

MEMORANDUM

Project: 37 Graham Road, Highett – Development Assessment	Date: 19/02/2021
To: Urbis c/o Sunkin Wolf Developments Pty Ltd CC:	From: Scott Dunn
Subject: 37 Graham Road – Flood Impact Assessment	

INTRODUCTION

The purpose of this memo is to present the outcomes of a flood impact assessment for the proposed redevelopment of 37 Graham Road, Highett.

The property is subject to an existing flood overlay (Special Building Overlay), depicted in Figure 1 below, as a result of being subject to overland flooding in a 1 % Annual Exceedance Probability (AEP) event.

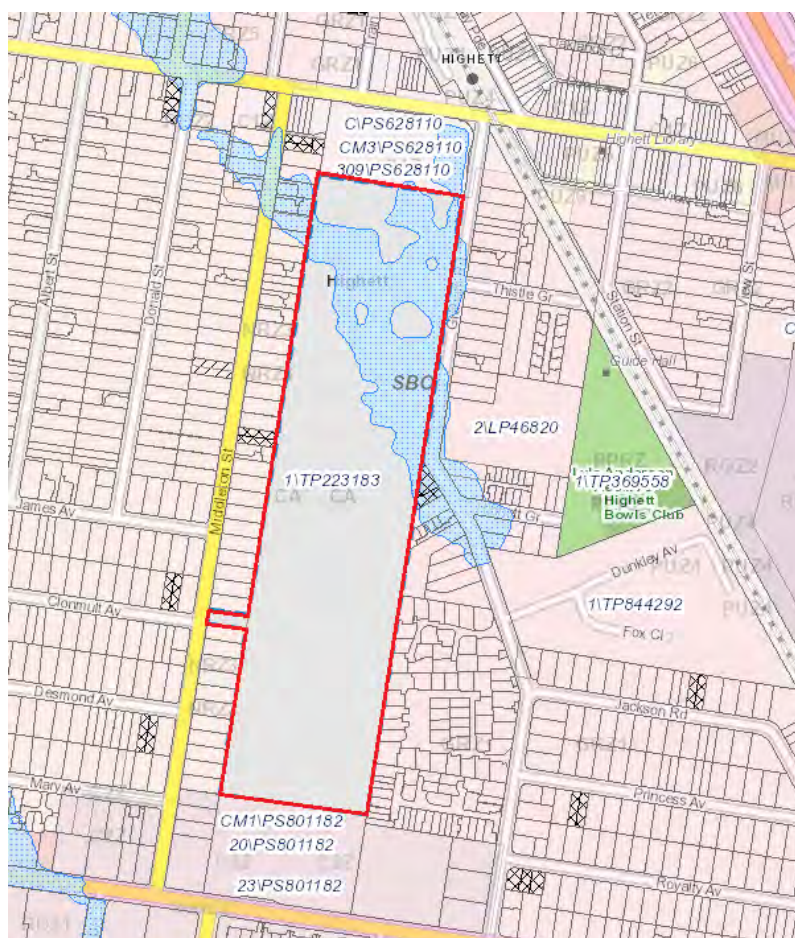


Figure 1 Extent of existing SBO within subject property

Melbourne Water is the responsible drainage authority for flooding defined by the SBO within the subject property.

As per Melbourne Water advice and outcomes of existing conditions flood modelling, undertaken by Melbourne Water, the property is subject to 4.47 m³/s of overland flooding in a 1 % AEP event. It is important to note that flooding is not expected within the subject property for more frequent flood events (e.g. 20 % and 10 % AEP events) as the Highett Main Drain has capacity to cater for these events, based upon the outcomes of Melbourne Water's flood modelling.

Engeny met with Melbourne Water in November 2019 to discuss the development and confirm the flood management requirements that development of the subject property will need to address. It was confirmed that the proposed development must meet the requirements of "Guidelines for Development in Flood Affected Areas" developed by the Department of Environment, Land, Water and Planning (February 2019). These guidelines outline the following requirements for the proposed development with reference to the 1 % Annual Exceedance Probability (AEP) flood event:

- Maximum depth: 300 mm
- Maximum velocity: 2 m/s
- Maximum product of velocity and depth: 0.3 m²/s

It is also a requirement that works associated with the proposed development do not adversely impact flooding on neighbouring, upstream or downstream, properties.

FLOOD MANAGEMENT PROPOSAL

To manage overland flooding impacting the subject property, it is proposed to provide above ground flood storage within the proposed open space areas and along roads. To meet the requirements of DELWP's "Guidelines for Development in Flood Affected Areas", peak flood depths are limited to a maximum depth of 300 mm during a 1 % AEP flood event.

The subject property is subject to overland flows only in a 5 % AEP (1 in 20 year) event and rarer events. As such the open space areas are not expected to hold any flood water during flood events more frequent than a 5 % AEP event.

FLOOD MODELLING

Background

As agreed with Melbourne Water, a copy of Melbourne Water's existing Park Street Main Drain TUFLOW model was obtained by Engeny for the purposes of extracting overland and pipe flow hydrographs. These hydrographs were included in a TUFLOW model developed as part of Engeny's work to model the impact of the proposed development. In our meeting with Melbourne Water on the 19th November 2019 it was agreed that a model focussed on the study area with inclusion of boundary conditions to represent inflows into the study area was appropriate given the size of the upstream catchment, estimated to be in the order of 85 hectares.

It is also important to note that Melbourne Water's existing model was developed using methodology and data consistent with Australian Rainfall and Runoff 1987 (ARR 1987). It was agreed with Melbourne Water that as part of Engeny's work, updates to the existing Melbourne Water modelling to account for the latest ARR 2019 guidelines was not required.

Model Inputs / Parameters

Table 1 below provides a summary of the key modelling inputs to the existing and proposed development conditions models.

Table 1 Key modelling inputs / parameters for existing and proposed development conditions models

Model Feature	Existing Conditions	Development Conditions
Hydrology	In accordance with ARR1987 as per existing MW Park Street Main Drain modelling	As per existing conditions
Drainage * - Further discussion of adopted form loss coefficients are provided below this table	Drains within model boundary include MW drains from existing MW Park Street Main Drain model and Council drainage within Graham Road low point included (not within exiting MW model) Drainage modelled with form loss to account for radius bends*.	Realignment of Melbourne Water drain (as proposed) with additional inlet pit and 300 mm dia. pipe to drain flood storage area (connection to MW Main Drain) Other internal drainage within the development was not included. Drainage modelled with form loss to account for radius bends*.
LiDAR (terrain data)	2007-08 LiDAR data as per existing MW Park Street Main Drain modelling	As per existing conditions plus design surface DEM for subject property to represent proposed development levels
Manning's (n) roughness	Subject property all grassed and no buildings	Subject property grassed and roads as per proposed Master Plan with buildings above 1 % AEP flood levels
Upstream boundary conditions	1d – "HT" type, Static Head @ 30.81 m AHD (approx. existing ground surface elevation) 2d – "HQ" type, slope @ 0.025 m/m	As per existing conditions
Downstream boundary conditions	1d – "HT" type, Static Head @ 30.81 m AHD 2d – "HQ" type, slope @ 0.025 m/m	As per existing conditions

Model Feature	Existing Conditions	Development Conditions
Grid Size	1 m	As per existing conditions
Time Step	2d: 0.25s 1d: 0.125s	As per existing conditions

With respect to the calculation of form losses used to represent radius bends, the loss coefficients were calculated using the curve losses in circular conduits chart posted on Melbourne Water's website (Developer Guides and Resources), refer to Figure 2 below.

