Review of Environmental Factors

The Cooks to Cove GreenWay (In-Corridor Works)

Appendix D: Flood Impact Assessment (WMA Water, 2020)

June 2021

eco logical AUSTRALIA
A TETRA TECH COMPANY

1300 646 131
www.ecoaus.com.au

Memorandum

TO: Ryan Hawken
FROM: Erin Askew
DATE: 2 April 2020
SUBJECT: Flood Impact Assessment, The Greenway Shared Path – Missing Links F to J (Old Canterbury Rd to Parramatta Rd, Summer Hill)
PROJECT NUMBER: 111054_16

1. INTRODUCTION

Inner West Council in collaboration with several other organisations are seeking to construct the missing links F to J (Old Canterbury Road to Parramatta Road) of The Greenway Shared Path.

The proposed route runs parallel to and traverses a section of the Hawthorne Canal. Sections are located to the west of and parallel to the open channel from Lewisham West Light Rail stop to upstream of Parramatta Road. This section includes a tunnel through the embankment of Longport Street. At Parramatta Road the route crosses the open channel to be aligned with the eastern bank to join with the existing shared path. Underneath Parramatta Road, the proposed route is to be constructed on a platform that in times of floods is designed to float upwards. Two options have been considered to support this structure; piers or suspended and cantilevered.

Upstream of the Lewisham West Light Rail stop, the path travels within the rail corridor (along the west side) and via a proposed tunnel through the Old Canterbury Road embankment to a lane off Weston Street.

2. METHODOLOGY

The hydrologic model used in the Hawthorne Canal Floodplain and Risk Management Study and Plan (2019) to define existing design flood flows was used in the current assessment with no further refinement. The hydrologic modelling software used was DRAINS.

The hydraulic model used in the FRMS to define existing design flood levels and behaviour was refined for the purpose of the current assessment. The FRMS used a TUFLOW 1D/2D hydraulic model. The terrain was defined by a 2 m grid resolution and the 1D had an average channel length of 22 m. The existing TUFLOW model was refined in the 1D domain to:

- Update the cross section defining the existing pedestrian bridge across the channel 80 m north of Longport Street,
- Include the steel beam and water supply pipe located approximately 4 m upstream of the Parramatta Road Bridge (shown in Figure 3). The afflux across this structure was verified against a HEC-RAS hydraulic model.

Under the proposed scenario the following modifications were made to the TUFLOW model to represent this section of the shared path:

- the 500 mm diameter pipe across the channel just south of Parramatta Road was relocated further south and the invert adjusted to 3.0 m AHD;
- the existing minor pedestrian bridge across the channel, 80 m north of Longport Street was removed and replaced with a new bridge 10 m further south with a higher obvert (4.8 m AHD); and
- the shared path through the Longport Street and Old Canterbury Road embankments are represented as 1D culverts, located to the east of the Hawthorne Canal, with an upstream invert level of 10.05 m AHD and 13.67 m AHD, respectively.

At Parramatta Road where the shared path crosses the open channel, two alternative structures are being considered to support the shared path, piers or a cantilever structure. The following describes how the alternatives have been incorporated into the TUFLOW model:

Option 1 – Piers:

- a hydraulic loss of 0.03 was applied to the 1D channel section to represent the piers supporting the floating ponton. The loss was applied for 60m upstream and downstream of the structure.

Option 2 – Suspended Structure:

- in order to represent the cantilevered structure, the 1D culvert at the Parramatta Road Bridge has been reduced in width above 2.50 m AHD.

The FRMS and the current assessment were conducted in accordance with methodology recommended in Australian Rainfall and Runoff (AR&R, Reference 2) and guideline documents produced as part of the AR&R 2019 revision (Reference 3).

The base case defined in the FRMS and for the current assessment includes no blockage (0%) of pipes and culverts or in the open channel. In order to understand the sensitivity of the changes in flood behaviour as a result of the two scenarios, described above, to varying degrees of blockage, impacts have also been determined under a 50% blockage scenario.

3. FLOOD BEHAVIOUR

The Old Canterbury Road embankment has two paths of conveyance through it. The first is through a culvert attached to the open channel network, with a cross sectional area of approximately 4.5 m^2. The second is through the railway underpass parallel to and located to the west of the open channel.

Upstream of the Old Canterbury Road embankment, the existing culvert has an invert elevation of 7.8 m AHD and the railway underpass has an elevation of approximately 12.8 m AHD. Therefore, flow that cannot be immediately conveyed through the culvert does not redirect through the light rail underpass until flood levels reach 12.8 m AHD.

Similarly. the Longport Street embankment has two paths of conveyance through it. The primary path of conveyance is through a culvert attached to the open channel network, with a cross-sectional area of approximately 11.6 m^2. The secondary path of conveyance is through the light rail underpass parallel to and located to the east of the open channel.

