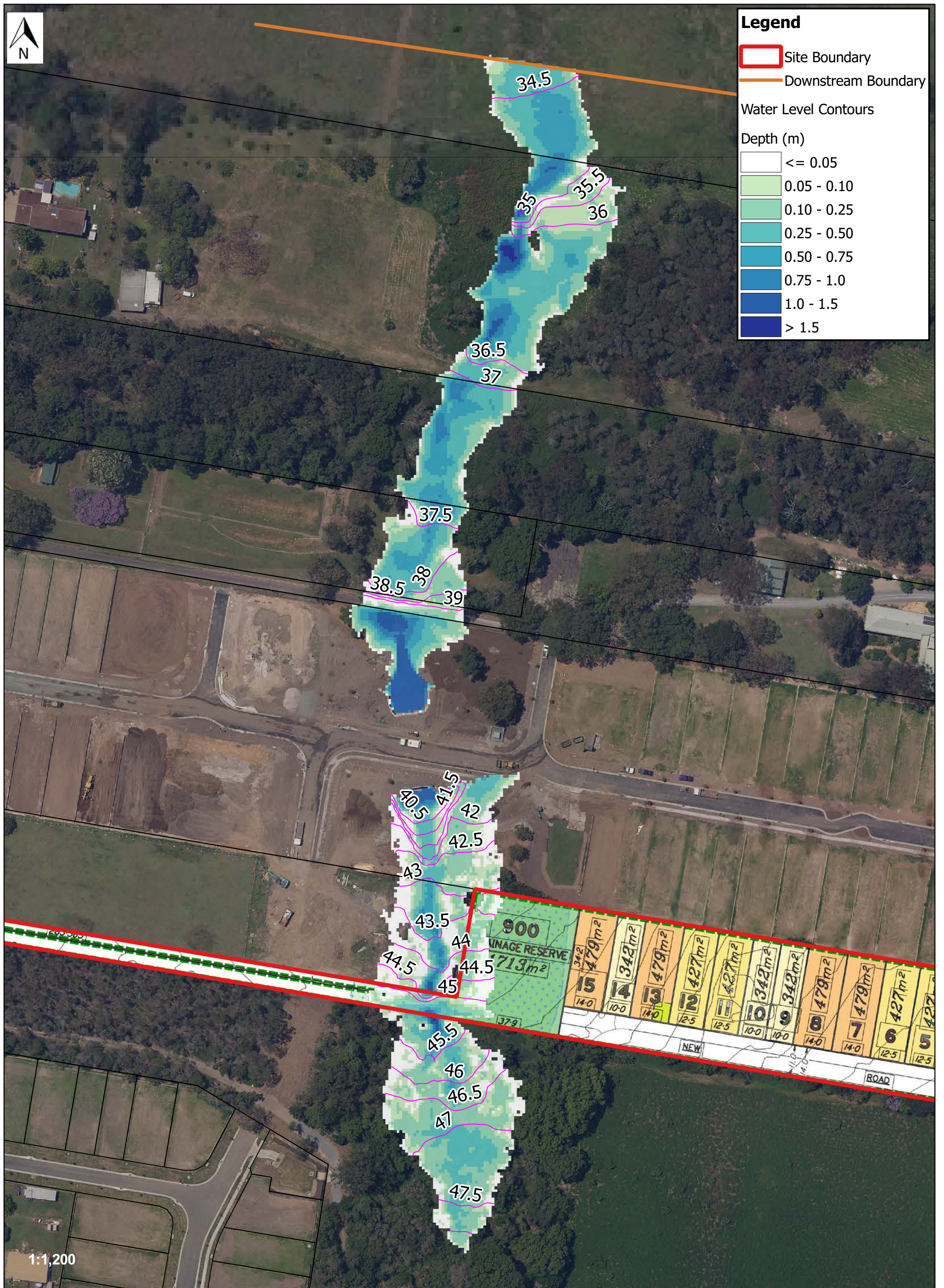
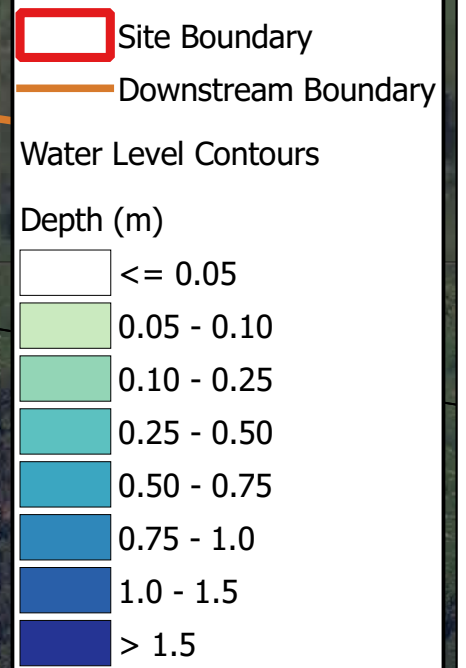








