Park Avenue, Waitara Redevelopment

Final Report - Flood Assessment

On behalf of Statewide Planning

October 2021

Park Avenue, Waitara Redevelopment – Flood Assessment

Final Report

Project:	Park Avenue Waitara Redevelopment – Flood Assessment
Project Number:	180010
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Date	Version	Description
19-Apr-2018	1	Initial Assessment
07-Nov-2018	1	Design Revision 1 - Final Report
29-Nov-2019	2	Design Revision 2 - Final Report
03-Dec-2020	3	Design Revision 3 - Final Report
03-Mar - 2021	4	Design Revision 4 - Final Report
25-Mar - 2021	5	Design Revision 5 - Final Report
26-Oct- 2021	6	Update Architectural plans

Filepath: J:\180010\Admin\Report_Rev102021\ParkAve_Flood_Study_October2021_v6_ndp.docx
Cover Image: Google StreetView

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Contents

1. Introduction

GRC Hydro have been engaged by Statewide Planning to undertake a flood study for proposed development at 22 – 32 Park Avenue, Waitara (the subject site), opposite Mark Taylor Oval. The site is currently zoned as High Density Residential (R4) and the locality is host to several similar residential developments. Figure 1 presents the site's locality.

Figure 1: Subject Site

This flood study has been carried out using the 2D hydrodynamic modelling program, TUFLOW.

The subject site lies at the downstream end of a 25-hectare local overland flow catchment to the east. The headwaters of the catchment area upstream of the subject site begin in the vicinity of Ingalara Avenue. Much of this catchment drains into a man-made basin at the Mark Taylor Tennis Courts. Ultimately the subject site drains into Hornsby Creek (approximately 1.1 km downstream of the site). Hornsby Creek flows in a north easterly direction and is a tributary of Cockle Creek.

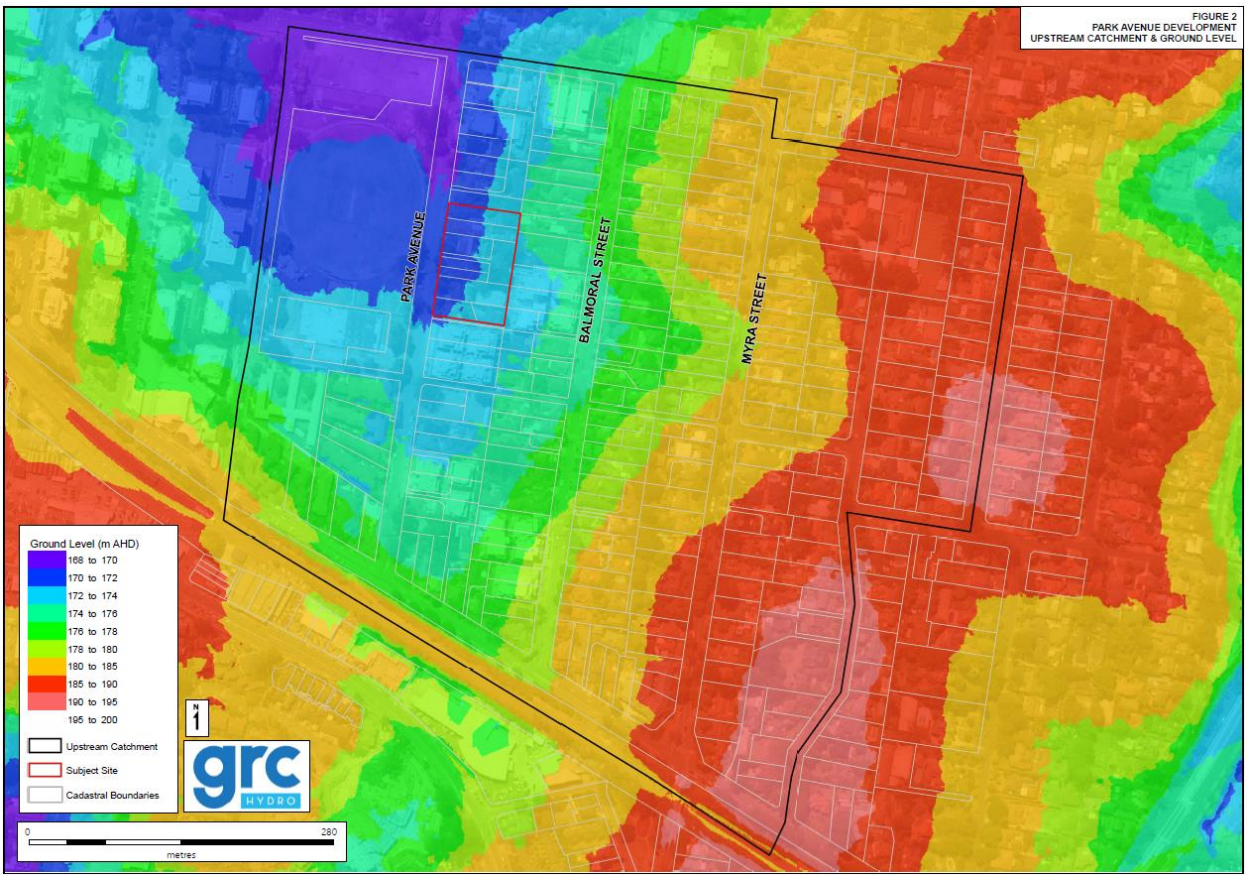


Figure 2: Catchment Area

The site is currently composed of eight residential homes built on individual lots. The proposed development consists of a merge of the existing property lots and the construction of five multi-storey residential developments with an underground car park.

2. Background

The site is subject to limited flooding in the 1% AEP event (100-year ARI) . A council owned drainage easement is located at the site's southern boundary.

The following work scope has been executed:

- Site Visit;
- Contacted Hornsby Shire Council (Council) to obtain trunk drainage details;
- Development of detailed hydrologic and hydraulic flood models for the site;
- Provision of relevant flood information for the site inclusive of mapping, levels etc;
- Assessment of flood impacts associated with the proposed building alignment; and
- Reporting inclusive of relevant flood mitigation and flood policy requirements for the proposed development.

The goal of the work was to provide a flood report to accompany the Development Application to Council. This work also involved summarising applicable flood provisions from the Hornsby Development Control Plan 2013 and providing recommendations regarding the development and compliance with consent requirements.

A Development Application for the site was first submitted to Council in November 2018. In response to that submission, Council provided the following flooding related comments:

Engineering Comments

1. *Submit cross sections of the overland flow through the drainage easement at 5m intervals along the southern boundary of the development assuming that the pipes above the size of 750mm in diameter will have only 50% capacity to carry 1 in 100 year ARI flow in accordance with clause 5.8 of Stormwater Drainage Design Specifications (Council website- Development Applications - Aus-Spec Specifications – Design Specifications-0074 Stormwater Drainage (design)– clause 5.8 and) on the basis of following:*
   - *1.1. Existing Council pipe within the drainage easement along southern boundary being replaced in accordance with Council's Plan No. 554.38 and include the following, see attachment- 2120 001:*
     - *1.1.1. 66.5m of 2.4m (w) x 0.750m (h) RCBC at 1.68% grade*
     - *1.1.2. Upstream invert: 171.750 AHD at south eastern corner*
     - *1.1.3. Downstream invert: 170.630 AHD*
     - *1.1.4. Two pits, G10273I and G10273H connecting the pipeline (upstream and downstream) are to be constructed in accordance with the Council Plan No. 554.38.*

A: Pipes of diameters < 750mm have been modelled as fully blocked while larger pipes are assumed to be 50% Blocked. The Existing culvert 1.3m (w) x 0.750m (h) has been replaced by a 2.4m(w) x 0.750m (h) culvert in the Proposed Scenario. Cross sections at 5m intervals along the southern drainage easement are shown in paragraph 5.5 of this report.

2. *The 1% flow is 7.04 m3/sec*

A: Following Council's comment, inflow to the model has been applied at the upstream of the Council drainage easement and peak flow of 7.04m³ in the 1%AEP has been assumed. This is described in paragraph 4.1 of this report.

3. *Provide cross sections to show building line of the development at 16-20 Park Avenue, the proposed wall of the development, floor level of the proposed units, existing and post development finished level of the ground with 1 in 100 year ARI water level., see attachment 2119 001.*

A: Appendix B includes Plans and Cross Sections extracted from the Architectural drawings. Additional views can be provided upon request. Table 1 in paragraph 5.4 are the proposed FPLs while Image 8 in the same paragraph shows the 1%AEP contours used to determine them.