Upstream of the Longport Street embankment, the existing culvert has an invert elevation of 2.37 m AHD and the light rail track has an elevation of approximately 9.5 m AHD. Therefore, flow that cannot be immediately conveyed through the culvert does not redirect through the light rail underpass until flood levels reach 9.5 m AHD.

Where the open channel crosses Parramatta Road there are two hydraulic control structures. The first occurs approximately 4 m upstream of the road bridge in the form of a steel beam and water supply pipe crossing perpendicular to the open channel. The underside of the steel beam was 2.51 m AHD and the obvert height of the pipe was 3.54 m AHD. The second is the road bridge that has an underside height of 5.2 m AHD (taken from the underside of steel beams supporting services under the Parramatta Road Bridge). The structure 4 m upstream of Parramatta Road is the primary control structure at this location, with peak flood levels upstream of 3.23 m AHD and downstream of 3.17 m AHD for the 1% AEP, 2.79 m AHD upstream and 2.71 m AHD downstream for the 5% AEP, 2.37 m AHD upstream and 2.30 m AHD downstream for the 20% AEP.

4. FLOOD IMPACT

The following sections describe the changes in flood behaviour as a result of the proposed works and alternatives being considered. Table 1 provides an overview of the changes in peak flood level for the 1% AEP, 5% AEP and 20% AEP events.

Table 1 – Peak Flood Level Comparison (1% AEP, 5% AEP and 20% AEP events)

	1% AEP Peak Flood Level (mAHD)			5% AEP Peak Flood Level (mAHD)			20% AEP Peak Flood Level (mAHD)		
Location	**Existing**	**Option 1**	**Option 2**	**Existing**	**Option 1**	**Option 2**	**Existing**	**Option 1**	**Option 2**
20m North of Parramatta Road	3.16	3.17	3.16	2.69	2.70	2.69	2.28	2.29	2.28
5m South of Parramatta Road	3.21	3.26	3.21	2.78	2.81	2.78	2.36	2.39	2.36
20m South of Parramatta Road	3.31	3.33	3.26	2.81	2.83	2.79	2.40	2.41	2.38
100m South of Parramatta Road	3.36	3.41	3.31	2.89	2.96	2.89	2.47	2.52	2.46
Gadigal Reserve Pedestrian Bridge	4.86	4.79	4.79	4.56	4.56	4.56	4.18	4.18	4.18

4.1. Option 1

At Old Canterbury Road the upstream invert of the proposed shared path culvert has a higher elevation than the 1% AEP peak flood level (13.67 m AHD and 13.63 m AHD, respectively) and therefore a higher elevation than the 5% and 20% AEP peaks. As such, the shared path culvert was found to carry no flow during the 1% AEP, 5% AEP and 20% AEP events and resulted in no flood level impact.

At Longport Street the upstream invert of the shared path culvert has a higher elevation than the 1% AEP peak flood level (8.97 m AHD and 7.03 m AHD, respectively) and therefore a higher elevation than the 5% and 20% AEP peaks. As such, the shared path culvert was found to carry no flow during the 1% AEP, 5% AEP and 20% AEP events and resulted in no flood level impact.

The replacement of the pedestrian bridge 80 m north of Longport Street reduced flood levels by up to 0.07 m, extending upstream to Longport Street for the 1% AEP event (no change in flood behaviour occurred in the 5% AEP and 20% AEP events).

The piers supporting the shared path in the vicinity of Parramatta Road cause an increase in peak flood level of up to 0.05 m in the 1% AEP, 0.04 m in the 5% AEP and no impact in the 20% AEP. The impact in the 1% and 5% AEP events extends for 30m upstream of the design pedestrian bridge. This increase is of minimal consequence as property is elevated relative to channel flood levels and as such the impact on property flood affectation is nil.

At the Parramatta Road Bridge, the moving of the 500 mm pipe was found to result in a peak flood level reduction of 0.03 m just upstream of the existing pipe in the 1% AEP event (no change in the 5% AEP and 20% AEP).

The structure below Parramatta Road is designed to float. Sydney Water have previously provided in principle support for the concept (refer to letter attached). If it were the case that the shared path was not suspended or did not have the capacity to float, the constriction to the bridge width would be greater and this would likely result in higher flood level impacts.

4.2. Option 2

At Old Canterbury Road the upstream invert of the proposed shared path culvert has a higher elevation than the 1% AEP peak flood level (13.67 m AHD and 13.63 m AHD, respectively) and therefore a higher elevation than the 5% and 20% AEP peaks. As such, the shared path culvert was found to carry no flow during the 1% AEP, 5% AEP and 20% AEP events and resulted in no flood level impact.

At Longport Street the upstream invert of the shared path culvert has a higher elevation than the 1% AEP peak flood level (8.97 m AHD and 7.03 m AHD, respectively) and therefore a higher elevation than the 5% and 20% AEP peaks. As such, the shared path culvert was found to carry no flow during the 1% AEP, 5% AEP and 20% AEP events and resulted in no flood level impact.