### Legend



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019



10% AEP Maximum Flood Depth and Level - Developed Case

238 Gardner Road Rochdale

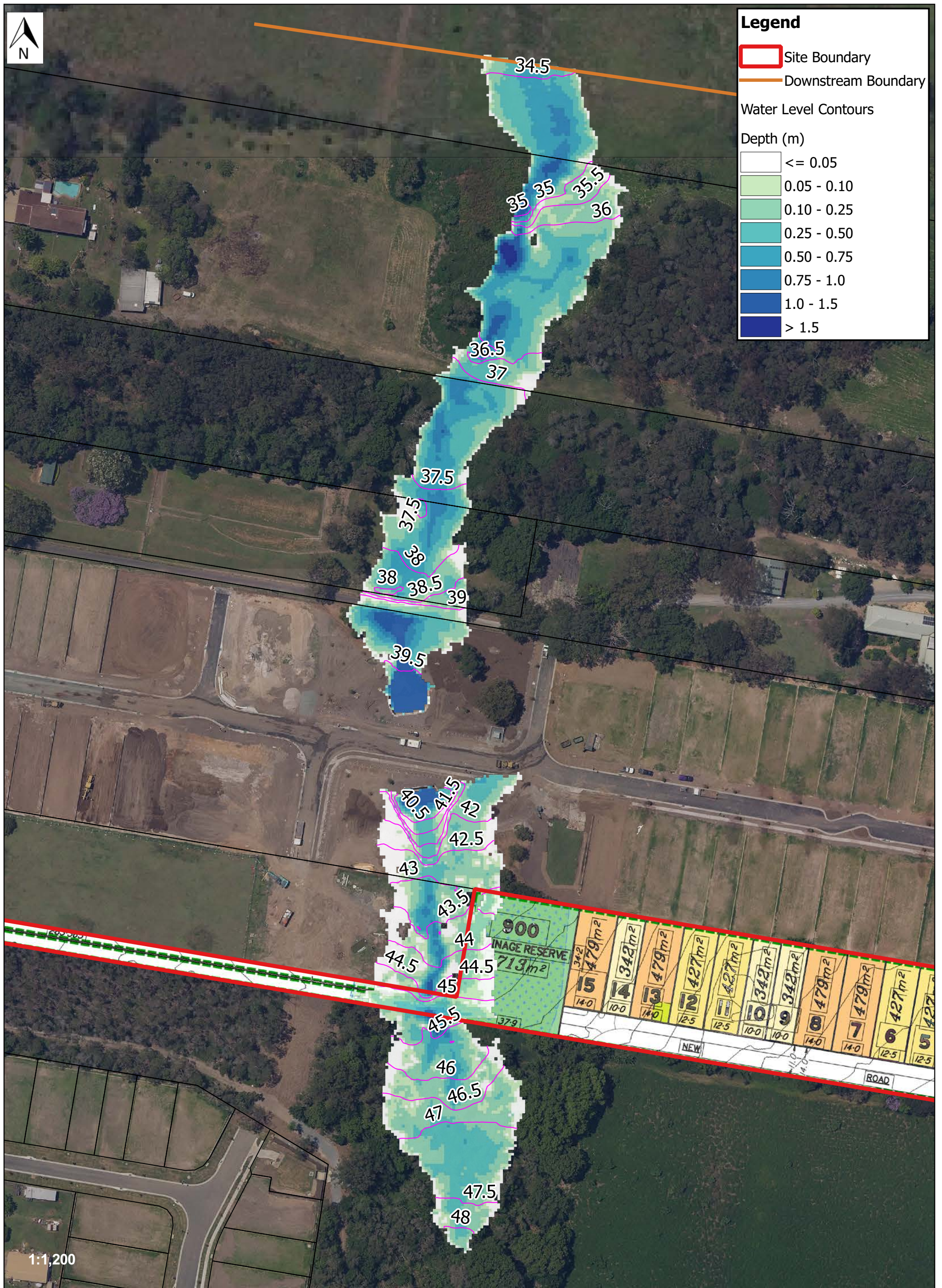
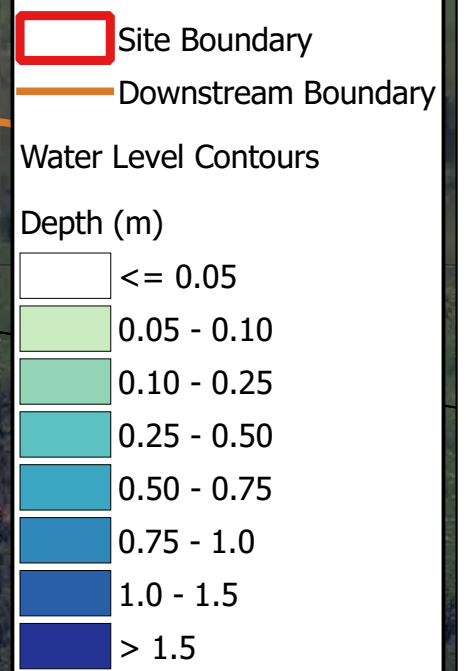


2019-04-12T12:41:37





### Legend



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019



2% AEP Maximum Flood Depth and Level - Developed Case

238 Gardner Road Rochdale

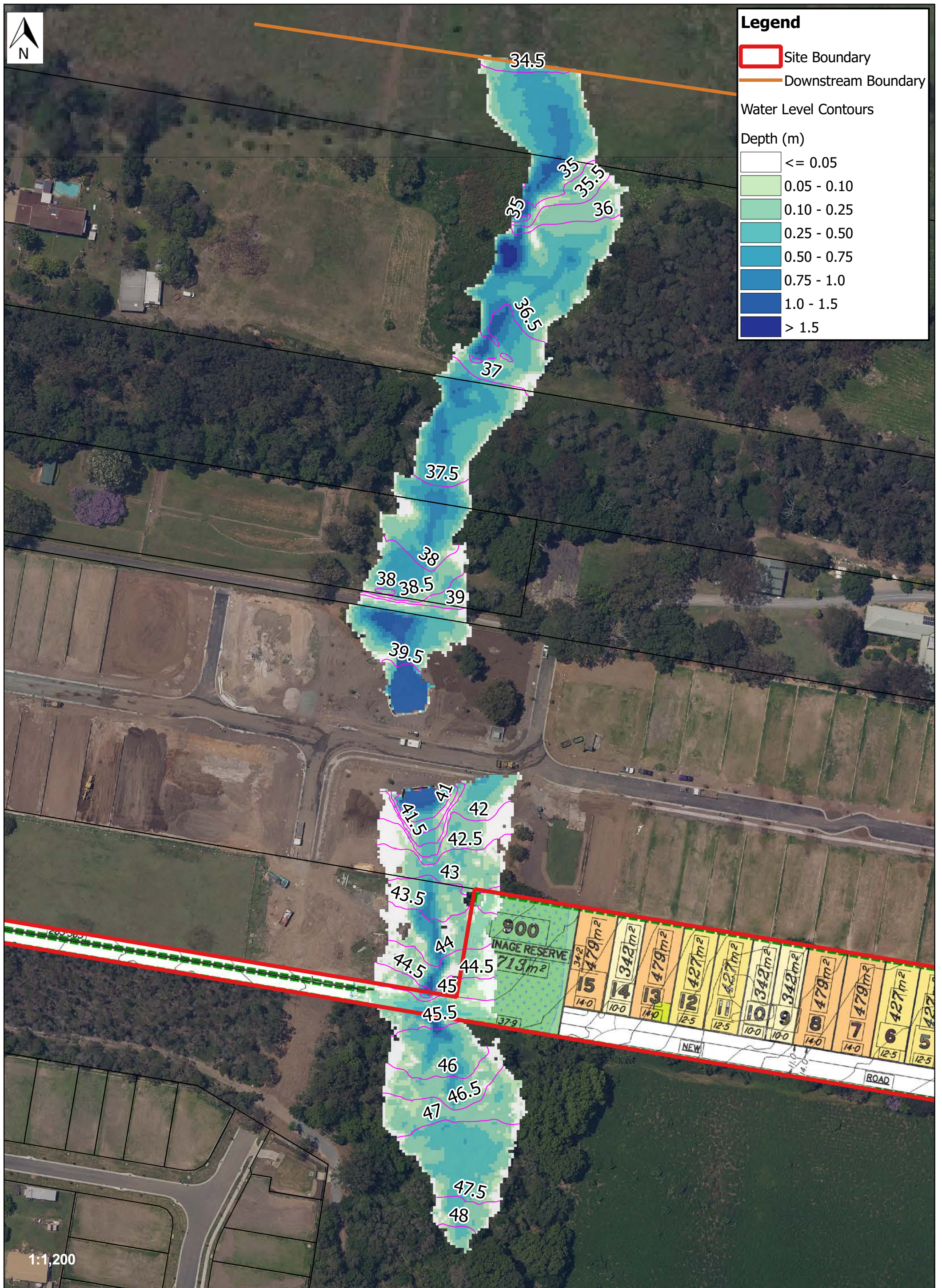
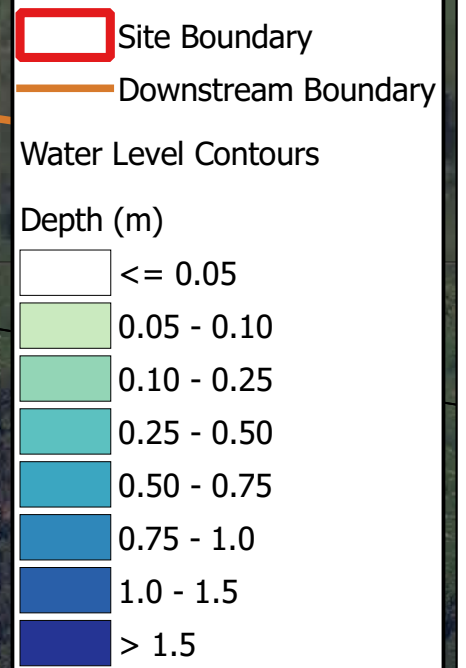


