Stormwater Management Plan, Proposed Development at 24 Bushman Drive & 68 Wyatt Road, Jimboomba, Qld

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Synopsis: This report presents a Stormwater Management Plan for the proposed development at 24 Bushman Drive & 68 Wyatt Road, Jimboomba, Queensland

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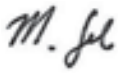
3	05/03/2019	Martin Giles RPEQ 9408		Lucy Peljo	

DISTRIBUTION

Destination	Revision										
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Executive Summary

This Stormwater Management Plan (SMP) has been prepared by BMT on behalf of Pacifiq in support of the development application for Lot 24 on SP142997 and Lot 1 on RP49296 in Jimboomba, Logan City (hereafter referred to as the site). The proposed development consists of residential housing, parkland and commercial areas.

The 43-hectare site is located within a mixed rural and forested area of Logan City. The site is bounded to the south by Wyatt Road, to the east by Bushman Drive and to the west by the Brisbane-Sydney Railway. Rural residential lots border the site to the north.

This SMP provides the following two components:

- **Flood impact assessment**: Detailed two-dimensional modelling was completed to define flood levels across the site for a range of events for the existing (pre-development) situation. The model was then revised to consider the increased runoff resulting from development of the site. For the assessment, consideration was given to both local catchment runoff and regional flooding in the Logan River. It was found that the flood level associated with regional flooding is typically significantly higher than that produced by local catchment flooding and will govern minimum development levels.

  The modelling determined that the new road constructed by Pacifiq to provide access to its Flinders development will provide sufficient detention storage to attenuate flow and ameliorate the impact of development on flows downstream of the site for a range of events. Further, the assessment determined that the works would not result in unacceptable increases in flood level external to the site.

  The earthworks solution for the site also involves no loss of floodplain storage to the 100-year flood level.

- **Stormwater quality management strategy**: this component describes the measures to be undertaken to achieve stormwater quality management objectives (SQMOs). The SQMOs are derived from the *Seqwater Development Guidelines* (Seqwater 2017) and require reductions (relative to the developed site without treatment) in total suspended solids (TSS), total phosphorus (TP), total nitrogen (TN) and gross pollutants (GP) loads of 85%, 65%, 45% and 95% respectively.

  MUSIC modelling was undertaken for the site for the following scenarios:

  - Developed site without a stormwater management strategy in place
  - Developed site with the proposed stormwater management strategy in place.

  There are a number of treatment options available for runoff from the site. For the purposes of this application, two stormwater quality management options have been developed which are outlined in the following points below:

  - **Option 1 – Bioretention basins**: This option consists of education and bioretention basins.
  - **Option 2 – Bioretention basins with swales**: This option consists of education, bioretention basins and swales.

The modelling demonstrates that both the stormwater management strategies will achieve the prescribed SQMOs.

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1 Introduction

1.1 Background

It is proposed to develop Lot 24 on SP142997 and Lot 1 on RP49296 in Jimboomba, Logan City (hereafter referred to as the site). The proposed development consists of residential housing, parkland and commercial areas. The development also includes an upgrade to Bushman Drive and Wyatt Road.

1.2 Scope

BMT was commissioned to provide a Stormwater Management Plan (SMP) in support of the proposed development. The investigation included the following elements:

- **Flood Impact Assessment**, including the following two components:
  - *Hydrologic Assessment:* A WBNM hydrologic model of the local catchment was created to provide inflow hydrographs to the hydraulic model.
  - *Hydraulic Assessment:* A two-dimensional model of the local catchment was established to demonstrate that the proposed development does not lead to any unacceptable adverse off-site impacts with respect to flooding. The model was used to assess both local catchment flooding alone and combined with a regional flood from Teviot Brook.
- **Stormwater Quality Management Strategy:** provides a conceptual water quality assessment of the proposed development and predicts how the estimated stormwater pollutant loads from the developed site will compare to the given stormwater quality management objectives.

2 Site Description

2.1 Location

The 43-hectare site is located within a mixed rural and forested area of Logan City. The two adjacent lots within the site are located at 24 Bushman Drive and 68 Wyatt Road, Jimboomba. The site is bounded to the south by Wyatt Road, to the east by Bushman Drive and to the west by the Brisbane-Sydney Railway. Rural residential lots border the site to the north.

The location of the site is presented in Figure 2-1.

2.2 Topography and Drainage

Ground elevations vary between 50.0m AHD in the north western corner of the site, to 27.7m AHD in the south-east corner at the culverts under Bushman Drive.

Flows from a 169-hectare upstream catchment enter the site under a bridge on the Brisbane-Sydney Railway. Drainage within the site is dominated by a defined watercourse traversing the centre of the site from the railway bridge to the culverts under Bushman Drive. The watercourse continues from the culverts to Teviot Brook, 1.3 km downstream.

Teviot Brook is located within the Logan River catchment, which covers an area of approximately 234,000 hectares upstream of the site.

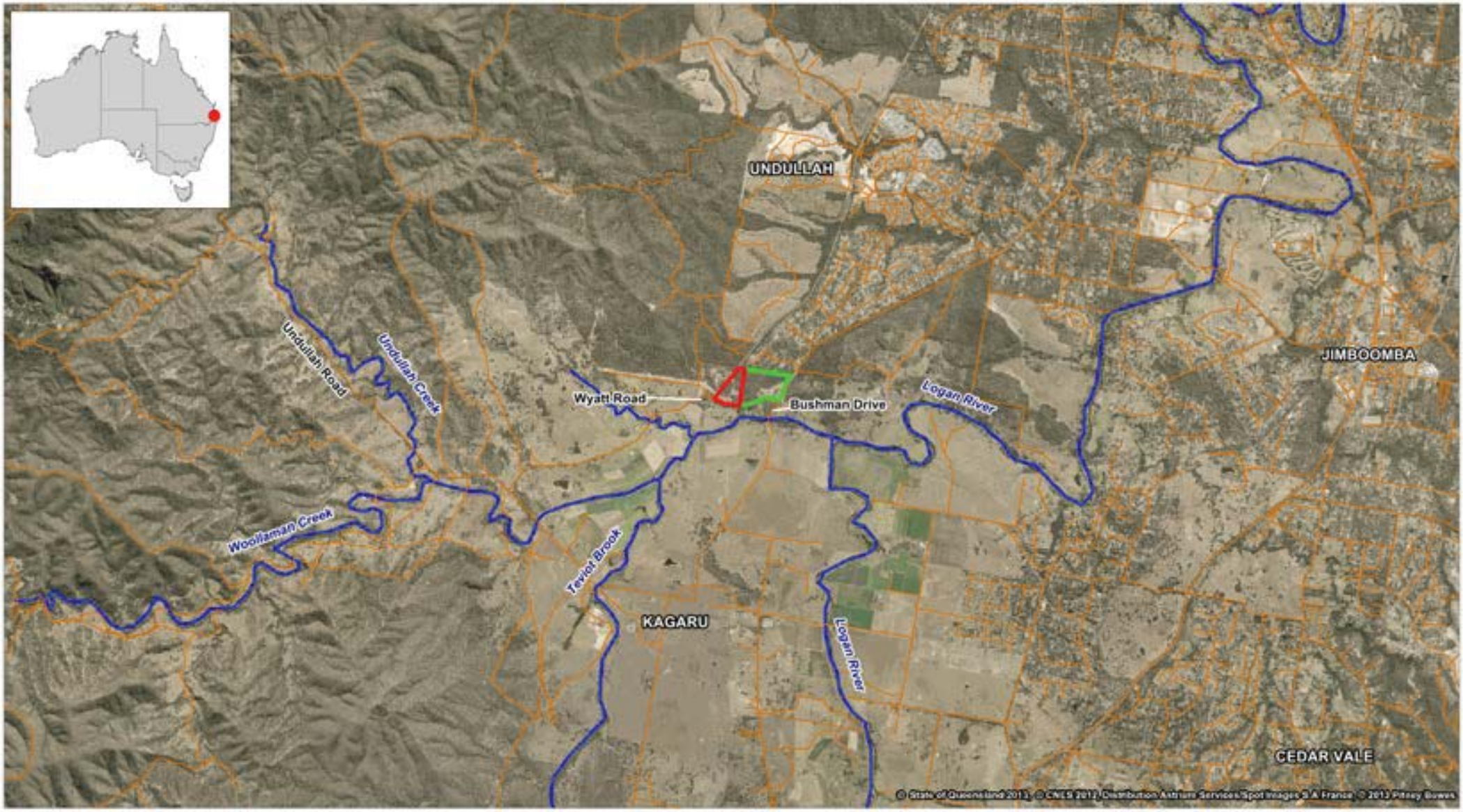
The topography for the site and surrounding areas is presented in Figure 2-2.

2.3 Proposed Development

A layout plan of the proposed development and associated land uses is presented in Figure 2-3. This has been adopted from information provided by Mortons and provided in Appendix B.

The topography of the proposed development has also been supplied by Mortons. This topography is presented in Figure 2-4.

It is noted that slight changes to the development topography have occurred since the flood modelling component of this SMP was completed. Theses change included some minor adjustment to the development footprint and drainage pathways. A comparison of the topography used for the flood modelling and the updated version indicated that the changes are not expected to result in unacceptable flood levels external to the site.



LEGEND

- Lot 1 RP49296
- Lot 24 SP142997
- Streams
- Roads

Title:

Site Location

Figure: 2-1

Rev: A

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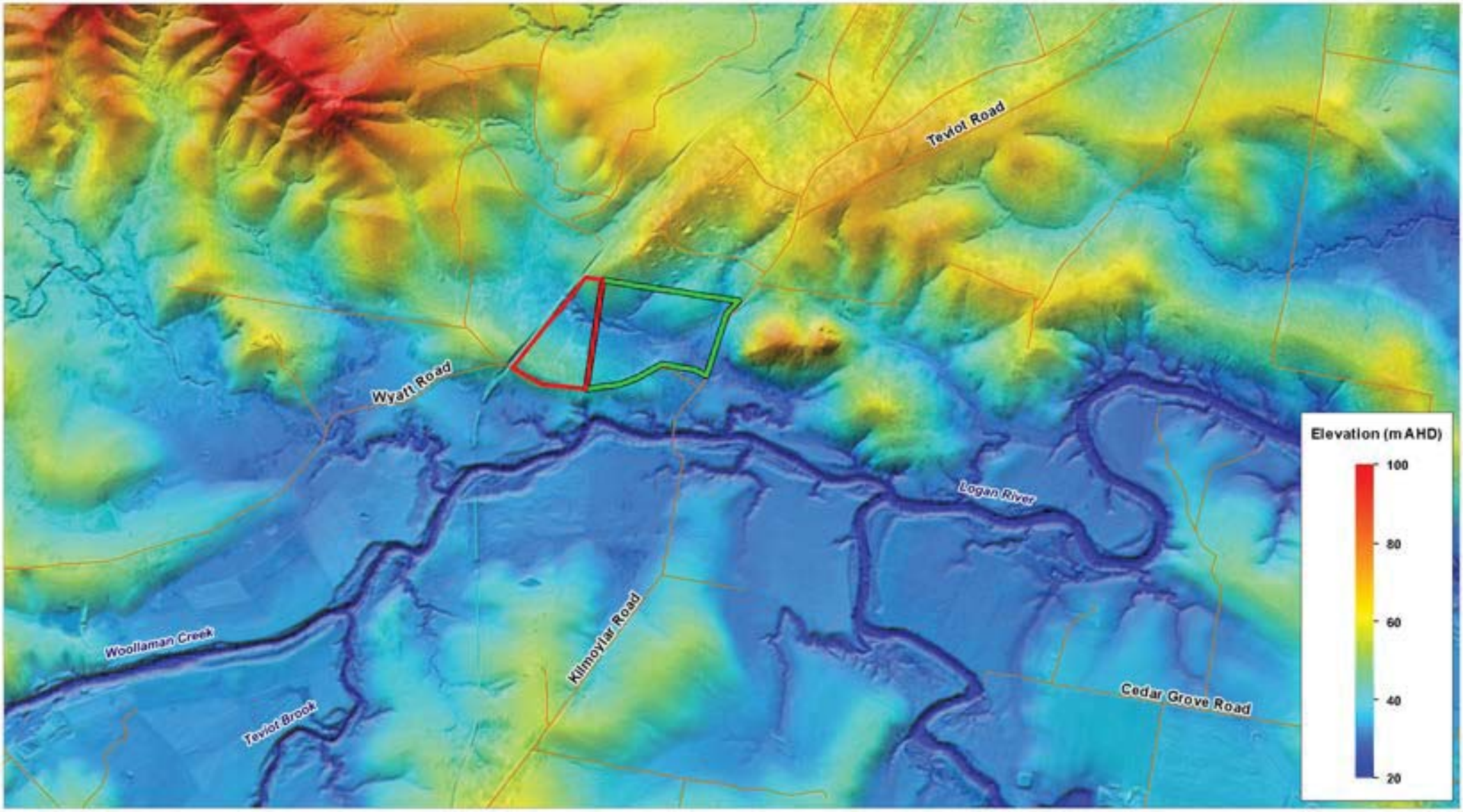

LEGEND

- Lot 1 RP49296
- Lot 24 SP142997
- Streams
- Roads

Title:

Existing Site Topography

Figure: 2-2

Rev: A

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LEGEND

- Site Boundary

Land Use

- Residential
- Commercial
- Linear Park
- Park
- Road
- Major Road Upgrade

Title:

Plan of the Proposed Development

Figure: 2-3

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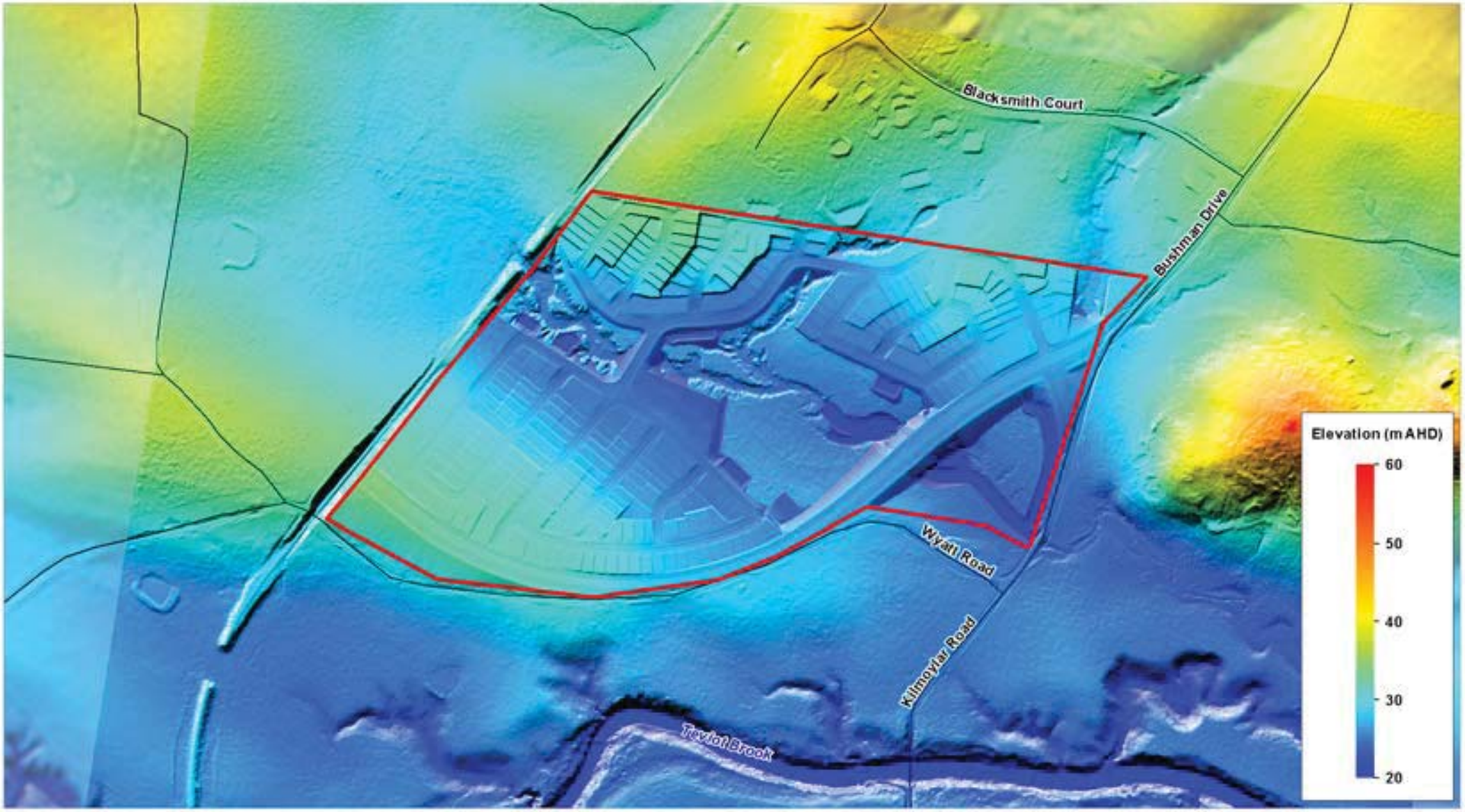

LEGEND

- Site Boundary
- Streams
- Roads

Title:

Developed Site Topography

Figure: 2-4

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3 Flood Impact Assessment

3.1 Hydrologic Assessment

3.1.1 Overview

This section provides a description of the hydrologic model of the local catchment that was established to provide runoff hydrographs suitable for use in the hydraulic model.

3.1.2 Existing Case Hydrologic Model Setup

3.1.2.1 Catchment

To represent the hydrologic behaviour of the catchment, 25 sub-catchments were created using CatchmentSIM software and modelled using WBNM. The sub-catchment layout is presented in Figure 3-1. The area of each sub-catchment is presented in Table 3-1.

Table 3-1 Sub-Catchment Areas

Sub-catchment Name	Area (ha)	Sub-catchment Name	Area (ha)
1.01	8.98	3.01	10.65
1.02	16.19	4.01	14.11
1.03	10.54	4.02	13.18
1.04	14.35	4.03	20.51
1.05	11.24	5.01	20.91
1.06	12.85	6.01	16.69
1.07	10.61	7.01	8.58
1.08	2.33	7.02	17.09
1.09	8.84	8.01	15.76
1.10	5.93	8.02	4.85
1.11	6.46	8.03	3.21
2.01	11.38	9.01	11.00
		10.01	12.89
		Total	**289.13**

3.1.2.2 Land Use Fraction Impervious

The fraction imperviousness for the existing case was determined using aerial photography. The corresponding QUDM fraction imperviousness was then adopted for each land use, as outlined in Table 3-2. It should be noted that the previous flood study for the Kilmoylar Road intersection upgrade assumed the upstream catchment to be in a future developed state, which was reflected in the hydrologic model by an increase in imperviousness associated with a residential development.

Table 3-2 Land Use Impervious Area

Land Use	Impervious Area (%)
Medium Density Vegetation	0%
Rural	5%
Road Reserve	90%
Railway	90%
Vegetated Watercourse	0%
Rural Residential	20%
Recreation Open Space	5%
Commercial	90%
High Density Residential (including roads)	80%

3.1.2.3 Rainfall Parameters

The rainfall parameters used in the WBNM model were extracted from *Australian Rainfall and Runoff* (Institution of Engineers Australia, 1987) for the Logan City area. The adopted parameters are presented in Table 3-3.

Table 3-3 Rainfall Parameters

Parameter	Value
2 Year ARI 1 hour	44.3
2 Year ARI 12 hour	7.06
2 Year ARI 72 hour	1.97
50 Year ARI 1 hour	82.64
50 Year ARI 12 hour	13.31
50 Year ARI 72 hour	4.2
Skew Coefficient	0.17
Geographical Factor F2	4.39
Geographical Factor F50	17.11

3.1.2.4 Hydrologic Parameters

Rainfall losses were accounted for using an initial loss/ continuing loss model. The rainfall losses adopted for use in the WBNM model were as follows:

- Initial loss (pervious areas): 0 mm;
- Initial loss (impervious areas): 0.5 mm;
- Continuing loss (pervious areas): 1.5 mm/h; and
- Continuing loss (impervious areas): 0.0 mm/h

3.1.2.5 *Rational Method Verification*

Due to the absence of a stream gauge on the watercourses that drain through the study area, it was not possible to calibrate the hydrologic models to historic flood events.

In lieu of calibration data, recourse was made to the Rational Method to confirm that the peak flows calculated by the hydrologic model were reasonable. The catchment flowing into the site under the railway was chosen for the comparison due to the lack of hydraulic structure upstream of this point. The Rational Method assessment was completed in accordance with the procedures nominated in Section 4 of QUDM, with the parameters presented in Table 3-4 adopted for the catchment.

Table 3-4 Rational Method Parameters

Parameter	Existing Catchment
Catchment Area (ha)	169
Fraction Impervious (%)	0%
Channel Length (m)	2 km
Time of Concentration (min)	53 min
Runoff Coefficient (C_{10})	0.65

A comparison of the peak flow predicted using the Rational Method and that calculated by the WBNM model is presented in Table 3-5.

Table 3-5 Rational Method Comparison

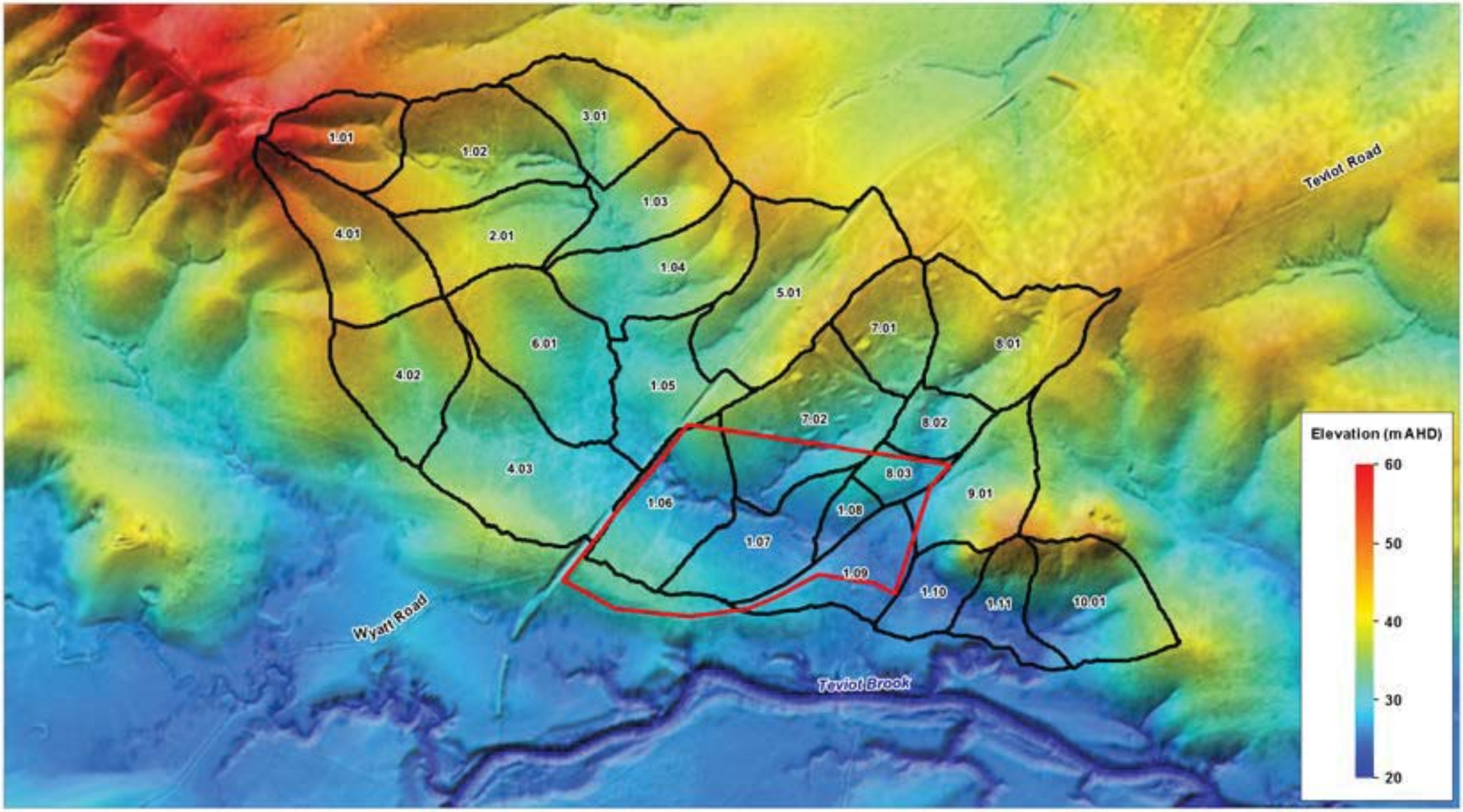
ARI (Years)	Rational Method	WBNM	% Difference
1	8.8	10.8	22%
2	12.1	14.8	23%
5	17.1	20.0	17%
10	20.3	23.1	14%
20	24.6	27.6	12%
50	31.7	33.2	5%
100	37.0	38.0	3%

Based on the results presented in Table 3-5 above, it is considered that a reasonable correlation exists between the WBNM model and the Rational Method and that therefore the model can be used with confidence to define runoff hydrographs for use in the hydraulic model.

