Proposed Mixed Use Development

4 Alexander Street, Collaroy NSW 2097

Overland Flow Assessment Report

18 March 2022

Contents

Document control

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A	16.02.2022	Issued for Review	JC	JC	LN
B	18.03.2022	Issued for Review	JC	JC	LN

1.0 Introduction

Woolacotts Consulting Engineers were engaged by PBD Architects to undertake the flood water depth assessment in 4 Alexander Street, Collaroy. The report will outline the current flooding issues including water ponding issues and overland flow conditions, and provide appropriate measures to mitigate the flood impacts.

The property has a site area of approximately 1200m^2 and is known as DP379308. The property is bounded by Alexander Street to the North and the residential dwellings/buildings to the East, the South, and the West. The location of the property is shown in Figure 1 below.

Figure 1 – Site location

2.0 Existing Conditions

2.1 Site Conditions

The existing site is approximately 60% impervious, covered almost entirely by a single dwelling building.

2.2 Existing Drainage System

Upon review of the 1m interval DEM file and the images from the google maps, water runoff predominately drains to the existing pit and pipe network within Alexander Street.

The site is not identified to be impacted by flooding based on Northern Beaches Council's flood studies, however historically the intersection of Alexander Street and Pittwater Road (southeast of the site) is known for localised ponding in major storm events due to the roads existing sag point, and the existing undersized minor drainage system beneath the existing Cinema site.

Major stormwater upgrade works have recently been undertaken within Pittwater Road to assist in the drainage ponding at this location.

2.3 Existing Flooding Issues

The site was impacted by two overland flow paths – the first overland flow formed by 0.11ha upstream catchment area -see figure 2- while the second overland flow causing the ponding issues at the sag point near the junction between Pittwater Road and Alexander Street was generated by 3.95 ha upstream catchment area- see figure 3. The following data is used to determine the two overland flows.

- 1m interval Design Elevation Model (DEM) from ELVIS NSW.
- ARR2016 Rainfall.
- Materials roughness values.

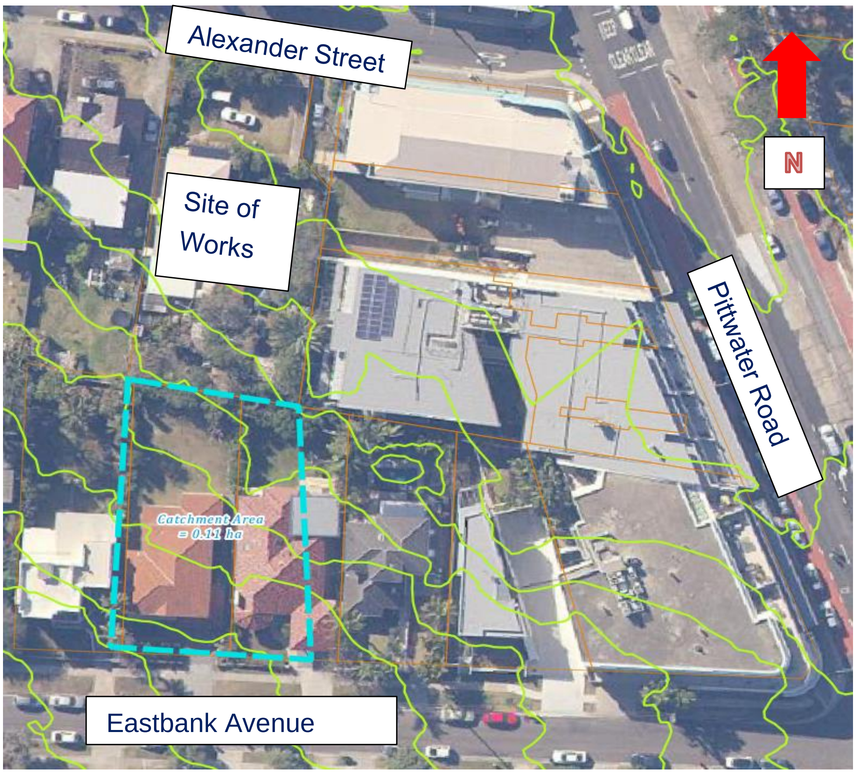


Figure 2 – The Upstream Catchment Generating the First Overland Flow

Figure 3 – The Upstream Catchments Generating The Second Overland Flow.

The DRAINS software is used to determine the peak flow through the property during the 1% AEP storm events

The XP-RAFT software is employed to estimate the peak flow through Alexander Street during 1% AEP storm events and PMF storm events. The figure 3 below shows the XPRAFT model.

From the aerial photo of the region, most of the catchment is hard paved, consisting of buildings, roadway, and pedestrian paths. The catchment is assumed to be 70% impervious and 30% pervious The manning's roughness values of 0.035, 0.02 have been applied for the pervious area and the impervious area respectively.

The 1% AEP rainfall intensity was increased by 10% to account for potential increases in rainfall intensity associated with climate change and the PMP should not be further adjusted to consider potential climate change implications. The procedures outlined in Book 1, Chapter 6 of ARR2019 were applied with the following parameters/assumptions, East Coast South Cluster, medium consequence risk rating, RCP4.5, 2090 planning horizon.

2.3.1 The First Overland Flow.

The site flood extent – see Figure 4 - is determined by combining the flood extents of 7 cross sections which are distributed evenly along the centre line of the overland flow path. The HEC-RAS summary and the graphical profile of each section are attached in the Appendix A. The table 1 outlines the 1% AEP flood level relevant to each cross section

Chainage	Min Chainage Elevation (mAHD)	1% AEP Flood Level (mAHD)	1% AEP with Climate Change Factors Flood Level (mAHD)	1% AEP Flood Depth (m)	Climate Change Flood Depth (m)
52.37	5.51	5.71	5.71	0.2	0.2
50	5.11	5.29	5.29	0.18	0.18
40	4.96	5.06	5.07	0.10	0.11
30	4.30	4.33	4.33	0.03	0.03
20	3.72	3.78	3.78	0.06	3.78
10	3.51	3.57	3.58	0.06	0.07
0	3.21	3.26	3.26	0.05	0.05