4. *Demonstrate that the velocity depth product does not exceed the safety factor 0.4m3 per second to comply with Council Civil Works Specifications. A table showing the product at every section must be submitted.*

A: see Paragraph 5.3 of this report

5. *A flood risk management plan, including location of warning signs is to be submitted.*

   A: see Chapter 6 of this report

A new Development Application for the site (DA/65/2019) was submitted to Council in 2019. In response to that submission, Council provided the following flooding related comments which have been addressed with this report:

Engineering Comments

The applicant has not provided a satisfactory detailed flood report for Council to determine compliance with Clause 1C.3.2 of the HDCP and Clause 5.8, Section 0074 -Stormwater drainage (Design) of Council's AUS–SPEC specifications in respect of:

1. *1% (1 in 100-year Average Recurrence Interval) overland flow meeting the safety factors not addressed.*

2. *Replacement of the Council pipe within the drainage easement to a box culvert is not addressed which is Council's preferred option which would connect the existing upstream stormwater infrastructure (1.5m wide x 1.2m high box culvert) between No.33 and 35 Balmoral Street which was recently upgraded to Park Avenue.*

   A: The existing 1.3(w) x 0.75(h) culvert has been replaced by a 2.4(w) x 0.75(h) culvert as described in Chapter 5 of this report

3. *Floor levels of the units adjoining the overland flow are not in accordance with Council requirements to be 500mm above freeboard.*

   A: Building FPL has been determined with a min freeboard of 500mm (see paragraph 5.4 of this report)

4. *Flood impacts on adjoining properties as a result of the proposed stormwater works not addressed in flood report.*

   A: see paragraph 5.2 of this report

5. *Unintended outcomes with respect to flooding and drainage impacts to neighbouring properties as a result of 300mm high retaining wall capturing drainage not addressed.*

   A: flood impact assessment shows that no adverse impact is caused to neighbour properties (see paragraph 5.2 of this report

6. *Cross sections of overland flow and swale not submitted.*

   A: Previously proposed swale at the eastern boundary of the site is no longer required due to model revision

7. *Flood report modelling uses incorrect LIDAR levels and does not use current land survey levels prepared by a registered surveyor which is important as these revised levels would change the flood modelling.*

   A: a new survey has been incorporated into the hydraulic model (see par. 4.2 of this report)

3. Relevant Policy

3.1 Hornsby Shire Development Control Plan (DCP) (Reference 3)

The Hornsby Shire Development Control Plan (DCP) 2013 was adopted by Council in October 2013 and is applicable to this development proposal.

The following relevant controls are outlined in Section 1C.3.2 Flooding:

General

Clause a. Where a development proposal is on land shown as 'Flood Planning areas' on the HLEP Flood Planning Map or is on other land at or below the flood planning level, a comprehensive flood study should be prepared by a qualified hydraulic engineer and is to be submitted with any development application on land that demonstrates that:

- *The development addresses the provisions of Clause 6.3 of the HLEP, and*
- *The development complies with best practice.*

Clause b. The overland flow path should not be built upon and should have minimal planting. Development is required to demonstrate that any overland flow is maintained for 1 in 100 year average recurrence interval (ARI) flood.

Clause c. All potential pollutants that are stored or detained on-site (such as on-site effluent treatment facilities, chemicals or hazardous materials) should be stored 0.5 metres above 1 in 100 year ARI flood level. Details should be provided as part of any application.

3.2 Hornsby Local Environmental Plan 2013 (HLEP) (Reference 4)

The Hornsby Local Environment Plan (HLEP) 2013 is applicable to the proposed development. Section 6.3 Flood Planning outlines the following controls relevant to the development:

Clause 3. Development consent must not be granted to development on land to which this value applied unless the consent authority is satisfied that the development:

a) is compatible with the flood hazard of the land, and
b) will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and
c) incorporates appropriate measures to manage risk to life from flood, and
d) will not significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or reduction in stability of river banks or watercourses, and
e) is not likely to results in unsustainable social and economic costs to the community as a consequence of flooding.

Clause 5. In this clause, flood planning level means the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.

3.3 Hornsby Shire Development Design Specification 0074 -Stormwater Drainage Design (Reference 2)

The Hornsby Shire Development Design Specification 0074 for Stormwater Drainage Design provides guidance on the hydrologic and hydraulic modelling of catchments within the Hornsby Shire LGA. A summary of the flood related specifications relevant to the development is provided below.

Section 4.10 - Alternative Models and Computer Analysis addresses the use of hydrologic models for the calculation of design flow estimates in accordance with ARR1987. The current study has undertaken calculation in accordance with the specification with input details presented in Section 4.1.

Section 5.6 – Open Channels provides detail on the design of open channels in the LGA. This includes Manning's "n" coefficients and velocity/depth product criteria. This criterion has been addressed in Section 5.3.

Section 5.8 – Major System Criteria addresses criterion such as pipe blockage and floor level requirements for developments within Stormwater Flow Paths. These specifications require 100% blockage of pipes of less than 0.75 m in diameter and 50% blockage of structures greater than 0.75 m in diameter (see Section 4.2). This guideline requires a freeboard of 0.5 m above the 100 year flood level for the habitable floor level and 0.3 m above the 100 year flood level for garages and entrances to underground car parks (see Section 5.4).

4. Methodology

Existing design flood behaviour for the subject site is defined by hydrologic data and hydraulic modelling developed as a part of the current study. This modelling is based on the use of hydrologic data provided by Council then a hydraulic model (TUFLOW) to convert applied inflows into flood extents, depths, levels and velocities.

4.1 Hydrologic Model

Following Council's indications, the previously developed hydrologic model was replaced by inflow data extracted from the Donovan Associates report which was accompanying the development application (DA/1062/2013) for development at No.35-39 Balmoral street, Waitara.

With reference to the 100-years ARI event critical storm event, in accordance to Donovan report and as confirmed by Hornsby Council letter dated 17th June 2014,: "*all flows will be directed to the pipe line running between properties No. 33 and No.35 Balmoral street and the flow is to be accepted as 7.04m³/s*".

For assessing the overland flow along the easement between No.33 and No.35 Balmoral street, the documentation proposed by Hornsby Shire Council "Proposed Stormwater Upgrade Works Plans" has been adopted. The design incorporates the construction of a new culvert with internal dimensions 1.5m x 1.2m. The capacity of the culvert , as documented on the "Proposed Stormwater Upgrade Works Plans" is 5.69m³/s. As per Hornsby Council's request, the capacity of the culvert is to be assessed as 50% blocked. **Therefore, the capacity of the culvert was reduced to 2.84m³/s. The remaining flow which will traverse overland along the easement is 4.2m³/s.**

4.2 Hydraulic Model

GRC Hydro have developed a TUFLOW modelling system to undertake the following assessment. TUFLOW is a hydraulic modelling tool that can utilise one and two-dimensional model elements.

The hydraulic modelling system is comprised of the following elements:

- LiDAR data has been used to inform a 1 m TUFLOW grid resolution. LiDAR data has a typical accuracy of ±0.15 m (1st confidence interval);
- Land survey levels prepared by a registered surveyor was included to refine the Lidar within the flood way easement which runs between properties at No. 33 and No.35 of Balmoral street. Extent of the surveyed area is shown in Image 1 below.
- Pipe elements (Image 2) are based on data obtained from various sources.

    - Council provided the pipe configuration and sizes for the catchment;
    - Additional data was obtained from site visits and discussions with Council engineers working on the Park Avenue drainage upgrade (April 2018). This upgrade involved significantly enhancing the existing drainage capacity along Park Avenue and increasing the number of pit inlet locations. The Park Avenue drainage upgrade has been incorporated into the existing case TUFLOW model;
    - Advice from Council's comments to the Development Application submitted in November 2018 (see comment 1 (Section 2)); and
    - Where existing pipe sizes were not available, sizes were estimated based on GRC Hydro's experience in similar urban scenarios. Furthermore, pipe inverts were informed by an offset from Lidar ground elevations.
- Blockage of pipe elements has been undertaken as per Section 5.8 of Council's Design Specification (see Section 3.3) with pipe sizes of 0.75 m in diameter or less, fully blocked and those greater than 0.75 m in diameter, 50% blocked.
- Hydraulic features that impact on flood behaviour have been represented in the model as break lines. These features include the kerb/gutter and road crests, the levels of which were determined by analysis of the LiDAR;
- Buildings can block flood waters natural flow path and therefore significantly impact flood behaviour. As such, buildings in the vicinity of the subject site were blocked out of the TUFLOW model;
- Manning's roughness values were applied as follows :
    - General: 0.035
    - Roads: 0.02
    - Dense Vegetation: 0.07
    - Public Recreation: 0.04

Adopted manning values are in accordance with Donovan Associates Report.

- A free draining outlet was allowed at the catchment's downstream boundary.
- Fences: The drainage easement is bounded by a combination of concrete walls, steel walls, wooden fences and nets. All waterproofs elements were modelled as wall, while nets and gates were modelled as obstruction to the flow (see Image 3).

Image 1: Extent of Local survey (rainbow coloured area)

Image 2: Existing Stormwater network

Image 3: Fences in the floodway easement

5. Proposed Works

5.1 Proposed Case Configuration

The proposed building alignment was implemented in the TUFLOW model, assuming no significant change to the existing ground level topography. A boundary wall is proposed around the south, east and north side of the property lot: while the eastern and northern wall will have no impact on the existing flood behaviour, some impact is expected at south due to the replacement of the existing boundary net with a solid wall. The ending portion (at the western end) of the proposed new wall at south (shown in red in Image 4) has been shaped in order to limit the impact to the downstream Park Avenue.