2019-04-12T12:41:41





### Legend



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019



1% AEP Maximum Flood Depth and Level - Developed Case

238 Gardner Road Rochdale

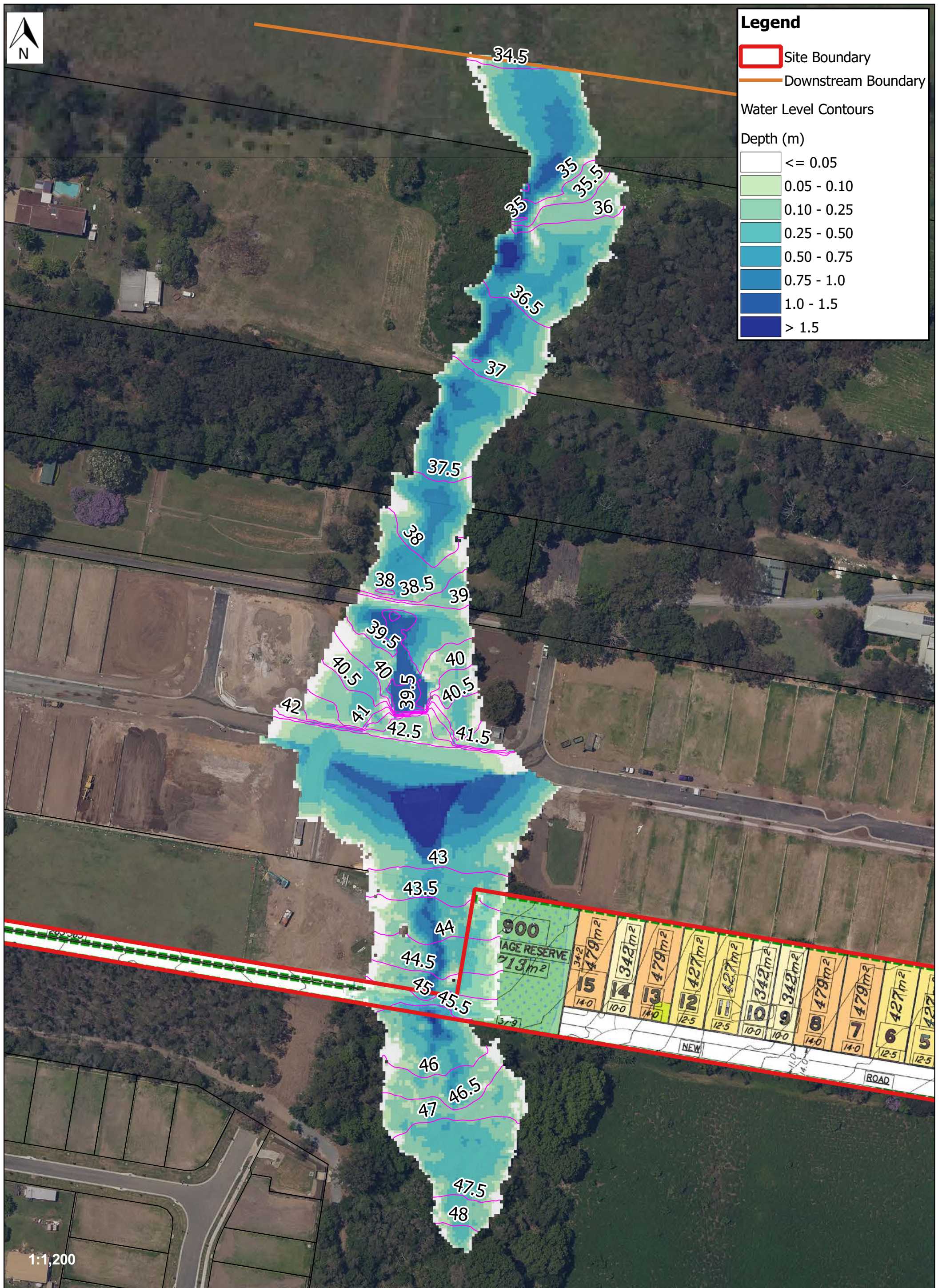
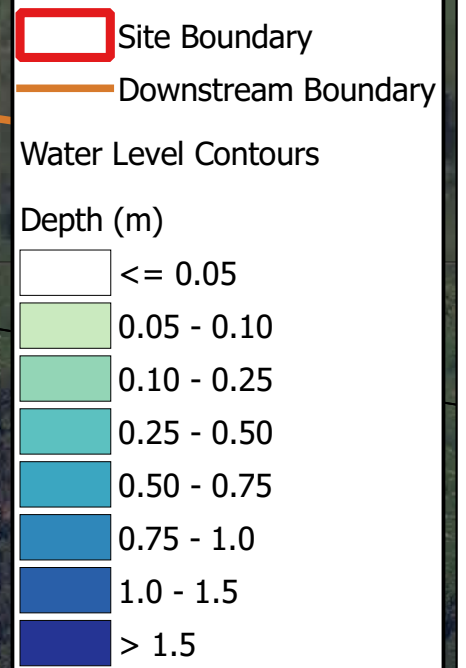