3.1.3 Developed Case Hydrologic Model Setup

The existing case model was revised to reflect the increased impervious area associated with the development (i.e. increased roof and pavement area).

The developed case model was then used to determine the increase in discharge associated with the development of the site and appropriately modified runoff hydrographs were applied to the hydraulic model.



LEGEND

Site Boundary

6.01 Sub-catchments

Title:

Existing Case Hydrologic Model

Figure: 3-1

Rev: A

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3.2 Hydraulic Assessment

3.2.1 Overview

To confirm that the development will not cause an unacceptable impact on adjacent properties, detailed flood modelling of the local catchment was undertaken.

For the analysis, a TUFLOW two-dimensional model of the local catchment was established. The model included a detailed representation of the surface drainage network via a two-dimensional grid, linked with one-dimensional elements representing the underground (pipe) drainage network under Bushman Drive.

This section provides a description of the assessment undertaken and the results obtained from the simulation.

3.2.2 Existing Case Model Setup

3.2.2.1 Model Extent and Topography

The TUFLOW model created for this assessment covers the area from the top of the local catchment to the confluence of the local watercourse and Teviot Brook. The downstream extent of the model was chosen to ensure that conditions at the downstream end of the model do not affect results at the site.

Ground level data for the model was obtained from 2014 LIDAR survey data provided by DNRM and a recent site survey supplied by the client.

To provide a high level of detail, a hydraulic model with a 5 metre grid cell size was used in the 2D domain.

3.2.2.2 Roughness

A roughness map representing the Manning ‘n’ roughness coefficients was based on a review of aerial photography. To confirm that the adopted values were reasonable, a comparison was made between the adopted values and those presented in Australian Rainfall and Runoff Project 15, *Two-Dimensional Modelling of Urban and Rural Floodplains* (AR&R, 2012). Based on the comparison, it was concluded that the adopted values were appropriate. Table 3-6 presents the adopted roughness coefficients for the model.

Table 3-6 Roughness Values

Land Use	Manning's Roughness
Medium Density Vegetation	0.07
Rural	0.05
Road Reserve	0.025
Railway	0.03
Vegetated Watercourse	0.15
Rural Residential	0.08
Recreation Open Space	0.04
Commercial	0.20
High Density Residential (including roads)	0.15

3.2.2.3 Pipe Network

A 1D domain was created to represent the existing pit and pipe network under Bushman Drive. Data for the network was provided by DTMR.

Table 3-7 Existing Case Hydraulic Structures

Crossing Id	Type	Length (m)	Upstream Level (mAHD)	Downstream Level (mAHD)	Width (m)	Height (m)	No. of Barrels
Existing (C_001*)	RCP	17	26.16	26.01	1.2	N/A	3

3.2.2.4 Boundary Conditions

Inflow boundary conditions were extracted from the WBNM model described in Section 3.

This assessment considered two downstream boundary conditions:

- ***Local Catchment Flows***

  For this assessment an automatic stage-discharge boundary condition was applied to the south of the model, assuming a 1 percent water surface slope.

- ***Coincident Regional Flood Event and Local Catchment Flows***

  The Logan City Council's regional flood model of the Logan-Albert River was used to determine the peak water levels at the local model downstream boundary. Presented in Table 3-8 are the peak water levels for a range of design storm events.

  For the coincident regional flooding assessment, it was assumed that the Logan River catchment was experiencing a 100 Year ARI flood. Subsequently, a value of 33.49 m AHD was applied as the initial and downstream boundary water level within the hydraulic model.

Table 3-8 Regional Flood Model Peak Water Level at Local Model Boundary

Regional Storm Event	Peak Water Level at Boundary (m AHD)
2 Year 36 Hour	25.67
5 Year 30 Hour	29.10
10 Year 18 Hour	30.47
20 Year 18 Hour	31.51
50 Year 24 Hour	32.92
100 Year 24 Hour	33.49

3.2.3 Developed Case Model Setup

The model created for the existing case was modified to reflect the proposed development outlined in Figure 2-3 and Figure 2-4. This involved updating the digital elevation model and land use characteristics.

The developed case model also included an upgrade to the intersection of Kilmoylar Road and Wyatt Road. The upgrade included modifications to the road profile and culvert network. The road profile upgrades were applied to the hydraulic model.

Table 3-9 Developed Case Hydraulic Structures

Crossing Id	Type	Length (m)	Upstream Level (mAHD)	Downstream Level (mAHD)	Width (m)	Height (m)	No. of Barrels
Kilmoylar Road							
Existing (C_001*)	RCP	17	26.16	26.01	1.2	N/A	3
Northern (C_002_DEV)	RCBC	131	34.5	31.8	3	1.2	3
Western (Bebo_001)	Bebo	50	28	27.9	6	3.1	1
Western (Regional)	RCBC	50	32	31.75	3.6	1.8	2
Internal							
Main creek crossing	RCBC	38	29.5	29.4	3.3	1.8	3
Northern crossing	RCBC	38	32.63	31.8	1.8	1.8	1

Note: C_001 is an existing structure*

3.2.4 Storage

Hydraulic modelling was based on a digital elevation model developed by consultants Mortons Urban Solutions. The modelling indicated that the development would result in a slight net increase in flood storage for the 100 year event of 698 m^3 compared to an overall storage volume of 288,188 m^3. Copies of the plans provided by Mortons Urban Solutions are included as Appendix C.

3.2.5 Hydraulic Model Results

The hydraulic model was used to calculate flood levels for both the pre-developed and developed cases for a range of storm events, durations and boundary conditions.

3.2.5.1 Local Catchment Flows

For the local catchment flow assessment, the hydraulic model was used to calculate flood levels for both pre-developed and developed cases for a range of storm events and durations.

The mapped resultant pre and post-development case peak flood levels for the 100 year ARI storm event are presented in Figure 3-2 and Figure 3-3 respectively. The peak water levels at the reporting shown in the post-development maps are tabulated in Table 3-10.

Table 3-10 Local Flooding - Post-Development Peak Water Levels at Reporting Points

ARI (Years)	RP1	RP2	RP3	RP4	RP5
1	28.10	28.51	29.49	33.60	31.11
2	28.21	28.58	29.84	33.75	31.41
5	28.33	28.68	30.23	33.93	31.71
10	28.38	28.74	30.40	34.04	31.88
20	28.46	28.80	30.65	34.20	32.03
50	28.53	28.87	30.93	34.30	32.23
100	28.58	28.91	31.14	34.43	32.44

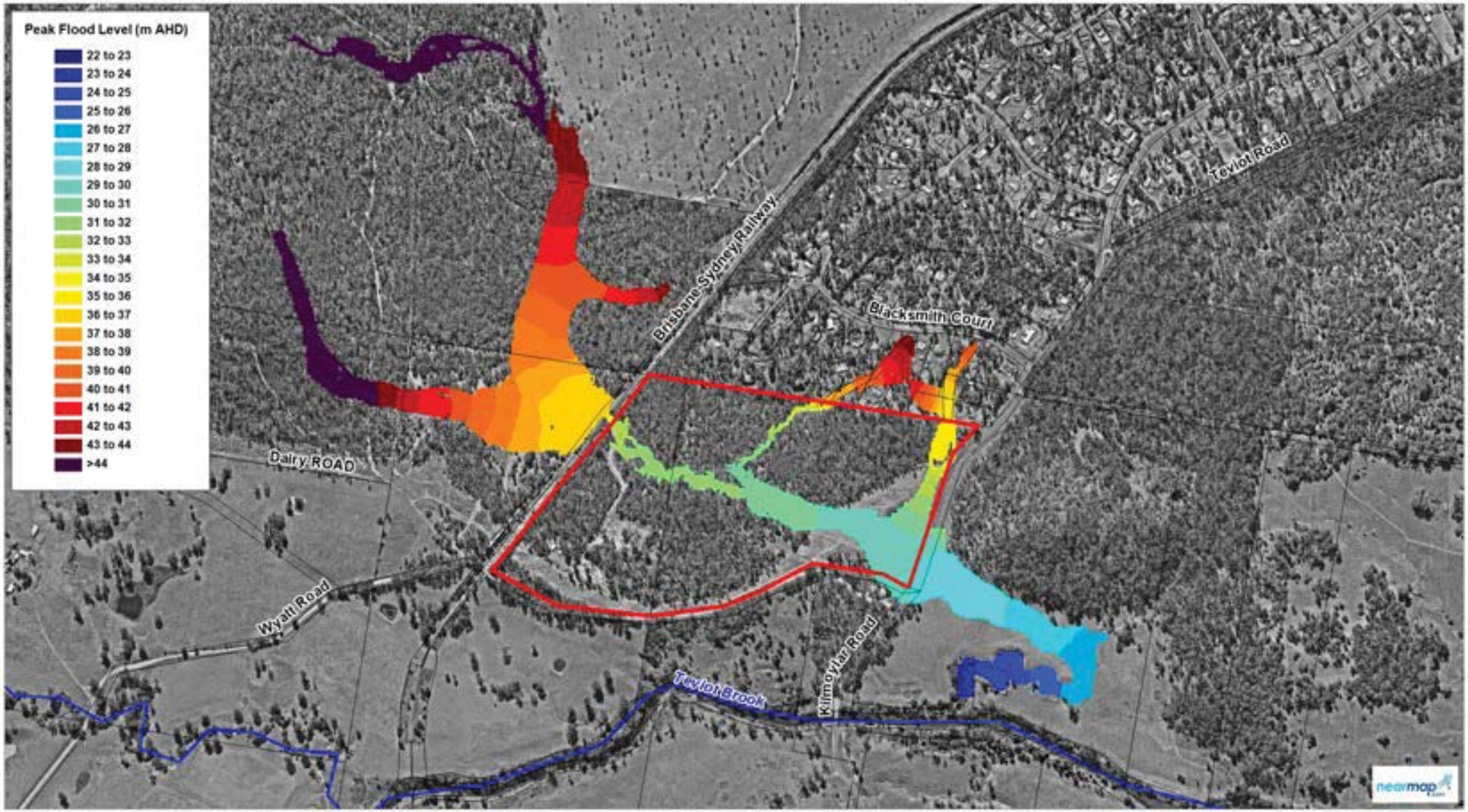
Mapped resultant pre and post-development case peak flood levels for the 2, 5, 10, 20 and 50 year ARI storm events are presented in Appendix A in the following figures.

- Figure A-1 1 Year ARI Peak Flood Level – Existing Case
- Figure A-2 2 Year ARI Peak Flood Level – Existing Case
- Figure A-3 5 Year ARI Peak Flood Level – Existing Case
- Figure A-4 10 Year ARI Peak Flood Level – Existing Case
- Figure A-5 20 Year ARI Peak Flood Level – Existing Case
- Figure A-6 50 Year ARI Peak Flood Level – Existing Case
- Figure A-7 1 Year ARI Peak Flood Level – Developed Case
- Figure A-8 2 Year ARI Peak Flood Level – Developed Case
- Figure A-9 5 Year ARI Peak Flood Level – Developed Case
- Figure A-10 10 Year ARI Peak Flood Level – Developed Case
- Figure A-11 20 Year ARI Peak Flood Level – Developed Case
- Figure A-12 50 Year ARI Peak Flood Level – Developed Case

Afflux plots for the 100 year ARI storm event are presented in Figure 3-4. The plot shows no unacceptable increase in water level external to the site.

Afflux plots for the 2, 5, 10, 20 and 50 year ARI storm events are presented in Appendix A in the following figures.

- Figure A-13 1 Year ARI Peak Flood Afflux
- Figure A-14 2 Year ARI Peak Flood Afflux
- Figure A-15 5 Year ARI Peak Flood Afflux
- Figure A-16 10 Year ARI Peak Flood Afflux
- Figure A-17 20 Year ARI Peak Flood Afflux
- Figure A-18 50 Year ARI Peak Flood Afflux



LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

100 Year ARI Peak Flood Level - Existing Case

Figure: 3-2

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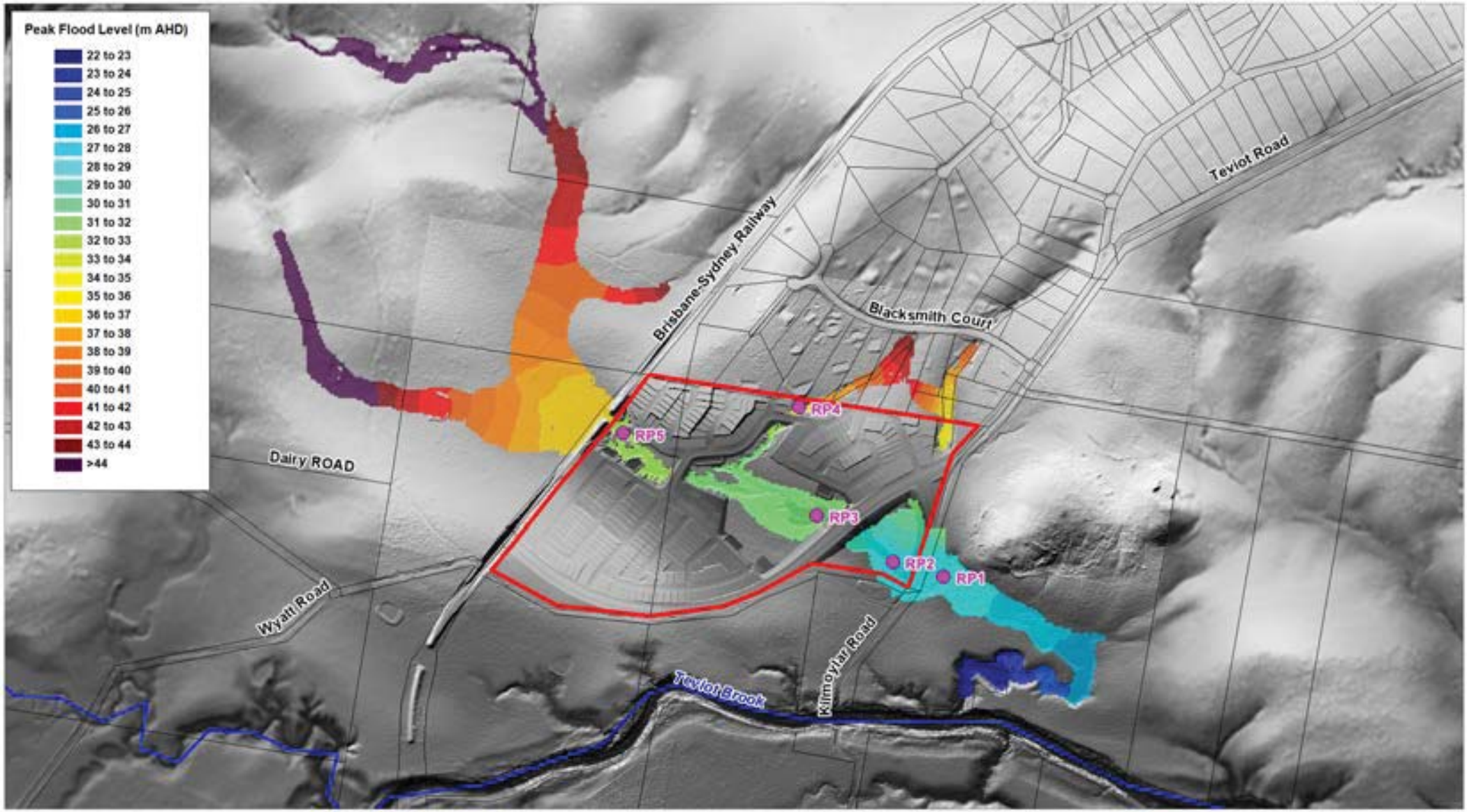

LEGEND

- Reporting Points
- Site Boundary
- Streams
- Cadastral Boundaries

Title:

100 Year ARI Peak Flood Level - Developed Case

Figure: 3-3

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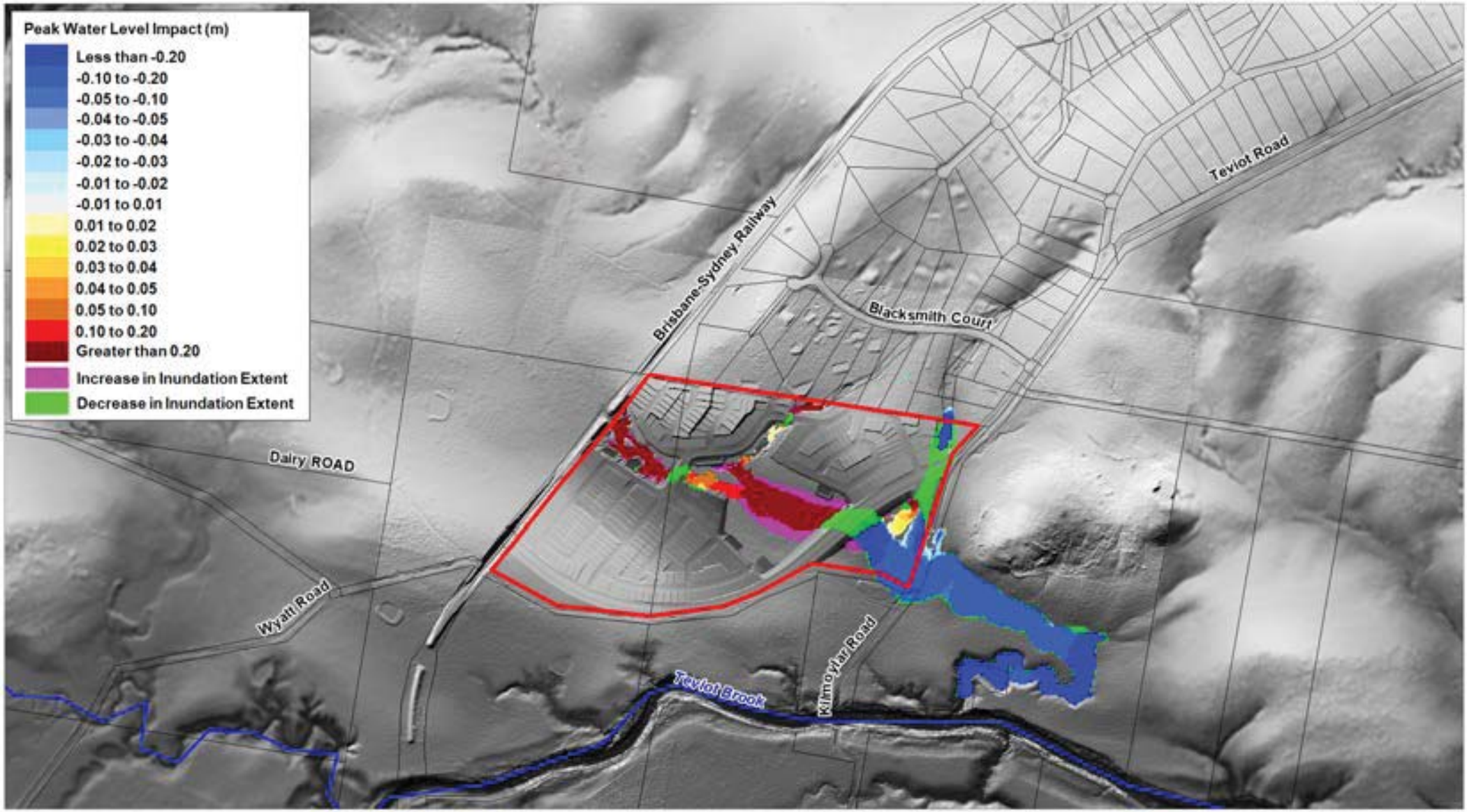

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

100 Year ARI Peak Flood Afflux

Figure: 3-4

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3.2.5.2 Coincident Regional Flood Event and Local Catchment Flows

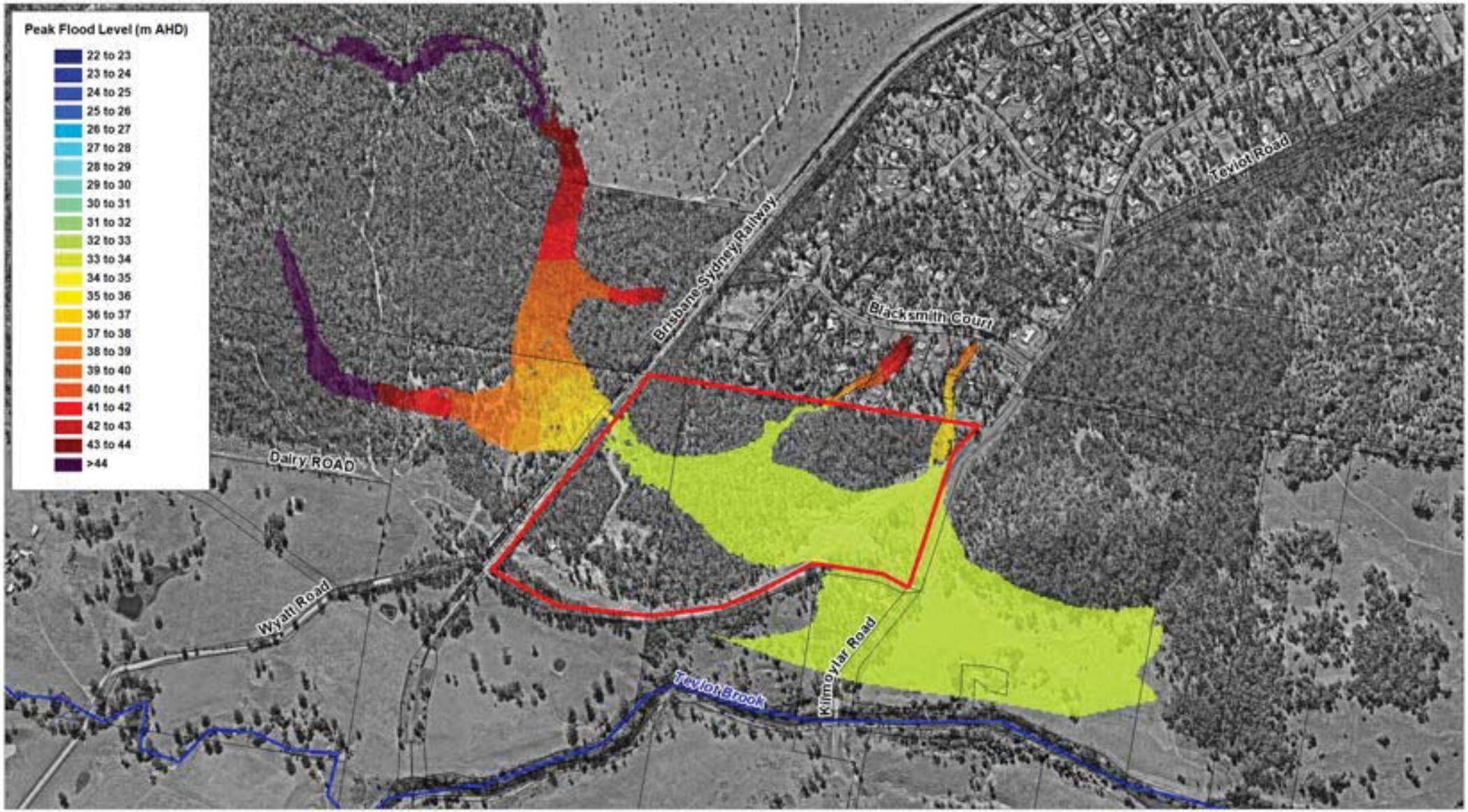
The local hydraulic model was used to simulate flooding from a combined local catchment and regional storm event. Given that the local catchment is approximately 0.1% of the Logan River Catchment, the 5 Year ARI local event was combined with the 100 Year ARI regional event to define the 100 Year ARI Flood Level in the local catchment. As outlined is Section 3.2.2.4, an initial water level and tailwater boundary of 33.49 m AHD was applied to the model to simulate the 100 Year ARI regional event.

The mapped resultant pre and post-development case peak flood levels for the 5 year ARI local storm, combined with the 100 year ARI regional storm, presented in Figure 3-5 and Figure 3-6 respectively. The peak water levels at the reporting point shown in the post-development map are tabulated in Table 3-11.