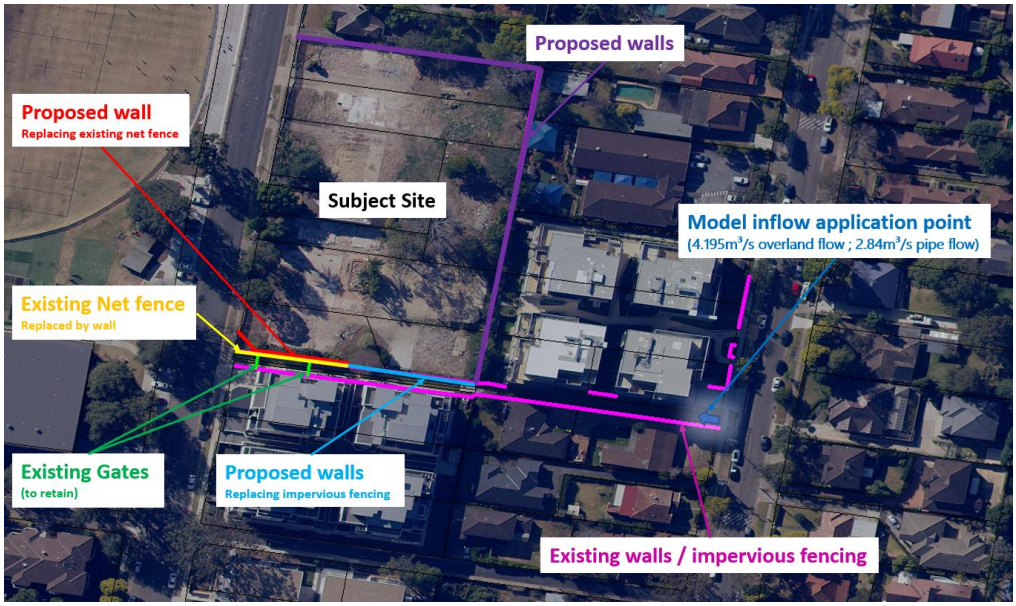


Image 4: Proposed site fencing

Moreover, following Council's recommendation, it is proposed to replace the existing 1.3m x 0.75m culvert with a 2.4m x 0.75m (see Image 5).

Image 5: Proposed Culvert Upgrade

5.2 Flood Impact Assessment

A flood impact assessment has been undertaken which assessed the existing and proposed development using the TUFLOW hydraulic model.

The impacts present the change in flood level between the existing and proposed conditions for the 1% AEP event.

Flood level impacts of 0.01 m or less are considered within the tolerance of the hydraulic model to determine and are therefore shown as no impact.

Figure 3 indicates that, in the 1% AEP event, flood levels within the upstream stretch of the floodway easement are generally reduced by 50 to 110mm and increased by the same amount in the downstream portion. This increase is due to the flow constriction caused by the new proposed wall portion replacing the existing net fence. Flow is now confined within the floodway easement and does not spread within the subject site and the Park avenue, but rather concentrates to the floodway outlet section on the parkway avenue. This results in a water level increases by around 20mm at the floodway outlet on Park Avenue and general decrease by 35mm further North on the Park Avenue.

Overall, in regard to flood impact, the proposed development does not result in significant flood impacts to other properties or public spaces. It will not result in increased requirement for government spending on flood mitigation measures.

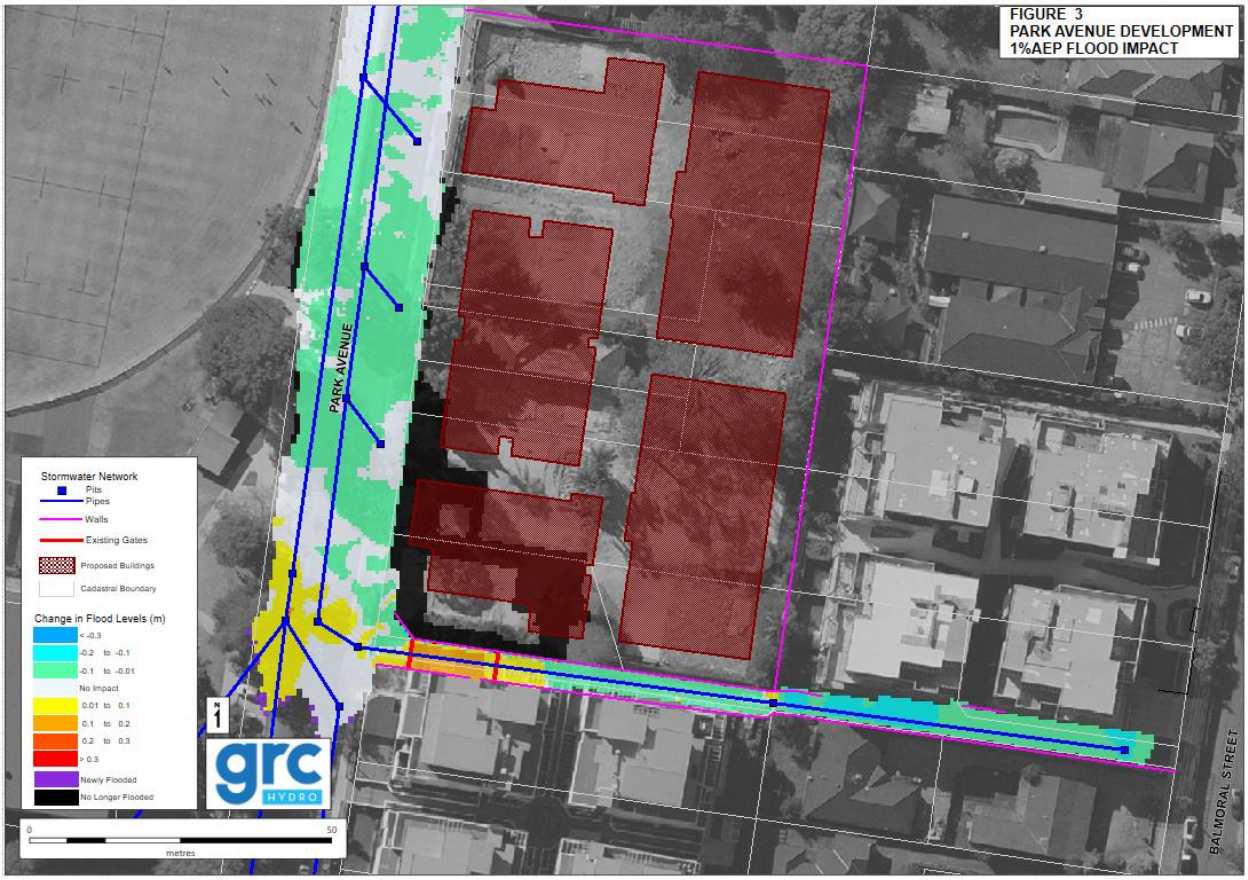


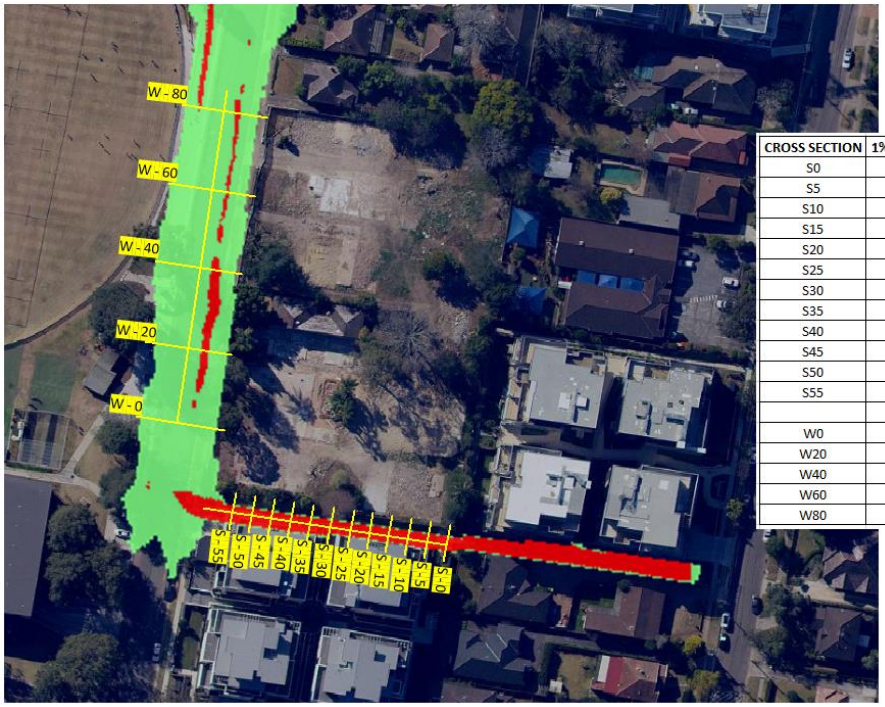
Figure 3: 1%AEP Flood Impact

5.3 Velocity Depth Product

Council's Design specifications for Open Channels requires that a velocity depth product greater than 0.4 m^2/s will be required to specifically provide for the safety of persons who may enter the floodway easement. The VxD product in the floodway easement is greater than $0.4m^2/s$ and therefore access gates to the floodway easement are in place to forbid unauthorized access.