Table 1: 1% AEP Flood Depth

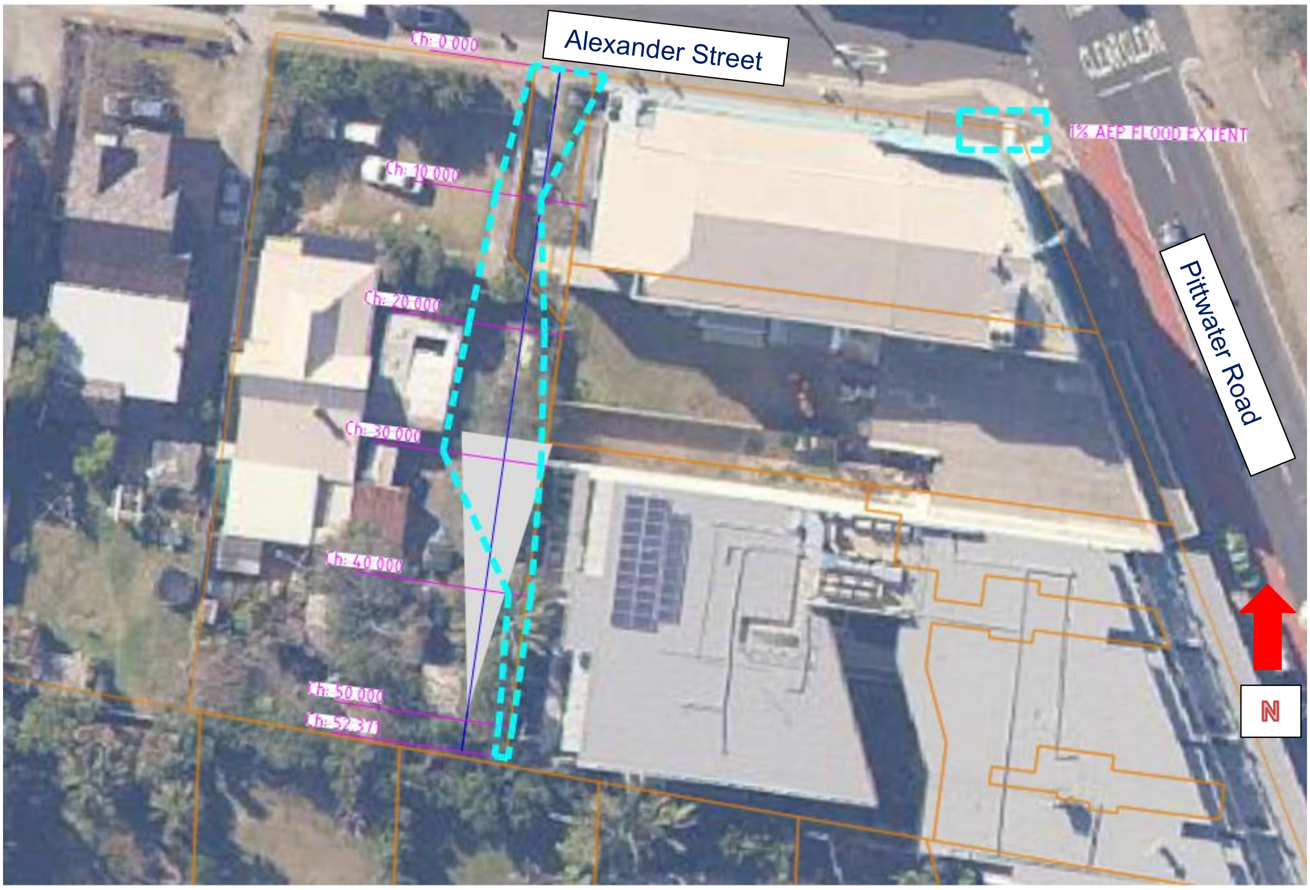


Figure 4 – The 1% AEP Flood Extent

2.3.2 The Second Overland Flow

In the XPRAFT model, it was established for events up to and including the 1% AEP and PMF, the critical duration for the 1% AEP storm events and the PMF storm events were 10 minutes and 15 minutes respectively. The table 2 below outlines the outputs from the analysis.

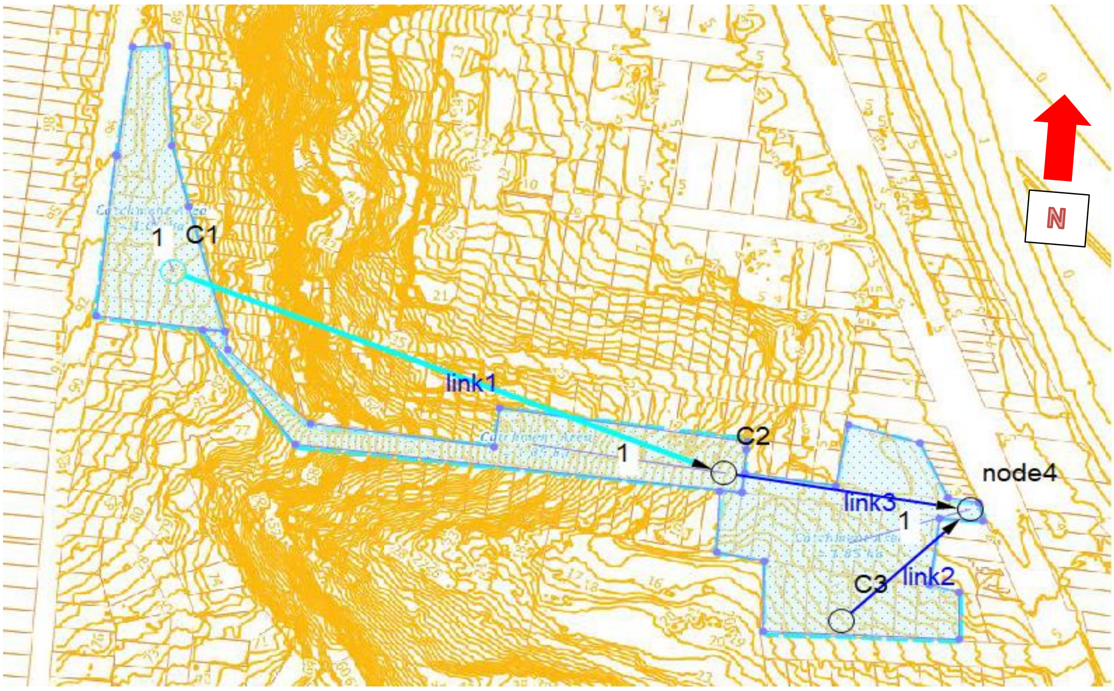


Figure 5 – XPRAFT Model

Sub catchment	Area (ha)	1% AEP Peak Flow (l/s)	1% AEP with Climate Change Factors (10% increases in rainfall)	PMF Peak Flow (l/s)
1	1.05	576	635	2103
2	1.05	1187	1307	4308
3	1.85	1.001	1104	3419

Table 2: 1% AEP and PMF peak flow

HEC-RAS 2D provides two-dimensional (2D) solutions of the free-surface flow equations to simulate flood propagation. The program can link 1D and 2D attributes, providing a visual representation of overland flow, as well as identifying areas of potential inundation.

The following parameter implemented in the HEC-RAS 2D model are described below.

- Model Domain and Grid Size – A model grid size of 1 m x 1 m was implemented with break lines along building's boundaries to generate an irregular mesh which adapts to the buildings' geometry.
- Digital Elevation Model (DEM) – The 1 m DEM has been used to inform the topography of the 2D hydraulic model.
- Hydraulic Roughness – Manning's 'n' values were selected based on inspection of aerial imagery. A general Manning value of 0.035 was applied to the 2D area while a value of 0.02 was applied to the roads.

- Boundary Conditions – Normal depth and 5% fall to be assigned at the downstream of the catchment and the flow hydrograph obtained from XPRAFT was set up at the upstream.
- The surrounding houses are modelled as obstructions.
- The existing stormwater infrastructure were not included in the model.