The replacement of the pedestrian bridge 80 m north of Longport Street reduced flood levels by up to 0.08 m, extending upstream to Longport Street for the 1% AEP event (no change in flood behaviour occurred in the 5% AEP and 20% AEP events).

The moving of the 500 mm pipe at Parramatta Road was found to result in a decrease in peak flood level by up to 0.07 m just upstream of the bridge for the 1 % AEP (no significant impact for the 5% AEP and 20% AEP). A decrease in flood level between 0.02 m and 0.07 m was observed all along the channel section between Longport Street and Parramatta Road.

At the Parramatta Road Bridge, the shared path structure was found to increase peak flood levels by less than 0.01 m in the 1% AEP, 5% AEP and 20% AEP events. This was due to the existing water supply structure located 4 m upstream of the road bridge controlling flood behaviour in this location and the relatively small constriction to the bridge width formed by the poles used to suspend the shared path (in the order of 0.2 m relative to a 9 m bridge width).

The structure below Parramatta Road is designed to float. Sydney Water have previously provided in principle support for the concept (refer to letter attached). If it were the case that the shared path was not suspended or did not have the capacity to float, the constriction to the bridge width would be greater and this would likely result in higher flood level impacts.

5. SENSITIVITY TO BLOCKAGE

5.1. Background

Blockage of hydraulic structures can occur with the transportation of materials by flood waters. This can include vegetation, garbage bins, building materials and cars, the latter of which has been seen post-flood in Newcastle. However, the variety of materials that may be mobilised within a catchment can vary greatly.

Debris availability and mobility can be influenced by factors such as channel shear stress, height of floodwaters, severity of winds, storm duration and seasonal factors relating to vegetation. The channel shear stress and height of floodwaters that influence the initial dislodgment of blockage materials are also related to the average exceedance probability (AEP) of the event. Storm duration is another influencing factor, with the mobilisation of blockage materials generally increasing with increasing storm duration (Barthelmess and Rigby 2009, cited in Engineers Australia 2013).

The potential effects of blockage include:

- decreased conveyance of flood waters through the blocked hydraulic structure or drainage system;
- variation in peak flood levels;
- variation in flood extent due to flows diverting into adjoining flow paths; and
- overtopping of hydraulic structures.

5.2. Analysis

Comparison of the existing scenario with no blockage against the existing scenario with 50% blockage of the open channel culverts found that the peak flood level increased upstream and decreased downstream of the blocked structure, such that:

- Blockage of the Old Canterbury Road culvert resulted in decreased flood levels at an unblocked Longport Street and an unblocked Parramatta Road culvert;
- Blockage of the Longport Street culvert resulted in increased flood levels at an unblocked Old Canterbury Road and decreased flood levels at an unblocked Parramatta Road culvert; and
- Blockage of the Parramatta Road Bridge resulted in increased flood levels up to the downstream edge of the Longport Street culvert.

Comparison of the Option 1 scenario with 50% blockage of the open channel culvert against the proposed scenario with 50% blockage of the open channel culvert through the individual road embankments analysed found that the flood behaviour was affected such that:

- At the Old Canterbury Road open channel culvert (with no blockage of the light rail underpass and proposed shared path culvert) the resulting flood level impact was negligible. This was due to the light rail culvert having an invert lower than the shared path culvert, therefore resulting in flows redirecting through the light rail culvert in both the existing and proposed scenarios.
- At the Longport Street open channel culvert (with no blockage of the light rail underpass and proposed shared path culvert) the resulting flood level impact of this scenario was decreased flood levels upstream and downstream of Longport Street. This was due to the higher obvert of the new pedestrian bridge in the proposed scenario. The proposed shared path culvert invert was above peak flood level in both existing and proposed scenario and thus had no impact on flood levels.

- At the Parramatta Road open channel bridge the resulting flood level impact was limited to +0.03 m under the bridge and +0.02 m on the immediate downstream. This was due to the losses created by the shared path piers.

Comparison of the Option 2 scenario with 50% blockage of the open channel culvert against the proposed scenario with 50% blockage of the open channel culvert through the individual road embankments analysed found that the flood behaviour was affected such that:

- At the Old Canterbury Road open channel culvert (with no blockage of the light rail underpass and proposed shared path culvert) the resulting flood level impact was negligible. This was due to the light rail culvert having an invert lower than the shared path culvert, therefore resulting in flows redirecting through the light rail culvert in both the existing and proposed scenarios.
- At the Longport Street open channel culvert (with no blockage of the light rail underpass and proposed shared path culvert) the resulting flood level impact of this scenario was decreased flood levels upstream and downstream of Longport Street. This was due to the higher invert of the new pedestrian bridge in the proposed scenario.
- At the Parramatta Road open channel bridge the resulting flood level impact of this scenario was decreased flood levels upstream and no impact downstream of the bridge. This was due to the moved pipe just upstream of the bridge.