Image 6 : Access Gate to the Drainage Easement

Figure 4: VxD product - Existing Scenario (left) VS Proposed Scenario (right)



CROSS SECTION	1% AEP - AVERAGE VxD (m^2/s)	1% AEP - MAX VxD (m^2/s)
S0	1.05	1.30
S5	1.30	1.49
S10	1.07	1.28
S15	1.02	1.20
S20	0.99	1.22
S25	0.90	1.22
S30	0.80	1.17
S35	0.76	0.96
S40	0.75	0.99
S45	0.75	0.94
S50	0.73	0.96
S55	0.75	0.95
W0	0.15	0.34
W20	0.16	0.51
W40	0.15	0.48
W60	0.15	0.45
W80	0.17	0.43

Image 7: : VxD product – Proposed Scenario

5.4 Entrance Levels

Council's design specifications (see Section 3.3) provide guidance on entrance levels for floor levels and garages. Along stormwater flow paths, Council requires a freeboard of 0.5 m above the 100-year (or 1% AEP) flood level for habitable floor levels. For garages and entrances to underground car parks, a freeboard of 0.3 m above the 100-year flood level is required.

Figure 5 is the 1%AEP Flood map for the Proposed Case Scenario: Flood depths up to 550mm are calculated in the drainage easement at South and up to 350mm in the gutters of Park Avenue.

Figure 5: 1%AEP Flood Depth and Levels

Image 8 are the 1%AEP Flood level contours superimposed on the proposed planimetry of the Site. Flood Contour levels that have been considered for determining the building FPLs have been marked in red.

The Table Below shows the FPL for the proposed buildings and the achieved freeboard above the 100y flood depth:

BUILDING E	FPL (mAHD)	1%AEP Water Lv. (mAHD)	Freeboard (mm)
-Lobby	172.2	171.7	500
-Basement Ramp	172.4	171.6	800
BUILDING B	**FPL (mAHD)**	**1%AEP Water Lv. (mAHD)**	**Freeboard (mm)**
-Lobby	172	171.5	500
BUILDING D	**FPL (mAHD)**	**1%AEP Water Lv. (mAHD)**	**Freeboard (mm)**
-Lobby	171.7	171.2	500
BUILDING A	**FPL (mAHD)**	**1%AEP Water Lv. (mAHD)**	**Freeboard (mm)**
-Lobby	172	170.8	1200
BUILDING C	**FPL (mAHD)**	**1%AEP Water Lv. (mAHD)**	**Freeboard (mm)**
-Basement Ramp	171.1	170.8	300
-Lobby	171.1	170.6	500

Table 1: Proposed FPLs

Image 8: 1%AEP Flood Level Contours

5.5 South Boundary Wall

A new Proposed wall will be built along the South end of the Subject Lot to contain the flood water within the Council drainage easement. The wall will be around 1.8m height and will be made of flood compatible materials.

Image 9 is the proposed wall longitudinal profile while Image 10 to Image 14 are cross sections at 5m spacing along the drainage easement.