2019-04-12T12:41:45





### Legend



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019



1% AEP Maximum Flood Depth and Level - Immunity Case

238 Gardner Road Rochdale





2019-04-12T12:42:05











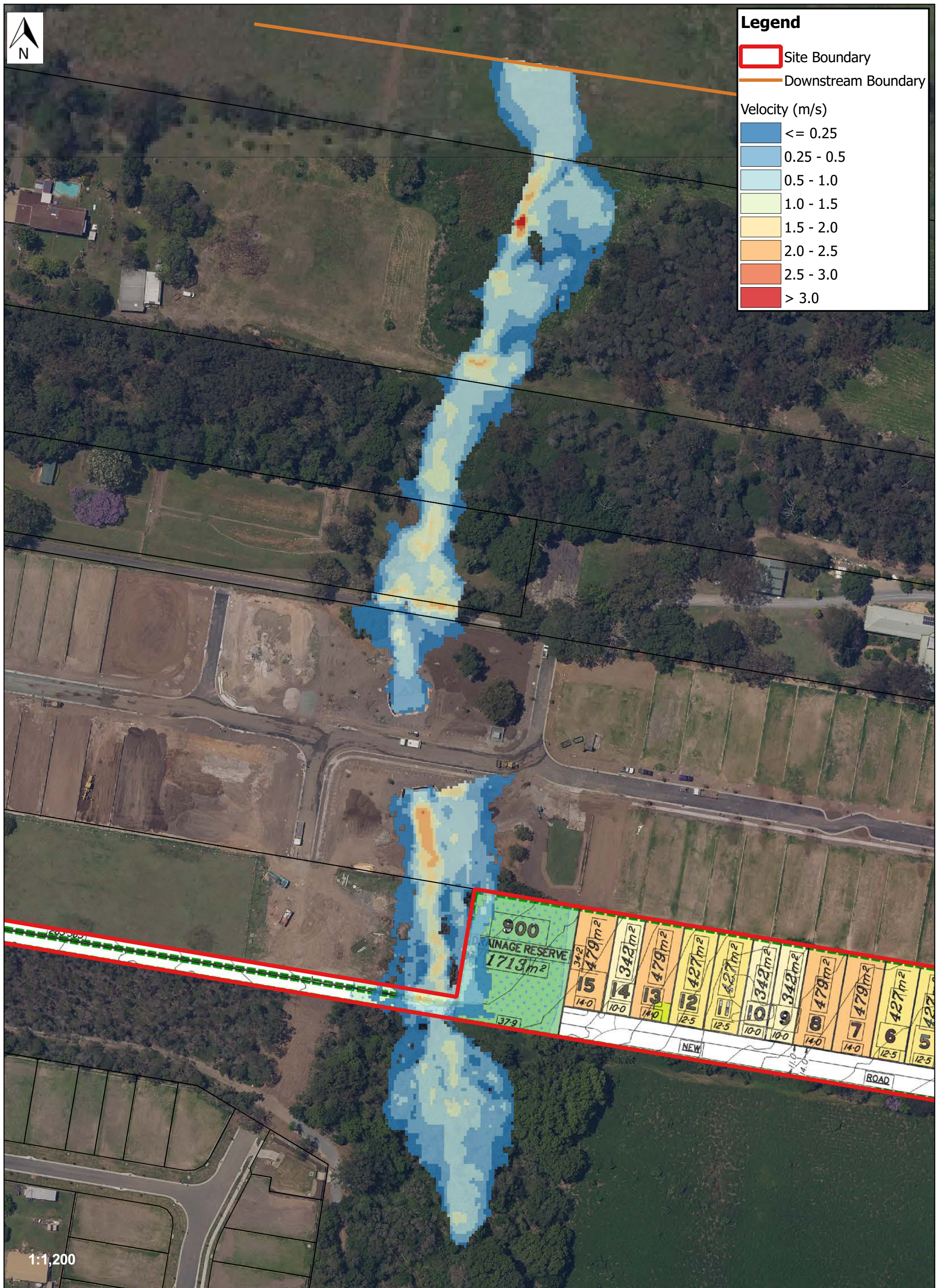


### Legend

-  Site Boundary
-  Downstream Boundary

### Velocity (m/s)

-   $\leq 0.25$
-  0.25 - 0.5
-  0.5 - 1.0
-  1.0 - 1.5
-  1.5 - 2.0
-  2.0 - 2.5
-  2.5 - 3.0
-   $> 3.0$



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

39% AEP Maximum Flood Velocity - Developed Case

238 Gardner Road Rochdale

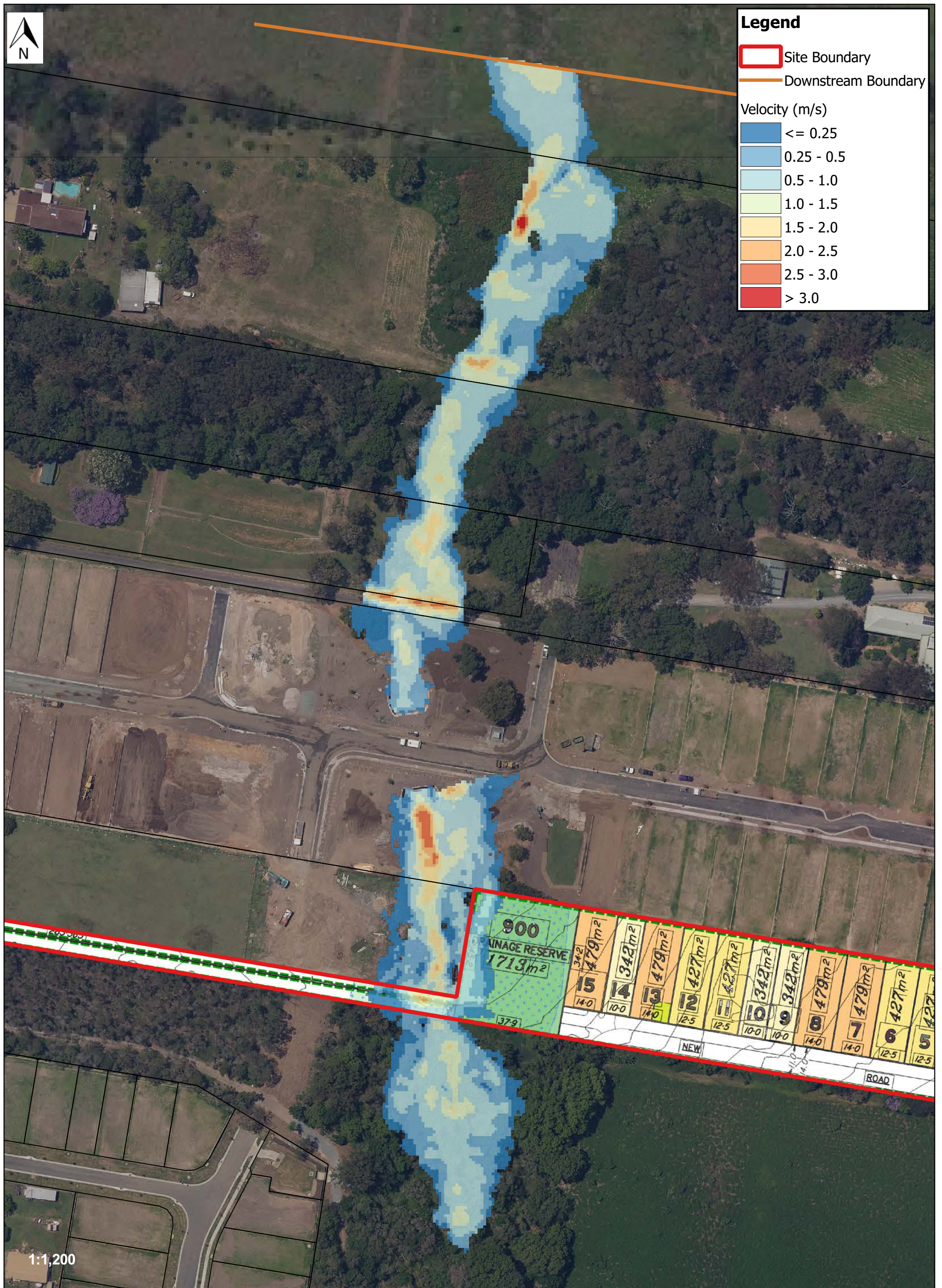
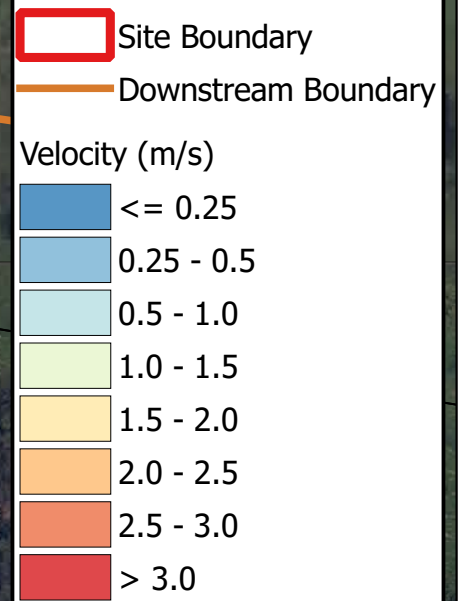