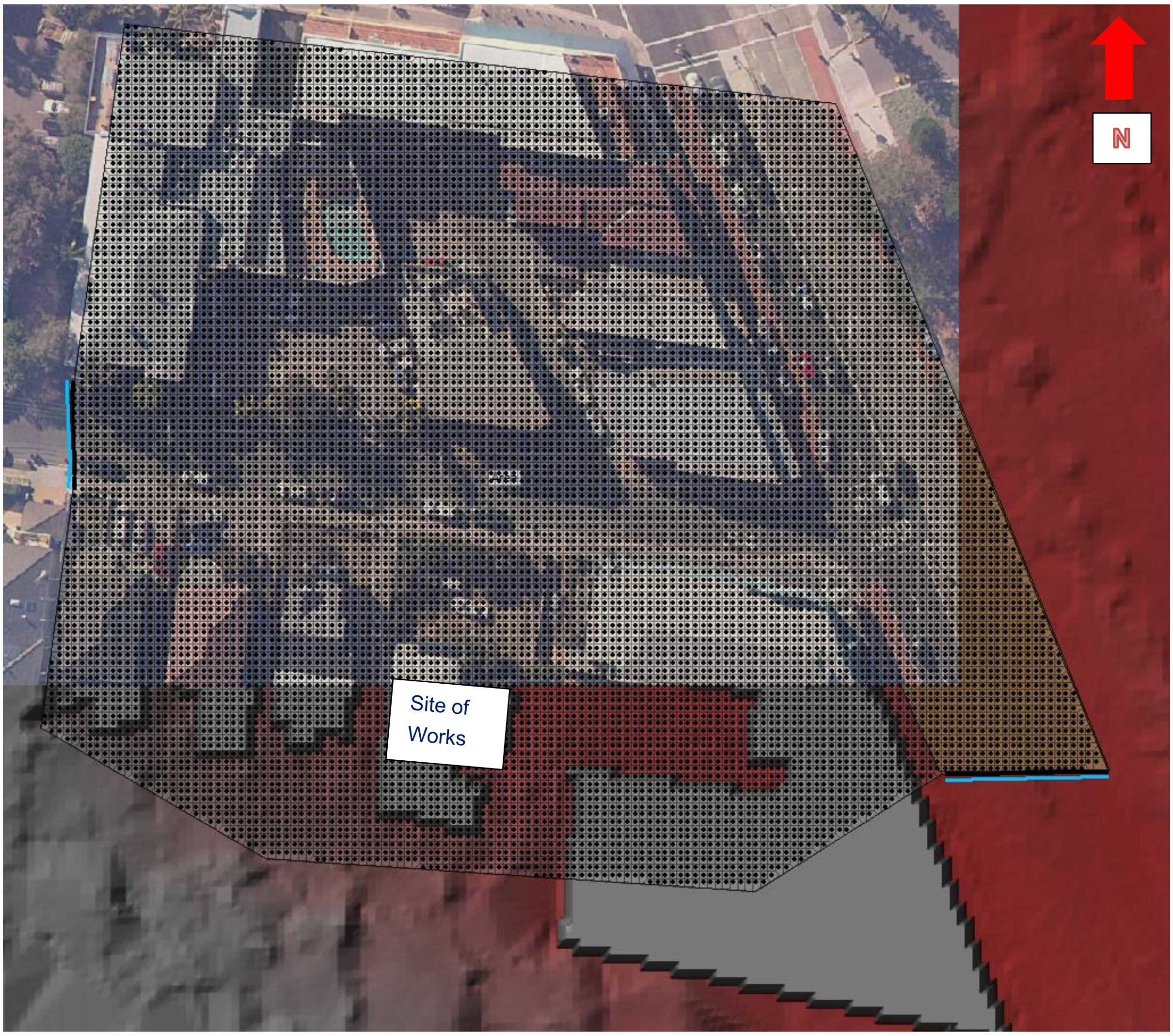


Figure 4 – HECRAS 2D Model

The site flood extent for the existing scenario is shown in attachment B, C, D.

3.0 Proposed Development

The proposed development comprises demolition of the existing structures and construction of the 3-level senior living building with a basement.

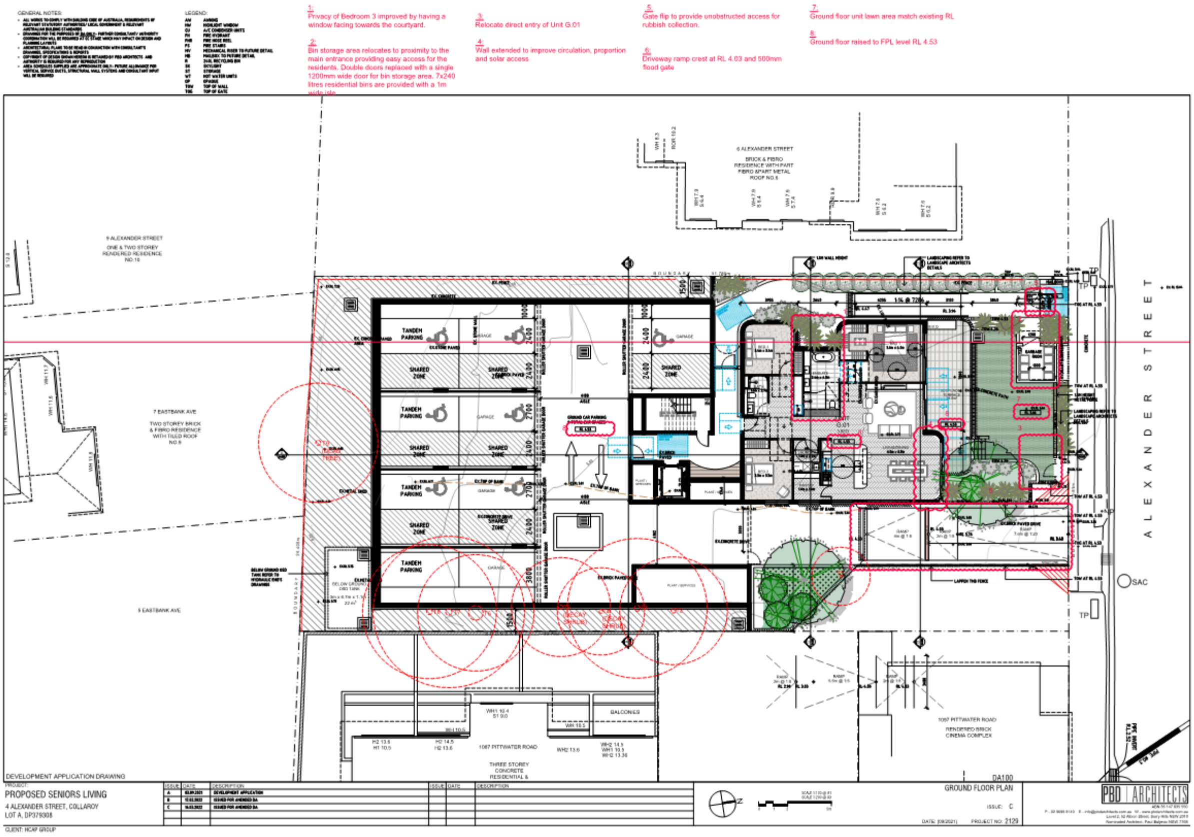


Figure 5: Ground Floor Plan

(Source: Architectural plans by PBD Architects with reference No.2129, revision C dated 16/03/2022)

4.0 Flood Planning Levels

Based on the result of the assessment undertaken in section 2.3.2 of this report, the flood planning levels recommended for different building components are listed below.

Component	1% Flood level with Climate Change factors (mAHD)	Flood Planning Level (mAHD)	Freeboard (m)
Basement Crest	4.03	4.03	0
Flood Gate	4.03	4.53 (In operation)	0.5
Unit G.01	4.03	4.53	0.5

Table 3: Flood Planning Levels

5.0 Flood Mitigation Measures.

The following measures should be implemented to maintain the current overland flood regime.

The First Overland Flow

- Propose a 1.5m width grass dish swale along the rear of the property and channel water runoff to a surface inlet pit. The pit will direct water to a junction in front of the property via a 300mm diameter upvc pipe. The outlet of the junction pit is connected to the existing stormwater line which originates from the existing sag pit and travels south-east. Another Junction pit is recommended to be installed at the connection point if feasible.

Figure 6: Flood Mitigation Measures for The First Overland Flow

A DRAINS analysis is undertaken to determine whether the proposed system has sufficient capacity to cater for the 1% AEP overland flow generated by the nominated catchment.