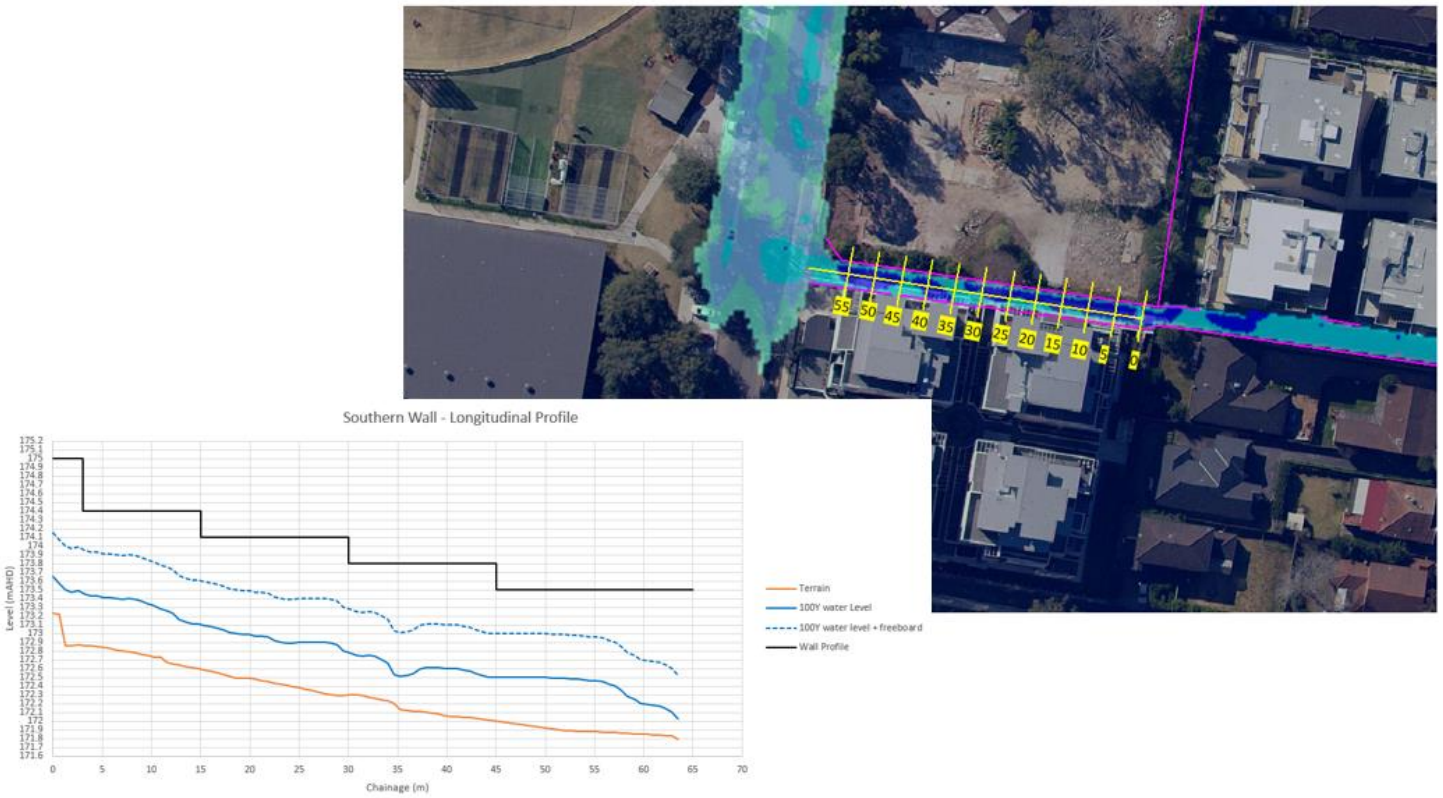


Image 9: Southern Wall Longitudinal Profile

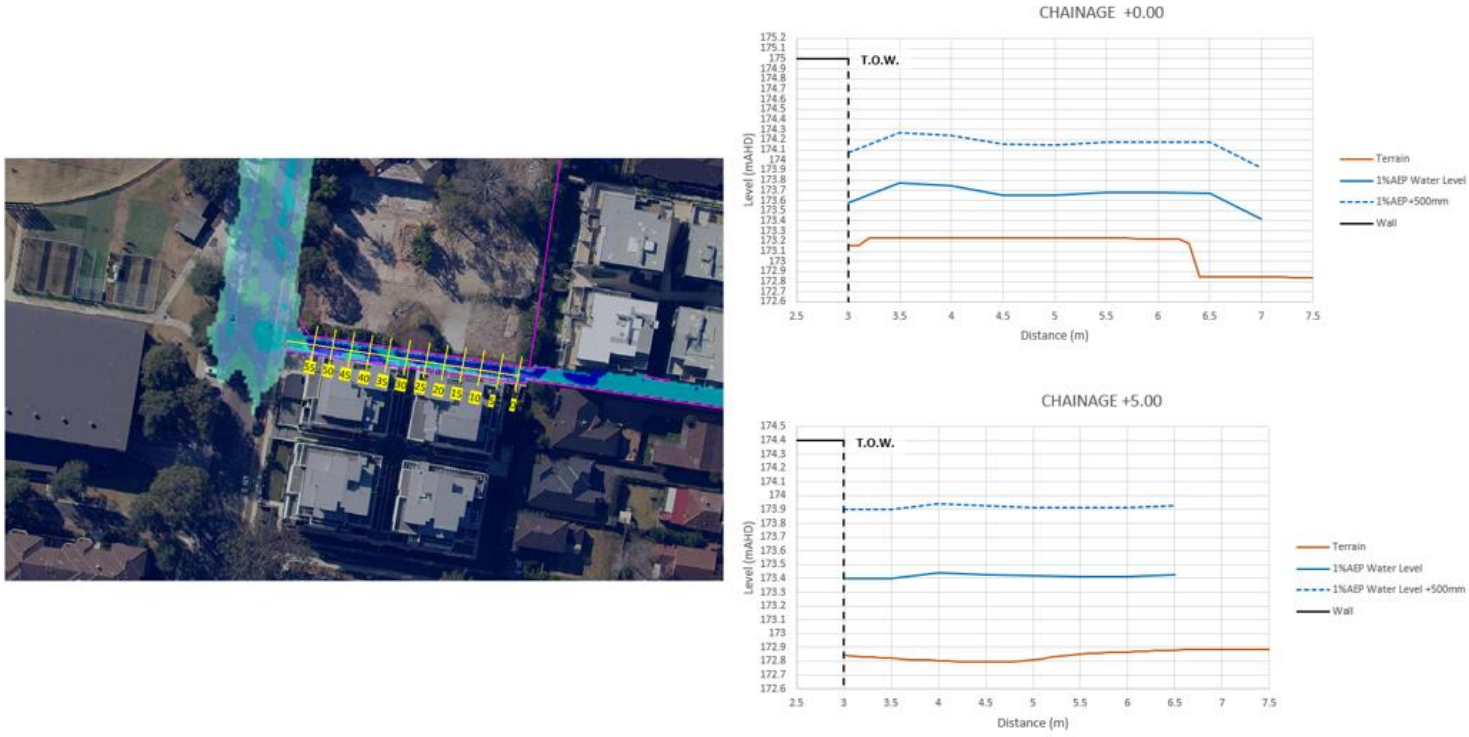


Image 10: Southern Wall - Cross sections at Chainages 0.00 and 5.00

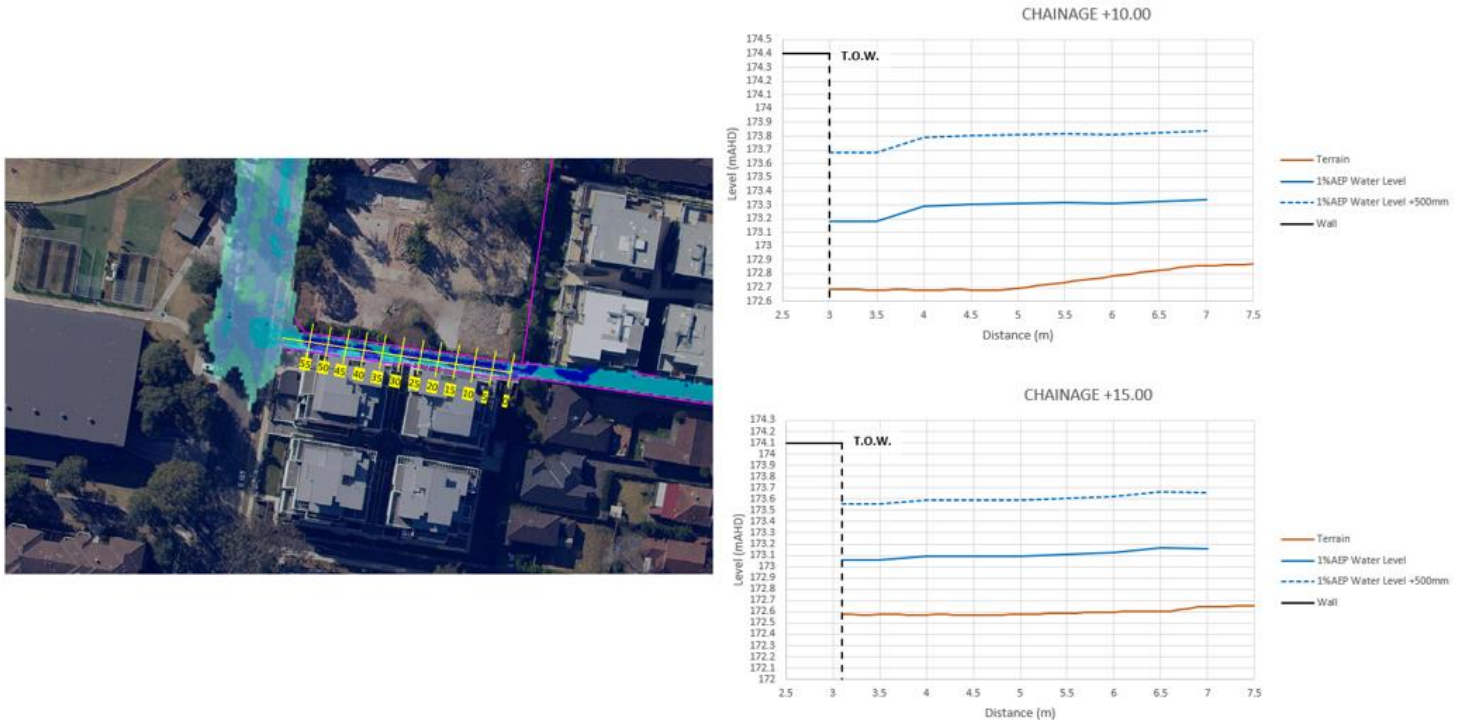


Image 11: Southern Wall - Cross sections at Chainages 10.00 and 15.00

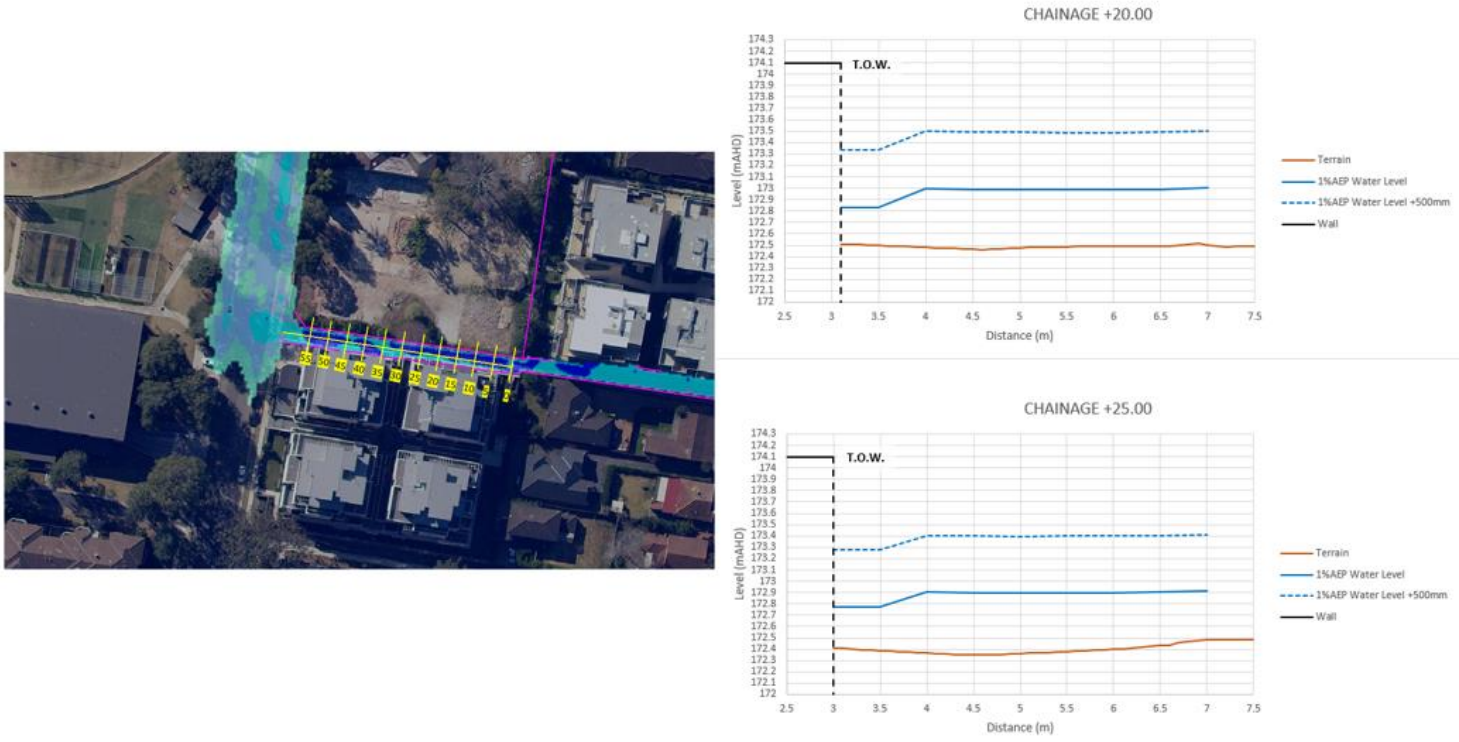


Image 12: Southern Wall - Cross sections at Chainages 20.00 and 25.00

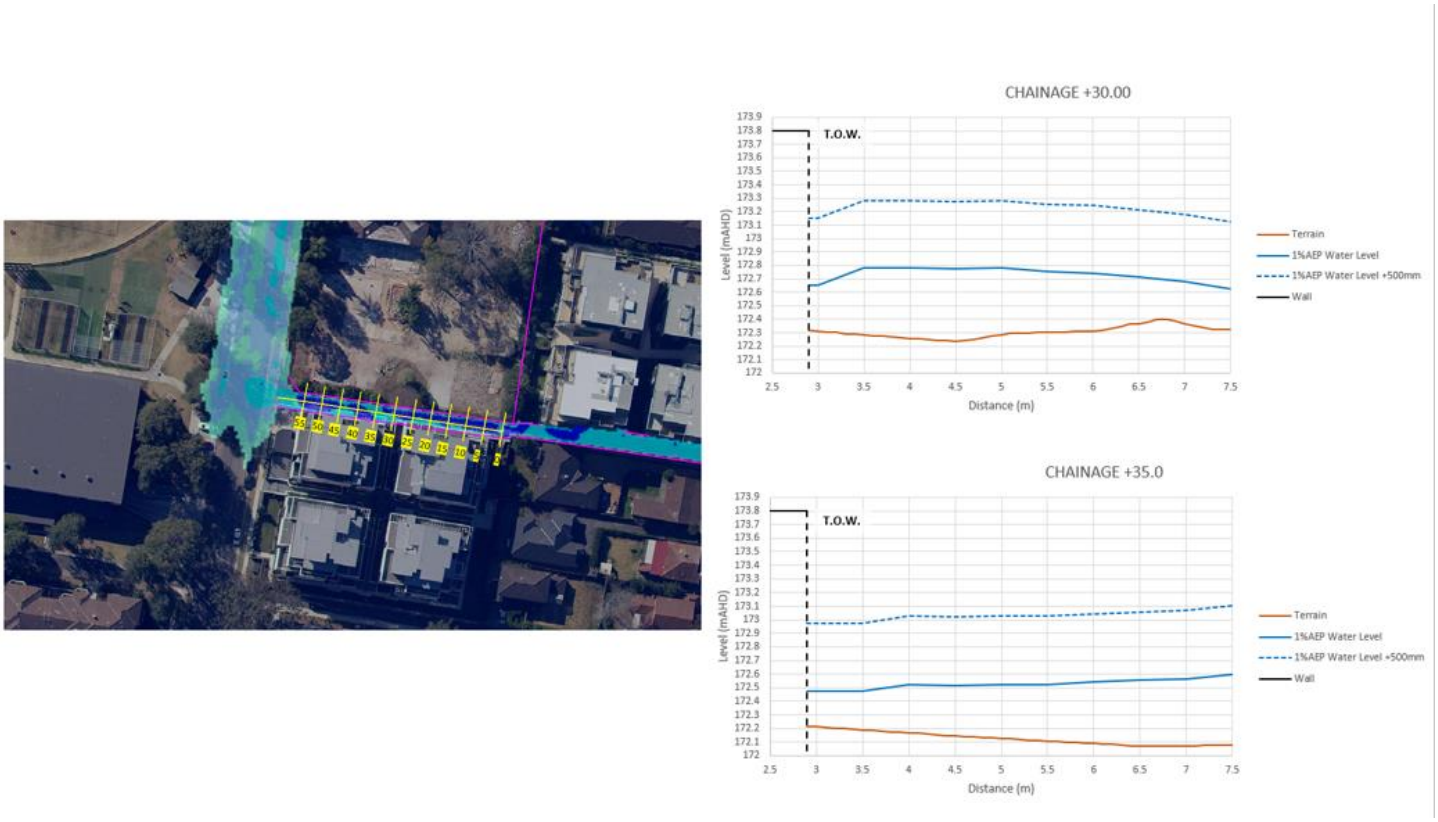