2019-04-12T12:42:29





### Legend



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

10% AEP Maximum Flood Velocity - Developed Case

238 Gardner Road Rochdale





2019-04-12T12:42:33











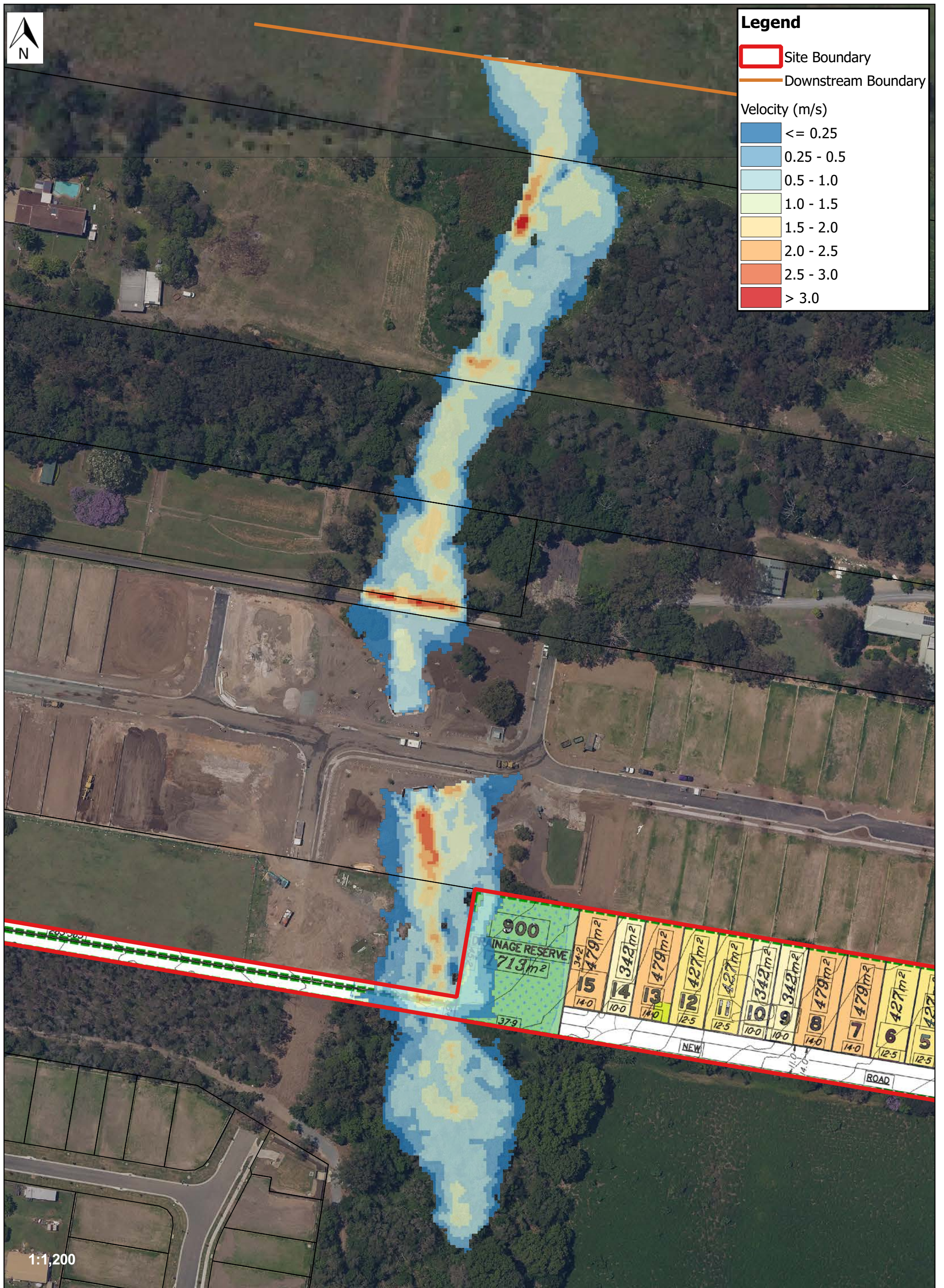


### Legend

-  Site Boundary
-  Downstream Boundary

### Velocity (m/s)

-   $\leq 0.25$
-  0.25 - 0.5
-  0.5 - 1.0
-  1.0 - 1.5
-  1.5 - 2.0
-  2.0 - 2.5
-  2.5 - 3.0
-   $> 3.0$