Table 3-11 Coincident Flooding - Post-Development Peak Water Levels at Reporting Points

ARI (Years)	RP1	RP2	RP3	RP4	RP5
5	33.49	33.49	33.57	33.58	33.74

Afflux plots for the 5 year ARI local storm, combined with the 100 year ARI regional storm, are presented in Figure 3-7. The plot shows no unacceptable increase in water level external to the site.



LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

Coincident 5 Year ARI Local and 100 Year ARI Regional Peak Flood Level - Existing Case

Figure: 3-5

Rev: A

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Approx.Scale

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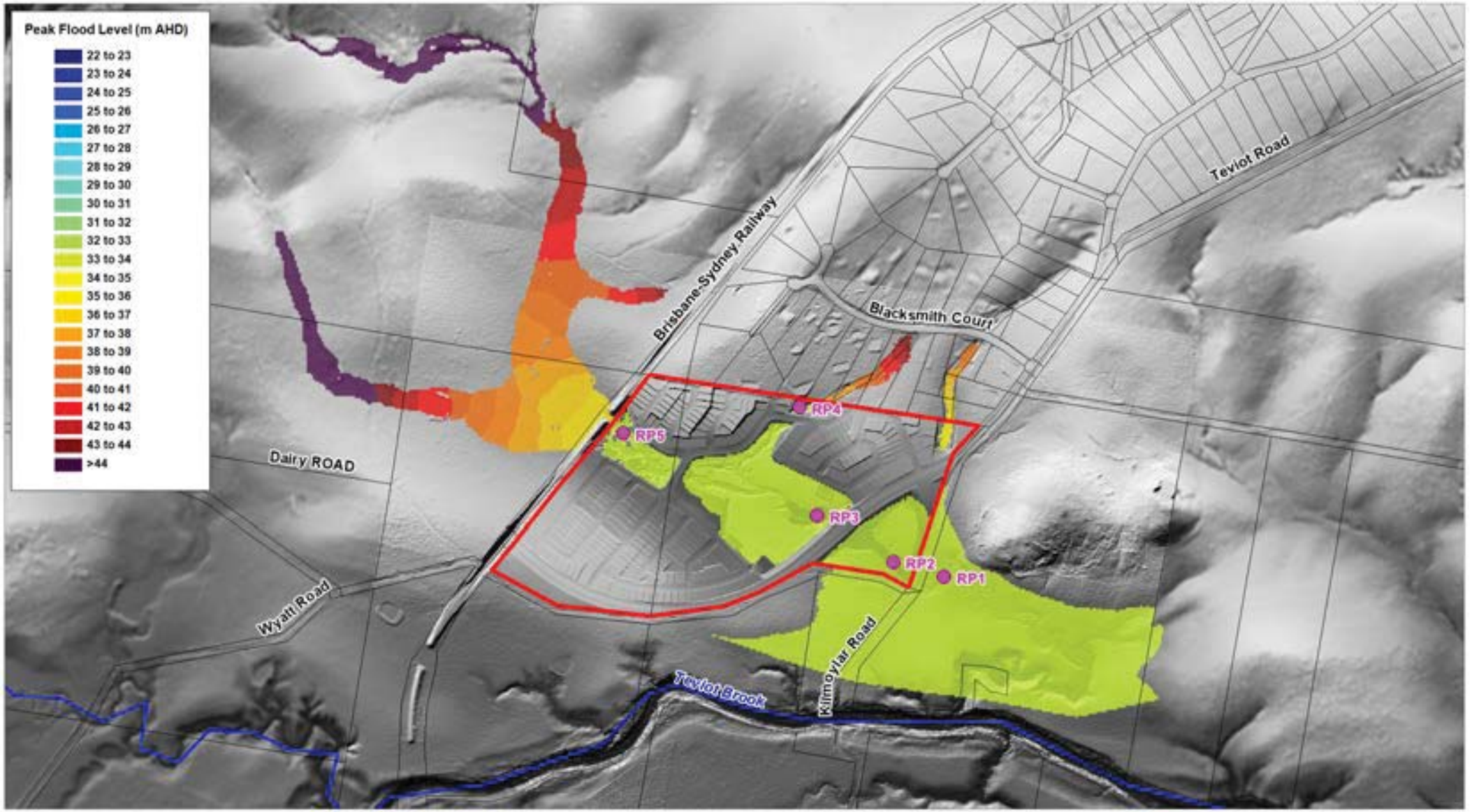

LEGEND

- Reporting Points
- Site Boundary
- Streams
- Cadastral Boundaries

Title:

Coincident 5 Year ARI Local and 100 Year ARI Regional Peak Flood Level - Developed Case

Figure: 3-6

Rev: A

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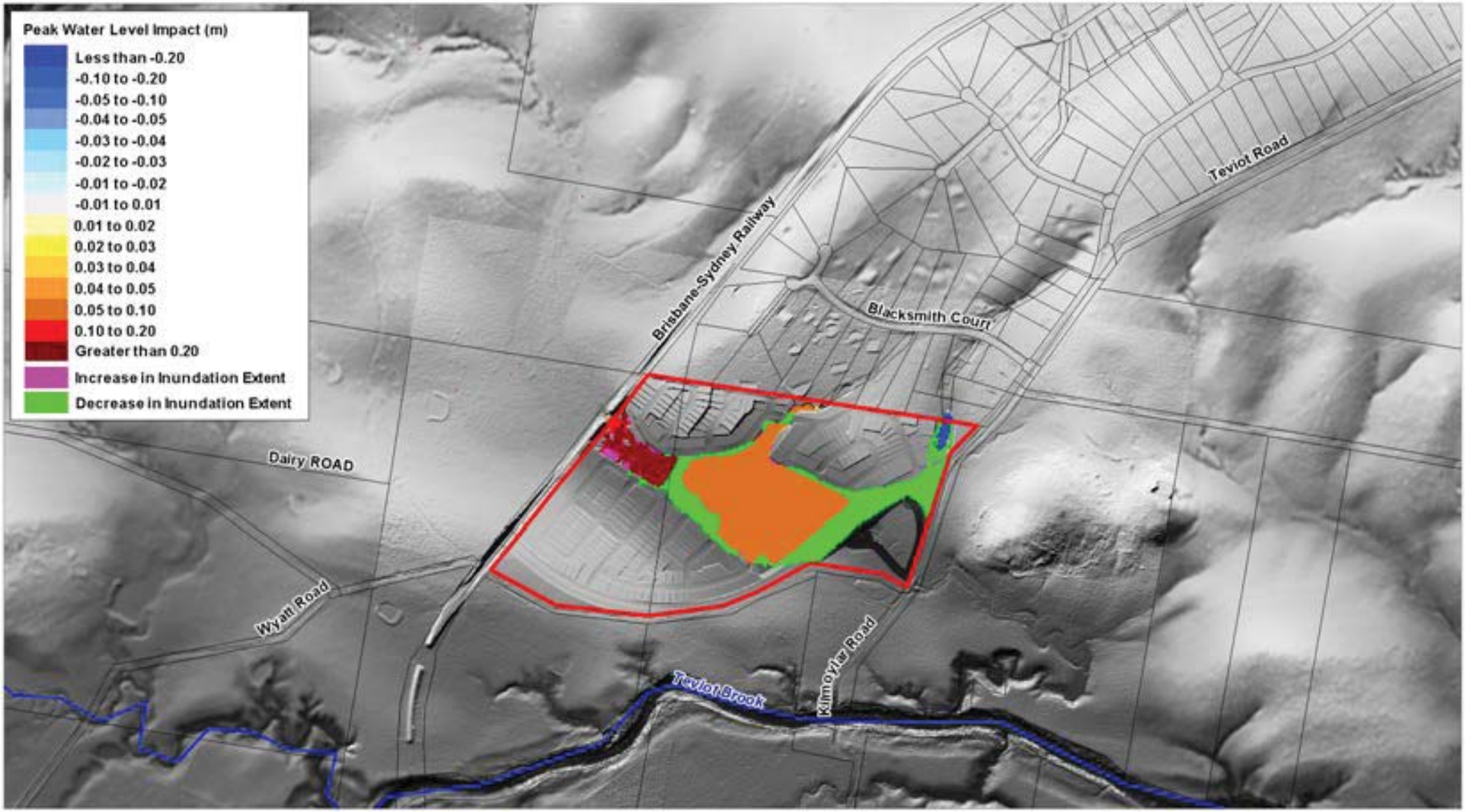

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

Coincident 5 Year ARI Local and 100 Year ARI Regional Afflux

Figure: 3-7

Rev: A

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3.3 Hydraulic Assessment of Development Staging

3.3.1 Overview

To confirm that a staged approach to the development will not cause an unacceptable impact on neighbouring properties, detailed flood modelling was undertaken.

The analysis was undertaken using the TUFLOW model described in Section 3.2, with adjustments made to reflect a partially developed site.

This section provides a description of the assessment undertaken and the results obtained from the simulation.

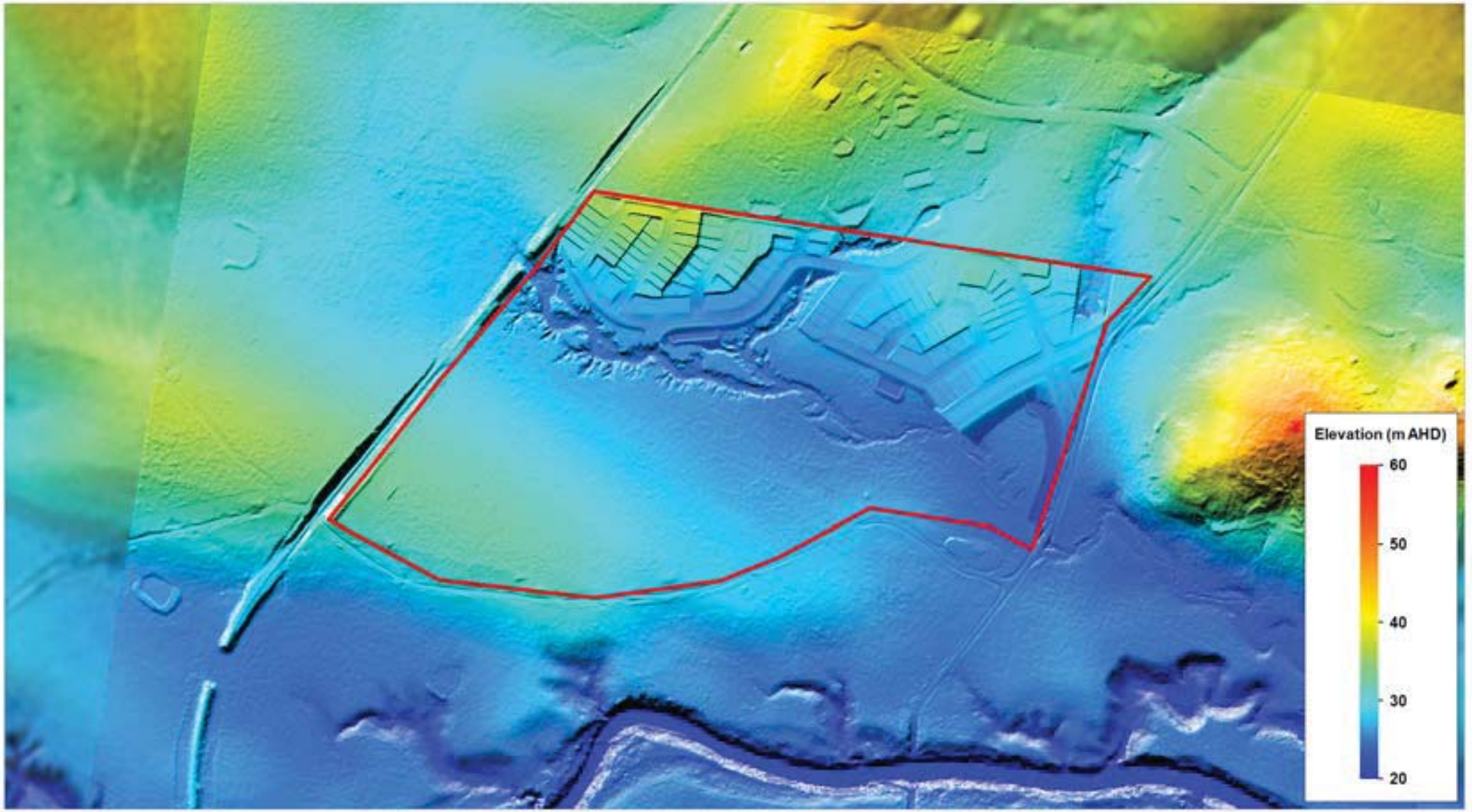
3.3.2 Staged Model Setup

For the first stage of the development, it is proposed to develop the two residential areas to the north of the central waterway. The upgrade to Wyatt Road will only extend as far as the intersection with Kilmoylar Road, not across the waterway corridor (with the associated road profile modifications and culvert network).

A digital elevation map of the first stage is presented in Figure 3-8.

3.3.3 Staged Model Results

The hydraulic model was used to calculate flood levels for both the pre-developed and developed cases for the 2 and 100 local catchment flows, and the coincident regional flood event. Afflux plots for the three events are shown in Figure 3-9, Figure 3-10 and Figure 3-11 below. From these plots it can be seen that the first stage of the development does not cause an adverse off-site impact.



LEGEND

- Site Boundary
- Streams
- Roads

Title:

Topography of the Proposed First Stage Development

Figure: 3-8

Rev: A

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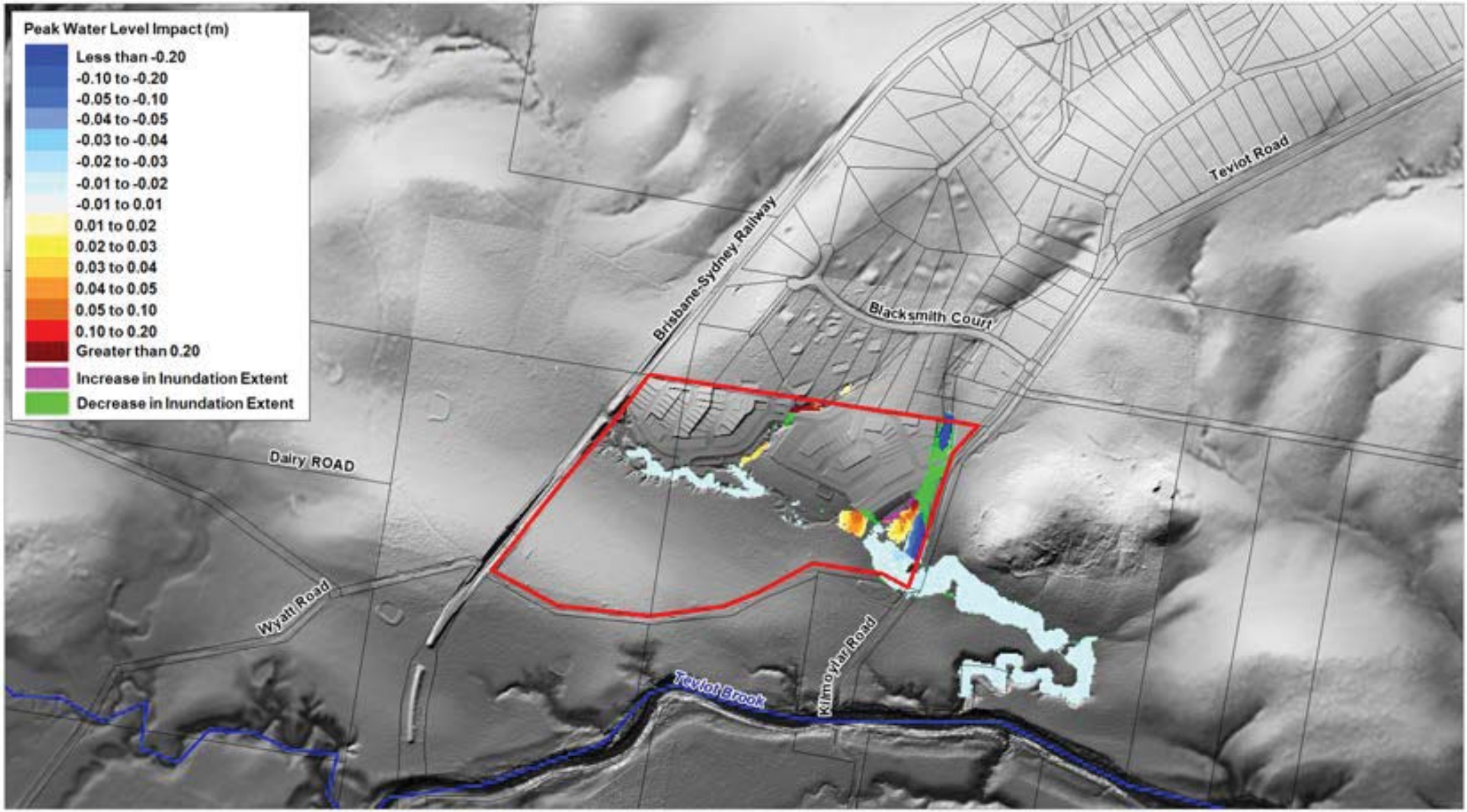

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

2 Year ARI Peak Flood Afflux - Staged Development

Figure: 3-9

Rev: A

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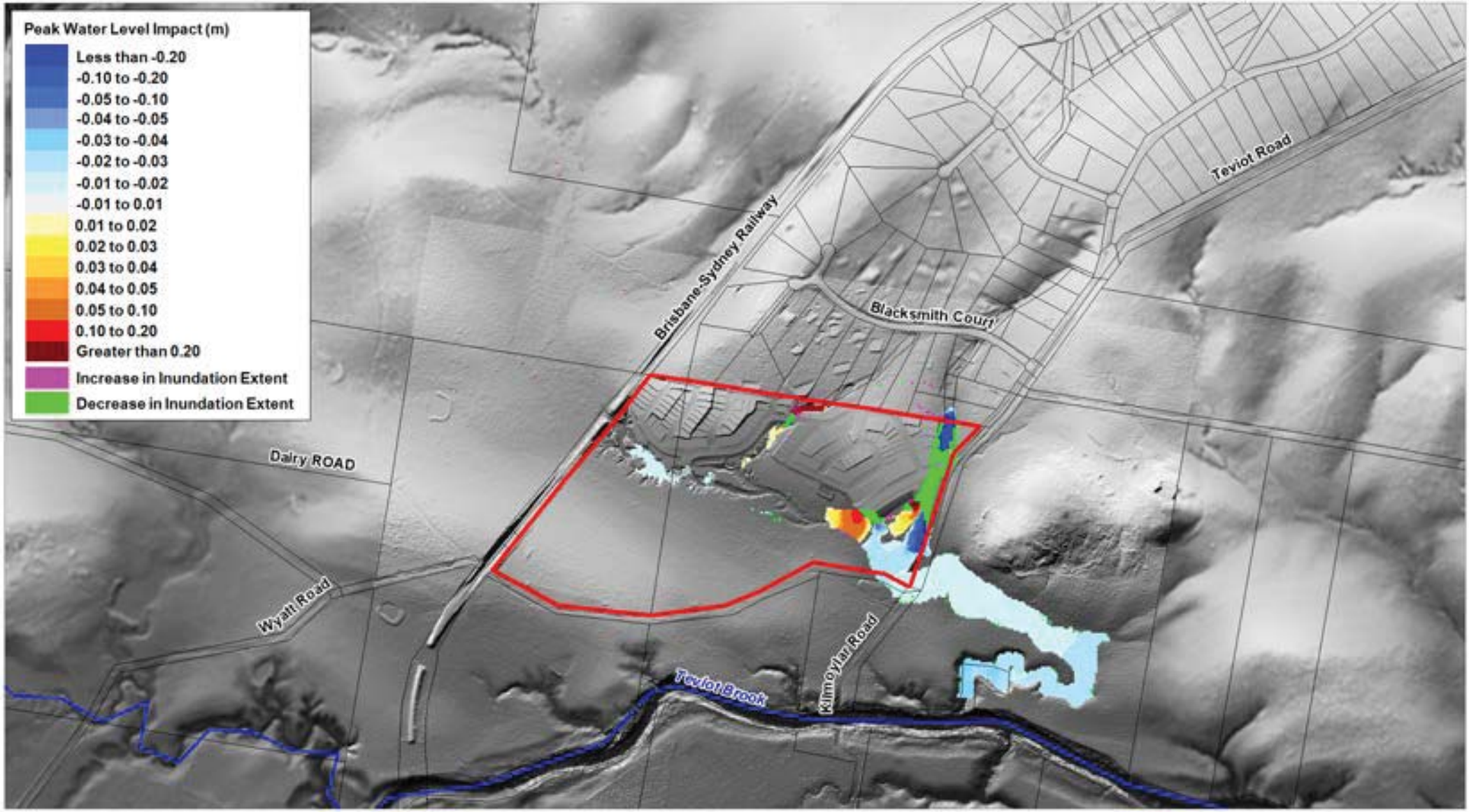

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

100 Year ARI Peak Flood Afflux - Staged Development

Figure: **3-10**

Rev: **A**

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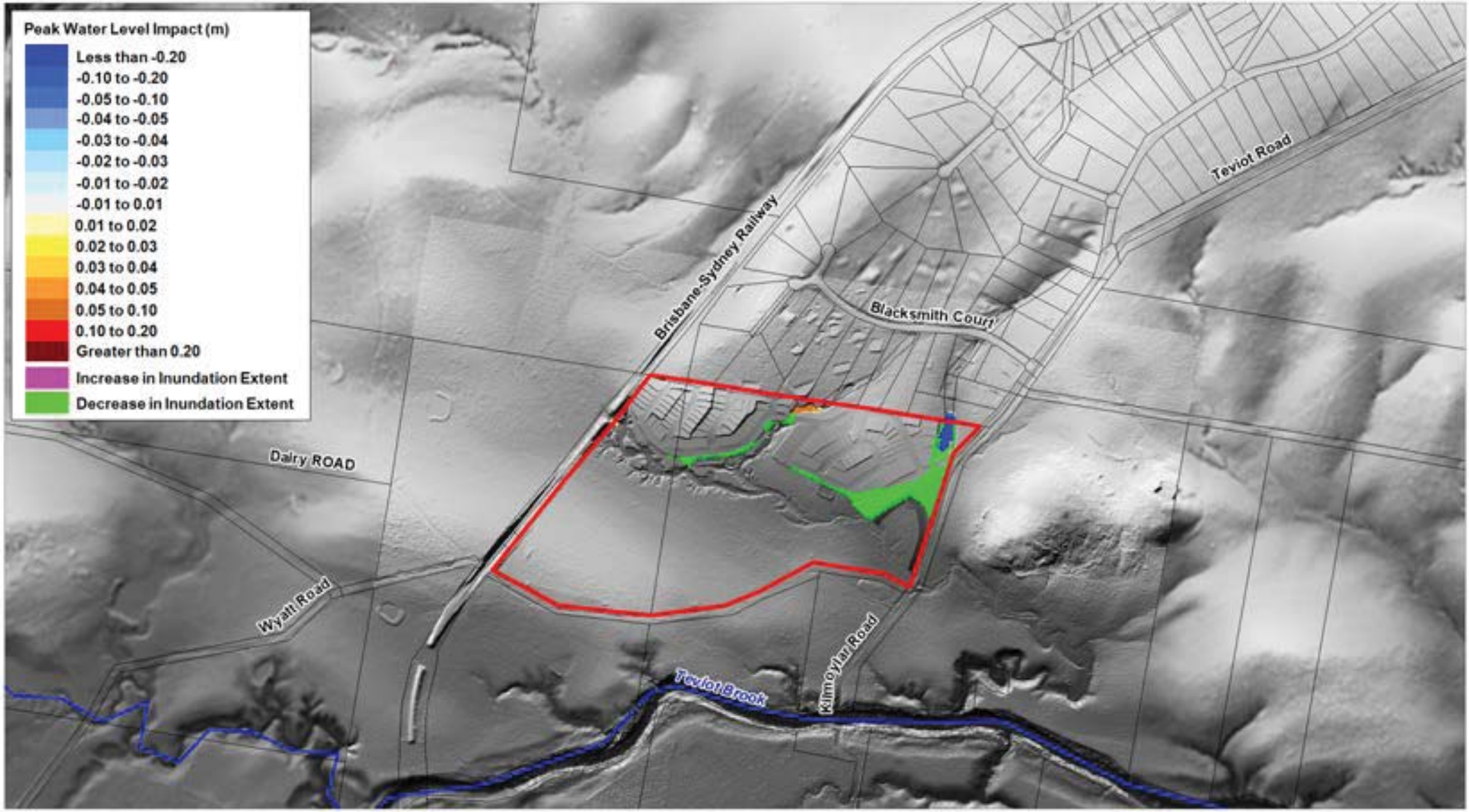

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

Coincident 5 Year ARI Local and 100 Year Regional Afflux Staged Development

Figure: 3-11

Rev: A

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4 Stormwater Quality Management Strategy

4.1 Preamble

This section proves a conceptual stormwater quality assessment of the proposed development. This has been prepared to determine the size, location and performance characteristics of the proposed stormwater management strategy. This section explains how predicted stormwater pollutant loads from the development will compare to the given stormwater quality management objectives.