Image 13: Southern Wall - Cross sections at Chainages 30.00 and 35.00

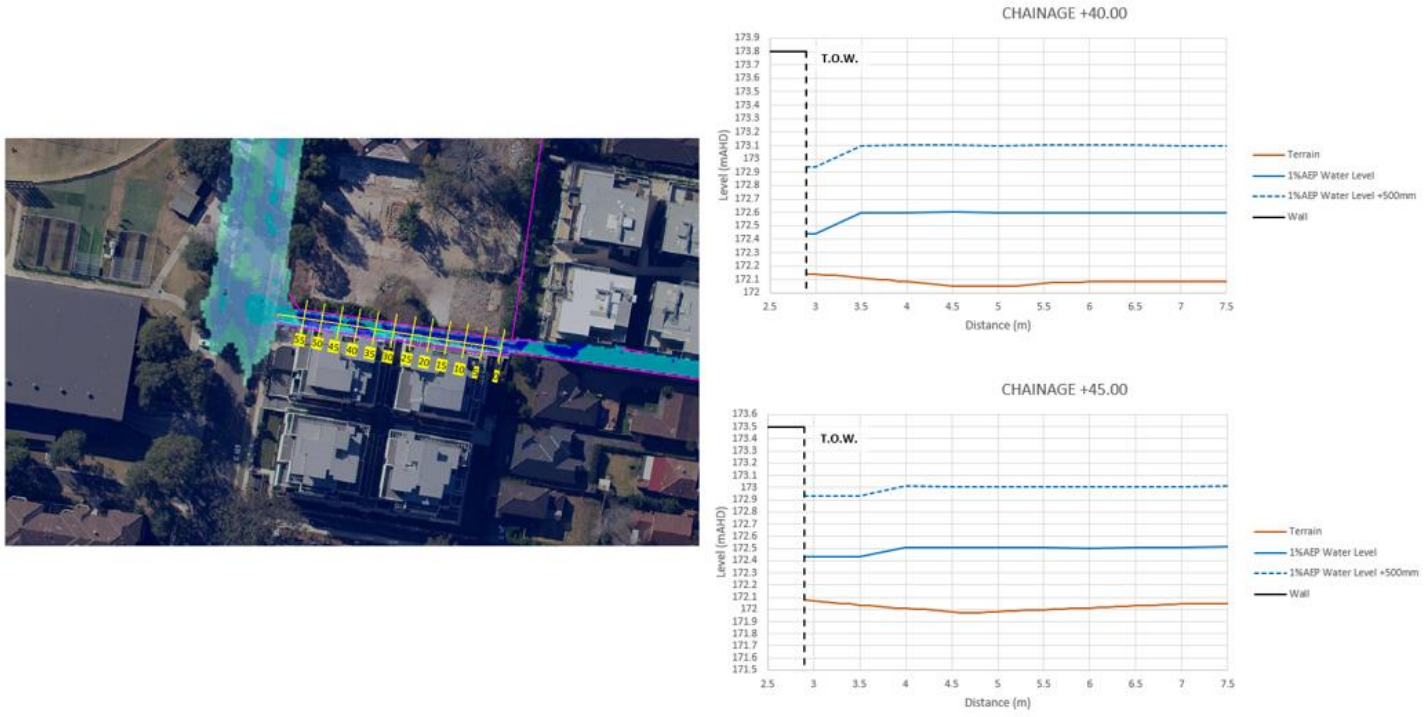


Image 14: Southern Wall - Cross sections at Chainages 40.00 and 45.00

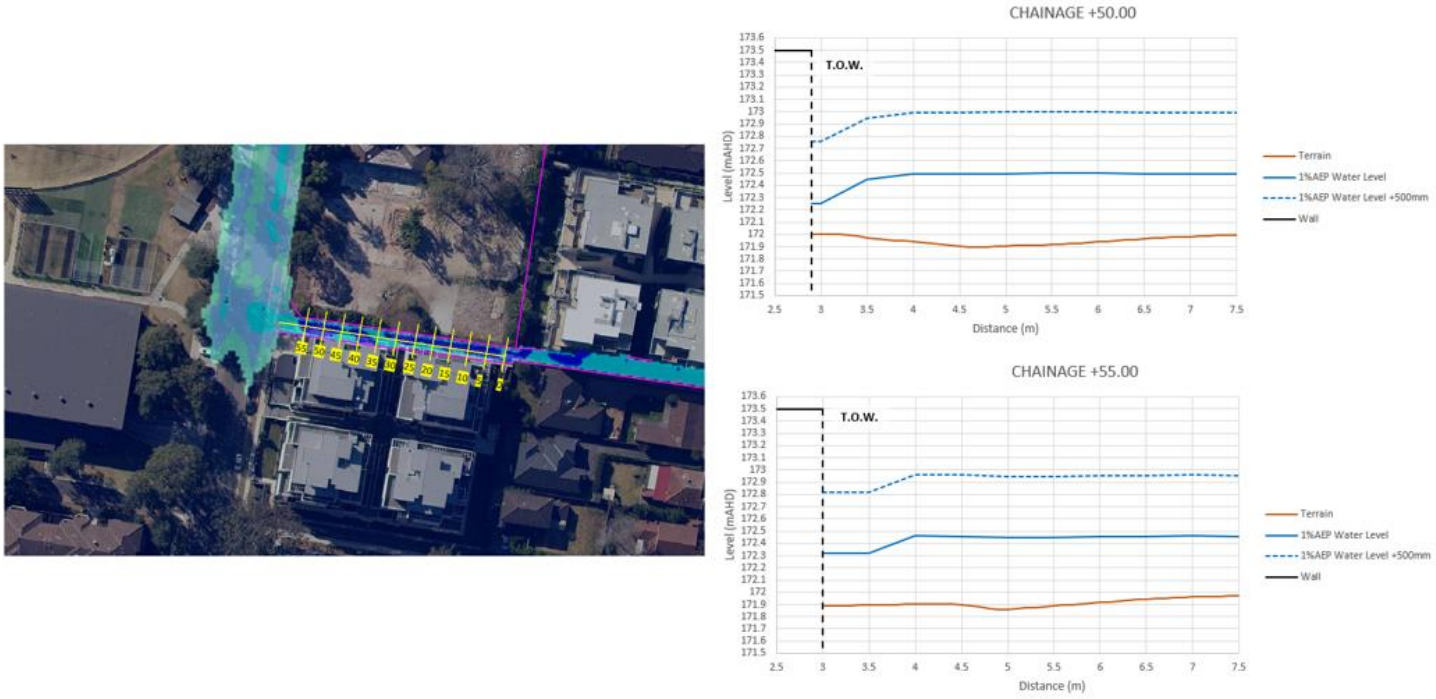


Image 15: Southern Wall - Cross sections at Chainages 50.00 and 55.00

6. Flood Risk Management

The potential risk to life as a result of flooding can be ascertained by assessing the flood hazard. Flood hazard can be quantified by considering the flood depth and velocity in combination (AIDR, 2017).