The following inputs have been adopted for the analysis:

- 1m interval Design Elevation Model (DEM) from ELVIS NSW.
- ILSAX parameters
  - Paved (impervious) area depression storage (mm): 1 mm
  - Supplementary area depression storage (mm): 1 mm
  - Grass (pervious) area depression storage (mm): 5 mm
  - Soil Type: 3
  - Climate Change Rainfall Multiplier: 1.1
- ARR2016 Rainfall
- Pit Blockage factor: 20%

The drainage layout is shown in Figure 7 and the DRAINS outputs are depicted in Figure 8,9 below

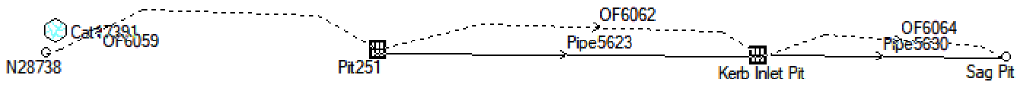


Figure 7: Drainage Layout in DRAINS Model

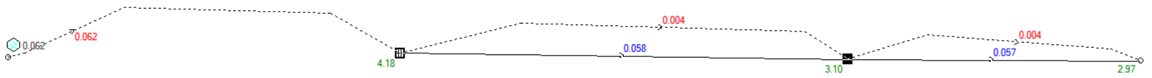


Figure 8: The 1% AEP Outputs From DRAINS

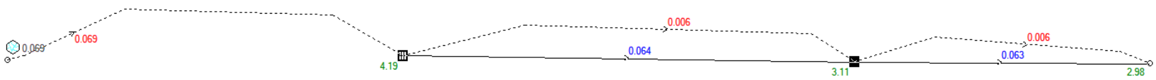


Figure 9: The 1% AEP with Climate Change Factors outputs from DRAINS

The Second Overland Flow

- Allow an opening (0.1m(H) x 0.1m(D)) every 1m along the proposed boundary walls.
- The terrace of unit 1 should be elevated to the existing ground level at a minimum or be suspended to suit the new ground floor RL.
- The planter box located at the eastern side of the building – see image below – should be levelled at the existing ground level.

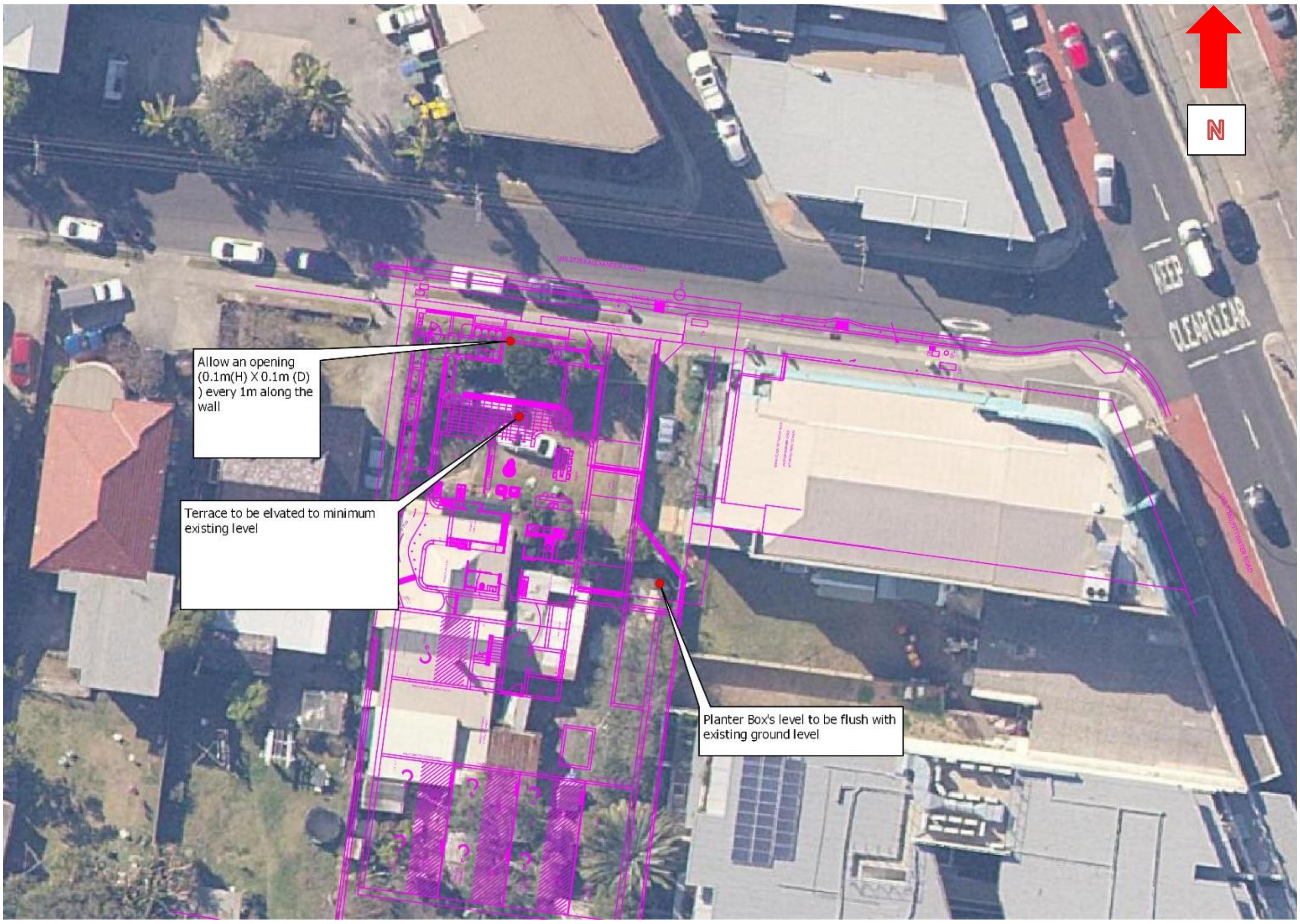


Figure 10: Flood Mitigation Measures for The Second Overland Flow

6.0 Conclusion

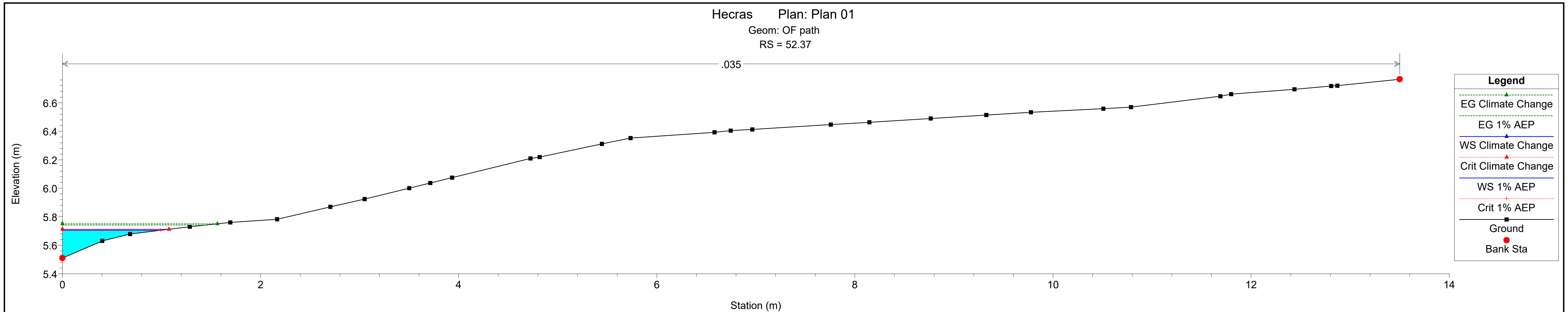
The Flood Water Depth Assessment by Woollacotts has demonstrated the proposed development with the approximate measurements will not worsen the existing flooding issues during the 1% AEP and PMF flood events.