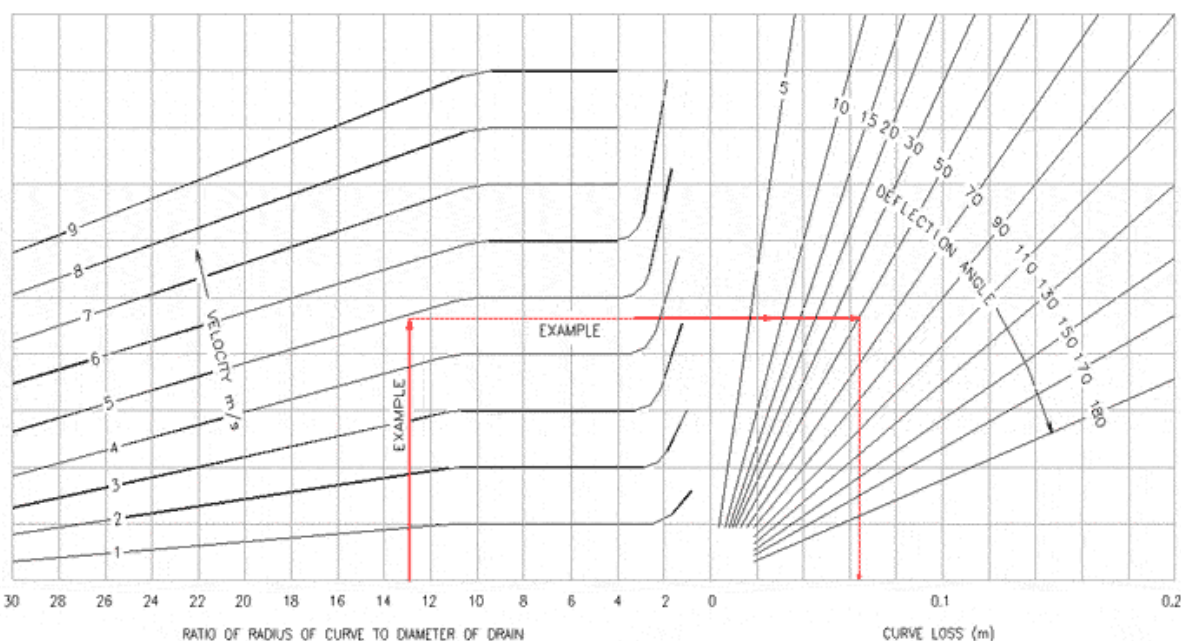


Figure 2 Curve Losses in Circular Conduits

A form loss coefficient of 0.04 was used in existing conditions modelling to represent the existing radius bend within the subject property, upstream of where the drainage realignment is proposed to connect to the existing drain. A form loss coefficient of 0.06 was used in the development conditions modelling to represent the two proposed radius bends within the subject property upstream of the connection with the existing drain.

Refer to **Attachment 1** for a layout plan of the existing conditions and proposed development conditions TUFLOW model configuration.

Results

Flood maps have been prepared to depict the results of the flood modelling and are attached to this memo as follows:

Attachment 2 – 20 % AEP Flood Depth Map for Existing and Proposed Development Conditions

Attachment 3 – 20 % AEP Proposed Development Conditions Flood Afflux Plot

Attachment 4 – 20 % AEP Flood Velocity Map for Existing and Proposed Development Conditions

Attachment 5 – 20 % AEP Flood Hazard Map for Existing and Proposed Development Conditions

Attachment 6 – 10 % AEP Flood Depth Map for Existing and Proposed Development Conditions

Attachment 7 – 10 % AEP Proposed Development Conditions Flood Afflux Plot

Attachment 8 – 10 % AEP Flood Velocity Map for Existing and Proposed Development Conditions

Attachment 9 – 10 % AEP Flood Hazard Map for Existing and Proposed Development Conditions

Attachment 10 – 1 % AEP Flood Depth Map for Existing and Proposed Development Conditions

Attachment 11 – 1 % AEP Proposed Development Conditions Flood Afflux Plot

Attachment 12 – 1 % AEP Flood Velocity Map for Existing and Proposed Development Conditions

Attachment 13 – 1 % AEP Flood Hazard Map for Existing and Proposed Development Conditions

The results highlight that for proposed development conditions the following is achieved:

- Maximum depth no greater than 300 mm
- Maximum velocity less than 2 m/s
- Maximum product of velocity and depth less than 0.3 m²/s
- No adverse impacts to flooding on neighbouring, upstream or downstream, properties.
- A benefit to downstream flooding north of the subject property, including the Woolworths development site on the corner of Graham Road and Highett Road. Overland flow is predicted to be prevented from reaching this area completely in developed conditions, as depicted by the “was wet now dry” area on the afflux plot (Attachment 8). This area is subject to flooding in excess of 500 mm deep in the 1 % AEP event for existing conditions.
- Flood depths within Graham Road are unchanged. In existing and proposed conditions, the depths within Graham Road, at the entrance to the subject property, are predicted to be in excess of 800 mm in the peak 1 % AEP event. In a 1 % AEP event all dwellings have a safe alternative access / egress via Middleton Street at the western property of the site.
- The capacity of the proposed realignment of Melbourne Water’s Highett Main Drain is the same as existing conditions, see Table 2 below for a comparison of pipe flows for a range of AEP events.
- Peak overland flows traversing the Middleton Street properties west of 37 Graham Road are also unchanged between existing and development conditions, see Table 2 below for a comparison for a range of AEP events.

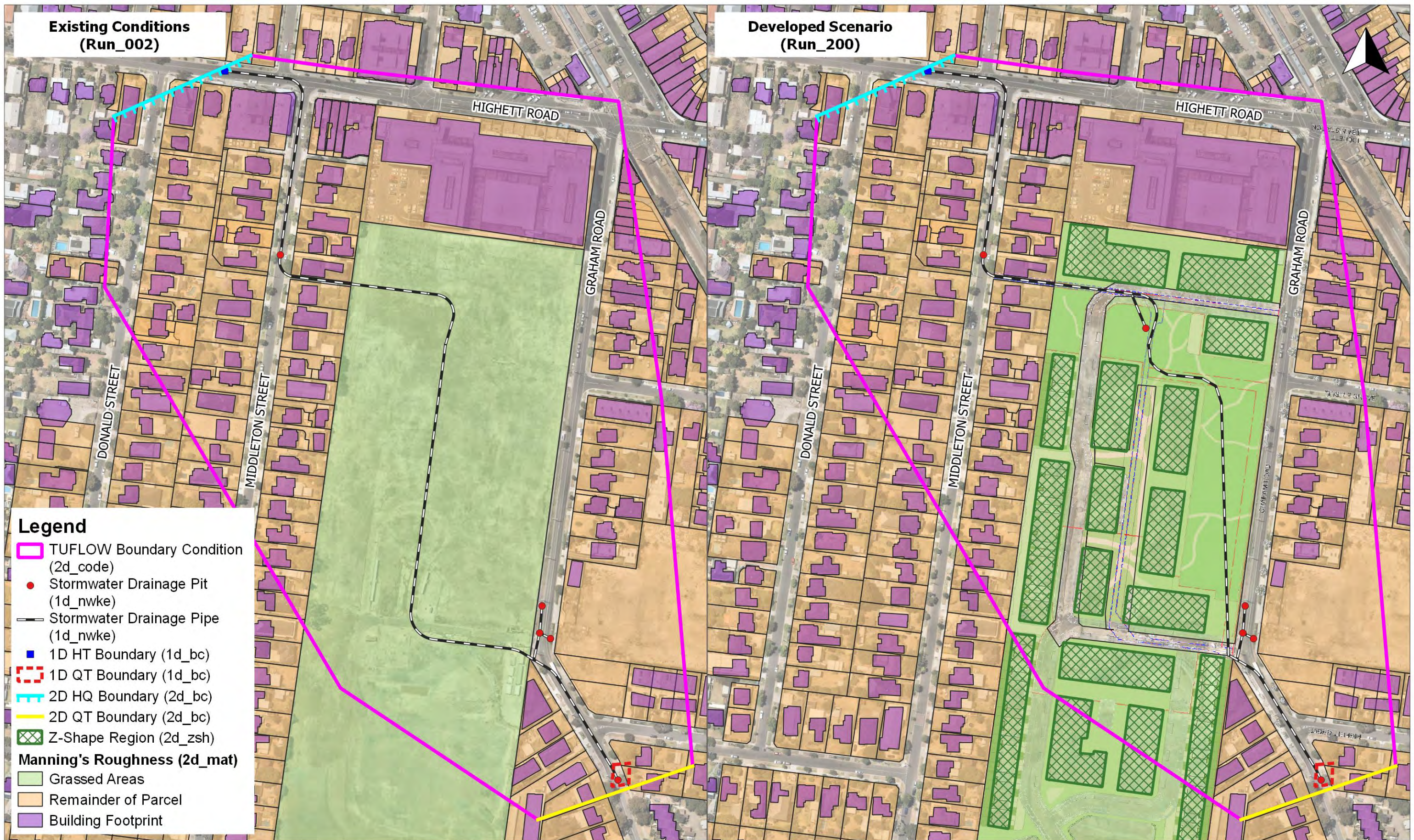
Table 2 Comparison of Pipe and Overland Flows