The hazard categories based on the Australian Emergency Management Institute (2014) of Image 16 were considered.

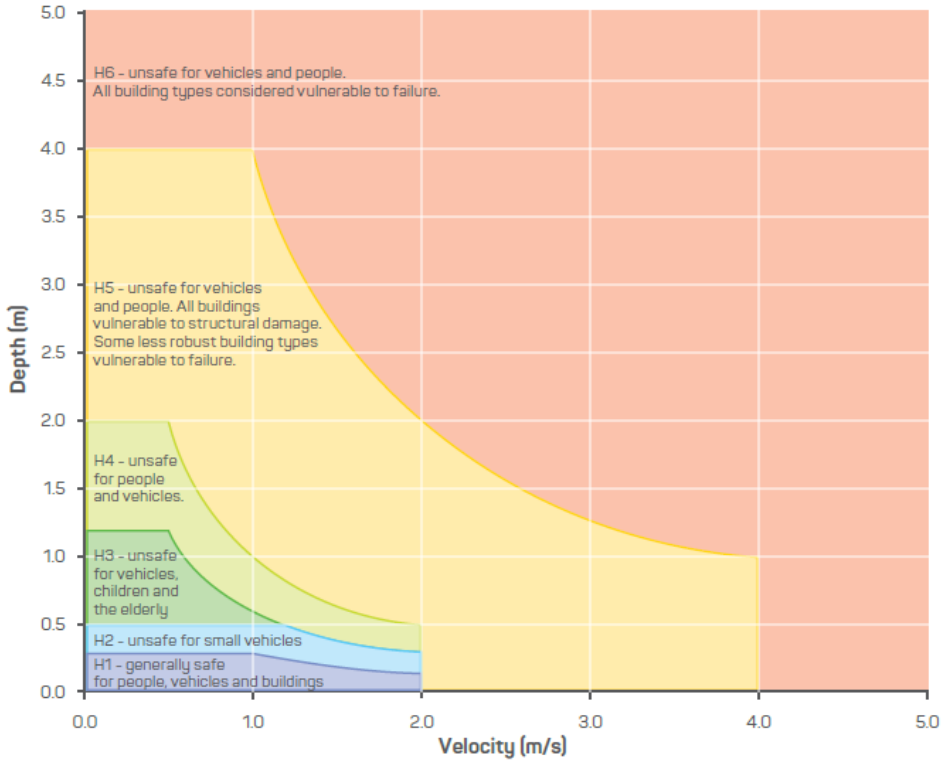


Image 16 :Flood Hazard Category by Australia Emergency Management Institute (2014)

Available warning time for the site is short due to the small size of the catchment upstream of the site, leading to a "flash flood" classification. The 1%AEP peak flood flow occurs approximately 10 minutes after the rainfall peak which leaves little time for flood evacuation and preparation. Evacuation of the buildings could potentially result in people entering hazardous floodwater areas. For flash flood catchments, the provision of an effective flood warning service is not available due to the difficulties with its prediction. A benefit of the flash flood setting is that the duration of flooding is typically short with hazardous flooding to typically last less than one hour.

Figure 6 are the 1%AEP flood hazard maps for the Existing and Proposed Scenario. It can be observed that the proposed developments does not increase flood hazard. Also, hazard along the Park Avenue is generally low, being globally classified as H1 level.

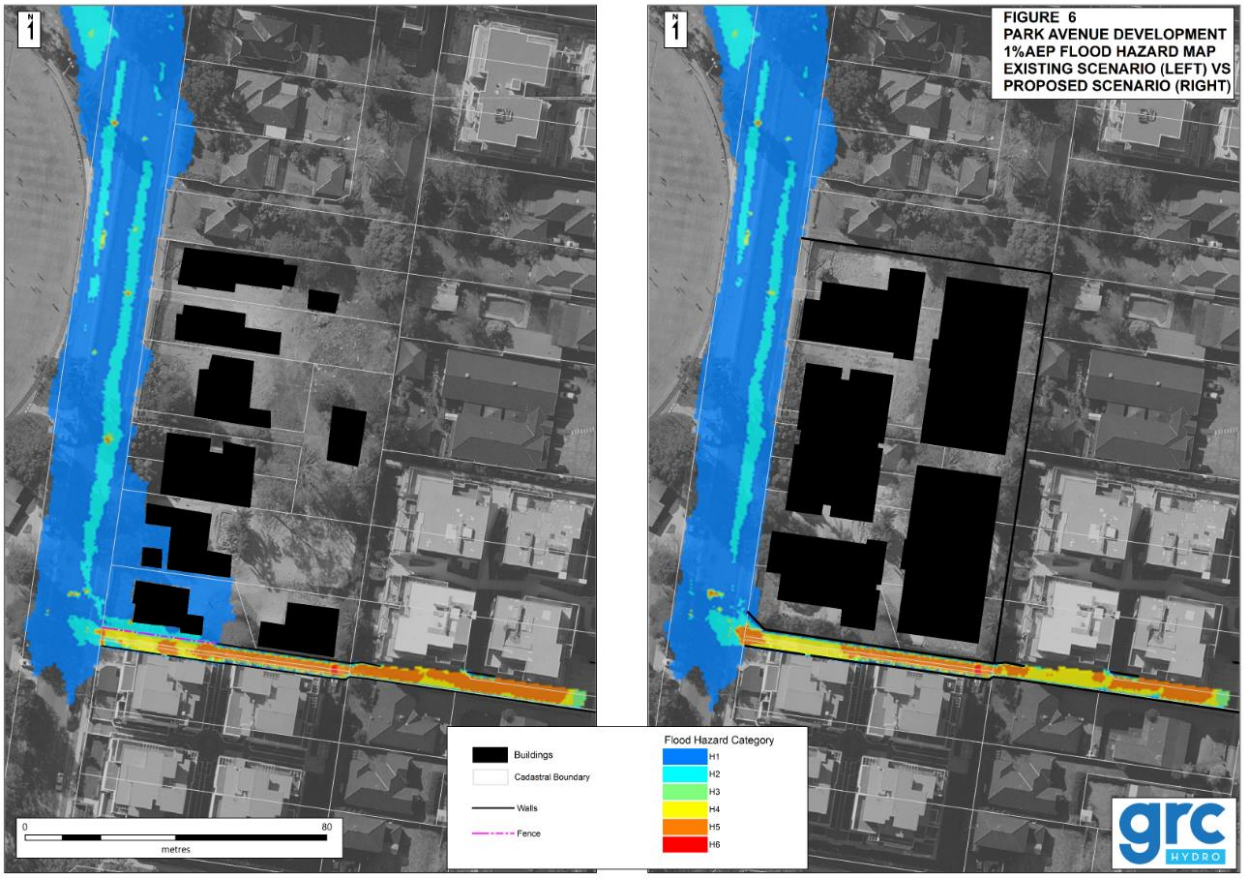


Figure 6: 1% AEP Flood Hazard map - Existing (Left) Vs Proposed Scenario (Right)

7. Conclusions

This flood study and flood impact assessment has been undertaken by qualified civil engineers (specialising in floodplain modelling), in accordance with Australian Rainfall and Runoff, the NSW Floodplain Development Manual and Council's DCP and HLEP.

Flood behaviour for the subject site has been modelled using TUFLOW hydraulic modelling system.

The existing conditions and proposed development flood behaviour has been examined. To mitigate the flood level impacts associated with the proposed development, mitigation elements are proposed herein.

Provided FPLs are as per Council requirements given they include 0.5 m freeboard for habitable floor level and 0.3m freeboard for car park basement and, as indicated, off-site impacts associated with the development are compliant.

8. References

1. Pilgrim DH (Editor in Chief), *Australian Rainfall and Runoff – A Guide to Flood Estimation*, Institution of Engineers, Australia, 1987.