4.2 Opportunities and Constraints for Water Quality Management

The development of the site presents a number of opportunities and constraints with respect to water quality management. These have been identified in subsequent Section 4.2.1 and Section 4.2.2.

4.2.1 Site Opportunities

There are a number of opportunities presented within the development for the application of stormwater quality measures, including:

- **Site layout** – The layout of the site generally provides opportunity for the implementation of stormwater management measures (SMMs) to be integrated into the site without greatly encroaching on the proposed urban living or natural areas land uses.
- **Education** – Potential exists at this site for the integration of stormwater quality management information and education programs. Education has the potential for greater community custodianship of vegetated stormwater assets, creeks and other natural corridors.
- **Roof water reuse** – Runoff from roof areas within the residential and commercial land use areas has the potential to be collected and utilised to supplement water demand where appropriate for both domestic and commercial uses.

4.2.2 Site Constraints

The major constraints identified for the development with respect to stormwater quality controls include the following:

- **In situ soil** – The site contains *in situ* soils which are likely to be dispersive in nature. This constraint will require consideration when developing the proposed stormwater management strategy and during the construction phase.

4.3 Stormwater Quality Management Objectives

Stormwater quality management objectives apply to both the construction and operational phases of the development. These management objectives are described in subsequent Section 4.3.1 and Section 4.3.2.

4.3.1 Construction Phase

Performance criteria for the for the construction phase for the development have been adopted directly from the *State planning policy* (DILGP 2017). These criteria are given in Table 4-1.

Table 4-1 Construction Phase Performance Criteria

Issue	Construction Phase Performance Criteria
Drainage control	1. Manage stormwater flows around or through areas of exposed soil to avoid contamination. 2. Manage sheet flows in order to avoid or minimise the generation of rill or gully erosion. 3. Provide stable concentrated flow paths to achieve the construction phase stormwater management design objectives for temporary drainage works as follows: • Design life and minimum design storm event of temporary drainage structures: – Design life: <12 months—1 in 2yr ARI. – Design life: 12-24 months—1 in 5yr ARI. – Design life: > 24 months—1 in 10yr ARI. • Where temporary drainage works are located immediately up-slope of an occupied property that would be adversely affected by the failure or overtopping of the structure—minimum 1 in 10yr ARI hydraulic capacity. • Temporary culvert crossing—minimum 1 in 1yr ARI hydraulic capacity 4. Provide emergency spillways for sediment basins to achieve the construction phase stormwater management design objectives for emergency spillways on temporary sediment basins as follows: • Design life <3 months—1 in 10yr ARI. • Design life 3-12 months—1 in 20yr ARI. • Design life > 12 months—1 in 50yr ARI.
Erosion control	1. Stage clearing and construction works to minimise the area of exposed soil at any one time. 2. Effectively cover or stabilise exposed soils prior to predicted rainfall. 3. Prior to completion of works for the development, and prior to removal of sediment controls, all site surfaces must be effectively stabilised13 using methods which will achieve effective short-term stabilisation.
Sediment control	1. Direct runoff from exposed site soils to sediment controls that are appropriate to the extent of disturbance and level of erosion risk. 2. All exposed areas greater than 2500 m^2 must be provided with sediment controls which are designed, implemented and maintained to a standard which would achieve at least 80% of the average annual runoff volume of the contributing catchment treated (i.e. 80% hydrological effectiveness) to 50mg/L Total Suspended Solids (TSS) or less, and pH in the range (6.5–8.5).
Litter, hydrocarbon and other contaminants	1. Remove gross pollutants and litter. 2. Avoid the release of oil or visible sheen to released waters. 3. Dispose of waste containing contaminants at authorised facilities.
Waterway stability and flood flow management	1. Where measures are required to meet post-construction waterway stability objectives, these are either installed prior to land disturbance and are integrated with erosion and sediment controls, or equivalent alternative measures are implemented during construction. 2. Earthworks and the implementation of erosion and sediment controls are undertaken in ways which ensure flooding characteristics (including stormwater quantity characteristics) external to the development site are not worsened during construction for all events up to and including the 1 in 100 year ARI (1% AEP).

The management strategy for achieving these criteria will be described as part of a detailed erosion and sediment control (ESC) plan. Details of the ESC plan have not been provided as part of this report.

4.3.2 Operational Phase

The site is located within a water resource catchment and water supply buffer area as identified in the *State Planning Policy Interactive Mapping System* (DSDIP 2018), therefore performance criteria for the operational phase of the development shall be in accordance with the *Seqwater Development Guidelines* (Seqwater 2017). These criteria are provided in Table 4-2.

Table 4-2 Operational Phase Performance Criteria

Pollutant	Criteria
Total suspended solids	85 % reduction in load
Total phosphorus	65% reduction in load
Total nitrogen	45% reduction in load
Gross pollutants (5 mm or larger)	95% reduction in load

4.3.3 Waterway Stability

In addition to the performance criteria listed above, the *State Planning Policy* (DILGP 2017) includes a waterway stability management criterion. The intent of this criterion is to reduce the impact of urban development on channel bed and bank erosion by limiting the post-development one-year average recurrence interval (ARI) event discharge within the receiving waterways to the pre-development peak. It has been demonstrated that there will be no impact on the downstream environment as the impacts will be mitigated by the proposed stormwater quantity management measures.

4.4 MUSIC Modelling

Version 6.3 of the MUSIC modelling software has been used to assess the generation, transportation and management/ treatment of flows and pollutant loads from the development. MUSIC modelling was undertaken for the following scenarios:

- Developed site without the proposed stormwater management strategy in place
- Developed site with the proposed stormwater management strategy in place.

Appendix A provides a detailed description of the MUSIC modelling methodology applied.

4.5 Proposed Strategy

There are several treatment options available for runoff from the site. For the purposes of this application, two stormwater quality management options have been developed, including:

- **Option 1**: This option consists of education and bioretention basins.
- **Option 2**: This option consists of education, bioretention basins and swales.

Two options have been provided to allow flexibility during the detailed design phase. The options are outlined in more detail below.

4.5.1 Option 1: Bioretention Basins

This option consists of education and bioretention basins to manage stormwater quality for the site. It is proposed that bioretention basins will be integrated into open space areas immediately downstream of areas proposed for development.

Bioretention basins have been adopted as the proposed SMM for the following reasons:

- These SMMs provide the greatest treatment per unit area compared to other best practice treatment measures.
- Bioretention basins are expected to be the most cost-effective solution (i.e. lowest cost per unit of stormwater pollutant removed relative to other typical SMMs).
- Bioretention basins can be readily integrated with other uses in parks and drainage corridors.

This proposed strategy is schematically illustrated in Figure 4-1. Details of the stormwater management measures proposed for use on the site are presented in Section D.4.

Table 4-3 provides a summary of the proposed stormwater management strategies for the site.

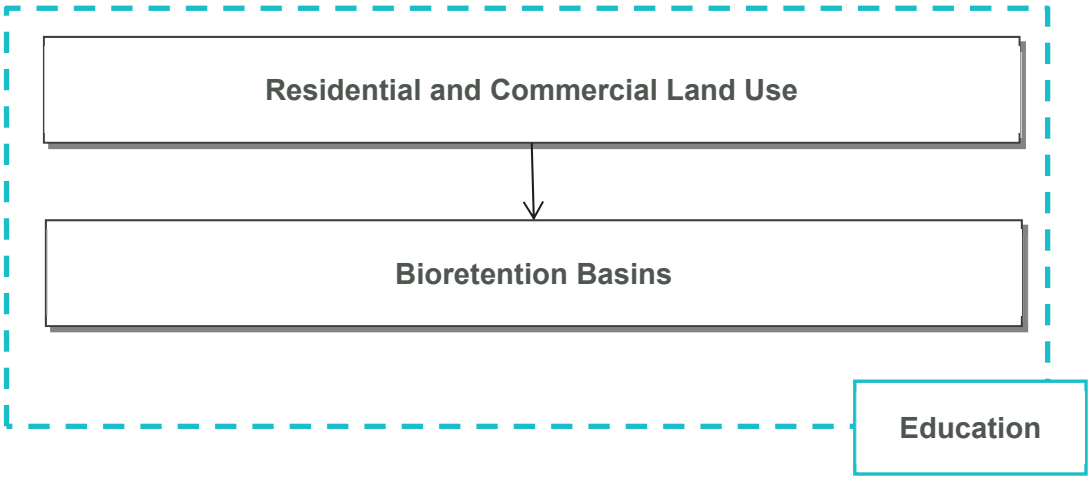

Figure 4-1 Option 1 - Stormwater Treatment Train

Table 4-3 Summary of Proposed Stormwater Treatment Strategy – Option 1

Component	Description
Education	Signage installed at appropriate locations (e.g. near bioretention basins). No pollutant removal capacity has been assumed in modelling or assessment.
Bioretention Basins	Bioretention basins located in open spaces and near road reserves. Each sub-catchment (identified in Table 4-4) below has been analysed and modelled in MUSIC with flow treated through bioretention systems. Each system has been assumed to have the following properties: • storage depth of 0.3 m • filter depth of 0.5 m • sandy loam filter media (saturated hydraulic conductivity 300 mm/hr, total nitrogen content 400 mg/kg, orthophosphate content 30 mg/kg) – As identified by Healthy Land and Water 2018 (Healthy Land and Water 2018) • vegetated with effective nutrient removal plants • zero exfiltration.

A conceptual plan view illustrating the location of the proposed bioretention basins is presented in

Figure 4-3 with the required total bioretention filter media area for each sub-catchment identified in Table 4-4.

Table 4-4 Required Bioretention Filter Media Area

Sub-catchment	Required Bioretention Filter Media Area (m^2)*
1	550
2	610
3	525
4	285
5	510
6	25
7	140

**It should be noted that the above table includes the filter media area only and the total footprint area can be up to double that of the filter media area (to account for the addition of internal and external batters, maintenance access, etc.)*

4.5.2 Option 2: Bioretention Basin with Swales

This option consists of education and bioretention basins with swales to manage stormwater quality for the site. It is proposed that bioretention basins will be integrated into open space areas immediately downstream of areas proposed for development with a small swale downstream of each system to treat the overflow.

This option was selected as the inclusion of swales can reduce the size of the required bioretention filter area, whilst still maintaining appropriate water quality treatment.

This proposed strategy is schematically illustrated in Figure 4-2. Details of the stormwater management measures proposed for use on the site are presented in Section D.4.

Table 4-3 provides a summary of the proposed stormwater management strategies for the site.

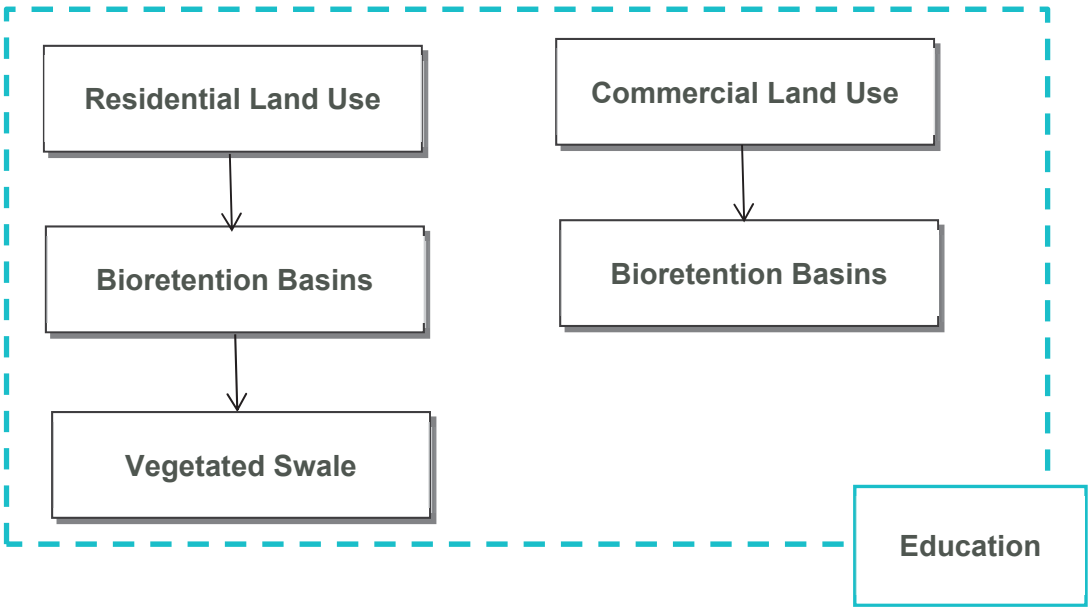

Figure 4-2 Option 2 - Stormwater Treatment Train

Table 4-5 Summary of Proposed Stormwater Treatment Strategy – Option 2

Component	Description
Education	Signage installed at appropriate locations (e.g. near bioretention basins). No pollutant removal capacity has been assumed in modelling or assessment.
Bioretention Basins	Bioretention basins located in open spaces and near road reserves. Each sub-catchment (identified in Table 4-4) below has been analysed and modelled in MUSIC with flow treated through bioretention systems. Each system has been assumed to have the following properties: • storage depth of 0.3 m • filter depth of 0.5 m • sandy loam filter media (saturated hydraulic conductivity 300 mm/hr, total nitrogen content 400 mg/kg, orthophosphate content 30 mg/kg) – As identified by Healthy Land and Water 2018 (Healthy Land and Water 2018) • vegetated with effective nutrient removal plants • zero exfiltration.
Vegetated Swales	Vegetated swales located to treat the overflow from the bioretention basins. Each swale is assumed to have the following properties: • length of 15 m • base width of 6 m • top width of 10 m • depth of 0.5 m with vegetation height of 0.25 m • bed slope of 8%, however it is assumed that check dams will be incorporated to reduce the slope

A conceptual plan view illustrating the location of the proposed bioretention basins is presented in Figure 4-3 with the required total bioretention filter media area for each sub-catchment identified in Table 4-6.

Table 4-6 Option 2 – Required Bioretention Filter Media Area and Swale Length

Sub-catchment	Required Bioretention Filter Media Area (m^2)*	Swale Length (m)
1	485	15
2	540	15
3	250	15
4	425	15
5	450	15
6	25	-
7	140	-

**It should be noted that the above table includes the filter media area only and the total footprint area can be up to double that of the filter media area (to account for the addition of internal and external batters, maintenance access, etc.)*

LEGEND

- 2 Catchments
- Bioretention Basins
- Cadastral Boundary

Land Use

- Residential
- Commercial
- Linear Park
- Park
- Road
- Major Road Upgrade

Title:

Proposed Sub-catchment Layout with Bioretention Basins

Figure: 4-3

Rev: A

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Approx Scale

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4.6 Model Results

The proposed management plan has been modelled using the MUSIC software, and results have been obtained, as described below.

Table 4-7 Predicted Average Annual Flows & Pollutant Loads (1968 to 1977)

Parameter	Unmitigated Development	Developed Site with Treatment	% Removal	% Removal Target
Option 1				
Flow (ML/year)	134	128	4.5	-
TSS (kg/year)	22,900	3,280	85.7	85
TP (kg/year)	46.4	10.1	78.2	65
TN (kg/year)	289	130	55.0	45
Gross Pollutants (kg/year)	3,760	50.2	98.7	95
Option 2				
Flow (ML/year)	134	129	3.7	-
TSS (kg/year)	22,600	3,400	85.0	85
TP (kg/year)	46.9	11.1	76.3	65
TN (kg/year)	286	135	52.8	45
Gross Pollutants (kg/year)	3,760	50.2	98.7	95

The results identified in the above table show that the proposed stormwater management strategy is predicted to achieve the operational pollutant load reduction targets for stormwater.

4.7 Construction and Establishment

The bioretention basins will need to be constructed and established in accordance with the guideline *Construction and establishment guidelines: swales, bioretention systems and wetlands* (Water by Design 2010a).

The appropriate construction and establishment of the bioretention systems will be critical to maximising their ability to protect waterway and waterbody health and minimise operational issues (and maintenance requirements).

4.8 Maintenance

Maintenance of the bioretention systems should be undertaken in accordance with the guideline *Maintaining vegetated stormwater assets* (Water by Design 2012).

4.9 Asset Hand-over

It is anticipated that ownership and maintenance requirements of the proposed bioretention basins within the site will be 'handed over' to Logan City Council. Handover of the bioretention systems should be undertaken in accordance with the guideline *Transferring ownership of vegetated stormwater assets* (Water by Design 2012).

5 Conclusion

The flood impact assessment has determined that the detention afforded by the construction of the new access road to the Flinders development will be sufficient to ameliorate the impact of development on runoff from the site. The analysis also confirmed that the proposed development will not result in an unacceptable impact on flood levels.

The conceptual Stormwater Quality Management Strategy presented in this plan broadly outlines the planning, management and maintenance issues for the selected stormwater treatment measures.

An assessment of the strategy demonstrated that adequate treatment of stormwater at this site is readily achievable. Sufficient consideration of stormwater controls has been made at this conceptual design stage of the development to demonstrate compliance with the *Seqwater Development Guidelines* (Seqwater 2017). (Refer to Table 4-7).

Modelling results indicate that the options proposed results in a significant decrease in stormwater pollutant loads, with removal targets being achieved for total suspended solids, total phosphorus, total nitrogen and gross pollutants.

6 References

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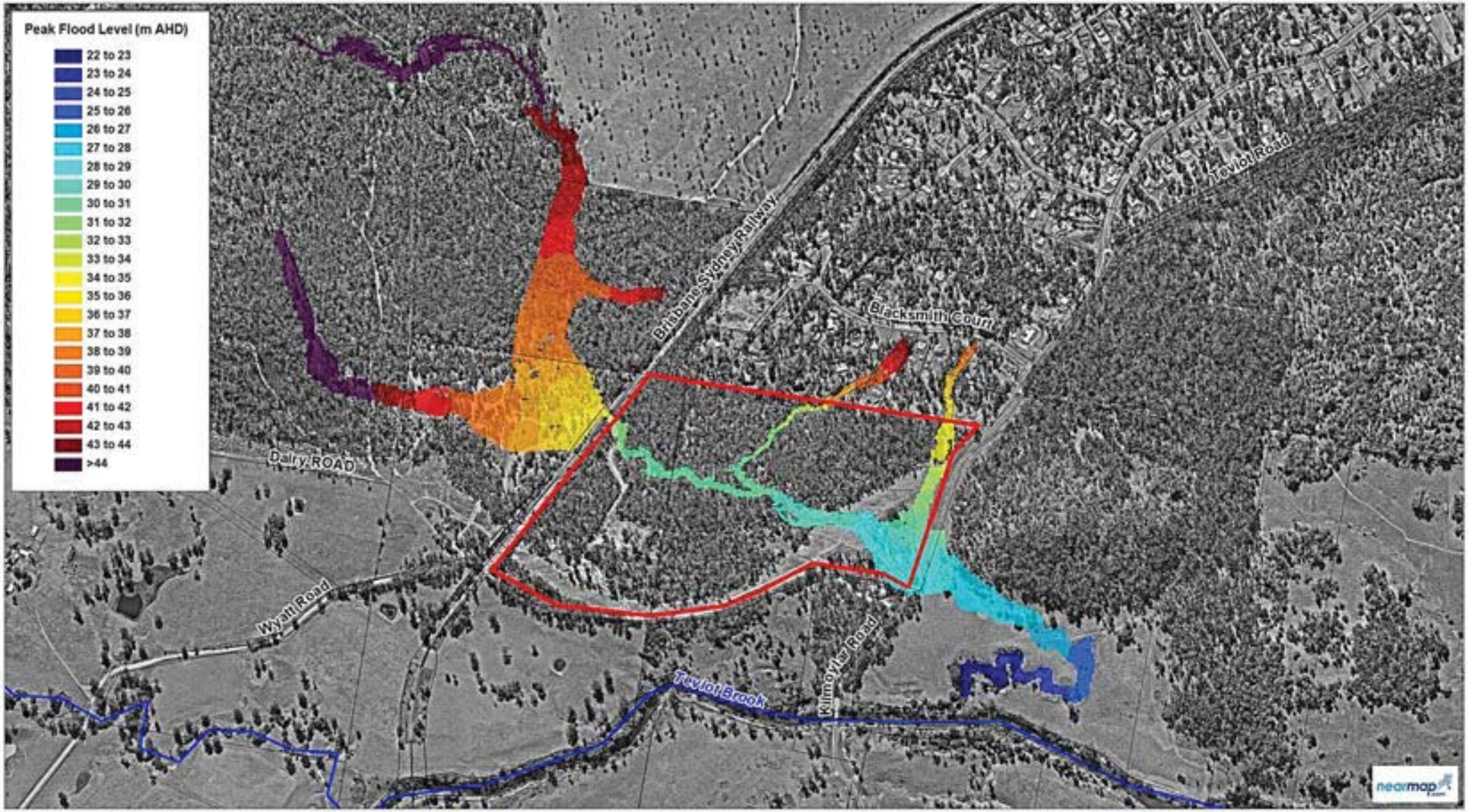
Water by Design 2010a, *Construction and establishment guidelines: swales bioretention systems and wetlands, ver. 1.1*, Healthy Waterways, Brisbane.

Water by Design 2010b, *MUSIC modelling guidelines*. Healthy Waterways, Brisbane.

Water by Design 2012, *Maintaining vegetated stormwater assets*, Healthy Waterways, Brisbane.

Water by Design 2014, *Bioretention technical design guidelines*, ver. 1.1, Healthy Waterways, Brisbane.