Description	20 % AEP	10 % AEP	1 % AEP
Peak flow through <u>existing</u> 1575 mm diameter Melbourne Water Drain	3.19 m ³ /s	3.57 m ³ /s	3.87 m ³ /s
Peak flow through <u>proposed</u> 1575 mm diameter Melbourne Water Drain realignment	3.21 m ³ /s	3.57 m ³ /s	3.87 m ³ /s
Peak overland flow traversing the Middleton Street properties west of 37 Graham Road (Existing Conditions)	0 m ³ /s	0 m ³ /s	1.90 m ³ /s
Peak overland flow traversing the Middleton Street properties west of 37 Graham Road (Developed Conditions)	0 m ³ /s	0 m ³ /s	1.90 m ³ /s

SUMMARY

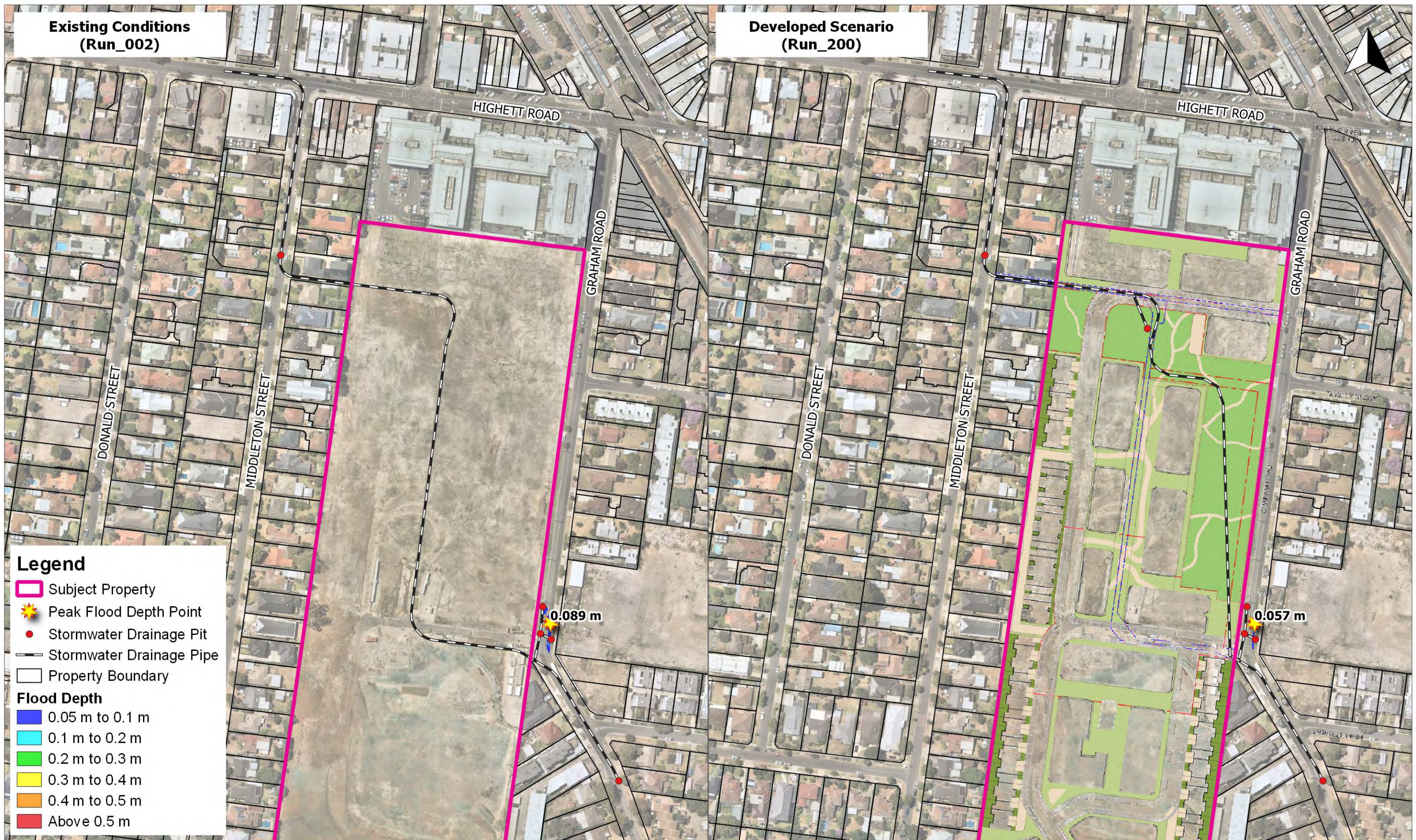
The stormwater management strategy for the subject property proposes aboveground flood storage within areas of open space. This open space is used to manage overland flow directed through the subject property from the upstream catchment, as defined by the existing Melbourne Water SBO. Flood modelling completed to date has demonstrated the following:

- The property is subject to overland flows only in a 5 % AEP (1 in 20 year) event and rarer events. As such the open space areas will not hold any flood water during flood events more frequent than a 5 % AEP event.
- Peak flood depths across the development will be limited to a maximum depth of 300 mm in the peak 1 % AEP (1 in 100 year) event.
- The flood storage within the large area of open space will hold flood water for approximately 4-5 hours during the peak 1 % AEP storm event.
- There are no adverse impacts with respect to flooding on neighbouring, upstream or downstream, properties.
- There will be a reduction in downstream flooding north of the subject property, including the Woolworths development site on the corner of Graham Road and Highett Road.
- Safe access / egress is afforded to all dwellings within the proposed development via Middleton Street at the western interface with the subject property.
- The proposed realignment of the existing Melbourne Water drainage asset is appropriate and does not impact the hydraulic capacity of the asset in minor or major storm events.