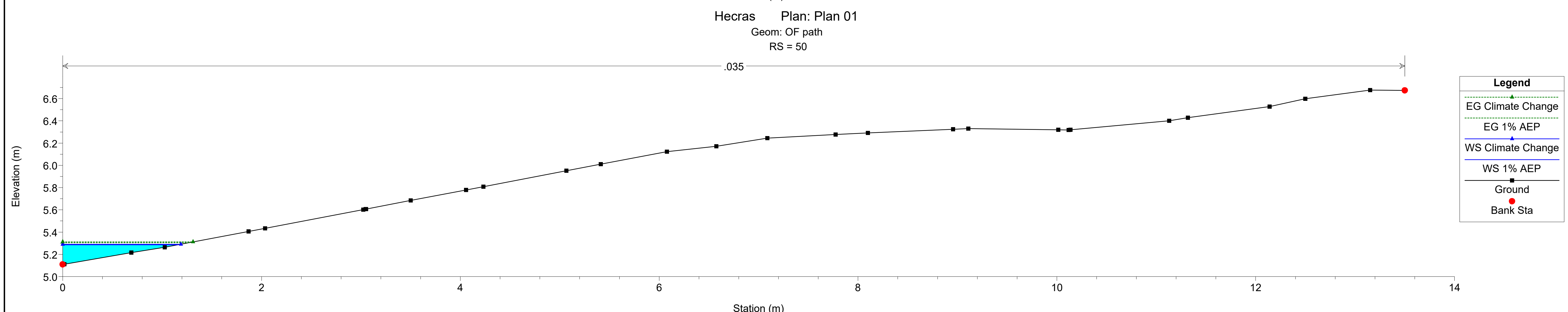
Appendix A

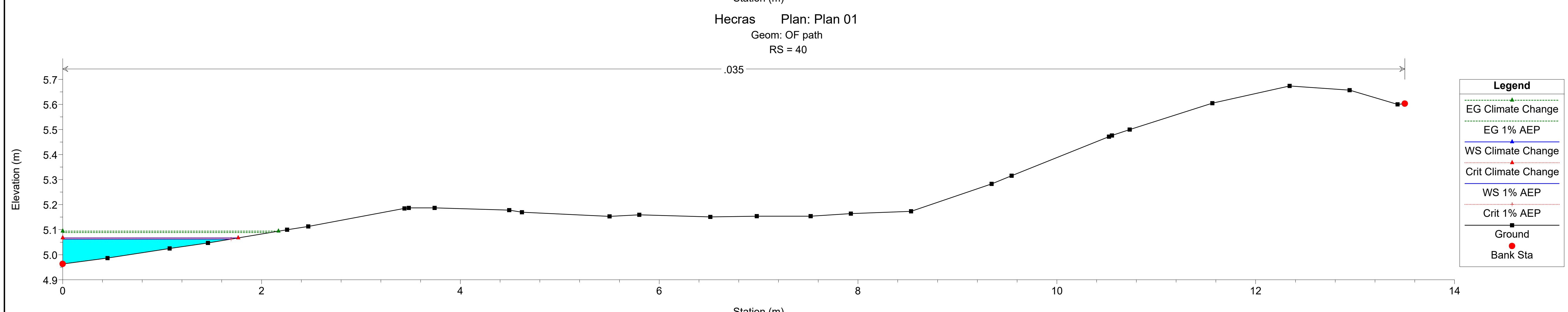
HECRAS Summary and Graphical Profiles For The First Overland Flow

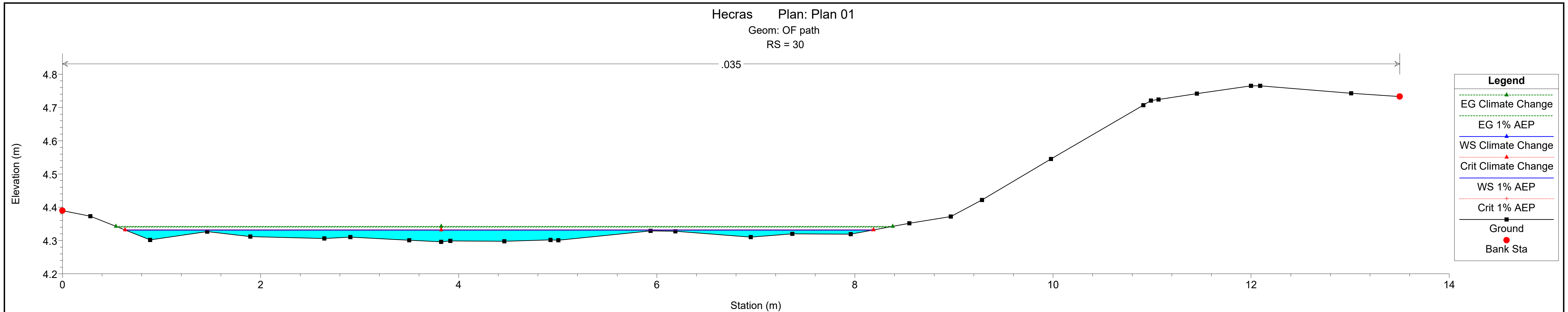
HEC-RAS Plan: 1 River: OF Flow Reach: CL-3

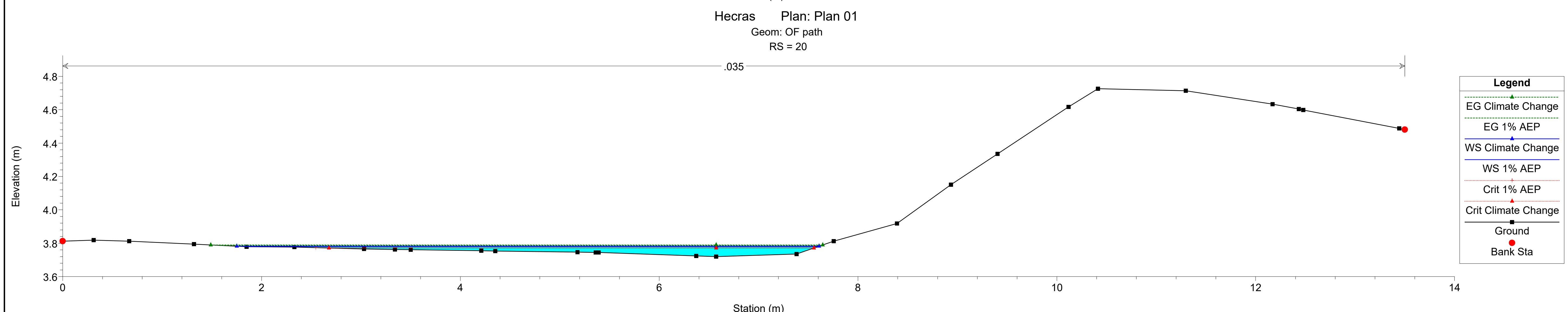
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
CL-3	52.37	1% AEP	0.06	5.51	5.71	5.71	5.74	0.038702	0.86	0.07	0.99	1.02
CL-3	52.37	Climate Change	0.07	5.51	5.71	5.71	5.75	0.038083	0.87	0.08	1.08	1.02
CL-3	50	1% AEP	0.06	5.11	5.29		5.30	0.014384	0.61	0.10	1.16	0.66
CL-3	50	Climate Change	0.07	5.11	5.29		5.31	0.015060	0.64	0.11	1.19	0.68
CL-3	40	1% AEP	0.06	4.96	5.06	5.06	5.09	0.035710	0.72	0.09	1.70	1.01
CL-3	40	Climate Change	0.07	4.96	5.07	5.07	5.09	0.034562	0.73	0.09	1.77	1.00
CL-3	30	1% AEP	0.06	4.30	4.33	4.33	4.34	0.045893	0.43	0.14	7.53	1.01
CL-3	30	Climate Change	0.07	4.30	4.33	4.33	4.34	0.048386	0.46	0.15	7.56	1.04
CL-3	20	1% AEP	0.06	3.72	3.78	3.77	3.79	0.018331	0.37	0.17	5.78	0.69
CL-3	20	Climate Change	0.07	3.72	3.78	3.77	3.79	0.018525	0.38	0.18	5.86	0.69
CL-3	10	1% AEP	0.06	3.51	3.57	3.56	3.58	0.022749	0.48	0.13	3.45	0.80
CL-3	10	Climate Change	0.07	3.51	3.58	3.57	3.59	0.022082	0.49	0.14	3.52	0.79
CL-3	0	1% AEP	0.06	3.21	3.26	3.26	3.27	0.044603	0.50	0.12	5.04	1.03
CL-3	0	Climate Change	0.07	3.21	3.26	3.26	3.27	0.047099	0.52	0.13	5.31	1.06