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

2% AEP Maximum Flood Velocity - Developed Case

238 Gardner Road Rochdale

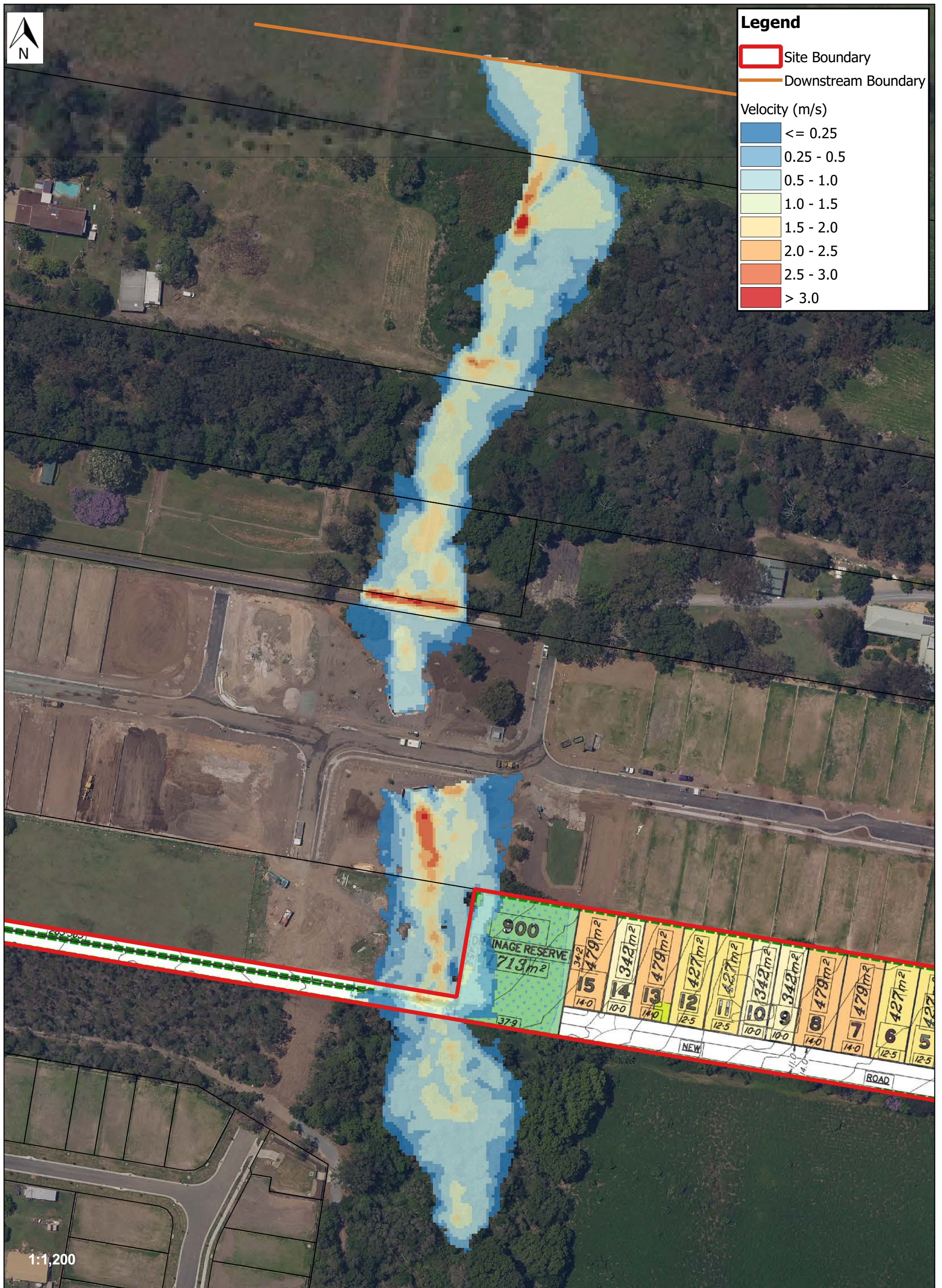
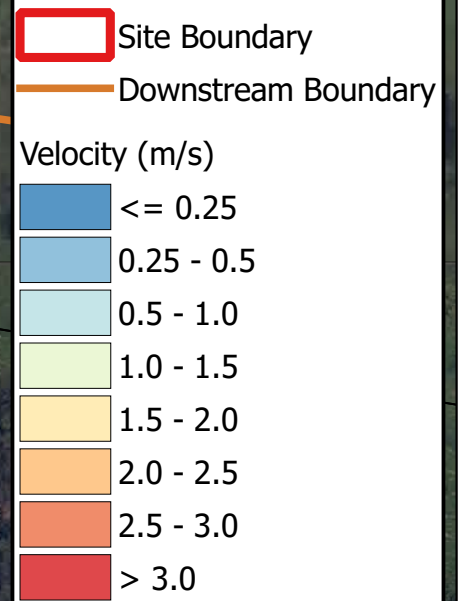


2019-04-12T12:42:37





### Legend



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

1% AEP Maximum Flood Velocity - Developed Case

238 Gardner Road Rochdale



2019-04-12T12:42:41





## APPENDIX E FLOOD IMPACT MAPPING

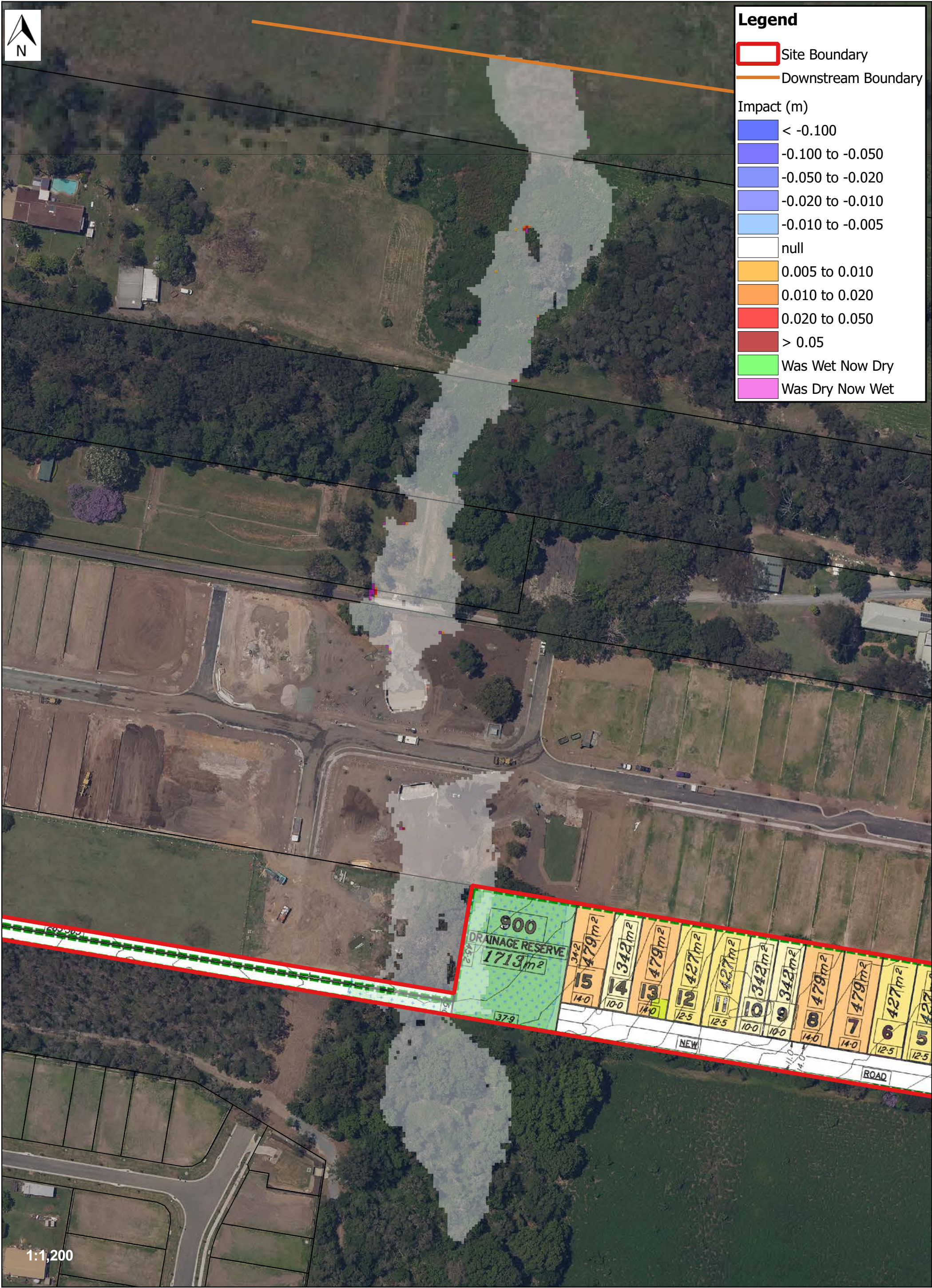






**Legend**

- Site Boundary
- Downstream Boundary
- Impact (m)
  - < -0.100
  - 0.100 to -0.050
  - 0.050 to -0.020
  - 0.020 to -0.010
  - 0.010 to -0.005
  - null
  - 0.005 to 0.010
  - 0.010 to 0.020
  - 0.020 to 0.050
  - > 0.05
  - Was Wet Now Dry
  - Was Dry Now Wet