The proposed shared path culverts through the embankments at Old Canterbury Road and Longport Street do not increase the probability of blockage of the existing open channel culverts as they are not within the open channel area and do not provide conveyance during the 1% AEP event. The proposed shared path underneath the Parramatta Road Bridge does slightly increase the probability of blockage both for Option 1 and Option 2 although this is largely mitigated by the floating nature of the structure. In any case, even with severe blockage (assume 50%) the impact on upstream levels is less than 0.1 m and this is within the channel. Adjacent property is raised well above channel flood levels and so remains unaffected.

6. CONCLUSIONS

The proposed shared path includes:

- the relocation of a 500mm pipe just south of Paramatta Road,
- the relocation and replacement of the pedestrian bridge at Longport Street,
- culverts through the embankments at Longport Street and Old Canterbury Road, and
- two alternative support structures for the crossing of the channel at Parramatta Road (referred to as Option 1 and Option 2 and described above in Section 2)

The culverts through the existing embankments at Longport Street and Old Canterbury Road result in no impact of flood behaviour in the events assessed as the culverts sit above the 1% AEP flood level. The replacement of the pedestrian bridge 80 m north of Longport Street decreased flood levels by up to 0.07 m under Option 1 and by slightly more at 0.08m under Option 2 in the 1% AEP event. This element did not impact on the 20% AEP and 5% AEP events.

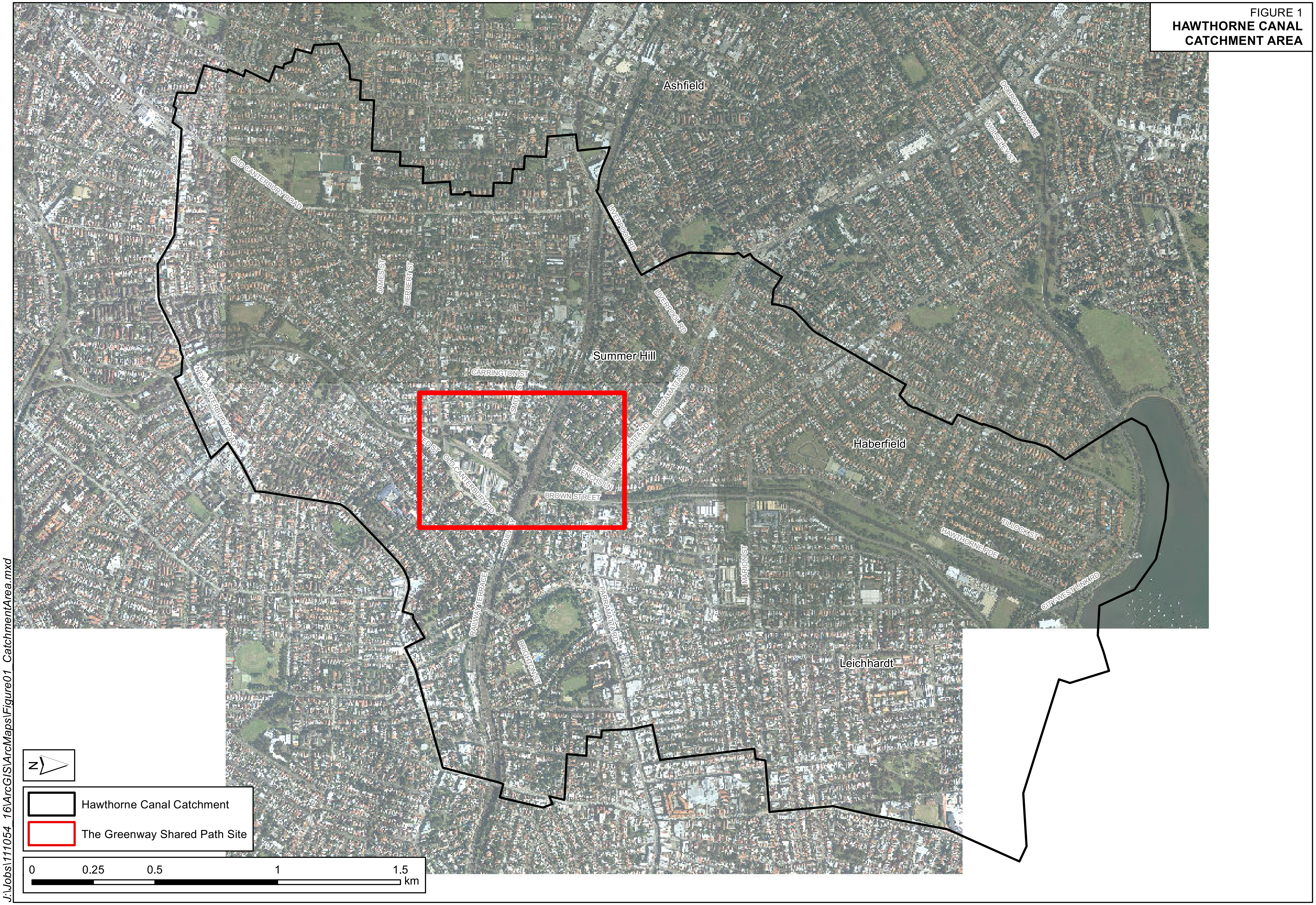
The relocation of the 500mm pipe was shown to slightly decrease flood levels in the 1% AEP event under both Options, 0.03m and 0.07m, for Options 1 and 2, respectively. The extent of this minor flood level reduction was more significant under Option 2, extending from Longport Street to Parramatta Road. Under Option 1 the benefit is offset by the negative impacts as a result of the piers.