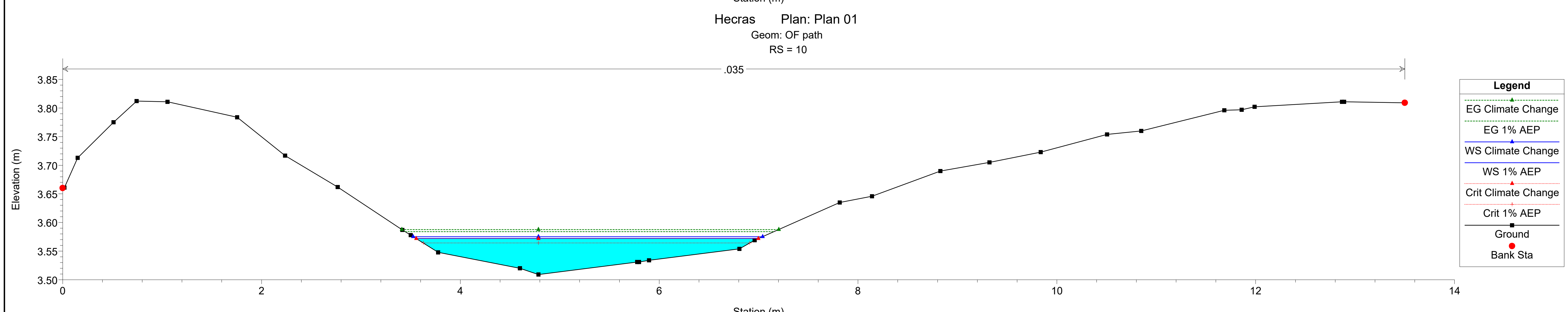

Hecras Plan: Plan 01
Geom: OF path
RS = 52.37
.035
Elevation (m)
Station (m)
Legend
EG Climate Change
EG 1% AEP
WS Climate Change
Crit Climate Change
WS 1% AEP
Crit 1% AEP
Ground
Bank Sta

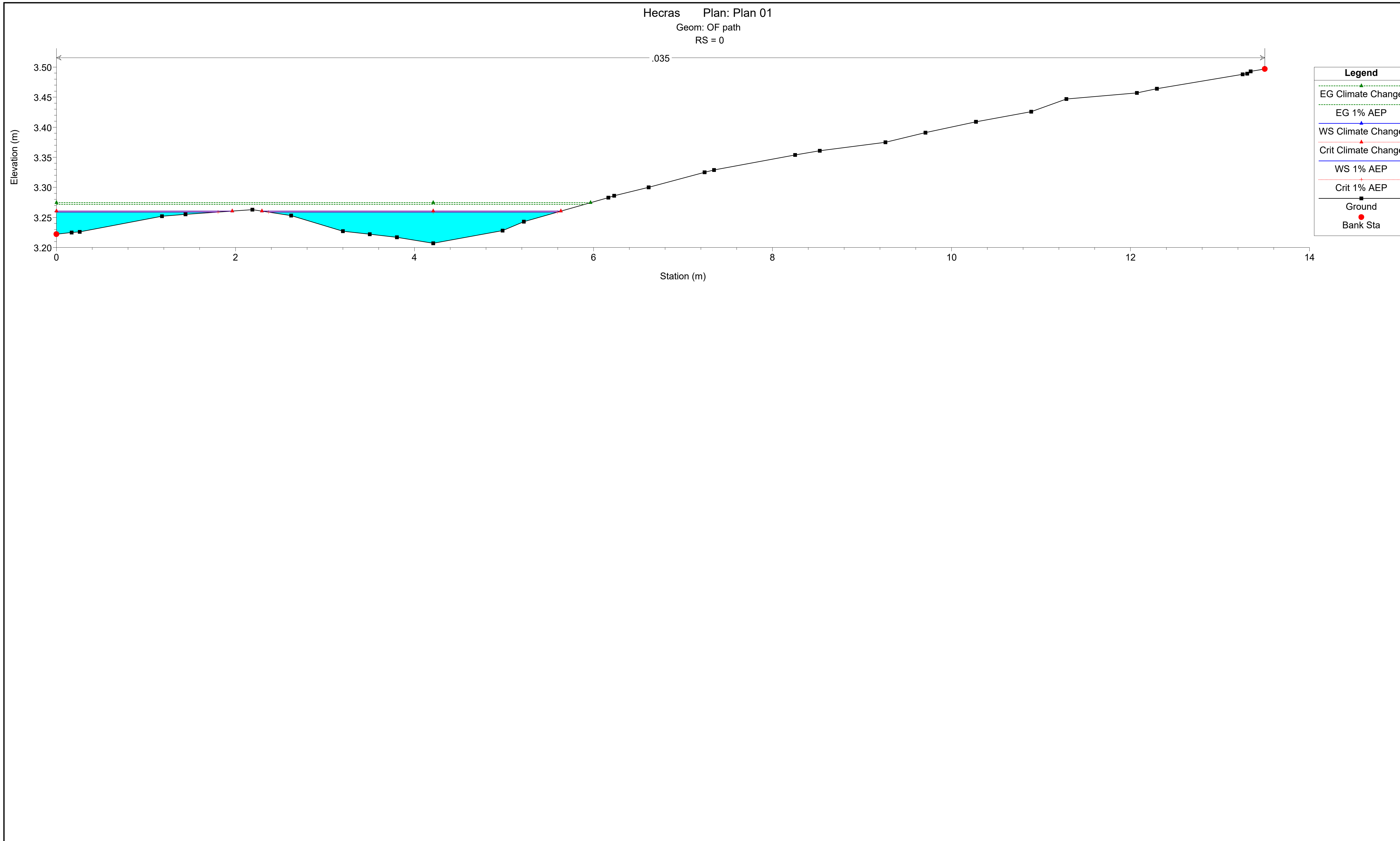

Hecras Plan: Plan 01
Geom: OF path
RS = 50
.035
Elevation (m)
Station (m)
Legend
EG Climate Change
EG 1% AEP
WS Climate Change
WS 1% AEP
Ground
Bank Sta


Hecras Plan: Plan 01
Geom: OF path
RS = 40
.035
Elevation (m)
Station (m)
Legend
EG Climate Change
EG 1% AEP
WS Climate Change
Crit Climate Change
WS 1% AEP
Crit 1% AEP
Ground
Bank Sta


Hecras Plan: Plan 01
Geom: OF path
RS = 30
.035
Elevation (m)
Station (m)
Legend
EG Climate Change
EG 1% AEP
WS Climate Change
Crit Climate Change
WS 1% AEP
Crit 1% AEP
Ground
Bank Sta


Hecras Plan: Plan 01
Geom: OF path
RS = 20
.035
Elevation (m)
Station (m)
Legend
EG Climate Change
EG 1% AEP
WS Climate Change
WS 1% AEP
Crit 1% AEP
Crit Climate Change
Ground
Bank Sta