Appendix A Hydraulic Model Results



LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

1 Year ARI Peak Flood Level - Existing Case

Figure: **A-1**

Rev: **A**

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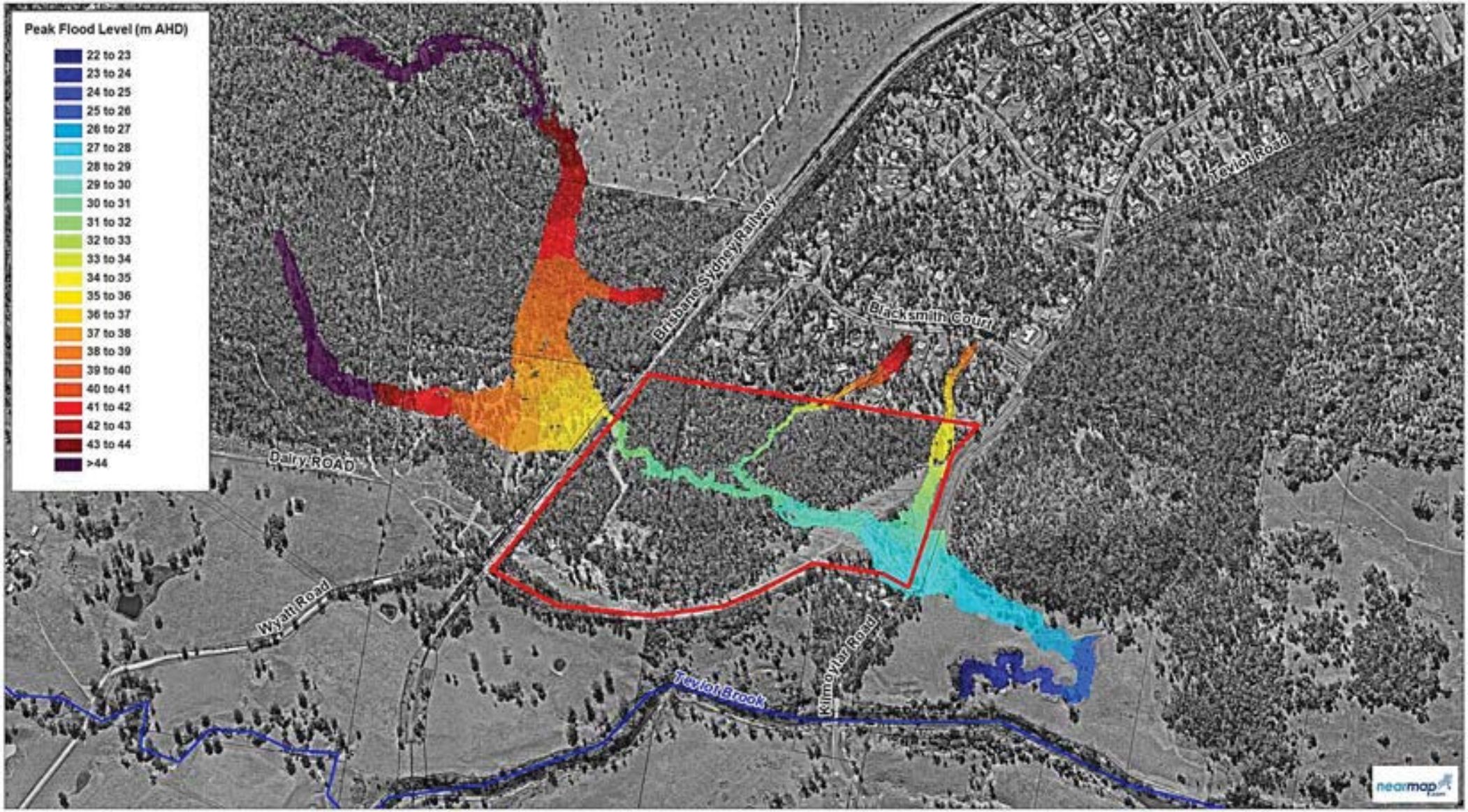

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

2 Year ARI Peak Flood Level - Existing Case

Figure: **A-2**

Rev: **A**

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Approx.Scale

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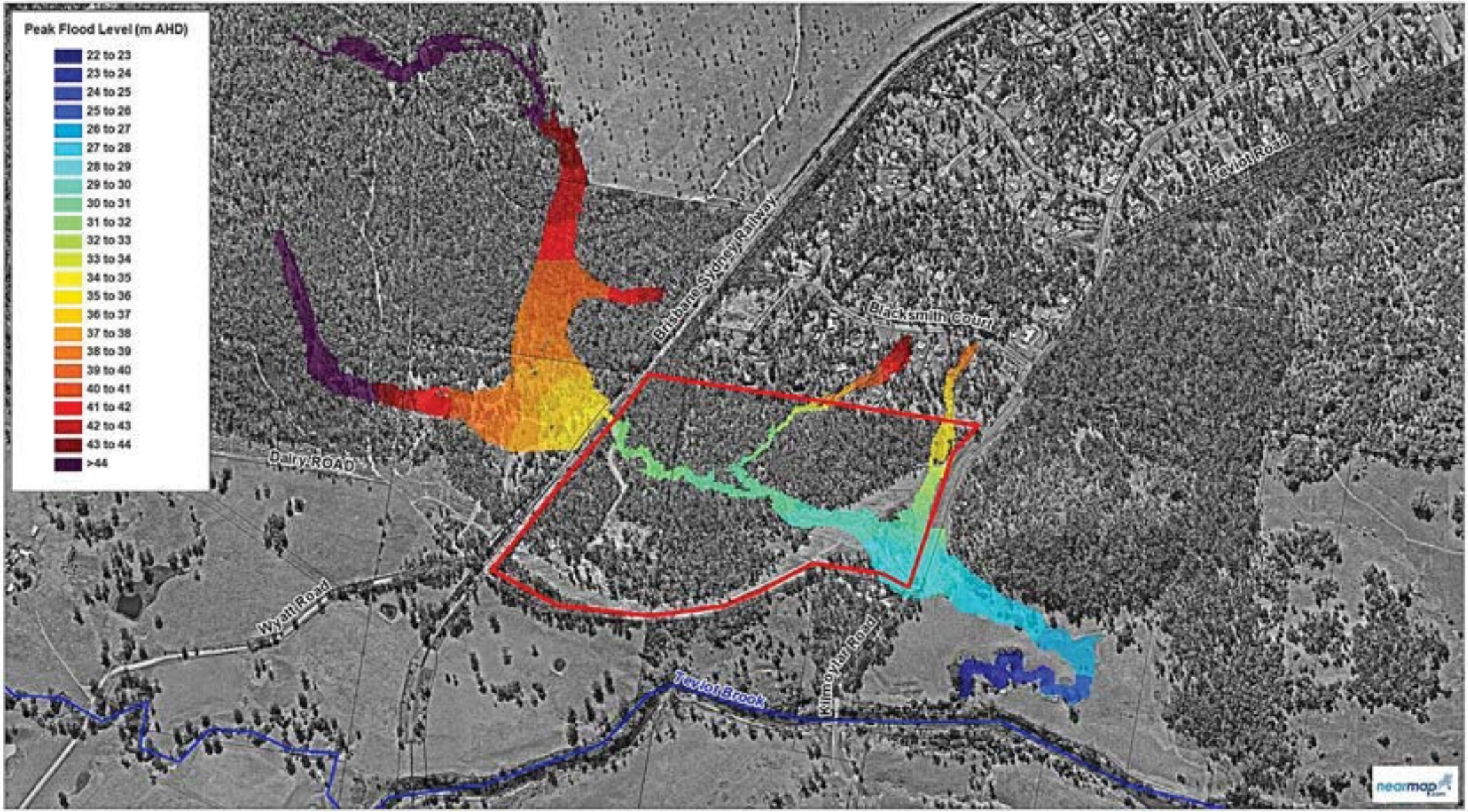

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

5 Year ARI Peak Flood Level - Existing Case

Figure: **A-3**

Rev: **A**

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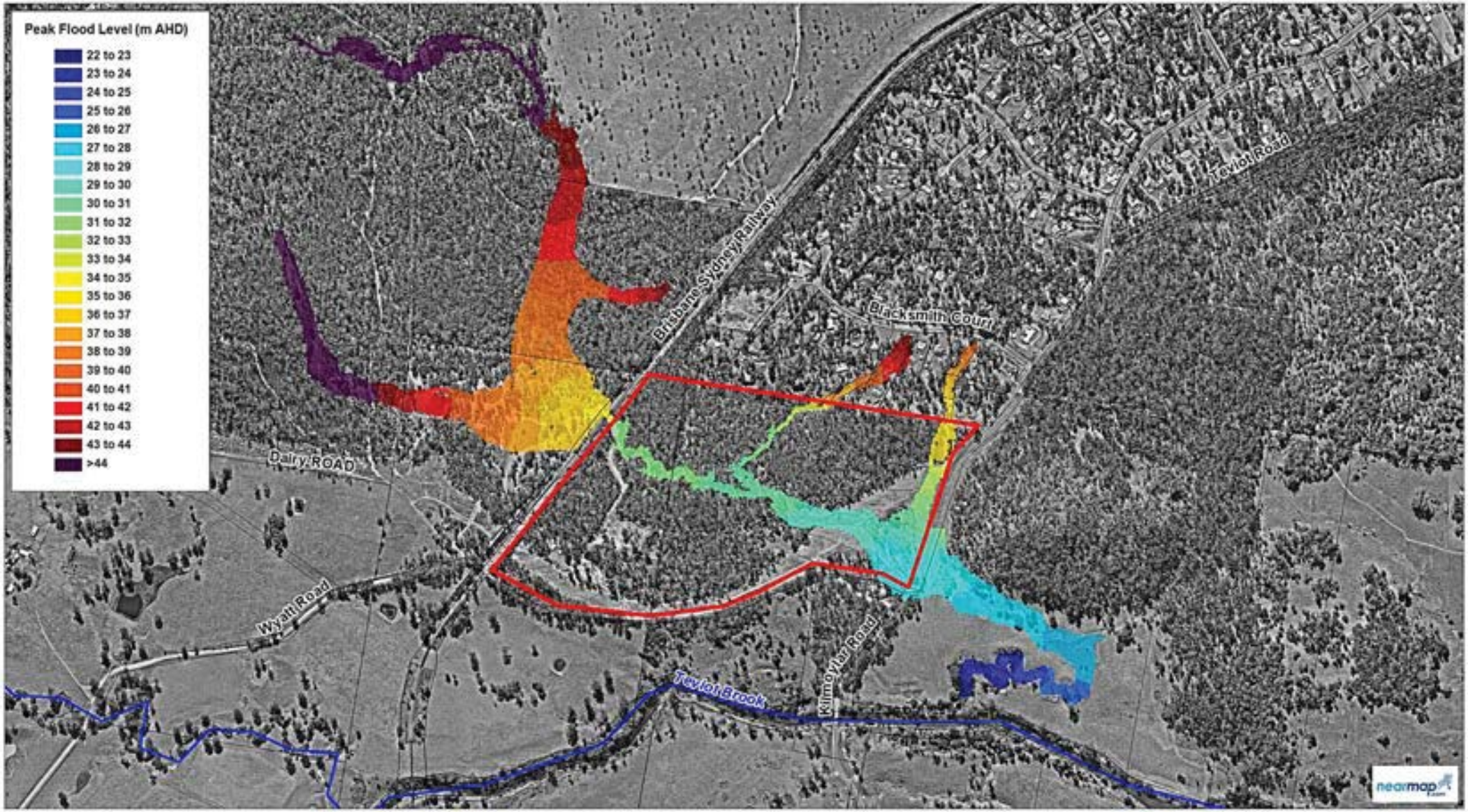

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

10 Year ARI Peak Flood Level - Existing Case

Figure: **A-4**

Rev: **A**

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Approx.Scale

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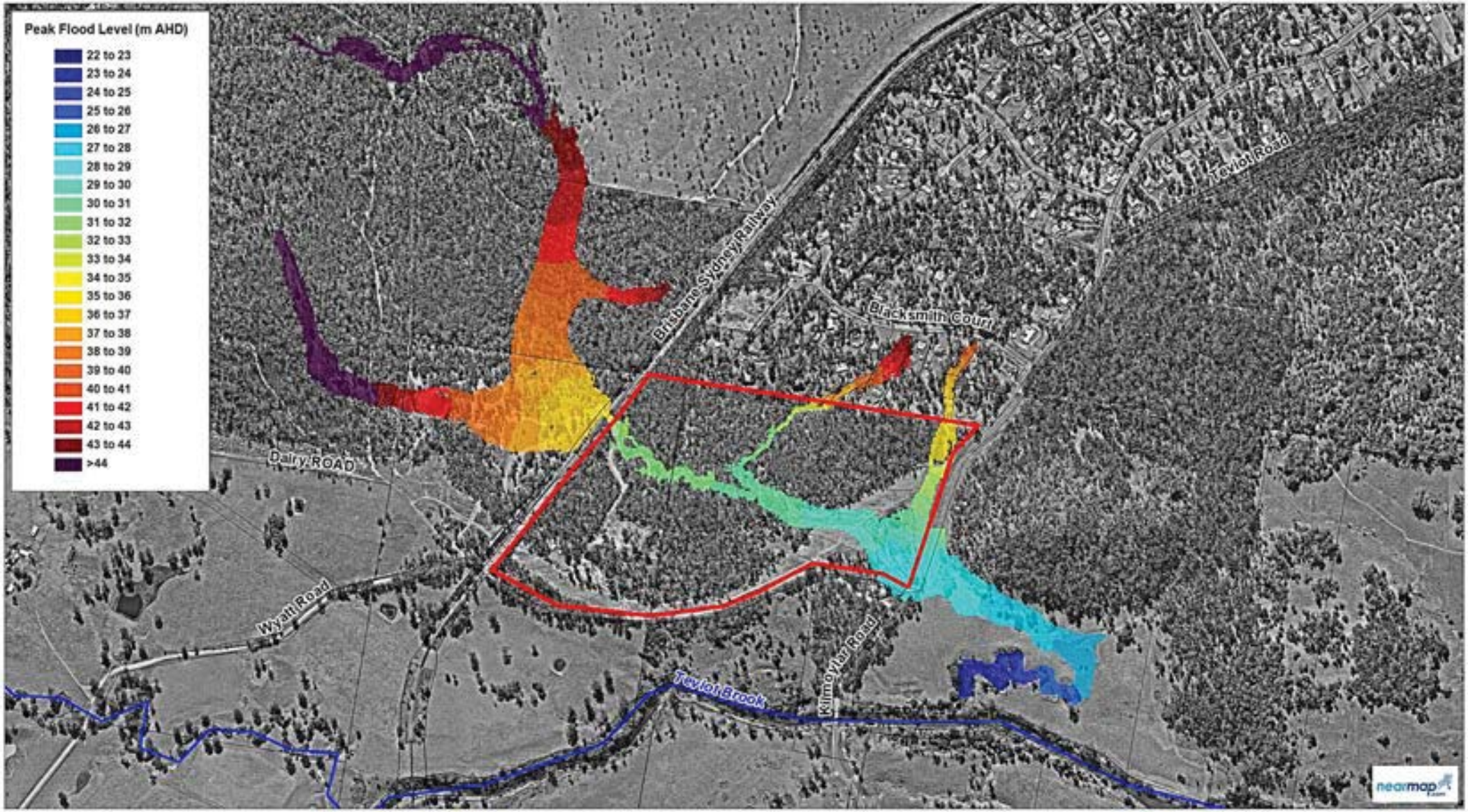

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

20 Year ARI Peak Flood Level - Existing Case

Figure: **A-5**

Rev: **A**

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Approx.Scale

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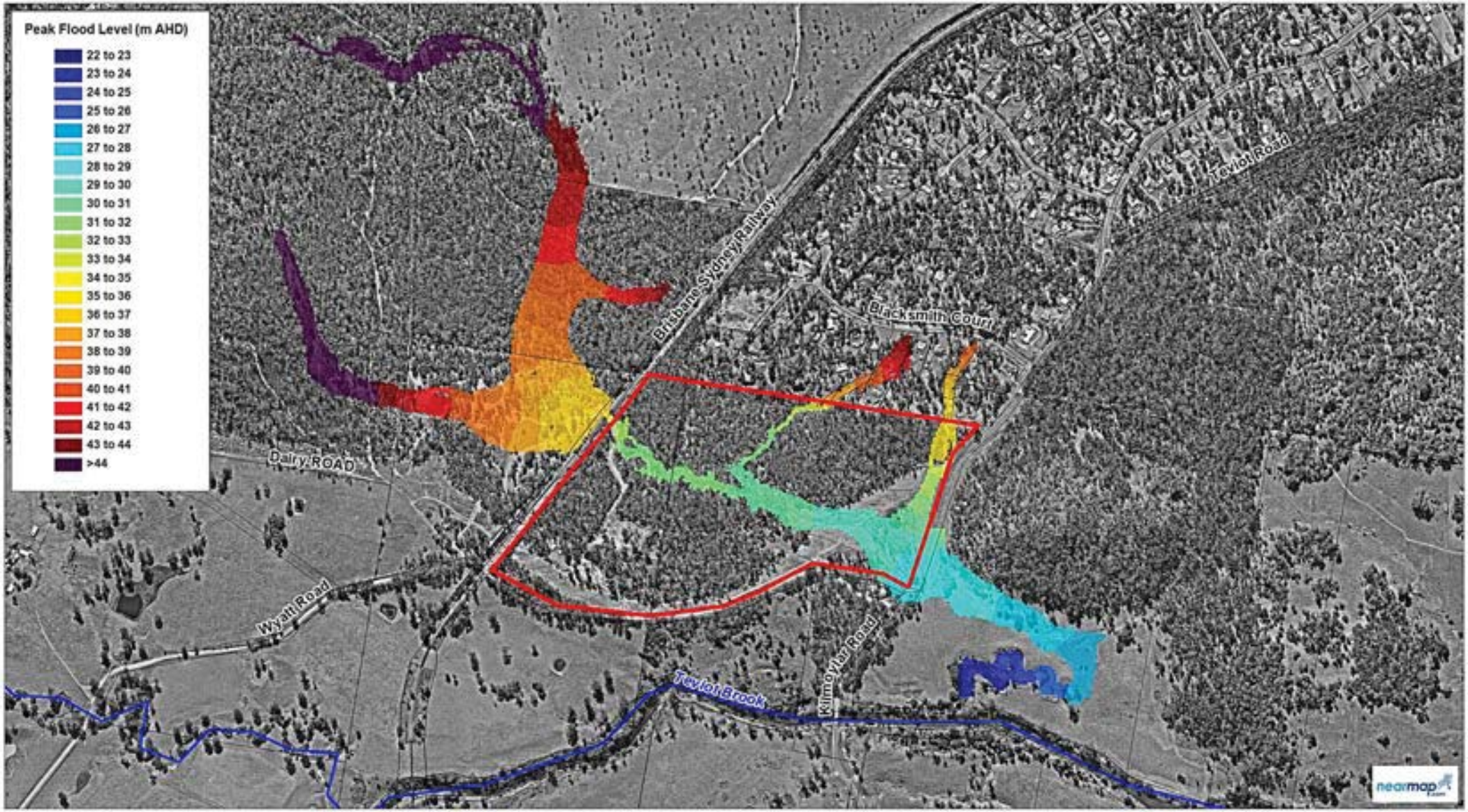


LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

50 Year ARI Peak Flood Level - Existing Case

Figure: **A-6**

Rev: **A**

N

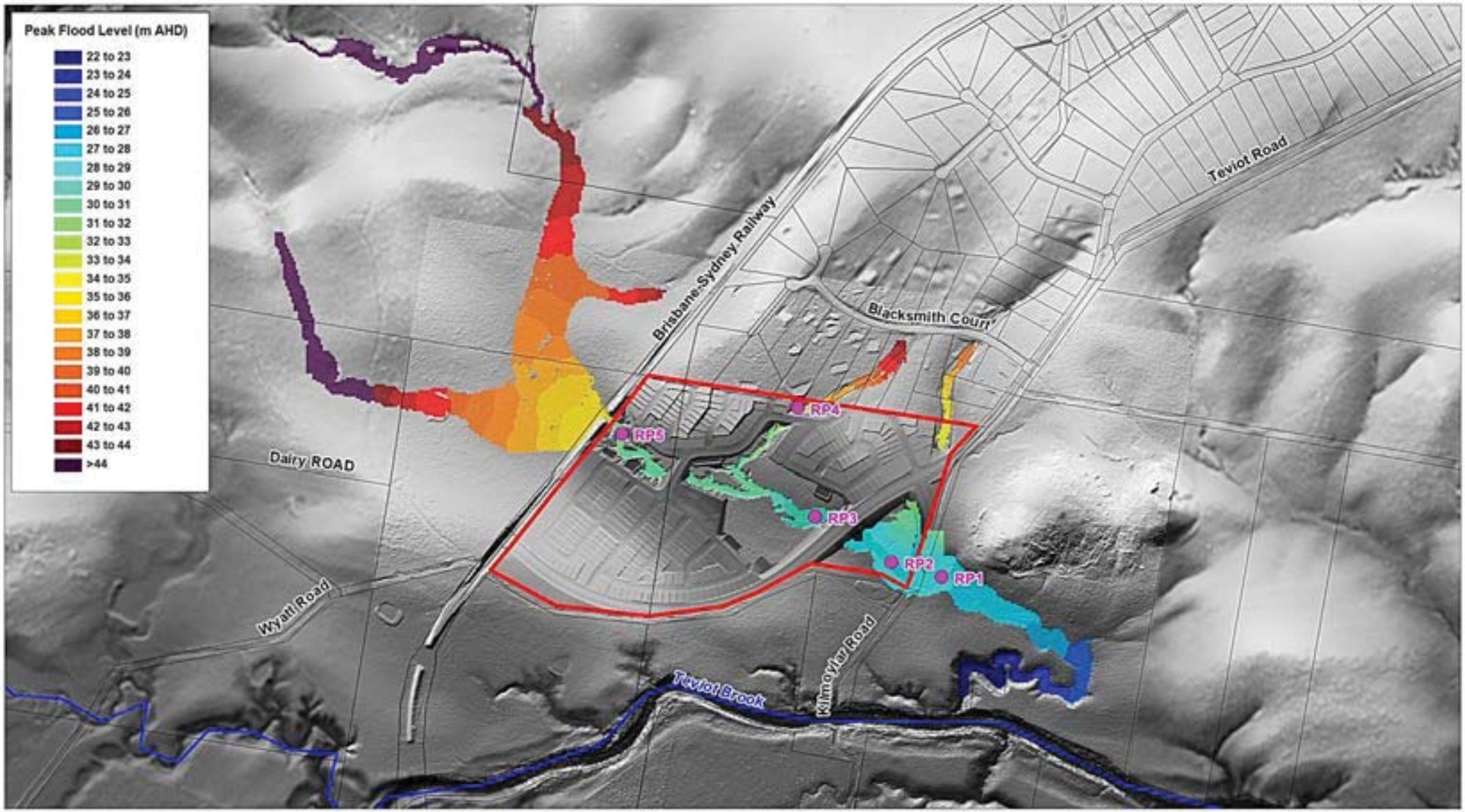
0 300 600m

Approx. Scale

BMT

www.bmt.org

Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_062_181112_50 Year ARI Peak Flood Level_Existing Case.wor



LEGEND

- Reporting Points
- Site Boundary
- Streams
- Cadastral Boundaries

Title:

1 Year ARI Peak Flood Level - Developed Case

Figure: **A-7**

Rev: **A**

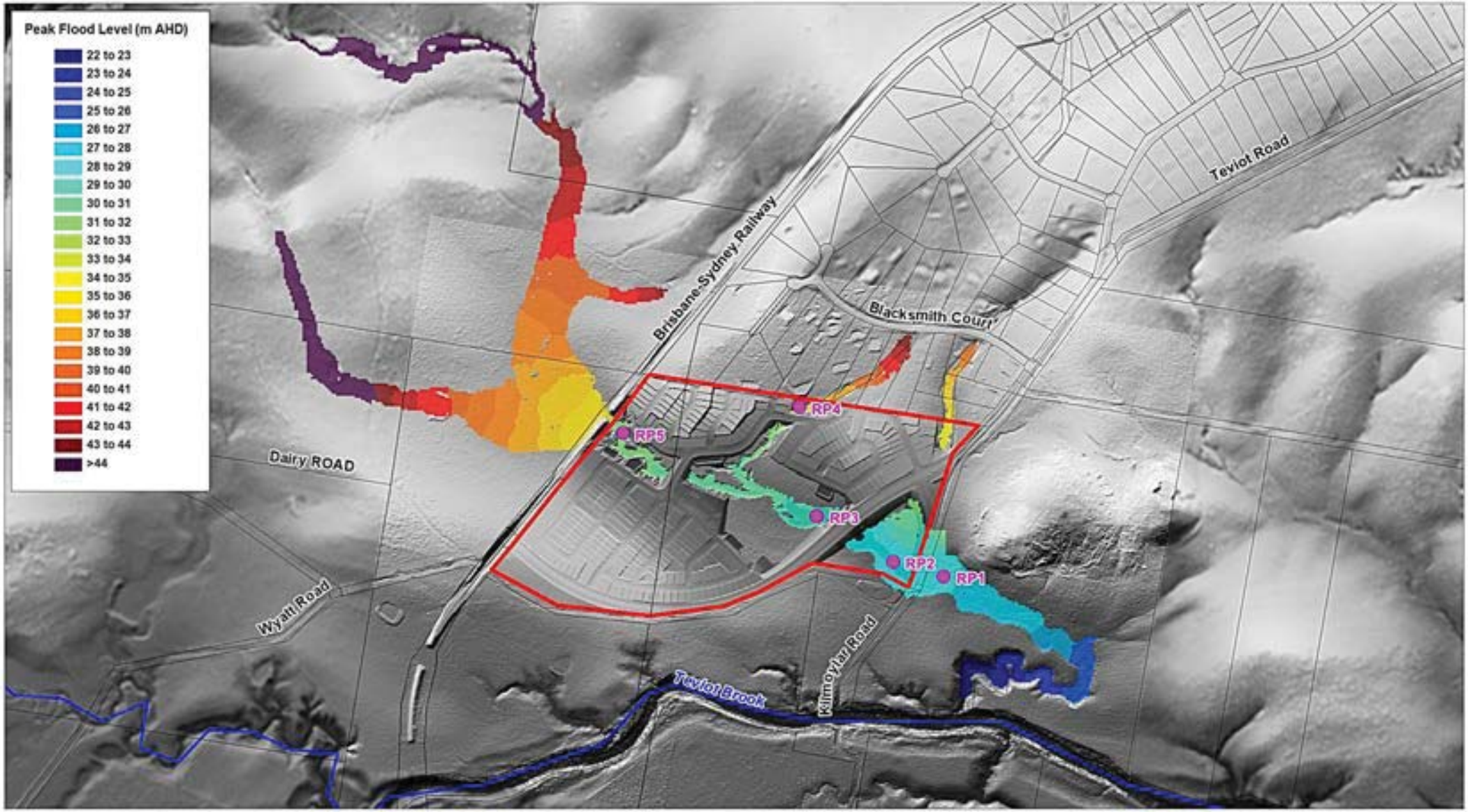
N

0 300 600m

Approx.Scale

BMT
www.bmt.org

Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_064_181112_1 Year ARI Peak Flood Level_Developed Case.wor