**Existing Conditions
(Run_002)**

**Developed Scenario
(Run_200)**



Level 34, Tenancy 5, 360 Elizabeth St,
Melbourne VIC 3000
PO Box 12192, A'Beckett St
VIC 8006
www.engeny.com.au
P: 03 9888 6978
F: 03 9830 2601
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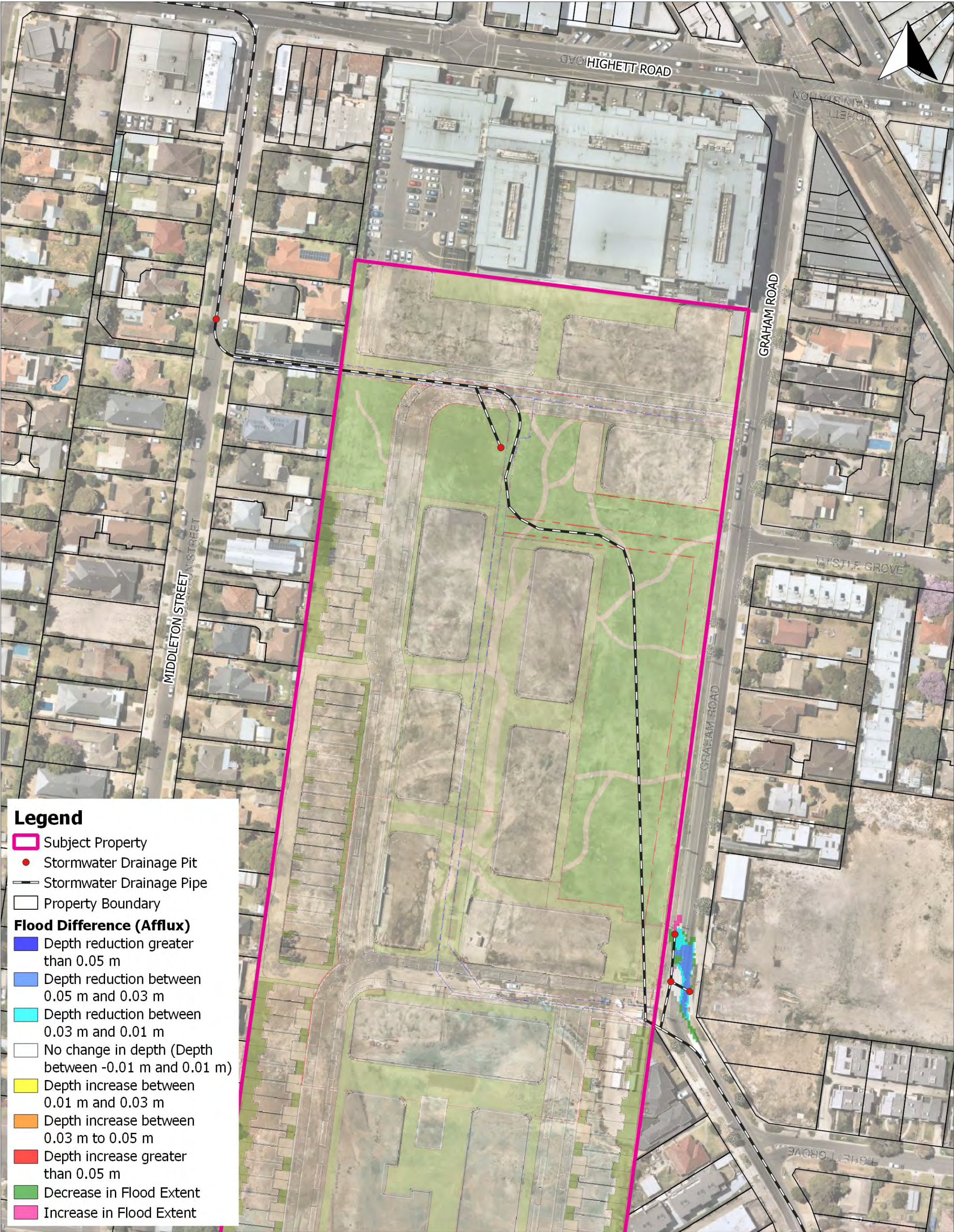
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Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

37 Graham Road - Flood Mitigation Assessment

Attachment 2
20 % AEP Flood Depth
Existing and Developed Conditions

Job Number: V1337_001
Revision: 0
Drawn: VW
Checked: SD
Date: 5/2/2021



Legend

Subject Property

Stormwater Drainage Pit

Stormwater Drainage Pipe

Property Boundary

Flood Difference (Afflux)

Depth reduction greater than 0.05 m

Depth reduction between 0.05 m and 0.03 m

Depth reduction between 0.03 m and 0.01 m

No change in depth (Depth between -0.01 m and 0.01 m)

Depth increase between 0.01 m and 0.03 m

Depth increase between 0.03 m to 0.05 m

Depth increase greater than 0.05 m

Decrease in Flood Extent

Increase in Flood Extent

Level 34, T5, 360 Elizabeth St, Melbourne VIC 3000
PO Box 12192, ABeckett St VIC 8006
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F: 03 9830 2601
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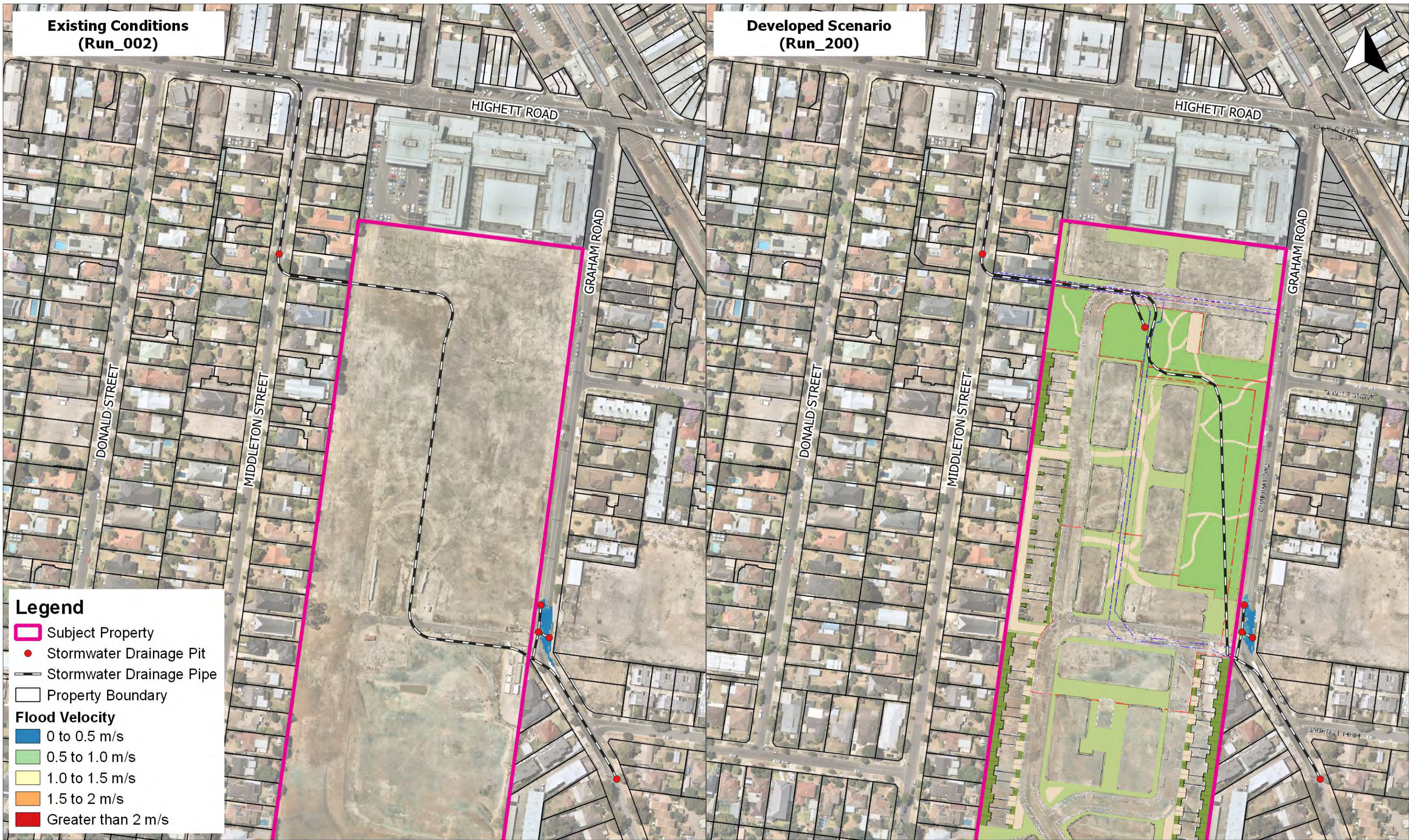
Scale in metres (1:1250 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