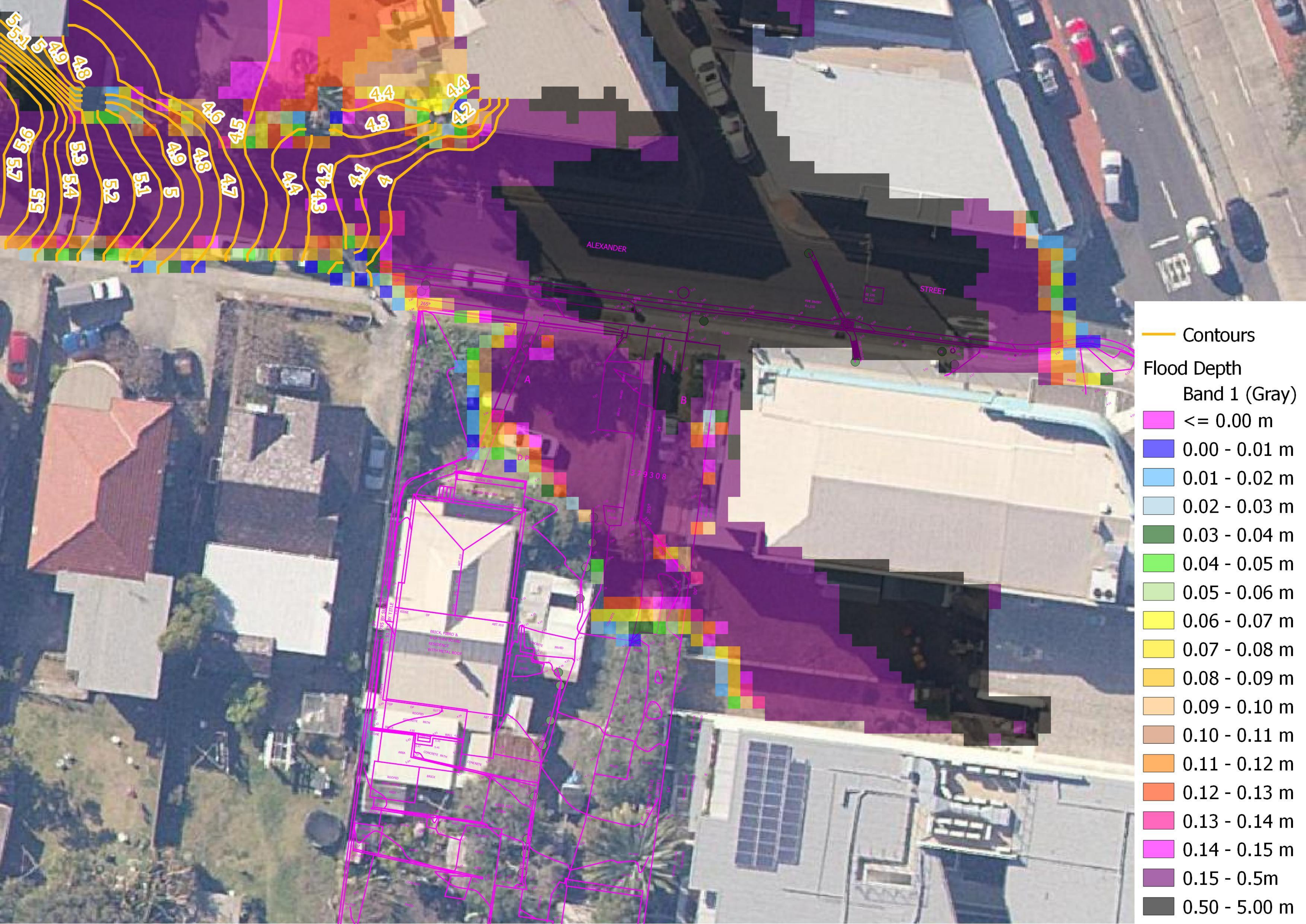

Hecras Plan: Plan 01
Geom: OF path
RS = 10
.035
Elevation (m)
Station (m)
Legend
EG Climate Change
EG 1% AEP
WS Climate Change
WS 1% AEP
Crit Climate Change
Crit 1% AEP
Ground
Bank Sta



Hecras Plan: Plan 01
Geom: OF path
RS = 0
.035
Elevation (m)
3.50
3.45
3.40
3.35
3.30
3.25
3.20
0
2
4
6
8
10
12
14
Station (m)
Legend
EG Climate Change
EG 1% AEP
WS Climate Change
Crit Climate Change
WS 1% AEP
Crit 1% AEP
Ground
Bank Sta

Appendix B

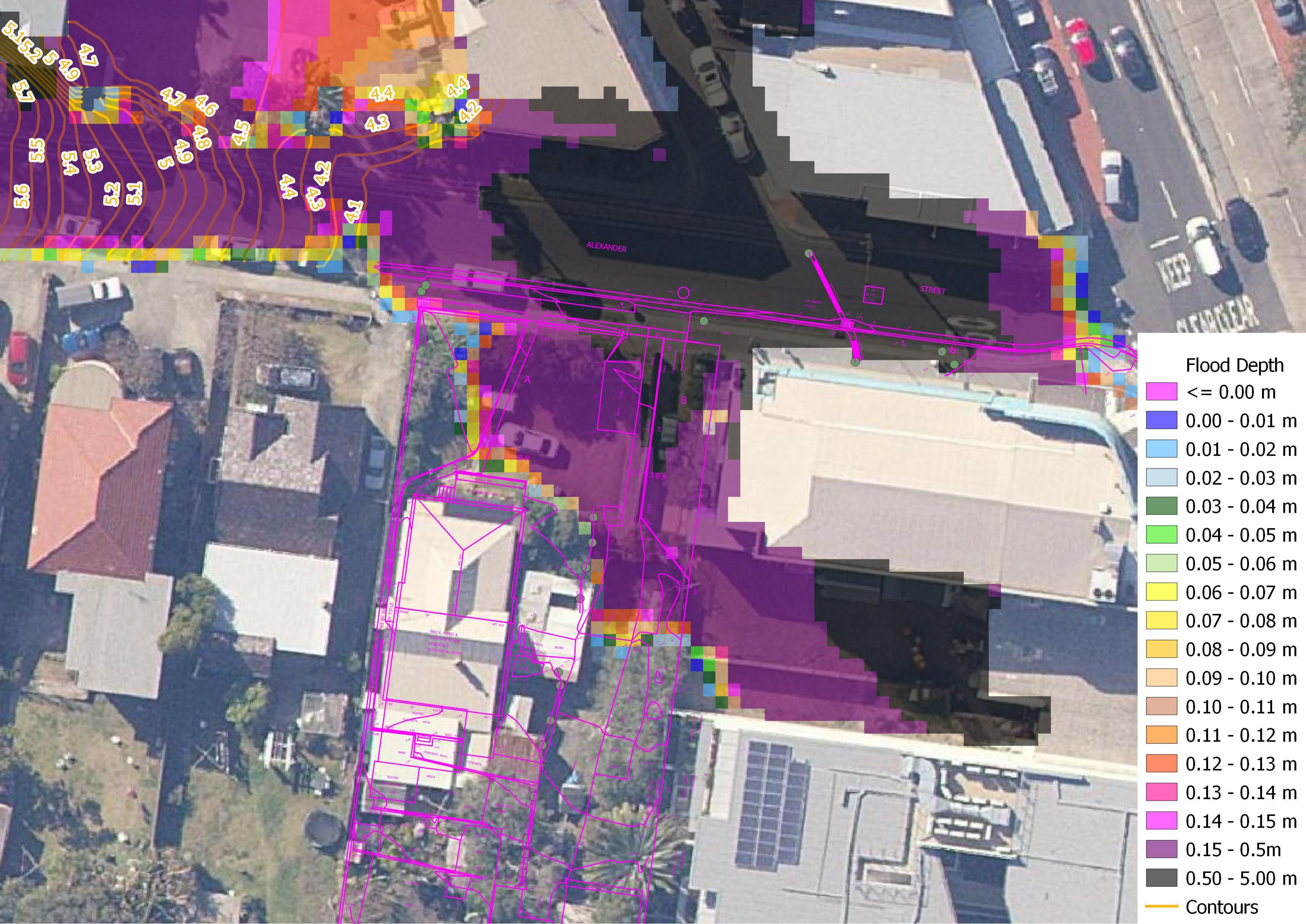
Existing Scenario – 1% AEP Flood Depth



ALEXANDER
STREET
Contours
Flood Depth
Band 1 (Gray)
<= 0.00 m
0.00 - 0.01 m
0.01 - 0.02 m
0.02 - 0.03 m
0.03 - 0.04 m
0.04 - 0.05 m
0.05 - 0.06 m
0.06 - 0.07 m
0.07 - 0.08 m
0.08 - 0.09 m
0.09 - 0.10 m
0.10 - 0.11 m
0.11 - 0.12 m
0.12 - 0.13 m
0.13 - 0.14 m
0.14 - 0.15 m
0.15 - 0.5m
0.50 - 5.00 m