LEGEND

- Reporting Points
- Site Boundary
- Streams
- Cadastral Boundaries

Title:

2 Year ARI Peak Flood Level - Developed Case

Figure: **A-8**

Rev: **A**

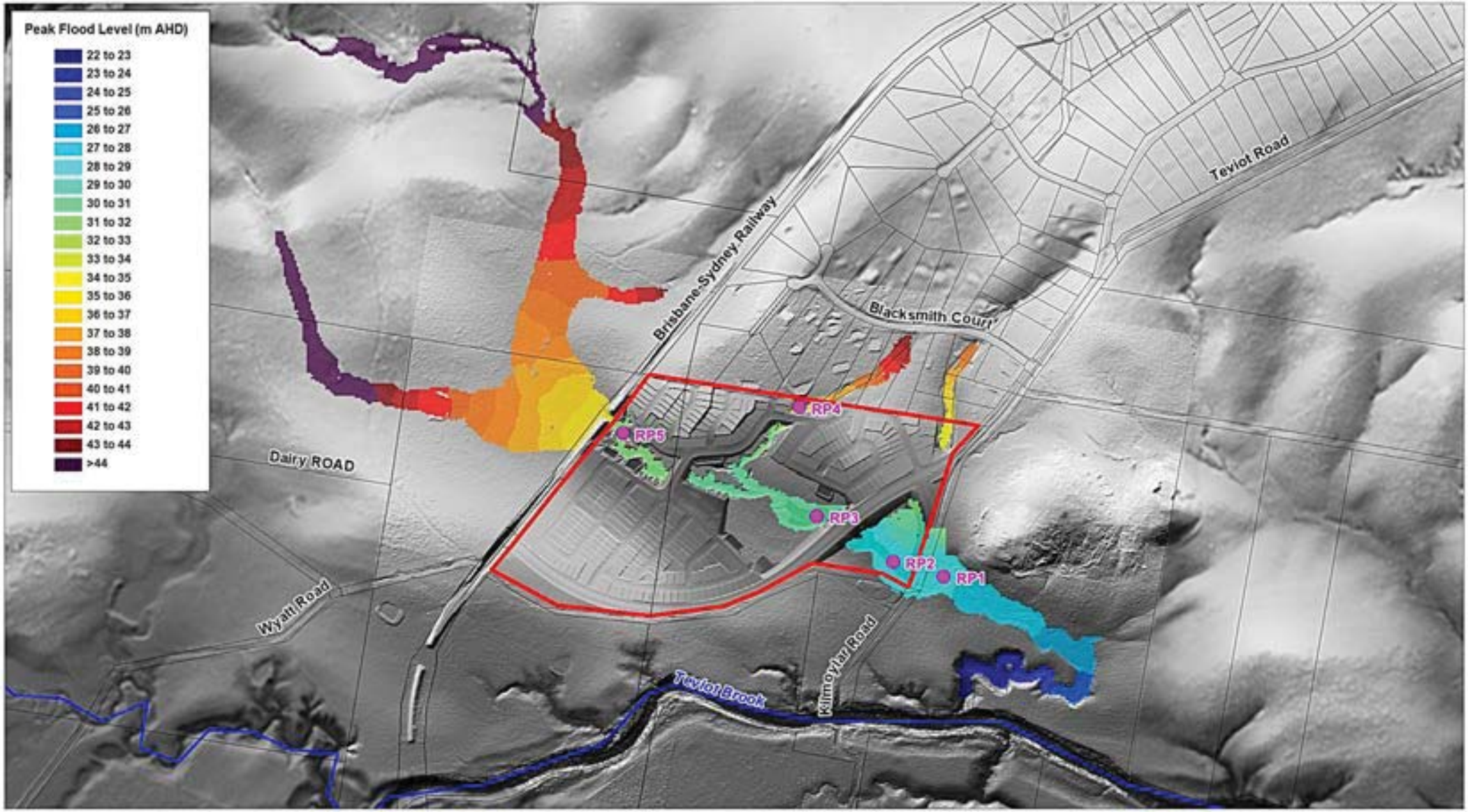
N

0 300 600m

Approx.Scale

BMT
www.bmt.org

Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_065_181112_2 Year ARI Peak Flood Level_Developed Case.wor



LEGEND

- Reporting Points
- Site Boundary
- Streams
- Cadastral Boundaries

Title:

5 Year ARI Peak Flood Level - Developed Case

Figure: **A-9**

Rev: **A**

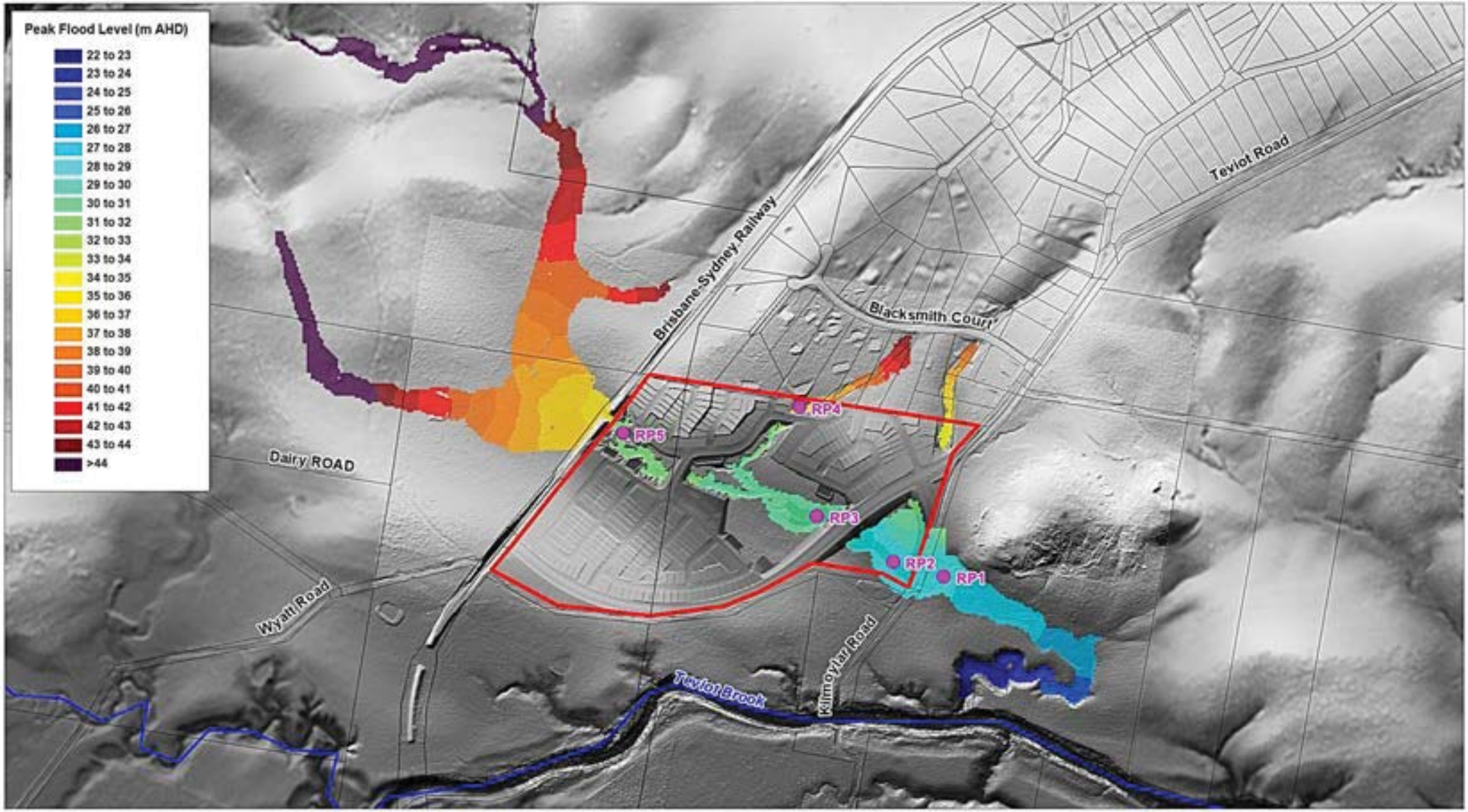
N

0 300 600m

Approx.Scale

BMT
www.bmt.org

Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_066_181112_5 Year ARI Peak Flood Level_Developed Case.wor



LEGEND

- Reporting Points
- Site Boundary
- Streams
- Cadastral Boundaries

Title:

10 Year ARI Peak Flood Level - Developed Case

Figure: **A-10**

Rev: **A**

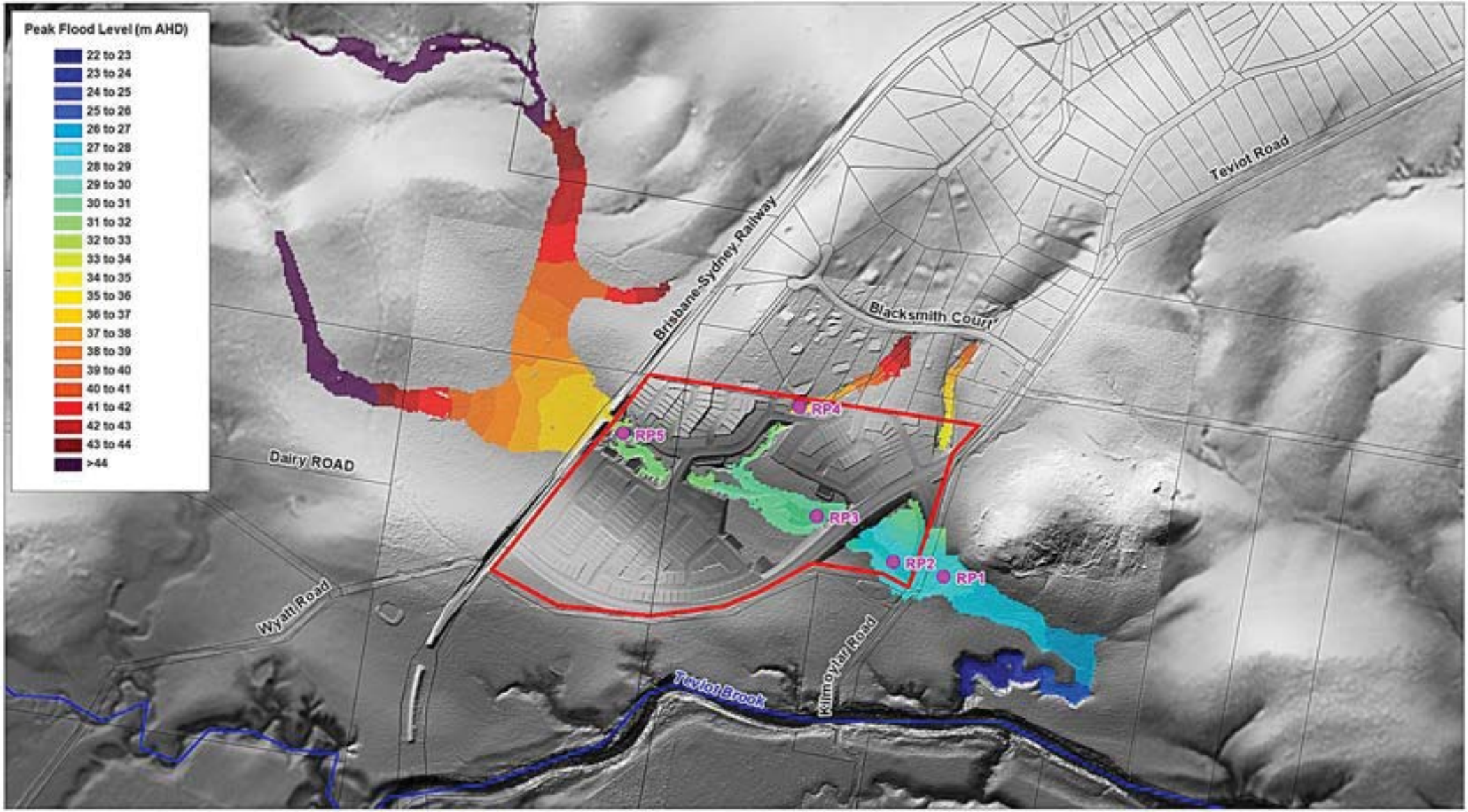
N

0 300 600m

Approx.Scale

BMT
www.bmt.org

Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_007_181112_10 Year ARI Peak Flood Level_Developed Case.wor



LEGEND

- Reporting Points
- Site Boundary
- Streams
- Cadastral Boundaries

Title:

20 Year ARI Peak Flood Level - Developed Case

Figure: A-11

Rev: A

N

0 300 600m

Approx. Scale

BMT
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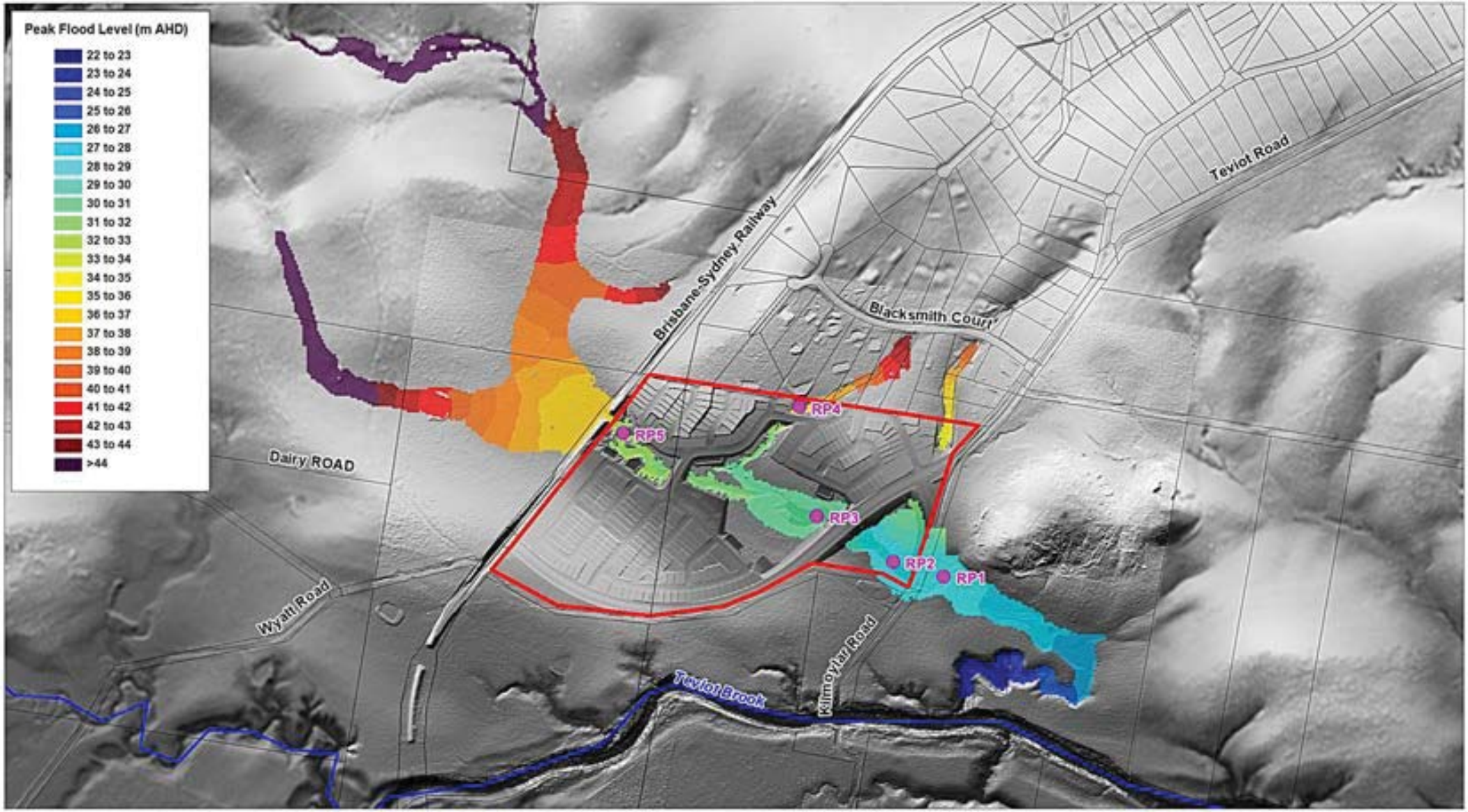
Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_068_181112_20 Year ARI Peak Flood Level_Developed Case.wor



LEGEND

- Reporting Points
- Site Boundary
- Streams
- Cadastral Boundaries

Title:

50 Year ARI Peak Flood Level - Developed Case

Figure: **A-12**

Rev: **A**

N

0 300 600m

Approx.Scale

BMT
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Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_069_181112_50 Year ARI Peak Flood Level_Developed Case.wor

LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

1 Year ARI Peak Flood Afflux

Figure: A-13

Rev: A

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N

0 300 600m

Approx. Scale

BMT
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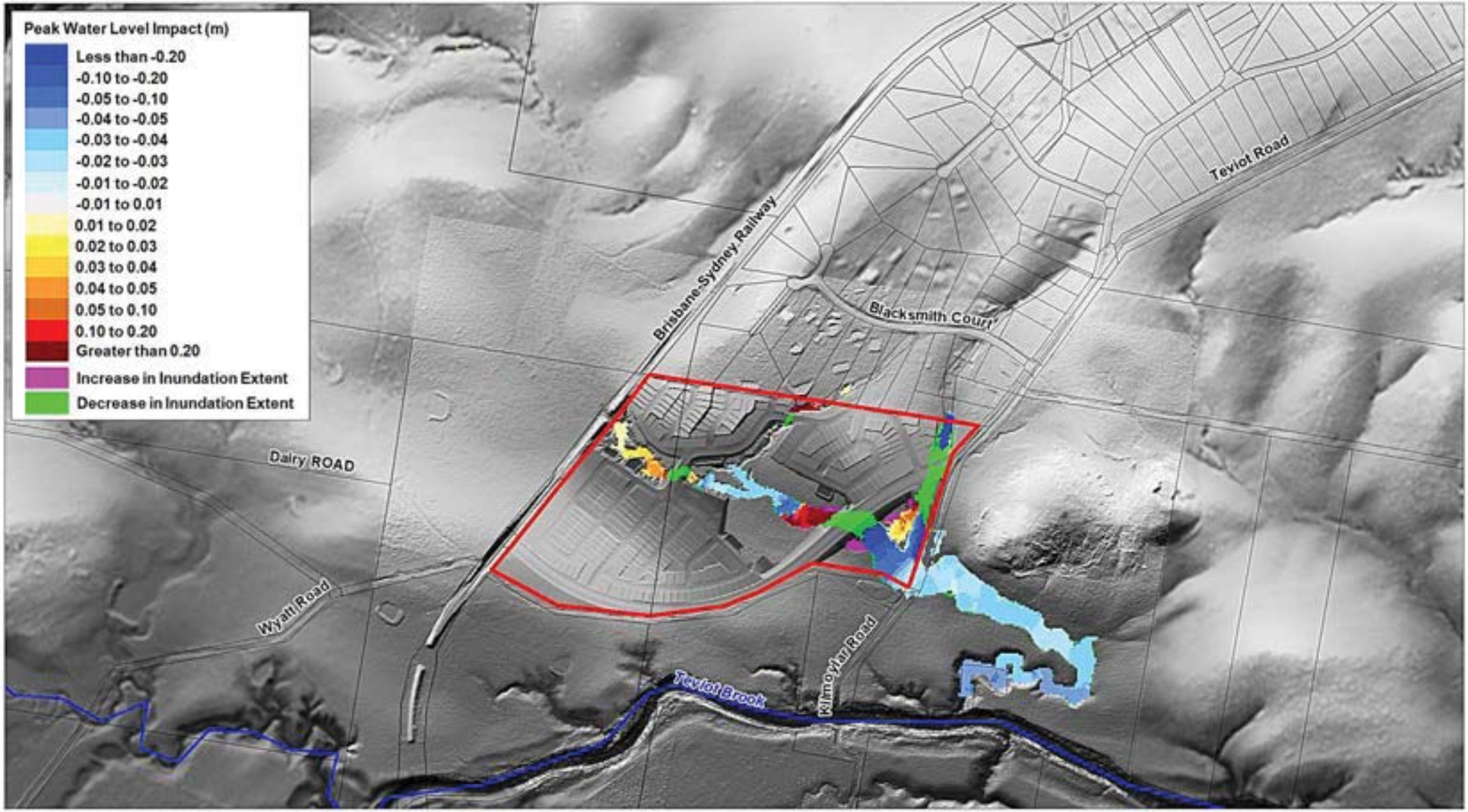
Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_073_181112_1_Year_Local_Afflux.wor



LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

2 Year ARI Peak Flood Afflux

Figure: **A-14**

Rev: **A**

N

0 300 600m

Approx. Scale

BMT
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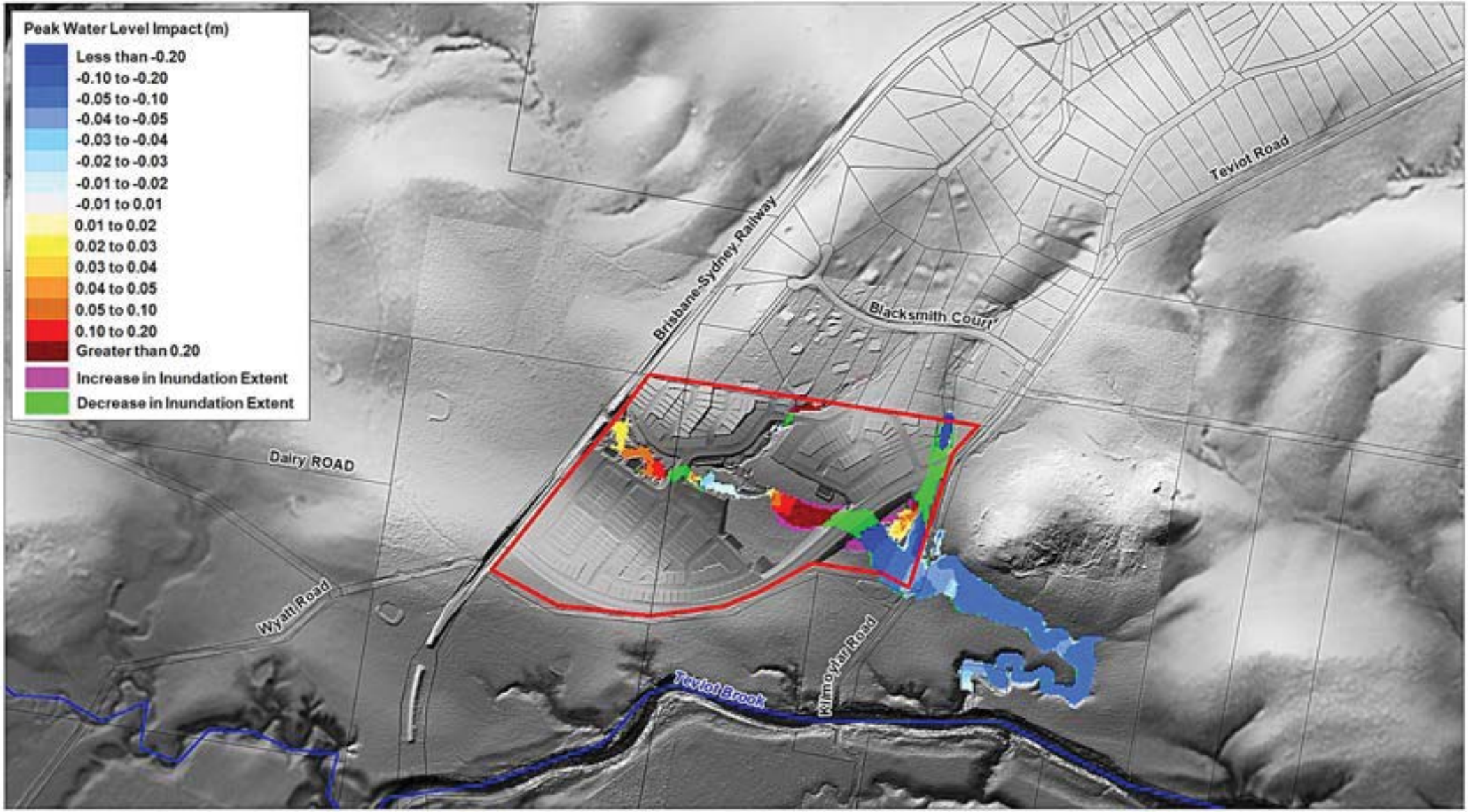
Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_074_181112_2_Year_Local_Afflux.wor



LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

5 Year ARI Peak Flood Afflux

Figure: **A-15**

Rev: **A**

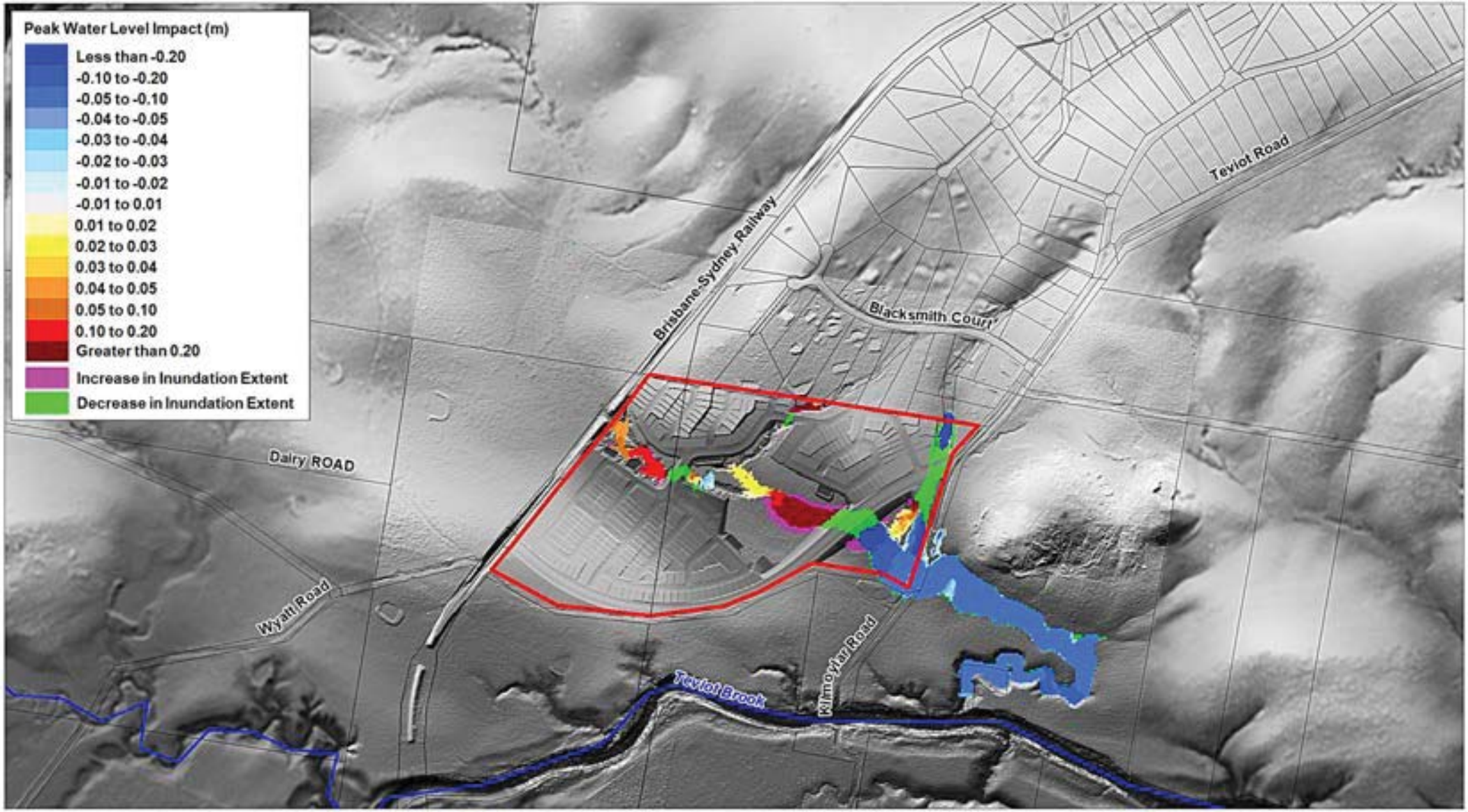
N

0 300 600m

Approx. Scale

BMT
www.bmt.org

Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_075_181112_5_Year_Local_Afflux.wor



LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

10 Year ARI Peak Flood Afflux

Figure: A-16

Rev: A

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N

0 300 600m

Approx. Scale

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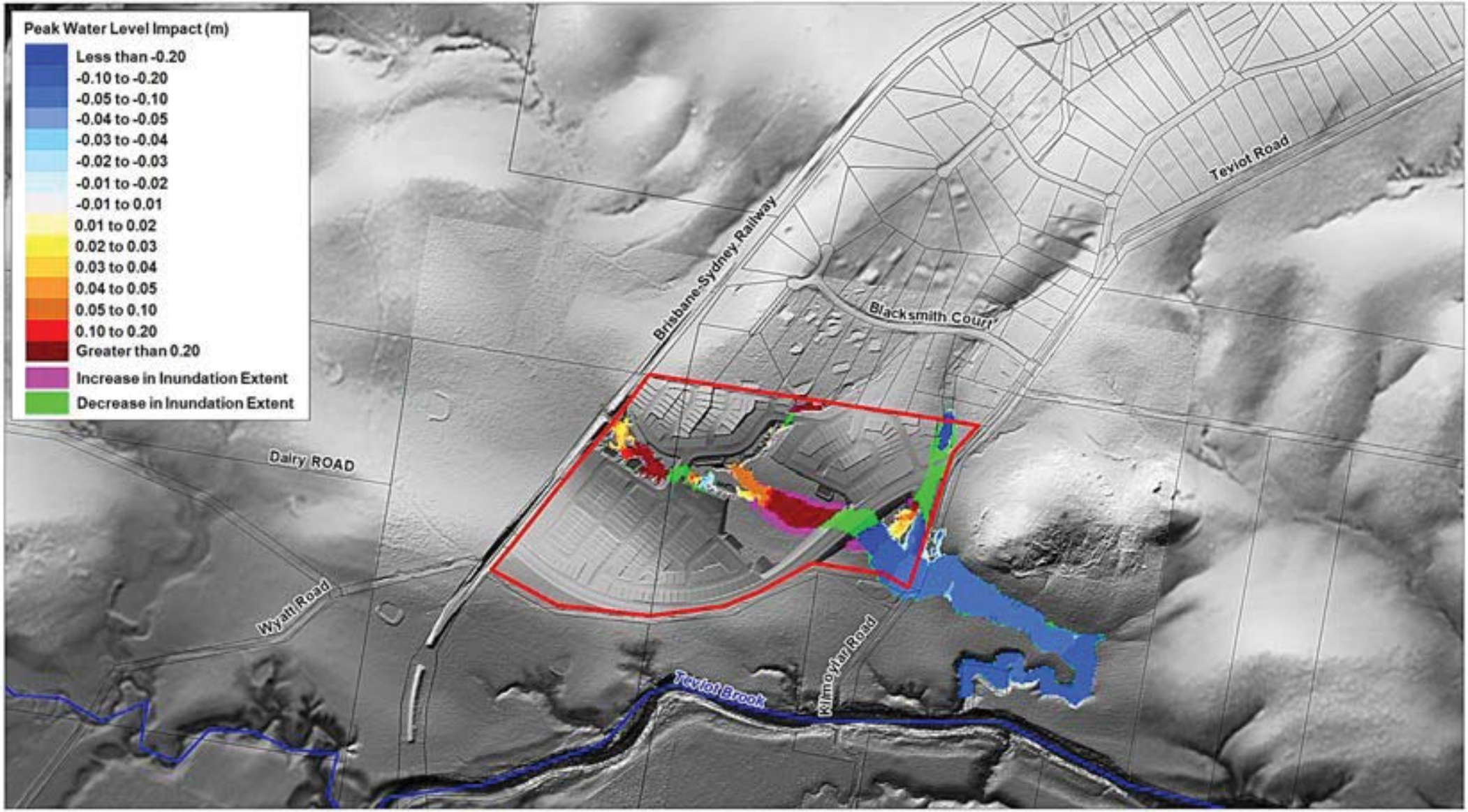
Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_076_181112_10_Year_Local_Afflux.wor



LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

20 Year ARI Peak Flood Afflux

Figure: A-17

Rev: A

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N

0 300 600m

Approx. Scale

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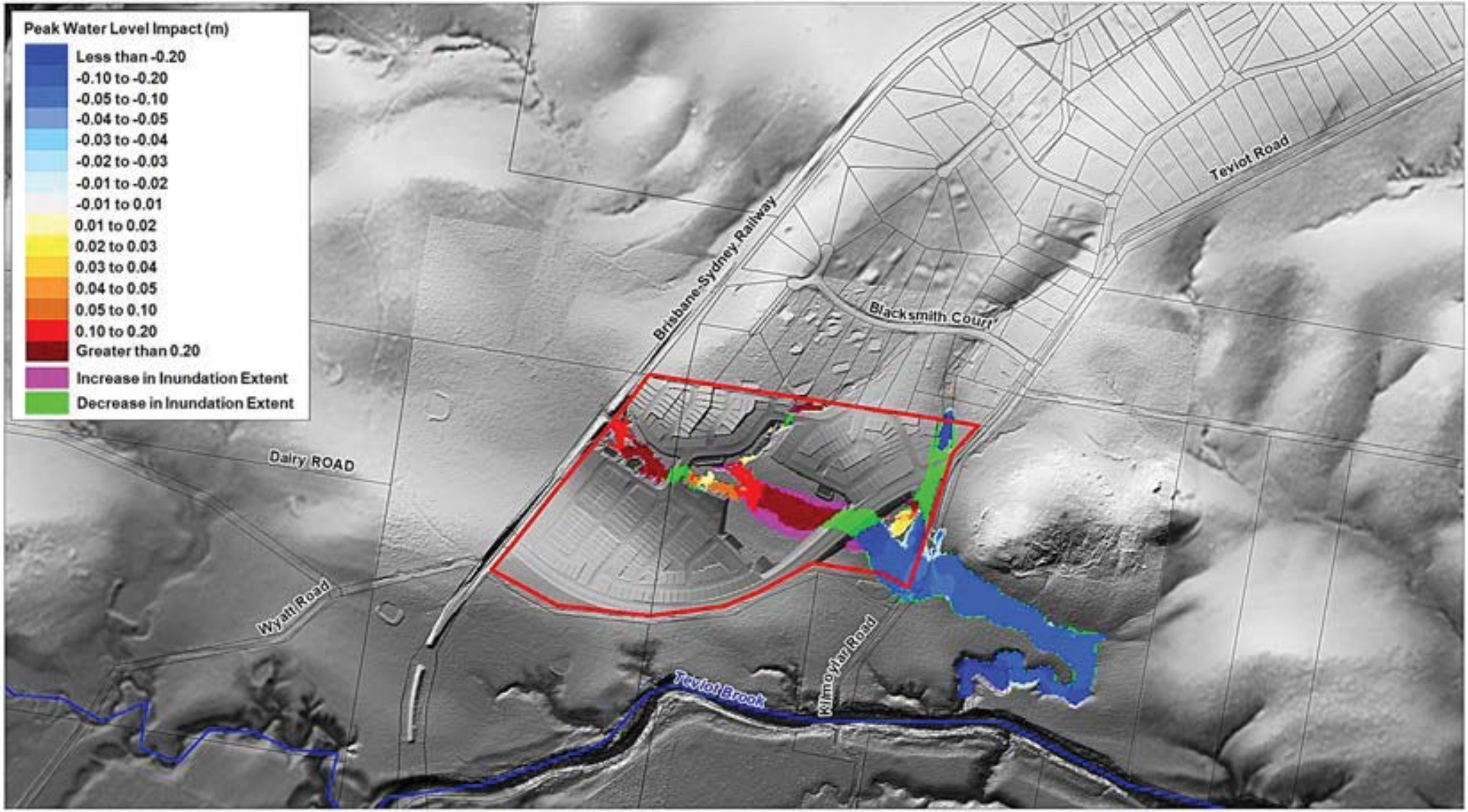
Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_077_181112_20_Year_Local_Afflux.wor



LEGEND

- Site Boundary
- Streams
- Cadastral Boundaries

Title:

50 Year ARI Peak Flood Afflux

Figure: **A-18**

Rev: **A**

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N

0 300 600m

Approx.Scale

BMT
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Filepath: S:\B23188.s.lp_24 Bushman Dr & 68 Wyatt Rd Jimboomba\02 Drafting\DRG\181112\ESG_078_181112_50_Year_Local_Afflux.wor

Appendix B Design Drawings

Development Summary

STAGE	1	1A	2	3	4	5	6	7	7A	7B	8	9	10	11	12	13	14	15	TOTALS
Area of Park	0.385 ha	-	1.045 ha	-	4.177 ha	-	1.893 ha	3.319 ha	3.213 ha	0.060 ha	-	-	-	-	-	-	0.129 ha	-	14.213 ha
Area of Road	0.782 ha	-	0.441 ha	0.536 ha	1.346 ha	0.739 ha	0.411 ha	0.767 ha	-	-	0.562 ha	0.639 ha	0.479 ha	0.244 ha	-	-	-	-	6.954 ha
Residential Lots	35	-	27	21	31	33	23	41	-	-	36	24	25	13	-	-	-	-	309
Mixed-use / Multi-res lots	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(1)	(1)	-	-	(2)
Commercial Lots	(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(1)	(2)
Sewer Pump Station Lot	-	0.085 ha	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.085 ha
Stage Area	3.244 ha	0.085 ha	2.693 ha	1.454 ha	7.209 ha	2.453 ha	3.354 ha	5.816 ha	3.223 ha	0.060 ha	2.383 ha	1.706 ha	1.643 ha	0.855 ha	0.572 ha	0.437 ha	0.129 ha	1.165 ha	38.461 ha

Park Area Table

Lot No	900	901	902	903	904	905	907	908
Area	0.129 ha	0.765 ha	1.899 ha	7.295 ha	0.473 ha	0.385 ha	3.213 ha	0.061 ha
Total Park	14.210 ha							

PROJECT NAME

Bushman + Wyatt

CLIENT

PACIFIQ

NOTE:
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R.P. DESCRIPTION

LOT 24 ON SP142997
AND
LOT 1 ON RP49296

ASSOCIATED CONSULTANTS

HDG
robertsday
BMT WBM
"Where will our knowledge take you?"
Cardno
saunders havill group
CRG ACOUSTICS
Steven Hosking Surveys Pty Ltd

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DRAWING TITLE

SUBDIVISION
PROPOSAL PLAN
(Page 1 of 5)

DESIGNED	APPROVED	JOB #
DRAWN CB DATE 12/11/18	AMEND CB DATE 04/02/19	4706

DRAWING NUMBER: 23305-PP-S001
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R.P. DESCRIPTION

LOT 24 ON SP142997
AND
LOT 1 ON RP49296

ASSOCIATED CONSULTANTS

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SUBDIVISION
PROPOSAL PLAN
SHEET 01
(Page 2 of 5)

DESIGNED	APPROVED	JOB NO 4706
DRAWN CB DATE 12/11/18	AMEND CB DATE 04/02/19	

DRAWING NUMBER 23305-PP-S002 AMEND B

PROJECT NAME

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R.P. DESCRIPTION

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AND
LOT 1 ON RP49296

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PROPOSAL PLAN
SHEET 02
(Page 3 of 5)

DESIGNED	APPROVED	JOB No 4706
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PROJECT NAME

Bushman + Wyatt

RP DESCRIPTION

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AND
LOT 1 ON RP49296

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DRAWN CB DATE 12/11/18	AMEND	DATE

DRAWING NUMBER	AMEND
23305-PP-S004	A

PROJECT NAME

Bushman + Wyatt

RP DESCRIPTION

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AND
LOT 1 ON RP49296

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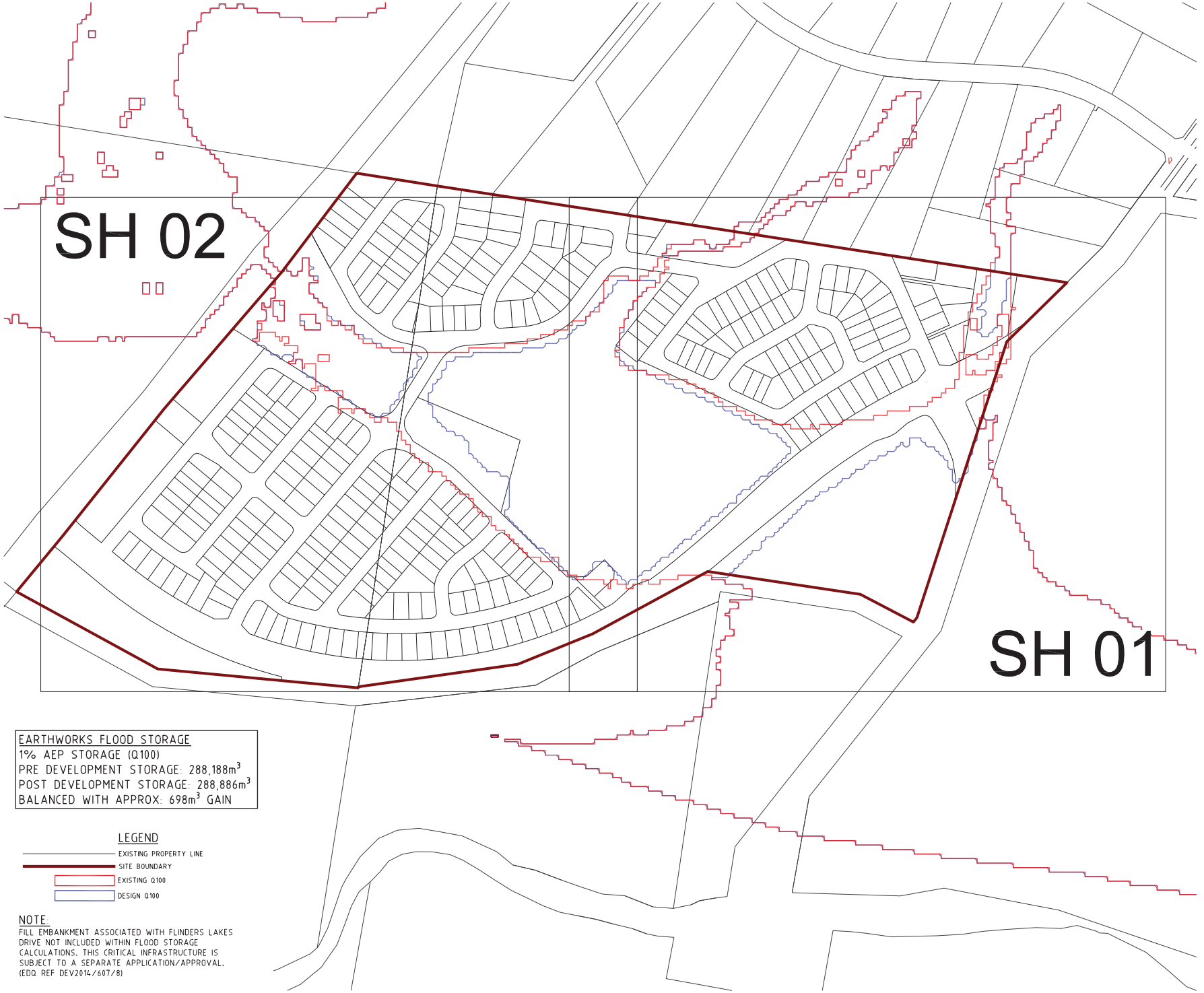
DESIGNED	APPROVED	RPEQ 4706
DRAWN CB	DATE 12/11/18	AMEND DATE

DRAWING NUMBER: 23305-PP-S005 | AMEND: A

Appendix C Flood Storage Q100 Extent Plan



EARTHWORKS FLOOD STORAGE
1% AEP STORAGE (Q100)
PRE DEVELOPMENT STORAGE: 288,188m^3
POST DEVELOPMENT STORAGE: 288,886m^3
BALANCED WITH APPROX: 698m^3 GAIN

LEGEND
- EXISTING PROPERTY LINE
- SITE BOUNDARY
- EXISTING Q100
- DESIGN Q100

NOTE:
FILL EMBANKMENT ASSOCIATED WITH FLINDERS LAKES DRIVE NOT INCLUDED WITHIN FLOOD STORAGE CALCULATIONS. THIS CRITICAL INFRASTRUCTURE IS SUBJECT TO A SEPARATE APPLICATION/APPROVAL. (EDQ REF DEV2014/607/8)

PROJECT NAME
Bushman + Wyatt
OVERALL SKETCH

CLIENT
PACIFIQ

NORTH
0 20 40 60 80 100m
Scale 1:2000 - A1 (1:4000 - A3)

ISSUES	DATE
TENDER	
COUNCIL	
CONSTRUCTION	

PRE	DATE	AMENDMENT
A	12-02-19	INITIAL ISSUE

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DRAWING TITLE
PRELIMINARY
FLOOD STORAGE
Q100 EXTENT PLAN
OVERALL

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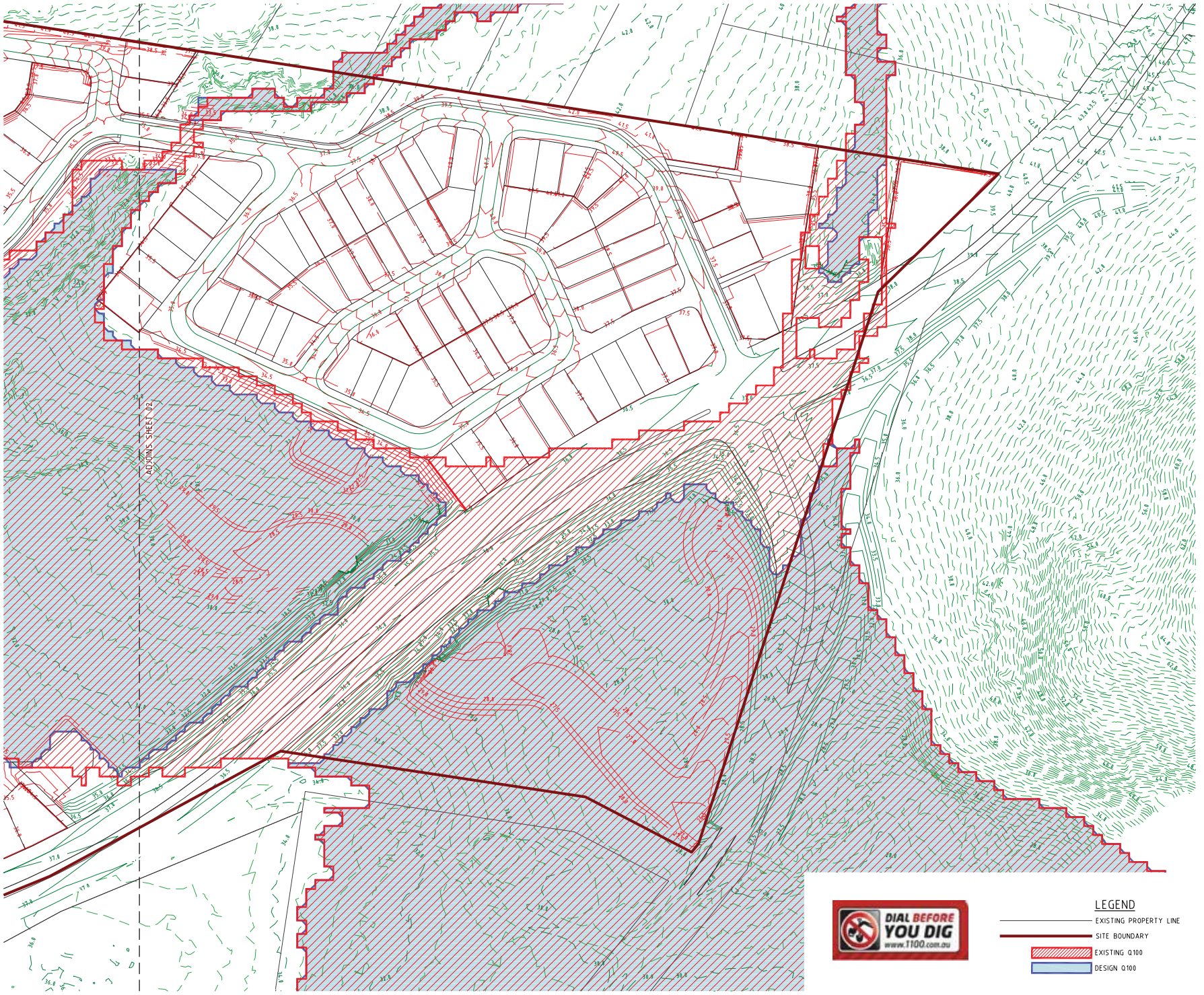