37 Graham Road - Flood Mitigation Assessment

Attachment 3
20 % AEP Flood Difference (Afflux) Plot
Developed Conditions minus Existing Conditions

Job Number: V1337_001
Revision: 0
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Checked: SD
Date: 19/2/2021



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Melbourne VIC 3000
PO Box 12192, A'Beckett St
VIC 8006
www.engeny.com.au
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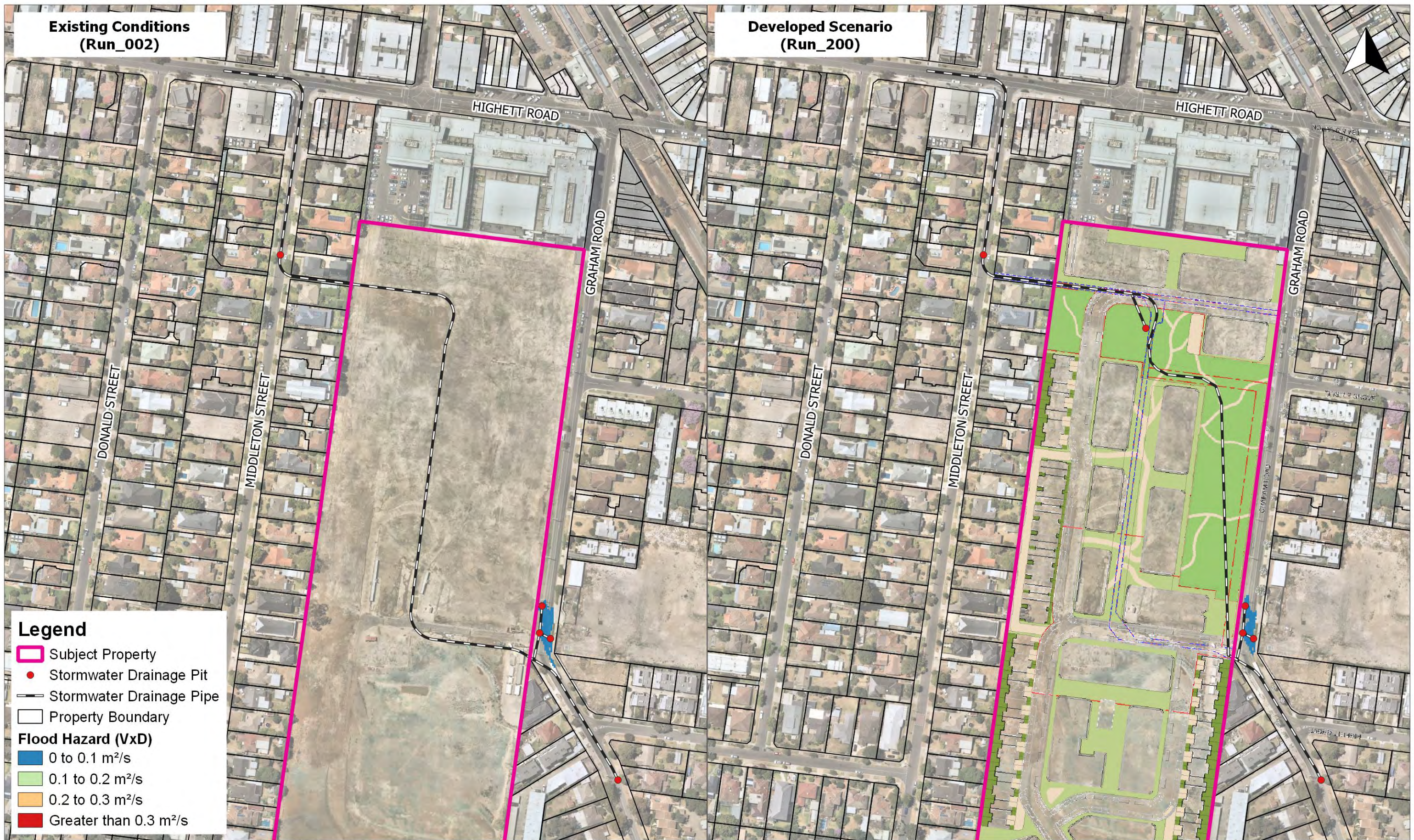
Scale in metres (1:2250 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

37 Graham Road - Flood Mitigation Assessment

Attachment 4
20 % AEP Flood Velocity
Existing and Developed Conditions

Job Number: V1337_001
Revision: 0
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Date: 5/2/2021



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Melbourne VIC 3000
PO Box 12192, A'Beckett St
VIC 8006
www.engeny.com.au
P: 03 9888 6978
F: 03 9830 2601
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40 0 40 80 m
Scale in metres (1:2250 @ A3)
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

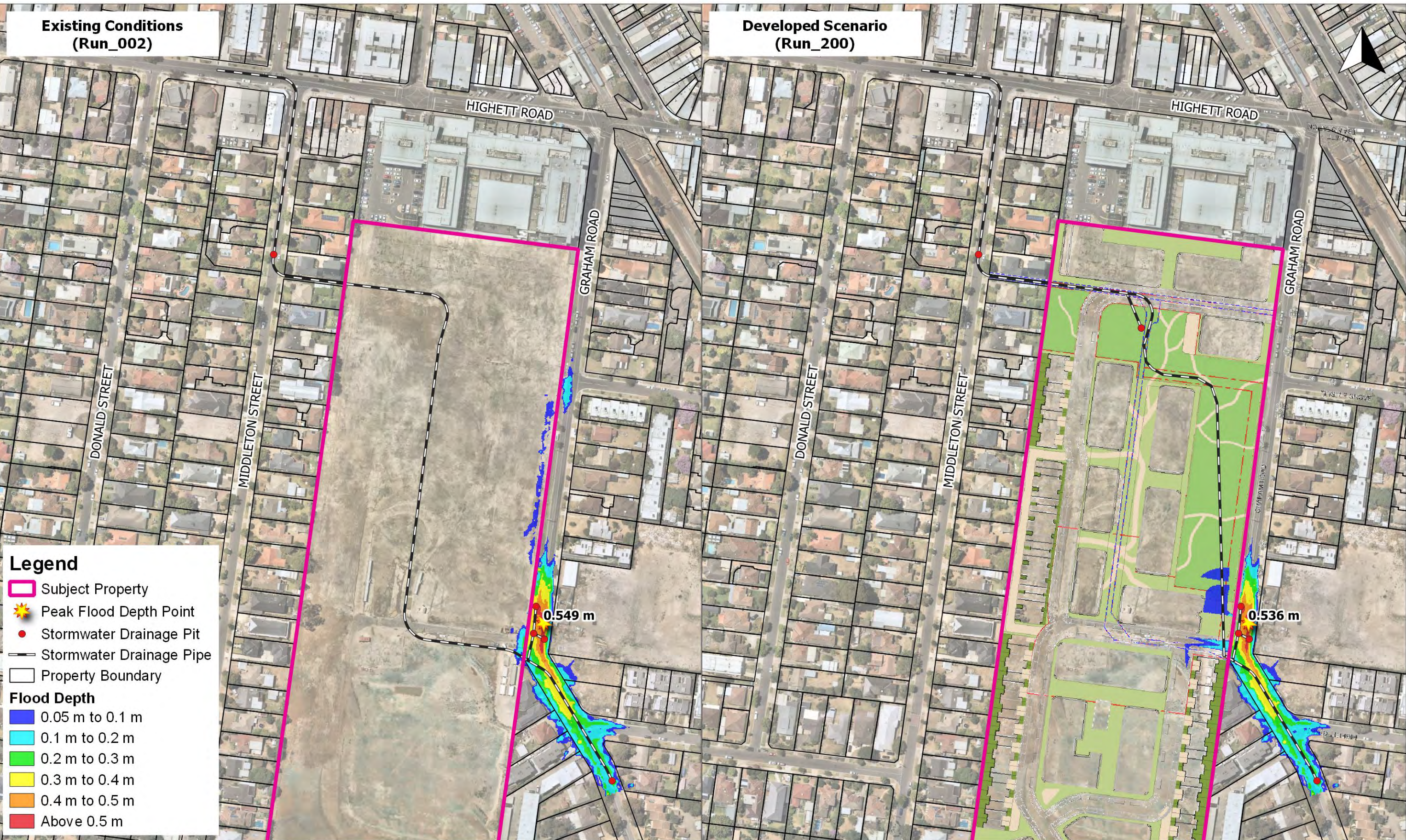
37 Graham Road - Flood Mitigation Assessment