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

238 Gardner Road Rochdale  
39% AEP Flood Level Impact



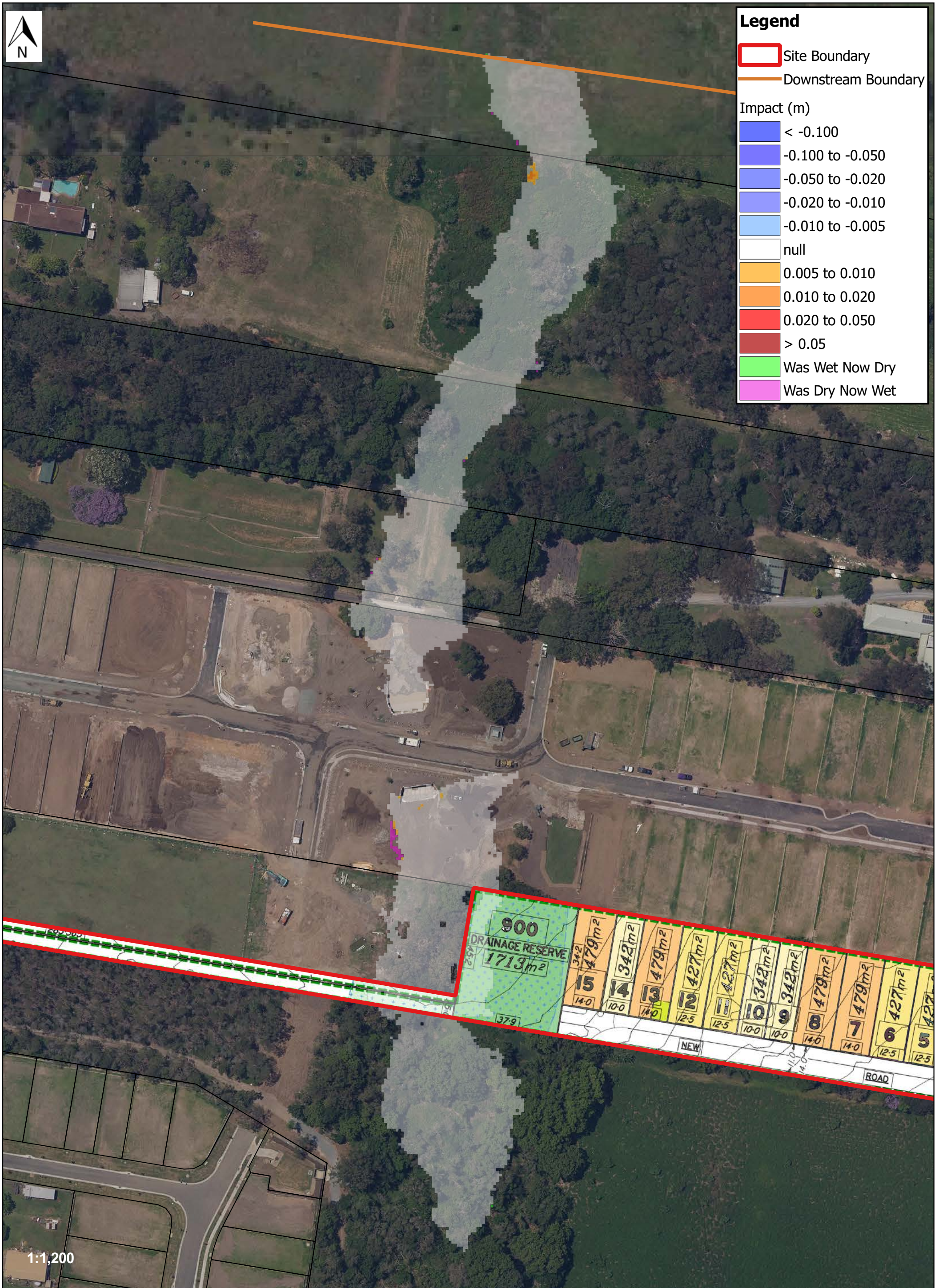
2019-04-12T12:42:10





### Legend

- Site Boundary
- Downstream Boundary
- Impact (m)
  - < -0.100
  - 0.100 to -0.050
  - 0.050 to -0.020
  - 0.020 to -0.010
  - 0.010 to -0.005
  - null
  - 0.005 to 0.010
  - 0.010 to 0.020
  - 0.020 to 0.050
  - > 0.05
  - Was Wet Now Dry
  - Was Dry Now Wet