PROJECT NAME

Bushman + Wyatt

OVERALL SKETCH

CLIENT

PACIFIQ

NORTH

0 10 20 30 40 50m

Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
A	12-02-19	INITIAL ISSUE

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PRELIMINARY
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Q100 EXTENT PLAN
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DRAWING NUMBER 23305-ALL-SK003

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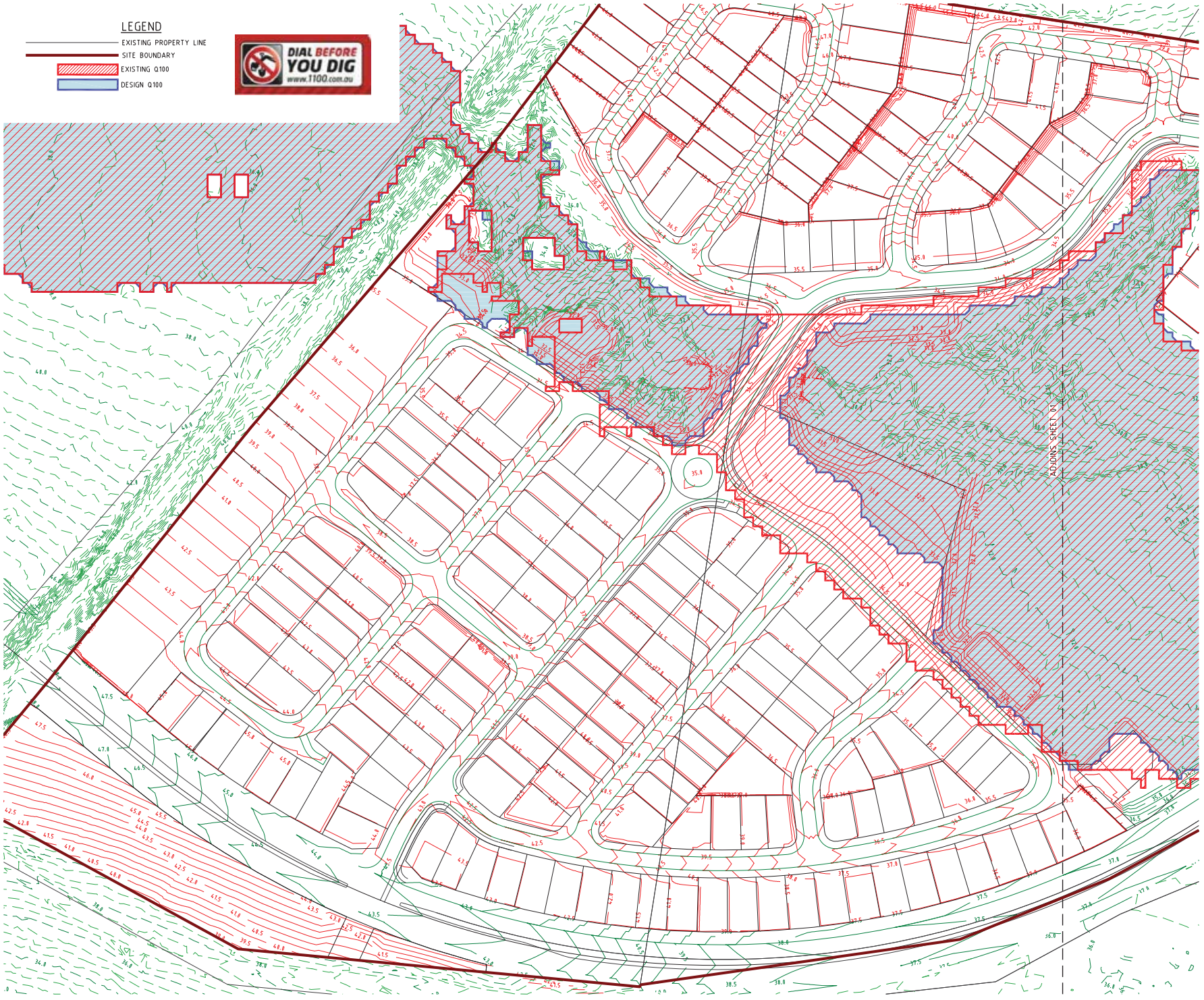

PROJECT NAME

Bushman + Wyatt

OVERALL SKETCH

CLIENT

PACIFIQ

NORTH

0 10 20 30 40 50m

Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE
TENDER	
COUNCIL	
CONSTRUCTION	

PRE	DATE	AMENDMENT
A	12-02-19	INITIAL ISSUE

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AMEND: A

Appendix D MUSIC Modelling Methodology, Results and Treatment Strategy

As described in Section 4.4, MUSIC software has been used to assess the generation, transportation and management/treatment of flows and pollutant loads from the site.

This appendix provides a detailed description of the modelling methodology applied.

D.1 Software

The performance of possible stormwater treatment strategies in managing stormwater pollutants (during the operational phase) has been assessed using the MUSIC software package (Version 6.3) developed by the CRC for Catchment Hydrology and now supported by the eWater CRC. MUSIC is well suited to the assessments required for the proposed development, i.e. prediction of annual discharge of TSS, TP, TN and GP loads. The software has been specifically designed to allow comparisons to be made between different stormwater management systems and thereby function as a decision support tool.

D.2 Modelling Scenarios

The following two scenarios were modelled:

- **Developed case – unmitigated site**. The developed case without mitigation is essentially an assessment of what would occur if the site were developed without any integration of stormwater treatment devices or pollution control measures. For consistency, the unmitigated site has been modelled using identical source node parameters as that of the scenario for modelling the developed site incorporating SMMs.
- **Developed case – with SMMs**. This case is an assessment of the fully developed site with all SMMs installed and working at their design capacities. Two options were assessed as outlined in Section 4.5.

D.3 Source Nodes

The user is required to specify source nodes within MUSIC. The source nodes represent the pollutant generating areas of the site. A summary of the source node properties used in the MUSIC modelling (and the methodology used to derive them) is provided in the subsequent sections.

D.3.1 Source Node Properties

Land use categories were selected to represent, as accurately as possible, how the development will generate stormwater. The proposed land uses of the site are presented in Figure 2-3. As this is a conceptual stormwater management strategy lumped source nodes have been applied using the land use plan supplied.

Rainfall-runoff and pollutant export characteristics for the existing and developed site have been applied from the *MUSIC modelling guidelines* (Water by Design 2010b). The source node properties applied have been summarised in Table D-1.

Table D-1 Summary of Source Node Properties Applied in the MUSIC Modelling

Parameter	Values		Comments
Assumed land usage for the proposed areas of the site	'Urban Residential' and 'Commercial'		'Urban Residential' and 'Commercial' pollutant export and rainfall-runoff properties were modelled in accordance with the *MUSIC modelling guidelines* (Water by Design 2010b).
Land Use	**Total Impervious Fraction**	**Approx. Area (ha)**	**Comments**
Urban Residential Roof	100%	8.7	Impervious fraction were estimated in accordance with the *MUSIC modelling guidelines* (Water by Design 2010a).
Urban Residential Roads	65%	6.9	
Urban Residential Ground	30%	7.1	
Commercial Roof	100%	0.67	
Commercial Roads	85%	0.40	
Commercial Ground	80%	0.27	

D.3.2 Meteorological Data

In accordance with Water by Design (2010b), meteorological data has been obtained for MUSIC from the Beaudesert Cryna Station (BOM Station no. 40014). Modelling of the site was performed over a period of ten years (from 1 January 1968 to 31 December 1977) at a 6-minute time step interval. Average potential evapo-transpiration data as described by Water by Design (2010b) has been adopted in the MUSIC modelling.

D.4 Proposed Treatment Strategy Elements

As outlined in Section 4.5, a stormwater quality management strategy consisting of education and bioretention basins has been proposed for the site. The individual elements of this strategy are described in the subsequent sections below. The stormwater treatment nodes specified in MUSIC essentially represent the stormwater treatment train.

D.4.1 Education

Education can increase people's understanding and acceptance of water quality issues and stormwater treatment devices. It is proposed that signage be installed at appropriate locations (e.g. adjacent to proposed bioretention systems). Through advanced awareness, it is possible that pollutant loads may be reduced at source level.

It should be noted that education will need to be ongoing, and relate to both pre and post development for all stakeholders.

Examples of educational signage to improve understanding of water quality issues are given in Figure D-1. No reduction in source pollutant loads have been assumed within the MUSIC model.

Figure D-1 Examples of Educational Signage

D.4.2 Bioretention Basins

A bioretention basin is a soil and plant-based stormwater management measure. A typical basin consists of a porous medium such as sandy loam. Vegetation is also established within the bioretention basin to promote evapotranspiration, maintain soil porosity, encourage biological activity, and promote uptake of some pollutants.

A series of bioretention basins are proposed to be incorporated throughout the development. The bioretention basins will receive stormwater flows from the urbanised residential areas from each of the sub-catchments identified in Figure 4-3.

For the purposes of this conceptual stormwater management strategy, the approximate filter media area for proposed bioretention basins has been derived as a percentage of the development area. All bioretention basins have been assumed to have a filter depth of 0.5 m and an extended detention depth of 0.3 m. The filter media for the bioretention system has been modelled as a sandy loam media of effective diameter 0.45 mm and a saturated hydraulic conductivity of approximately 200 mm/hr. The modelling assumes total nitrogen and orthophosphate concentrations of 400 and 30 mg/kg respectively as identified by Healthy Land and Water (Healthy Land and Water 2018), and that they will be vegetated with ‘effective nutrient removal plants’. The modelling also assumes a lined system, visually represented in Figure D-2.

Figure D-2 provides a conceptual cross section of a bioretention basin, illustrating the modelled properties of the system. Examples of bioretention basins are provided in Figure D-3.

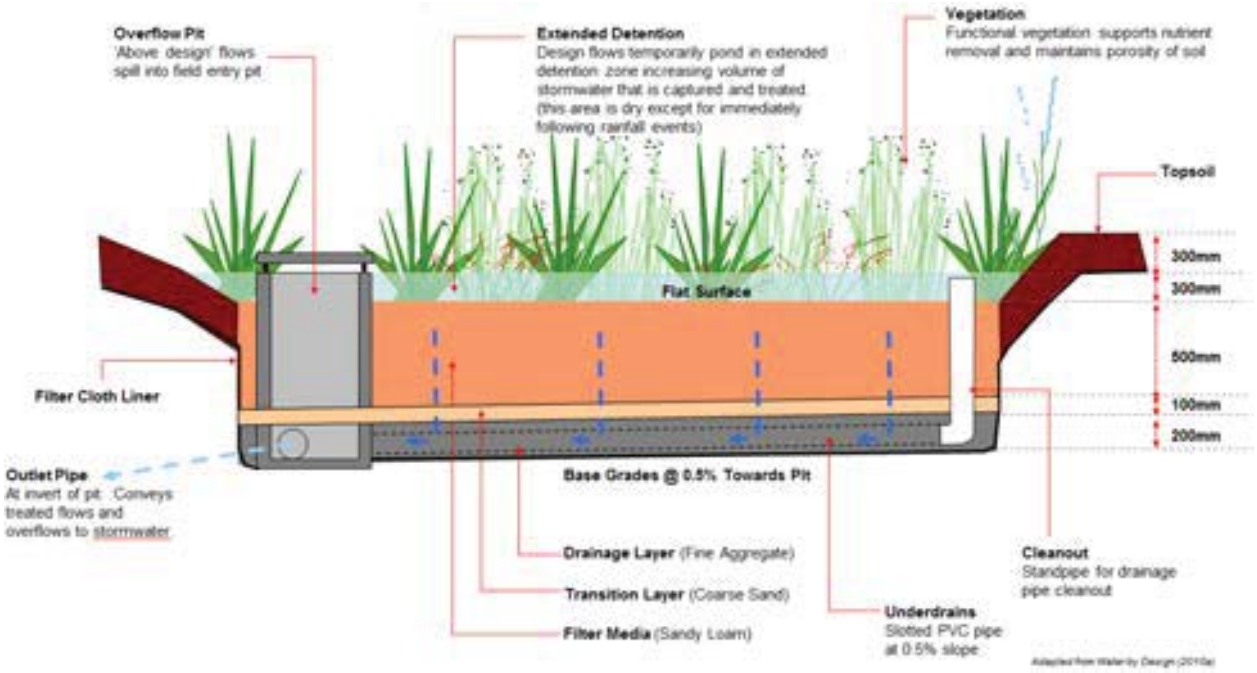


Figure D-2 Conceptual Cross Section of Bioretention Basin Properties

Figure D-3 Bioretention Basin Examples

D.4.3 Vegetated Swales

Vegetated swales are proposed downstream of the bioretention basins to treat the overflow from the basins as part of Option 2. The vegetated swales have been modelled as 'swale' treatment nodes.

For the purposes of this conceptual stormwater management strategy, the swales have been modelled as having a length of 15 m, base width of 6 m, top width of 10 m, depth of 0.5 m with vegetation height of 0.25 m, bed slope of 8% (however it is assumed that check dams will be incorporated to reduce the slope).

Examples of vegetated swales are provided in Figure D-4.

Figure D-4 Examples of Vegetated Swales for Stormwater Management

Appendix E Logan City Code Response

Provided in the table overleaf is a preliminary Flood Hazard Overlay code assessment.

Table 8.2.5.3.1.–Flood hazard overlay code: self-assessable and assessable development

Performance outcomes	Acceptable outcomes	Comments
For self-assessable and assessable development		
Risk to people and premises		
PO1 A building floor level of a habitable room has adequate allowance for the hydraulic gradient above the main floodway.	**AO1** A building has a finished habitable floor level a minimum of 500mm above the defined flood event.	Habitable floor levels will be located a minimum of 500mm above the defined flood event
PO2 Development must not increase the level of risk of injury to life or risk of damage to property or adversely affect flood evacuation procedures.	**AO2** Development: (a) does not result in any of the following: (i) an increase in the number of people at risk from flooding up to and including the defined flood event; or (ii) an increase in the number of people that need evacuation up to and including the defined flood event; or (iii) an increase in the number of premises or infrastructure at risk from flooding up to and including the defined flood event; or (iv) existing flood warning times being reduced for flood events up to and including the defined flood event; or (v) an adverse impact on the ability of traffic to use evacuation routes or unreasonably increase traffic volumes on evacuation routes; or (b) is located entirely within a development envelope area approved by an earlier development approval.	The development, with a filled platform above the regional 1 in 100 AEP flood event (i.e. DFE) will limit the number of people at risk of flooding. An evacuation route is possible up to the 1 in 100 AEP and will not impact on warning times up to the DFE.

Performance outcomes	Acceptable outcomes	Comments
For assessable development		
Risk to people and premises		
PO3 Development provides a development envelope area that is above the flood level during the defined flood event.	**AO3** Development provides a development envelope area above the flood level during the defined flood event with a minimum size and dimension specified in Table 8.2.5.3.2–Development envelope area.	The proposed development platform will be filled above the DFE.
PO4 Public safety and the environment are not adversely affected by floodwater by: (a) locating a Medium impact industry or High impact industry to be able to function safely during and immediately after flood events; (b) safely storing hazardous materials.	**AO4** Development: (a) for a Medium impact industry or High impact industry is above the flood level specified in column 2 of Table 8.2.5.3.3—Minimum flood levels; (b) involving the storage, sale or use of hazardous materials is located above the flood level during the defined flood event.	NA
PO5 A car park other than a Parking station is only located below the flood level during the defined flood event where there is no increase in risk to: (a) pedestrian and vehicular safety; (b) a building or other structure. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO5** No acceptable outcome provided.	NA

Performance outcomes	Acceptable outcomes	Comments
PO6 Development for any of the uses identified in column 1 Table 8.2.5.3.3—Minimum flood levels of are able to function effectively during and immediately after flood events. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO6** Development for any of the uses identified in column 1 of Table 8.2.5.3.3—Minimum flood levels is located above the flood level specified in column 2 of Table 8.2.5.3.3—Minimum flood levels	The development will be filled above the DFE.
Flood storage and discharge capacity		
PO7 An existing floodway is protected and maintained to ensure there are no losses of conveyance capacity of waterways and storage so as not to adversely affect other premises, infrastructure and the environment. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO7** No acceptable outcome provided.	A balance of floodplain storage will be achieved for the development. Flood impact assessment results indicate no adverse impacts occur as a result of either conveyance of loss of floodplain storage.
PO8 The natural conveyance of flood waters and natural overland flow paths are protected and maintained without adversely affecting adjoining premises. Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5—Infrastructure provides guidance to achieve this outcome.	**AO8** No acceptable outcome provided.	The proposed development is effectively located outside the regional 1 in 10-year AEP flood event. The banks of one bioretention system encroach into the 1 in 10-year AEP extent. The extent of encroachment is negligible in terms of the overall storage available in the site.
PO9	**AO9** No acceptable outcome provided.	

Logan City Code Response

Performance outcomes	Acceptable outcomes	Comments
Development (or development in combination with other development) for all flood events up to and including the defined flood event does not do any of the following: (a) cause or have the potential to cause damage; or (b) cause ponding of flood water; or (c) adversely affect the flood discharge capacity of the floodplain; or (d) decrease the flood resilience of properties and infrastructure; or (e) cause a cumulative increase in flood levels external to the premises. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.		

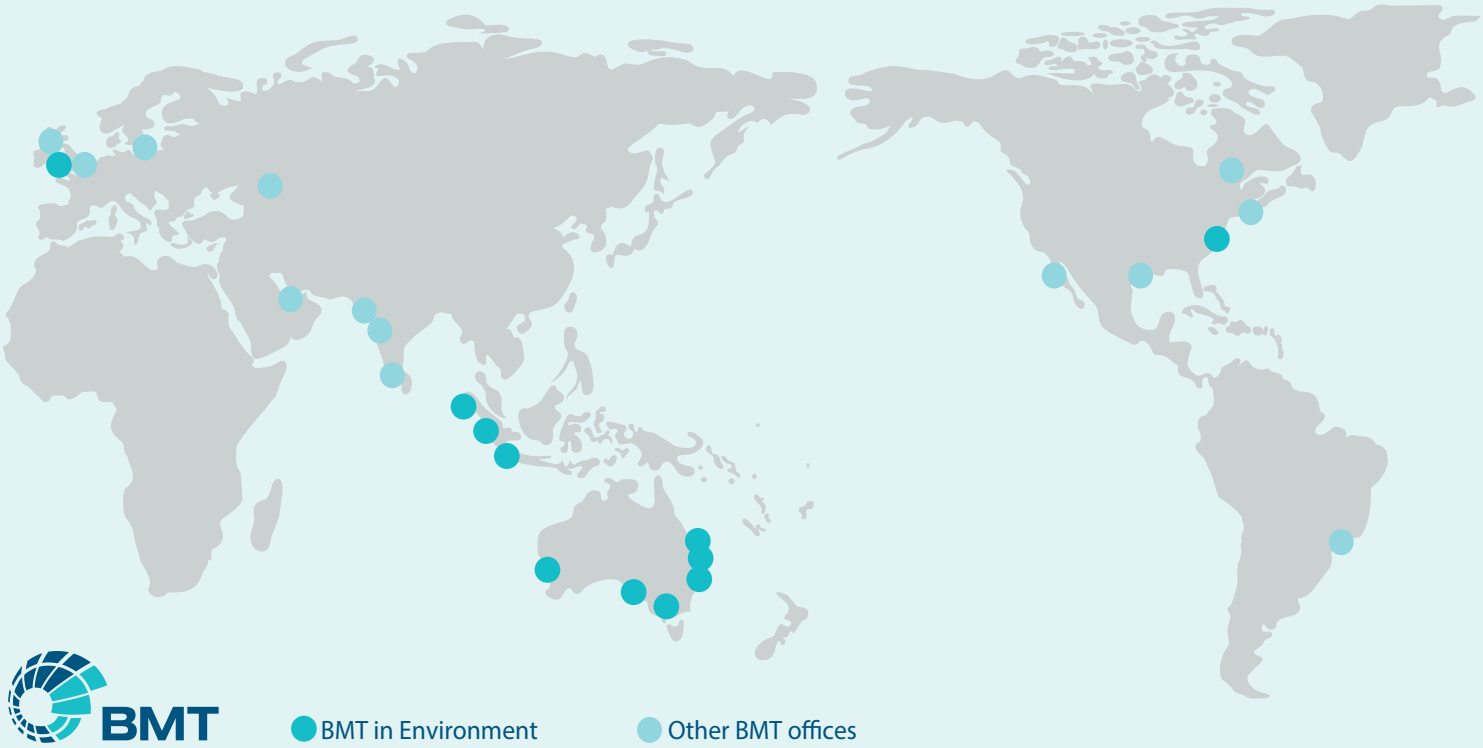
Performance outcomes	Acceptable outcomes	Comments
PO10 Any loss of floodplain storage is compensated with compensatory storage or excavation that: (a) is of equal volume, creating a balance of cut to fill; (b) is free draining; (c) is located within the premises; (d) does not adversely affect the hydraulic conveyance capacity of the flood channel or floodplain; (e) is provided to the corresponding flood level; (f) is landscaped to provide visual amenity and erosion control; (g) is solely for the purpose of compensatory storage. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO10** No acceptable outcome provided.	Earthworks modelling completed with respect to the proposed development has indicated that there will be no loss in floodplain storage to the 100-year regional flood level in the Logan River as a result of development. This position will be maintained for the detailed bulk earthworks design.
PO11 Development does not adversely change the following flood characteristics for all flood events up to and including the defined flood event: (a) peak flow; (b) flow of any part of the flood before the peak; (c) flood flow velocity; (d) level of flooding; (e) flood time to peak. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure	**AO11** No acceptable outcome provided.	The development will not result in an increase in discharge downstream of the site. As the site is located in close proximity to the Logan River, flooding will be governed by the higher flood levels produced by regional river flooding. The development will have a negligible impact on the time to peak or flows prior to the peak for regional flooding.

Performance outcomes	Acceptable outcomes	Comments
Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.		
PO12 A stormwater quality improvement device is located to retain existing flood plain storage capacity and ensure functionality of the stormwater quality improvement device.	**AO12** A stormwater quality improvement high flow outlet device is located: (a) above the five percent AEP flood event caused by local flooding; (b) above the two percent AEP flood event caused by regional flooding.	N/A to this assessment
PO13 A stormwater quantity management device is located to retain existing flood plain storage capacity and ensure functionality of the stormwater quantity management device.	**AO13** A stormwater quantity management high flow outlet device is located above the two percent AEP flood event.	
Filling and excavation		
PO14 Filling and excavation is carried out above the flood level of the 10 percent AEP event to protect in stream and banks of a waterway and wetland. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO14.1** Earthworks are limited to areas where: (a) flooding is predominately due to backflow; (b) the peak depth average velocity is less than the maximum permissible velocity for considerable bare earth channels (typically 0.5m/sec) in accordance with Table 9.0.5.3 of the Queensland Urban Drainage Manual; (c) the cut/fill batter is not steeper than 1V:4H and the exposed earth surface is landscaped with erosion resistant vegetation cover.	Filling of the proposed development footprint is located essentially outside the regional 1 in 10 year AEP flood event. While the banks of one bioretention basin slightly encroach into the 10 year flood extent, the area in question is subject to backflow and the area of encroachment is negligible.
	AO14.2 A filling and excavation plan is provided in accordance with section 2.2.2 of planning scheme policy 5–Infrastructure.	

Performance outcomes	Acceptable outcomes	Comments
Access		
PO15 Development provides vehicular access to a road network that is sufficient to enable safe access and egress. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO15** Development provides vehicular access to a road that is: (a) above the flood level during the defined flood event; or (b) below the flood level during the defined flood event where the road: (i) has a low flood hazard; (ii) remains trafficable until another road access to the development becomes trafficable; (iii) directly connects to a road that is above the defined flood event that provides access to the road network.	Areas to be developed and their associated roads will be above the 100 year flood level. These roads can access the external road network via access points that are above the 100-year flood level.
PO16 Development provides an access area to a building or fill area on which a building is to be constructed where the access is located on land classified as a low flood hazard in the defined flood event.	**AO16** Development provides access to a building or fill area that has: (a) a maximum depth of inundation of 300 mm during all flood events up to and including the defined flood event; (b) a maximum distance of inundation of 200 metres during all flood events up to and including the defined flood event; (c) a depth multiplied velocity product of less than or equal to 0.4m^2/s. Note—Velocity in flood waters is measured as the average velocity over a column of water.	The development footprint once filled will be above the DFE.

BMT has a proven record in addressing today's engineering and environmental issues.

Our dedication to developing innovative approaches and solutions enhances our ability to meet our client's most challenging needs.



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