Attachment 5
20 % AEP Flood Hazard (Velocity x Depth)
Existing and Developed Conditions

Job Number: V1337_001
Revision: 0
Drawn: VW
Checked: SD
Date: 5/2/2021

Existing Conditions (Run_002)

Developed Scenario (Run_200)



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Melbourne VIC 3000
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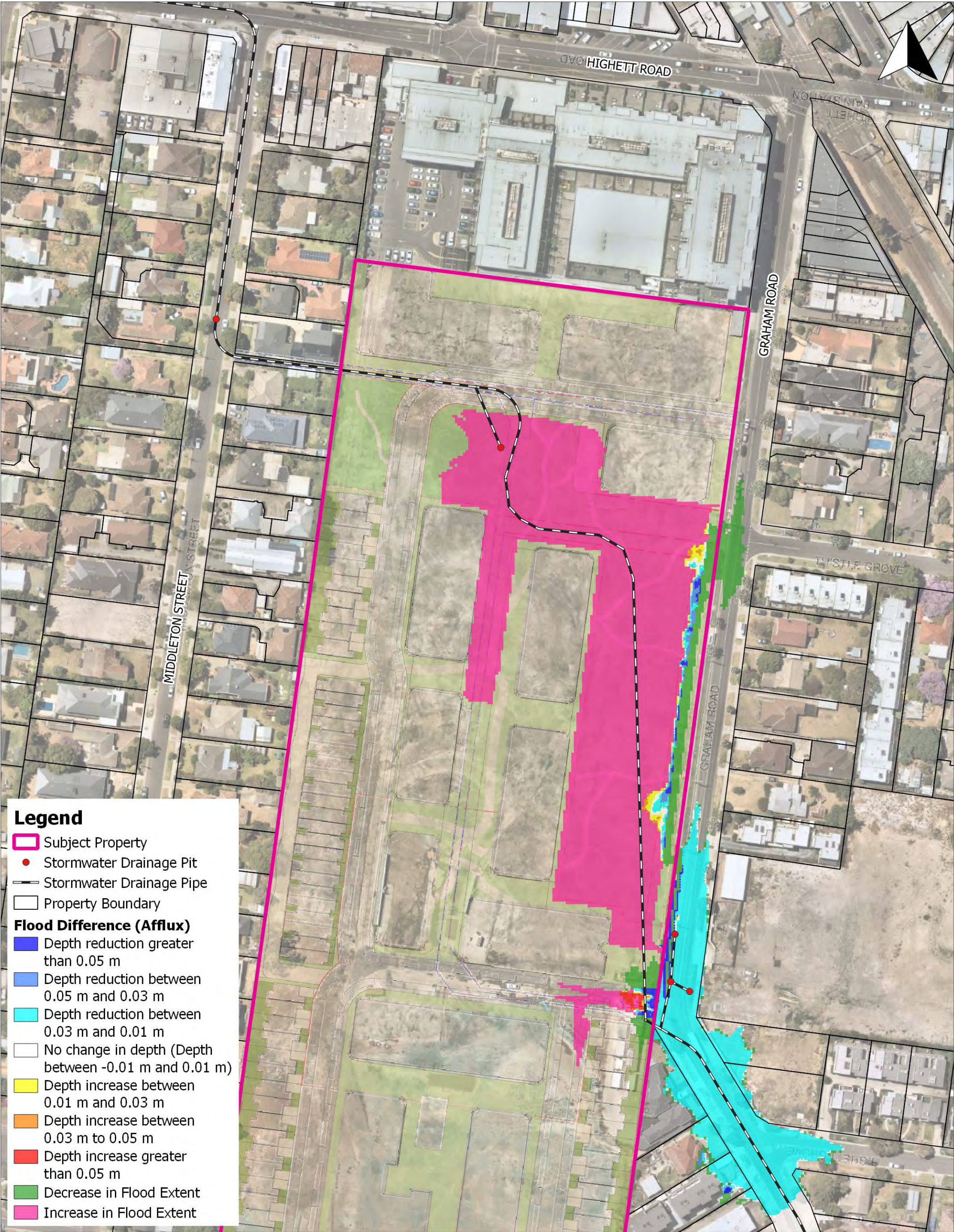
Scale in metres (1:2250 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

37 Graham Road - Flood Mitigation Assessment

Attachment 6
10 % AEP Flood Depth
Existing and Developed Conditions

Job Number: V1337_001
Revision: 0
Drawn: VW
Checked: SD
Date: 5/2/2021



Legend

Subject Property

Stormwater Drainage Pit

Stormwater Drainage Pipe

Property Boundary

Flood Difference (Afflux)

Depth reduction greater than 0.05 m

Depth reduction between 0.05 m and 0.03 m

Depth reduction between 0.03 m and 0.01 m

No change in depth (Depth between -0.01 m and 0.01 m)

Depth increase between 0.01 m and 0.03 m

Depth increase between 0.03 m to 0.05 m

Depth increase greater than 0.05 m

Decrease in Flood Extent

Increase in Flood Extent

Level 34, T5, 360 Elizabeth St, Melbourne VIC 3000
PO Box 12192, ABeckett St VIC 8006
www.engeny.com.au
P: 03 9888 6978
F: 03 9830 2601
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25 0 25 m

Scale in metres (1:1250 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

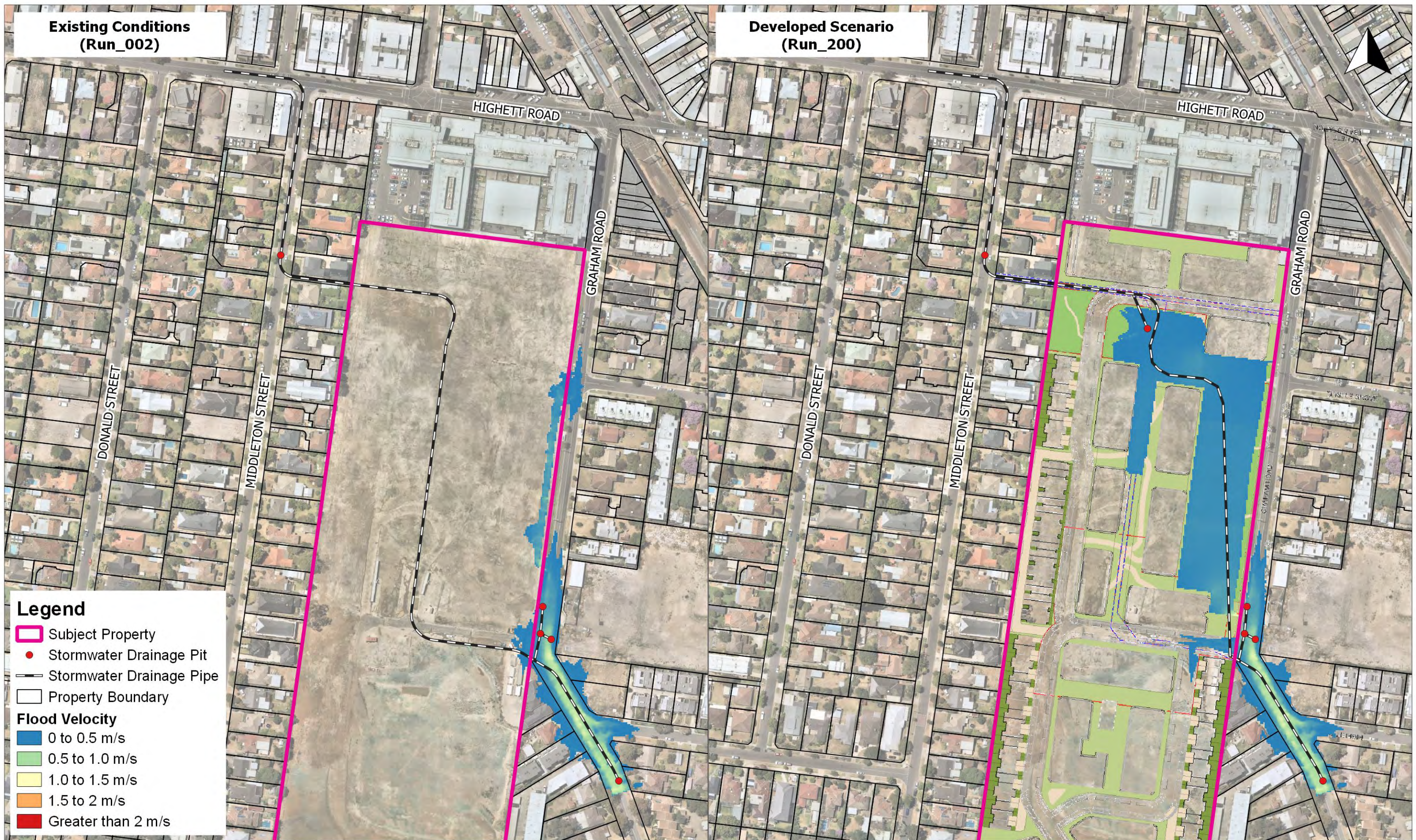
37 Graham Road - Flood Mitigation Assessment