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

238 Gardner Road Rochdale  
10% AEP Flood Level Impact



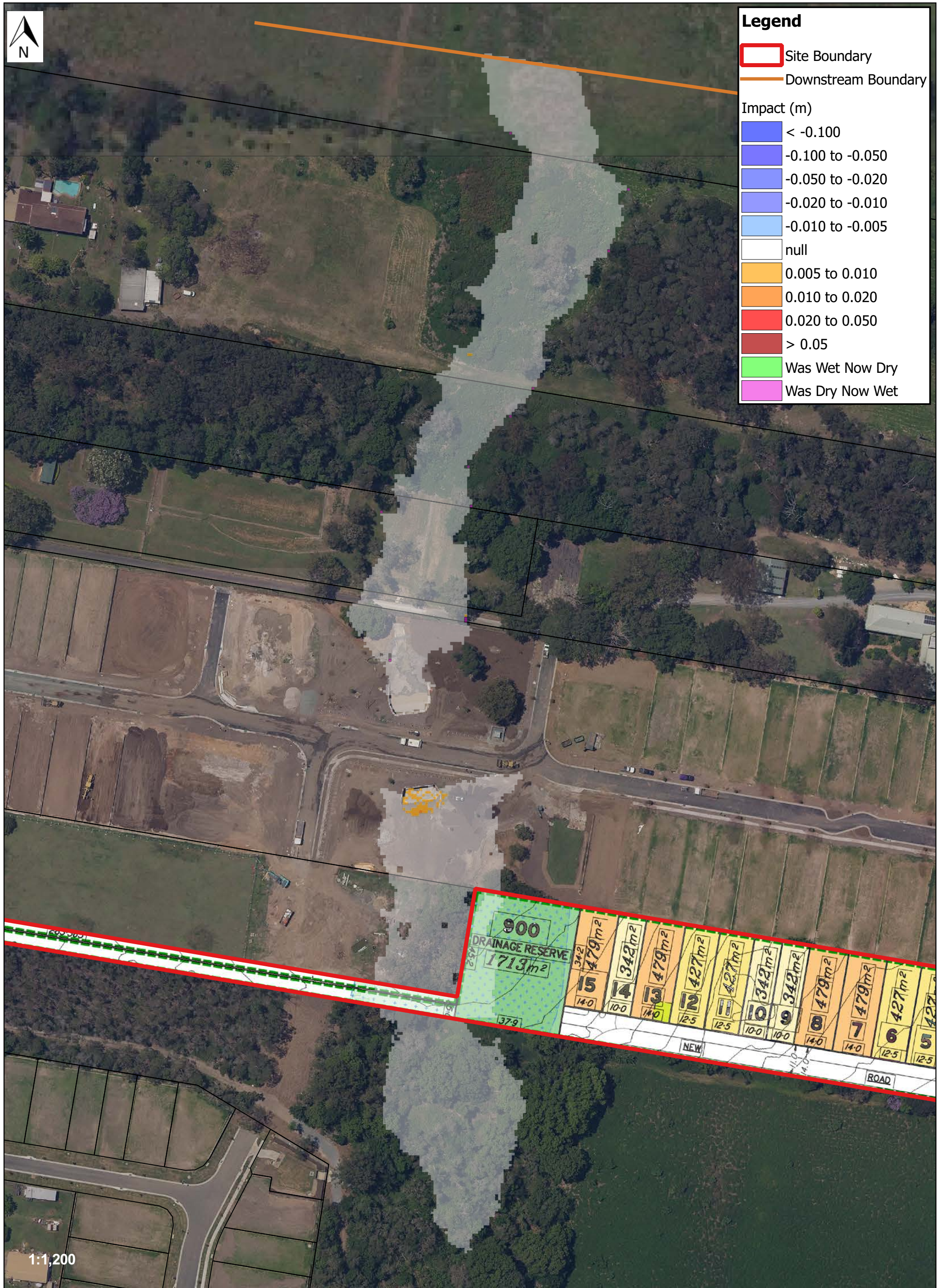
2019-04-12T12:42:15





### Legend

- Site Boundary
- Downstream Boundary
- Impact (m)
  - < -0.100
  - 0.100 to -0.050
  - 0.050 to -0.020
  - 0.020 to -0.010
  - 0.010 to -0.005
  - null
  - 0.005 to 0.010
  - 0.010 to 0.020
  - 0.020 to 0.050
  - > 0.05
  - Was Wet Now Dry
  - Was Dry Now Wet



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

238 Gardner Road Rochdale  
2% AEP Flood Level Impact



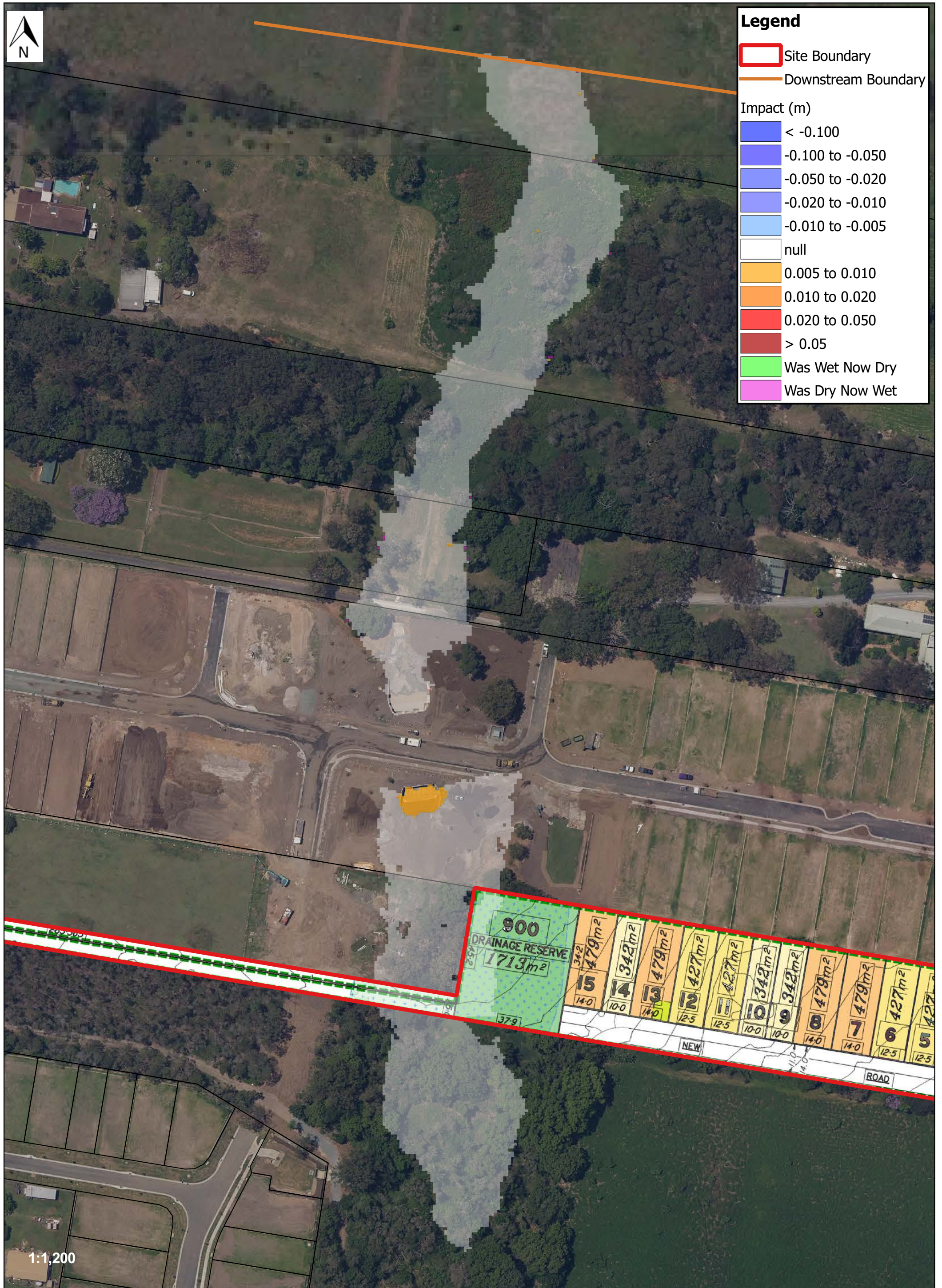
2019-04-12T12:42:20





### Legend

- Site Boundary
- Downstream Boundary
- Impact (m)
  - < -0.100
  - 0.100 to -0.050
  - 0.050 to -0.020
  - 0.020 to -0.010
  - 0.010 to -0.005
  - null
  - 0.005 to 0.010
  - 0.010 to 0.020
  - 0.020 to 0.050
  - > 0.05
  - Was Wet Now Dry
  - Was Dry Now Wet



1:1,200



Projection: GDA/MGA94 Zone 56  
Water Technology Pty Ltd  
Imagery Source: Spookfish 2019

0 10 20 30 40 m

238 Gardner Road Rochdale  
1% AEP Flood Level Impact



2019-04-12T12:42:25





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