Under Option 1, there is an increase in peak flood levels of up to 0.05m in the 1% AEP event associated with the proposed piers. This impact reduces to 0.04m and 0.0m in the 5% AEP and 20% AEP events, respectively. In comparison the relatively minor obstruction presented by the cantilever structure under Option 2 increases flood levels by less than 0.01m and to a lesser extent in the 1% AEP, 5% AEP and 20% AEP events.

7. REFERENCES

1. WMAwater, **DRAFT HAWTHORNE CANAL FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN**, prepared for Inner West Council, August 2019.
2. Pilgrim DH (Editor in Chief), **Australian Rainfall and Runoff – A Guide to Flood Estimation**, Institution of Engineers, Australia, 1987.
3. Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) **Australian Rainfall and Runoff: A Guide to Flood Estimation**, © Commonwealth of Australia (Geoscience Australia), 2019.

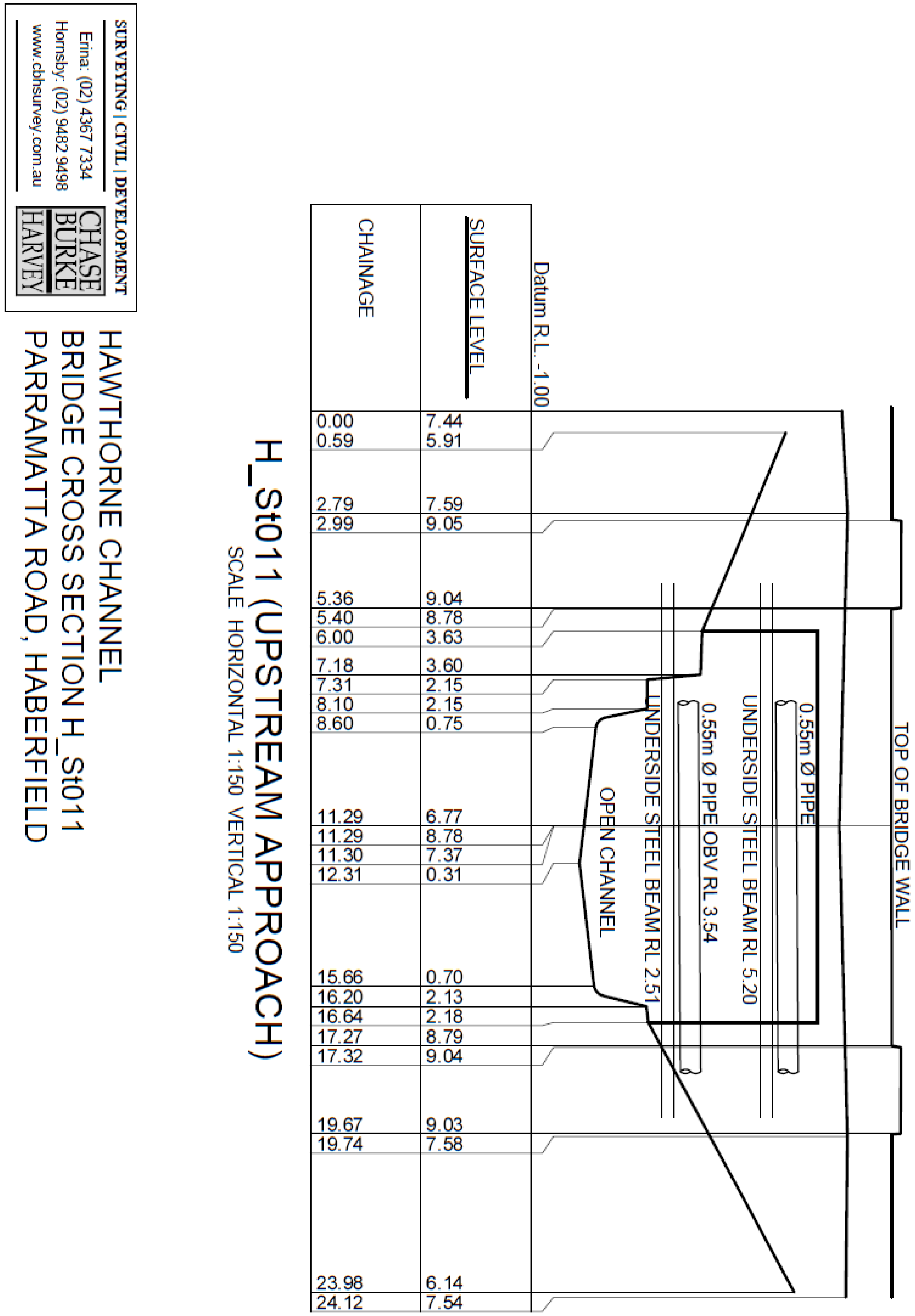
FIGURE 1
HAWTHORNE CANAL CATCHMENT AREA



J:\Jobs\111054_16\ArcGIS\ArcMaps\Figure01_CatchmentArea.mxd

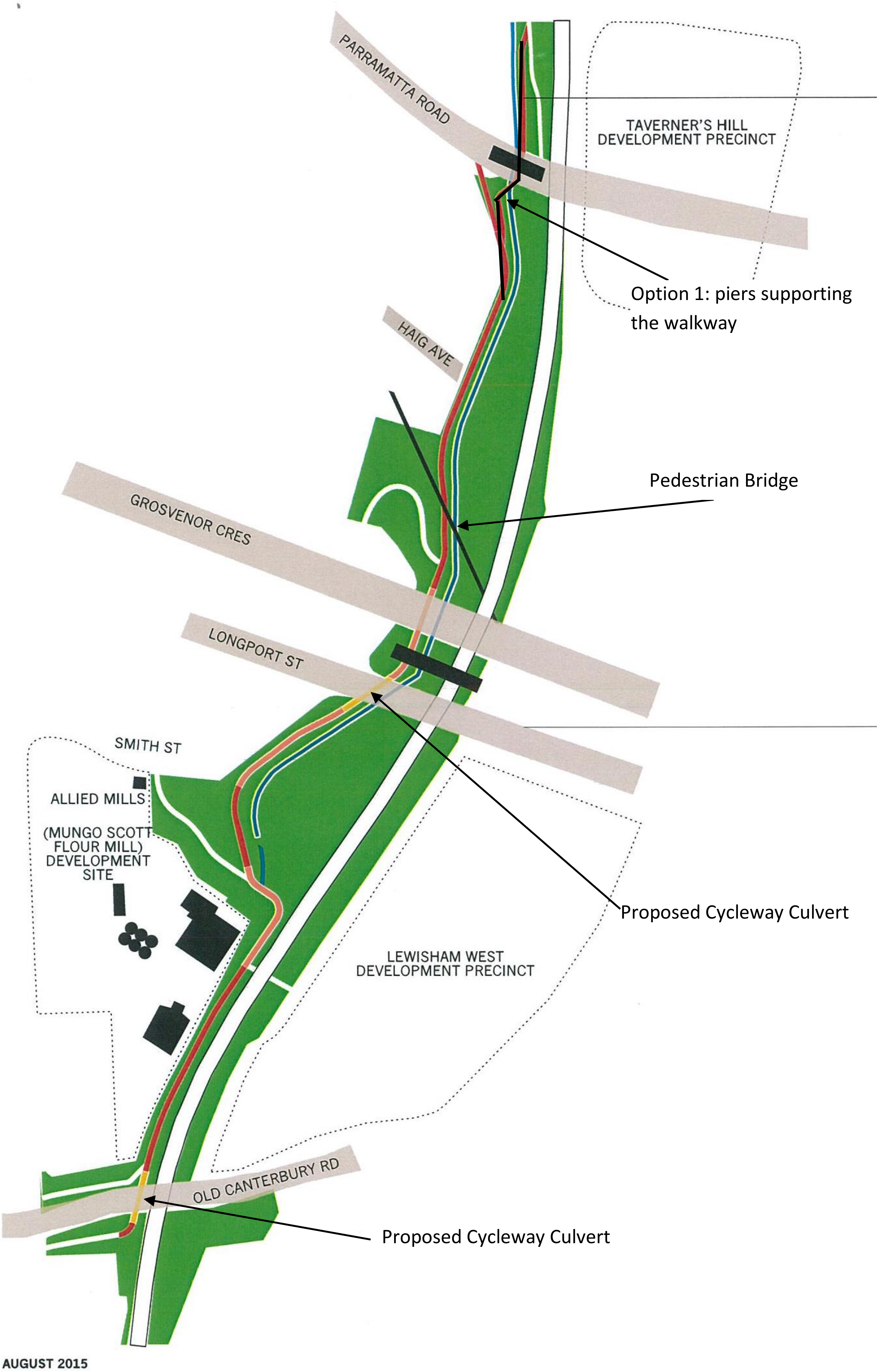

FIGURE 2
THE GREENWAY
SHARED PATH SITE
SPENCER ST
SPENCER ST
FLEET ST
BOGAN ST
KENSINGTON RD
GROSVENOR CRES
CARLTON CRES
SMITH ST
WELLESLEY ST
EDWARD ST
EDWARD ST
CHAPMAN ST
SMITH ST
DOVER ST
KENSINGTON RD
CARLTON CRES
FRED STREET
GROSVENOR CRES
DOVER ST
PARRAMATTA RD
HAIG AVE
OLD CANTERBURY ROAD
TOOTHILL STREET
LONGPORT STREET
BROWN STREET
HENRY STREET
ST JOHN STREET
N
Culverts / Bridges (SWC)
Open Channel (SWC)
Pipes (SWC)
Pipes (Ashfield Council)
Pipes (Marrickville Council)
0
50
100
200
m
J:\Jobs\111054_16\ArcGIS\ArcMaps\Figure02_Greenway_Shared_Path_Site.mxd