Attachment 7
10 % AEP Flood Difference (Afflux) Plot
Developed Conditions minus Existing Conditions

Job Number: V1337_001
Revision: 0
Drawn: VW
Checked: SD
Date: 19/2/2021

Existing Conditions (Run_002)

Developed Scenario (Run_200)



Legend

- Subject Property
- Stormwater Drainage Pit
- Stormwater Drainage Pipe
- Property Boundary
- Flood Velocity**
- 0 to 0.5 m/s
- 0.5 to 1.0 m/s
- 1.0 to 1.5 m/s
- 1.5 to 2 m/s
- Greater than 2 m/s

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Melbourne VIC 3000
PO Box 12192, A'Beckett St
VIC 8006
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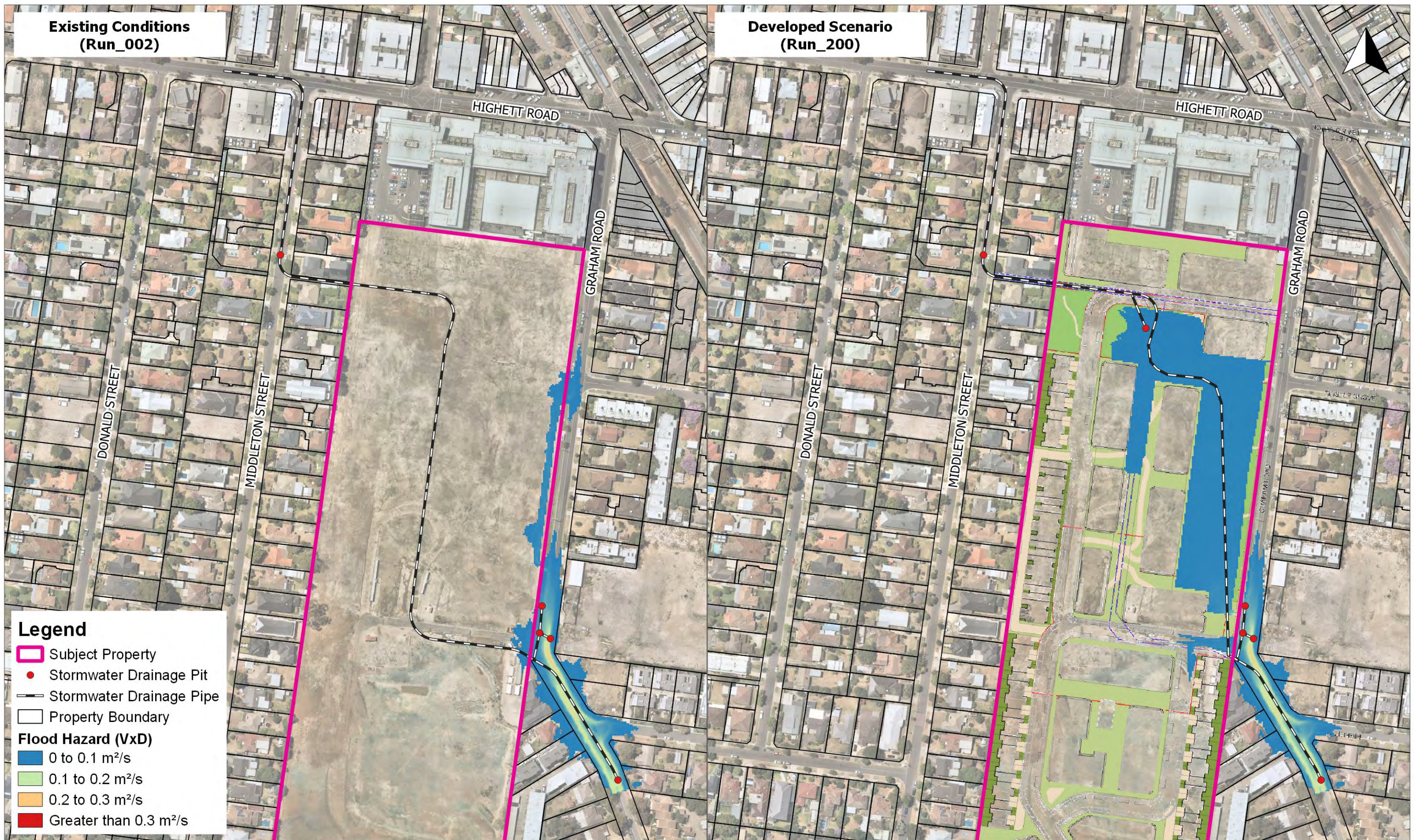
Scale in metres (1:2250 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

37 Graham Road - Flood Mitigation Assessment

Attachment 8
10 % AEP Flood Velocity
Existing and Developed Conditions

Job Number: V1337_001
Revision: 0
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Scale in metres (1:2250 @ A3)