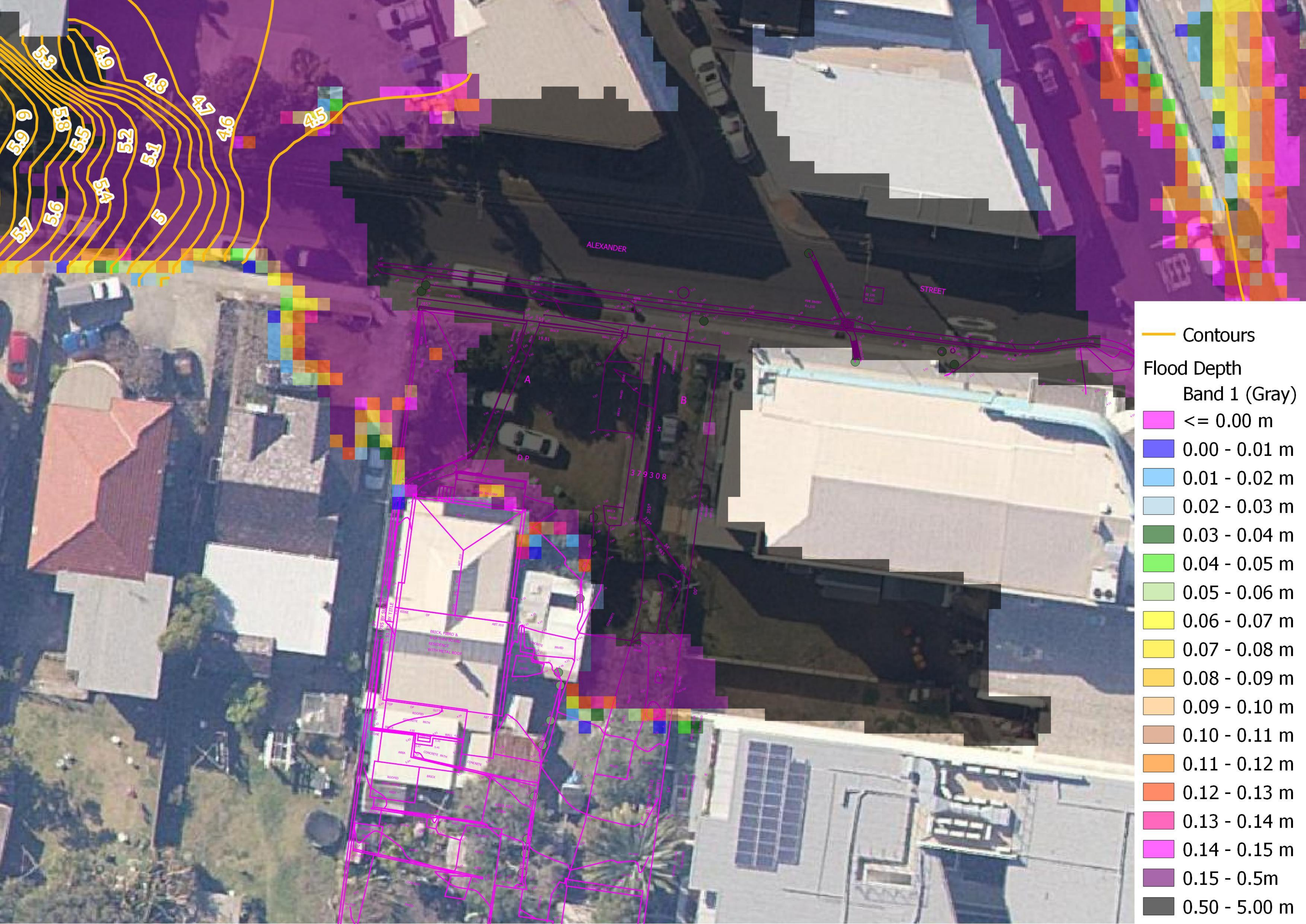
Appendix C

Existing Scenario – 1% AEP (With Climate Change Factors) Flood Depth


ALEXANDER
STREET
A
B
Flood Depth
<= 0.00 m
0.00 - 0.01 m
0.01 - 0.02 m
0.02 - 0.03 m
0.03 - 0.04 m
0.04 - 0.05 m
0.05 - 0.06 m
0.06 - 0.07 m
0.07 - 0.08 m
0.08 - 0.09 m
0.09 - 0.10 m
0.10 - 0.11 m
0.11 - 0.12 m
0.12 - 0.13 m
0.13 - 0.14 m
0.14 - 0.15 m
0.15 - 0.5m
0.50 - 5.00 m
Contours

Appendix D

Existing Scenario – PMF Flood Depth



5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
ALEXANDER
STREET
A
B
DP
379308
Contours
Flood Depth
Band 1 (Gray)
<= 0.00 m
0.00 - 0.01 m
0.01 - 0.02 m
0.02 - 0.03 m
0.03 - 0.04 m
0.04 - 0.05 m
0.05 - 0.06 m
0.06 - 0.07 m
0.07 - 0.08 m
0.08 - 0.09 m
0.09 - 0.10 m
0.10 - 0.11 m
0.11 - 0.12 m
0.12 - 0.13 m
0.13 - 0.14 m
0.14 - 0.15 m
0.15 - 0.5m
0.50 - 5.00 m

Appendix E

Proposed Scenario – 1% AEP Flood Depth


ALEXANDER STREET
VEHICLE CROSSING
Contours
Flood Depth
Band 1 (Gray)
<= 0.00 m
0.00 - 0.01 m
0.01 - 0.02 m
0.02 - 0.03 m
0.03 - 0.04 m
0.04 - 0.05 m
0.05 - 0.06 m
0.06 - 0.07 m
0.07 - 0.08 m
0.08 - 0.09 m
0.09 - 0.10 m
0.10 - 0.11 m
0.11 - 0.12 m
0.12 - 0.13 m
0.13 - 0.14 m
0.14 - 0.15 m
0.15 - 0.5m
0.50 - 5.00 m

Appendix F

Proposed Scenario – 1% AEP (With Climate Change Factors) Flood Depth


ALEXANDER STREET
Flood Depth
<= 0.00 m
0.00 - 0.01 m
0.01 - 0.02 m
0.02 - 0.03 m
0.03 - 0.04 m
0.04 - 0.05 m
0.05 - 0.06 m
0.06 - 0.07 m
0.07 - 0.08 m
0.08 - 0.09 m
0.09 - 0.10 m
0.10 - 0.11 m
0.11 - 0.12 m
0.12 - 0.13 m
0.13 - 0.14 m
0.14 - 0.15 m
0.15 - 0.5m
0.50 - 5.00 m
Contours

Appendix G

Proposed Scenario – PMF Flood Depth

Contours
Flood Depth
Band 1 (Gray)
<= 0.00 m
0.00 - 0.01 m
0.01 - 0.02 m
0.02 - 0.03 m
0.03 - 0.04 m
0.04 - 0.05 m
0.05 - 0.06 m
0.06 - 0.07 m
0.07 - 0.08 m
0.08 - 0.09 m
0.09 - 0.10 m
0.10 - 0.11 m
0.11 - 0.12 m
0.12 - 0.13 m
0.13 - 0.14 m
0.14 - 0.15 m
0.15 - 0.5m
0.50 - 5.00 m