FIGURE 3
EXISTING CONDITIONS



J:\Jobs\111054_16\ArcGIS\ArcMaps\Figure03_Existing_Conditions.docx

FIGURE 4
PROPOSED CONDITIONS



J:\Jobs\111054_16\ArcGIS\ArcMaps\Figure04_Proposed_Conditions.docx

FIGURE 5

PEAK FLOOD LEVEL PROFILES

EXISTING SCENARIO

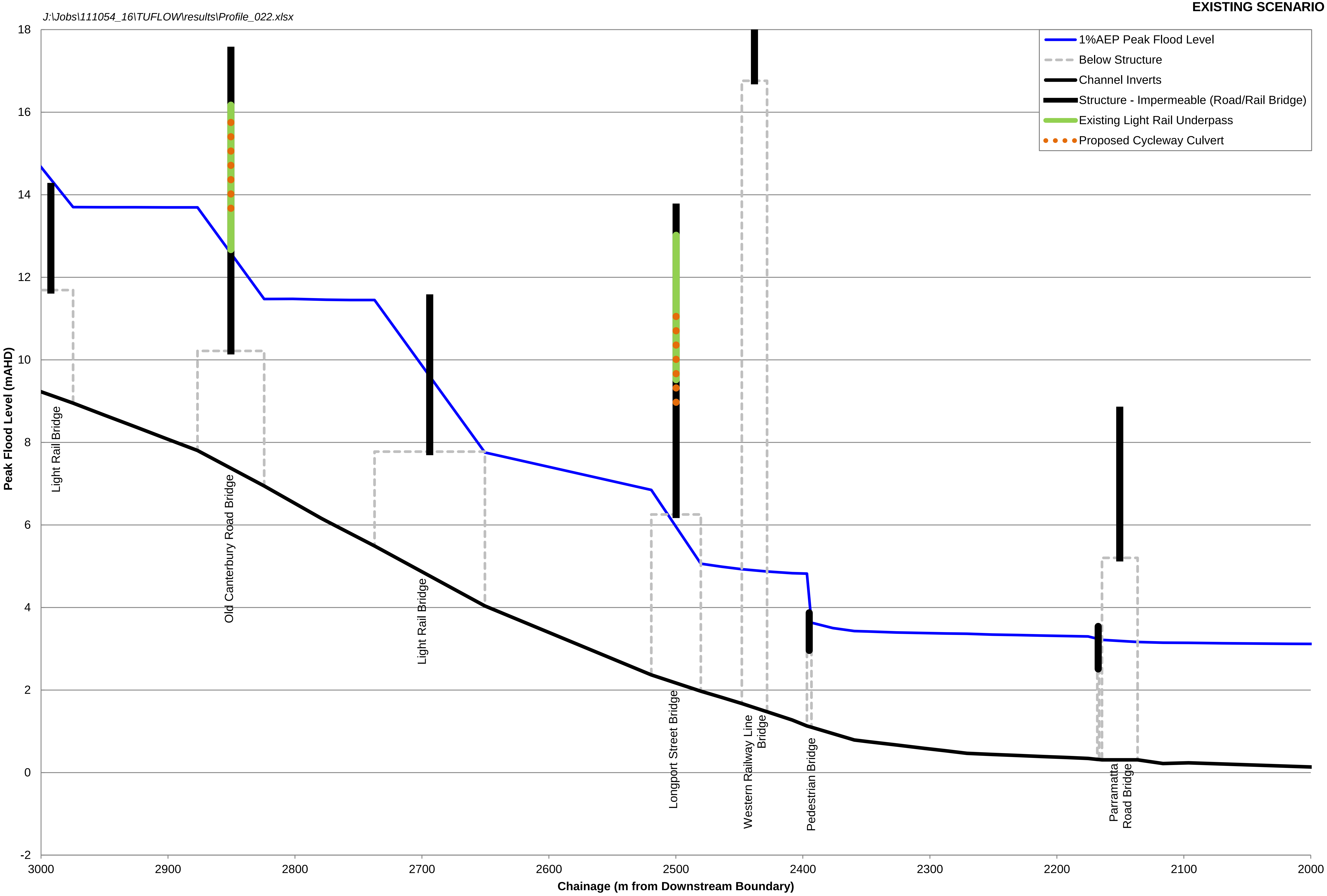
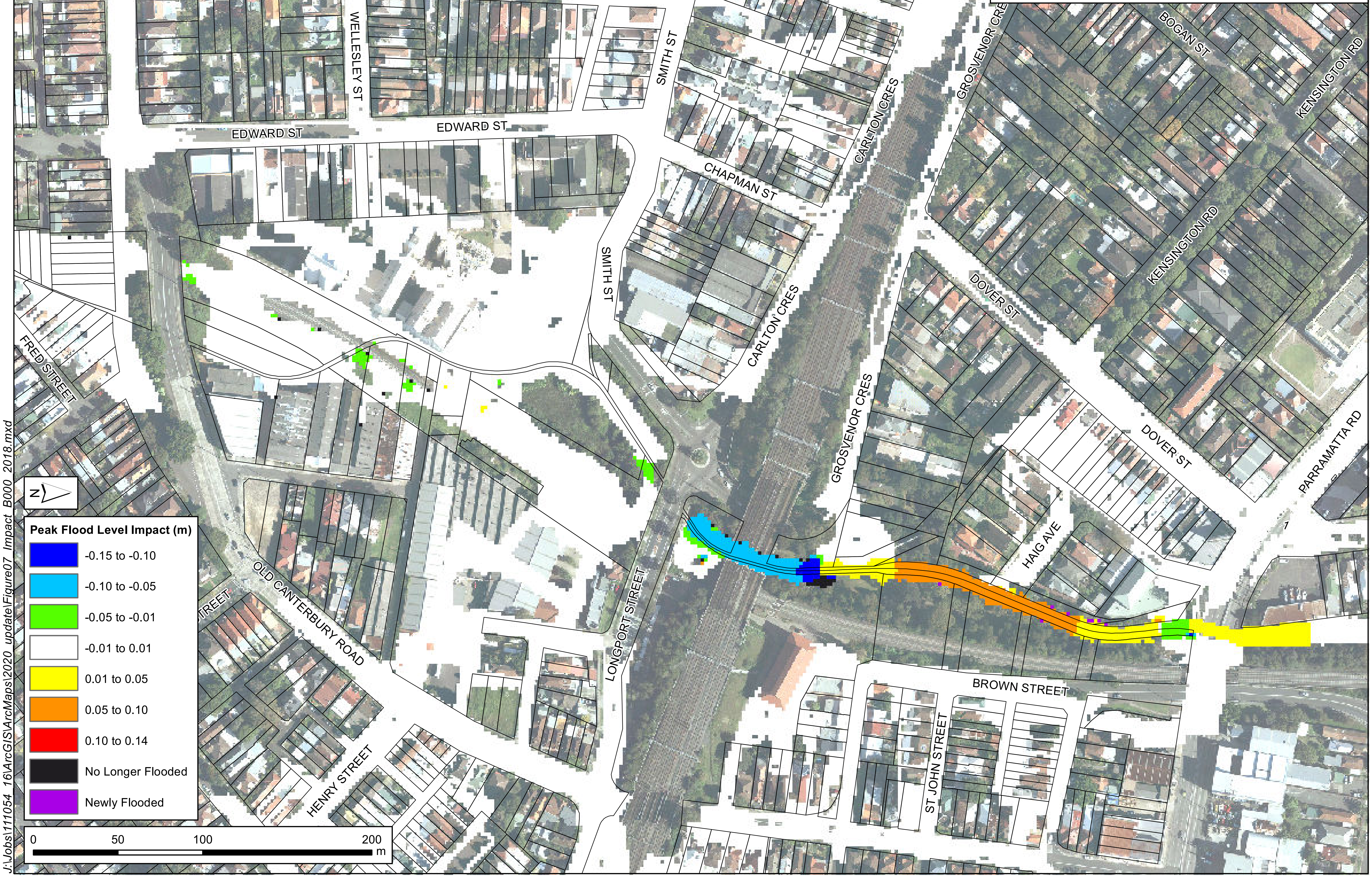


FIGURE 6
1% AEP PEAK FLOOD DEPTHS AND FLOOD LEVEL CONTOURS EXISTING CONDITIONS

J:\Jobs\111054_16\ArcGIS\ArcMaps\2020_update\Figure06_Depth_Existing_2018.mxd

FIGURE 7

1% AEP PEAK FLOOD LEVEL IMPACT DUE TO THE PROPOSED CULVERTS/BRIDGE - OPTION 1 WITH NO BLOCKAGE



J:\Jobs\111054 16\ArcGIS\ArcMaps\2020 update\Figure07 Impact B000 2018.mxd

FIGURE 8
1% AEP PEAK FLOOD LEVEL IMPACT DUE TO THE PROPOSED CULVERTS/BRIDGE - OPTION 2 WITH NO BLOCKAGE

J:\Jobs\111054_16\ArcGIS\ArcMaps\2020_update\Figure08_Impact_B000_Option2.mxd