Map Projection: Transverse Mercator
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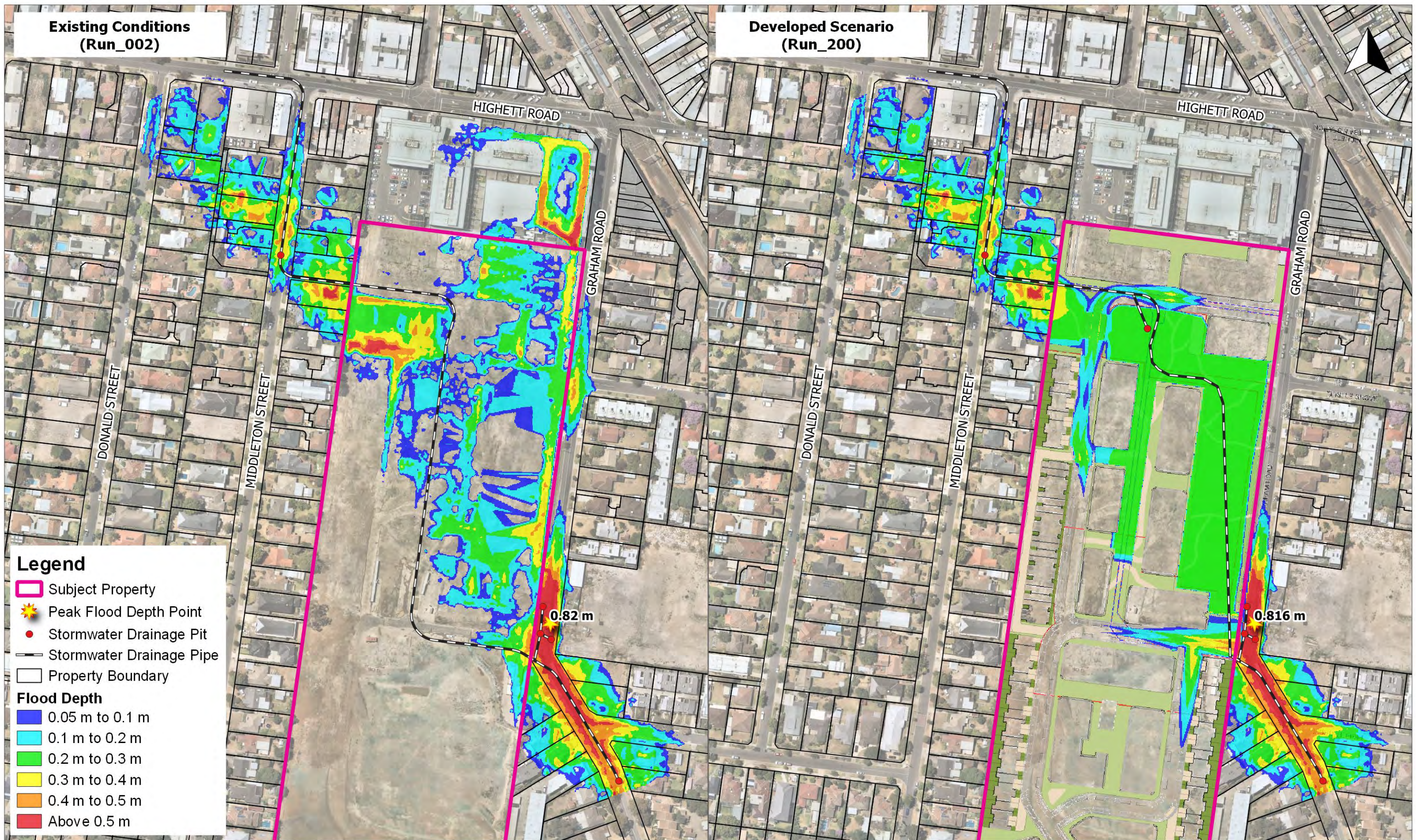
37 Graham Road - Flood Mitigation Assessment

Attachment 9
10 % AEP Flood Hazard (Velocity x Depth)
Existing and Developed Conditions

Job Number: V1337_001
Revision: 0
Drawn: VW
Checked: SD
Date: 5/2/2021

Existing Conditions (Run_002)

Developed Scenario (Run_200)



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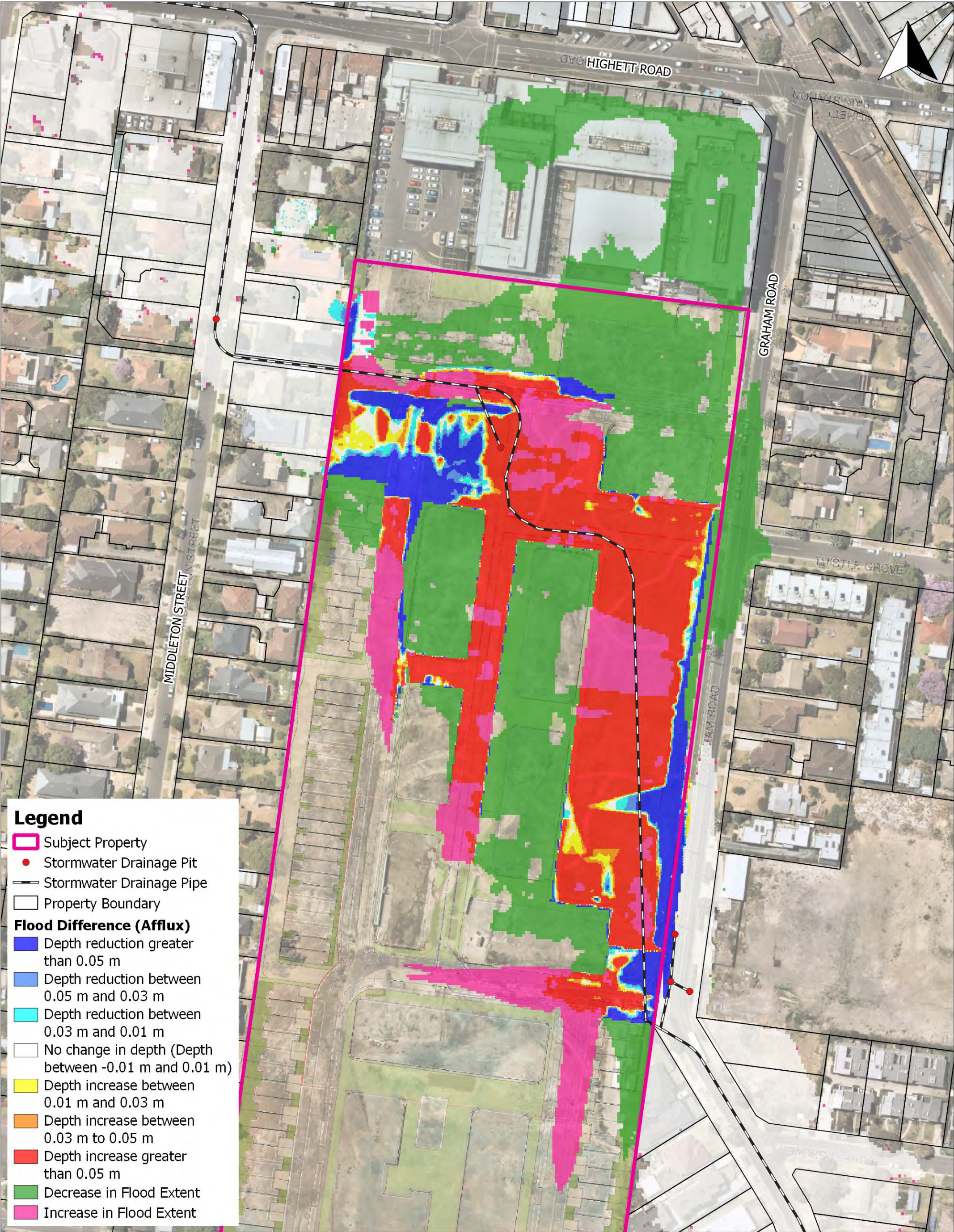
Scale in metres (1:2250 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

37 Graham Road - Flood Mitigation Assessment

Attachment 10
1 % AEP Flood Depth
Existing and Developed Conditions

Job Number: V1337_001
Revision: 0
Drawn: VW
Checked: SD
Date: 5/2/2021



Legend

Subject Property

Stormwater Drainage Pit

Stormwater Drainage Pipe

Property Boundary

Flood Difference (Afflux)

Depth reduction greater than 0.05 m

Depth reduction between 0.05 m and 0.03 m

Depth reduction between 0.03 m and 0.01 m

No change in depth (Depth between -0.01 m and 0.01 m)

Depth increase between 0.01 m and 0.03 m

Depth increase between 0.03 m to 0.05 m

Depth increase greater than 0.05 m

Decrease in Flood Extent

Increase in Flood Extent

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F: 03 9830 2601
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Scale in metres (1:1250 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
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37 Graham Road - Flood Mitigation Assessment

Attachment 11
1 % AEP Flood Difference (Afflux) Plot
Developed Conditions minus Existing Conditions

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