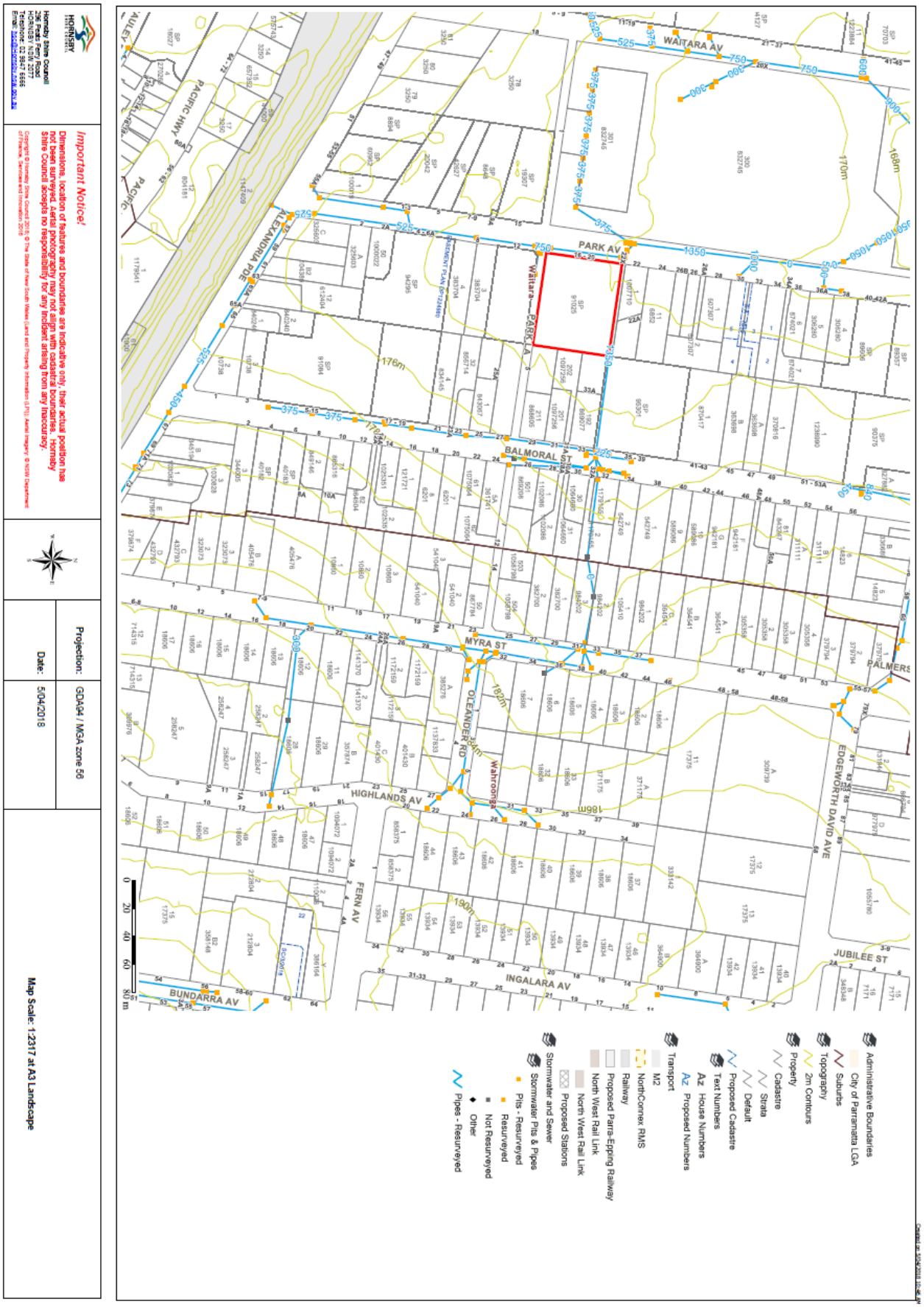
2. Hornsby Shire Council, Development Design Specification 0074 – Stormwater Drainage (Design), July 2016.

3. Hornsby Shire Council, Hornsby Development Control Plan 2013, March 2018.

4. NSW Government, Hornsby Local Environmental Plan 2013, April 2018.

5. NSW Government, NSW Floodplain Development Manual, April 2005, DIPNR

APPENDIX A

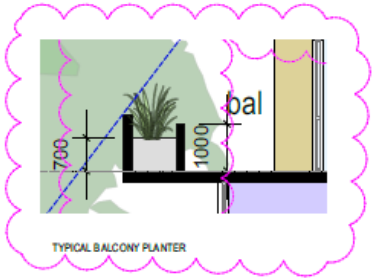

Hornsby Shire Council
296 Pacific Highway
Hornsby NSW 2077
Australia
Telephone: 02 9847 6666
Email: hsc@hornsby.nsw.gov.au
Important Notice!
Dimensions, location of features and boundaries are indicative only, their actual position has not been surveyed. Aerial photography may not align with cadastral boundaries. Hornsby Shire Council accepts no responsibility for any incident arising from any inaccuracy.
Projection: GDA94 / MGA zone 56
Date: 5/04/2018
Map Scale: 1:2317 at A3 Landscape
WAITARA AV
PARK AV
BALMORAL ST
MYRA ST
OLEANDER RD
HIGHLANDS AV
FERN AV
INGALARA AV
BUNDARRA AV
JUBILEE ST
EDGEWORTH DAVID AVE
PACIFIC HWY
ALEXANDRA PDE
Administrative Boundaries
City of Parramatta LGA
Suburbs
Topography
2m Contours
Property
Cadastre
Strata
Default
Proposed Cadastre
Text Numbers
House Numbers
Az Proposed Numbers
Transport
M2
NorthConnex RMS
Railway
Proposed Parra-Epping Railway
North West Rail Link
North West Rail Link
Proposed Stations
Stormwater and Sewer
Stormwater Pits & Pipes
Pits - Resurveyed
Resurveyed
Not Resurveyed
Other
Pipes - Resurveyed

APPENDIX B


NO. 36 PARK AVE
NO. 34A PARK AVE
NO. 34 PARK AVE
BUILDING C
BUILDING D
BUILDING E
BUILDING A
BUILDING B
NO. 41-43 BALMORAL ST
NO. 35-39 BALMORAL ST
NO. 33A BALMORAL ST
NO. 16-20 PARK AVENUE
EL05
EL01
EL09
PARK AVENUE
FOR DEVELOPMENT APPLICATION ONLY

SECTION AA

SECTION BB



TYPICAL BALCONY PLANTER

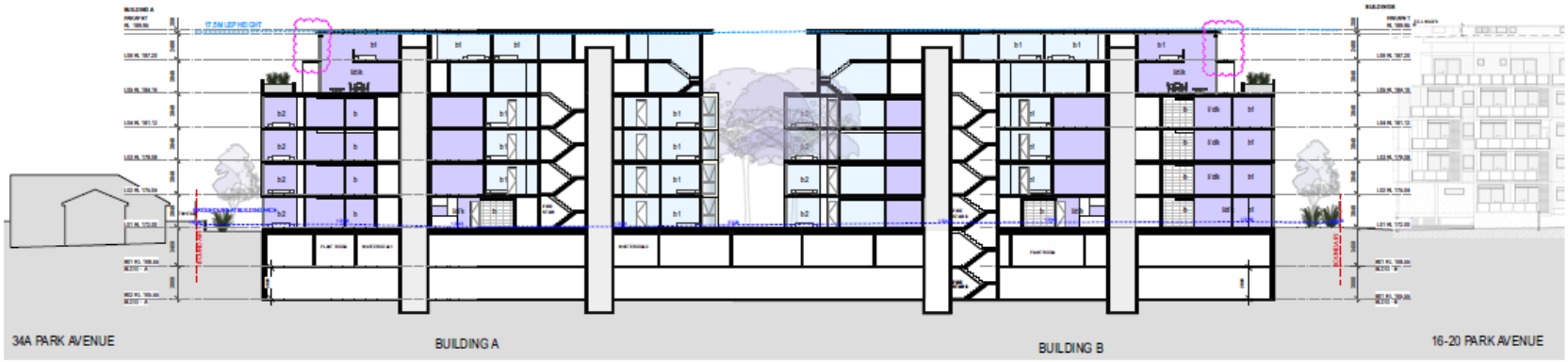
ALEKSANDAR

FOR DEVELOPMENT APPLICATION ONLY

17095

DA12 D

D



SECTION CC
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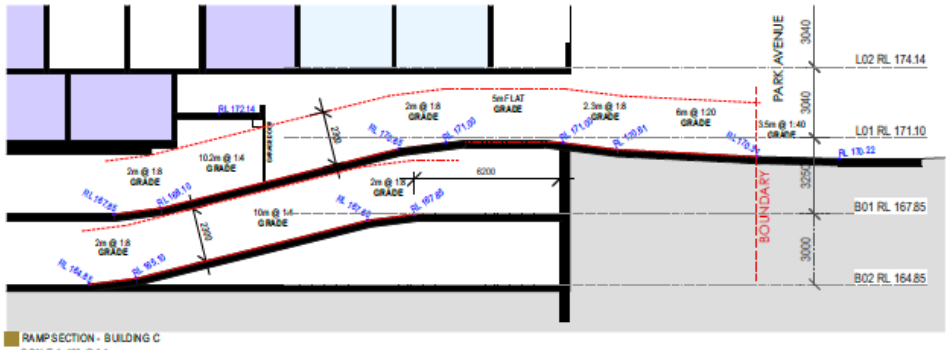
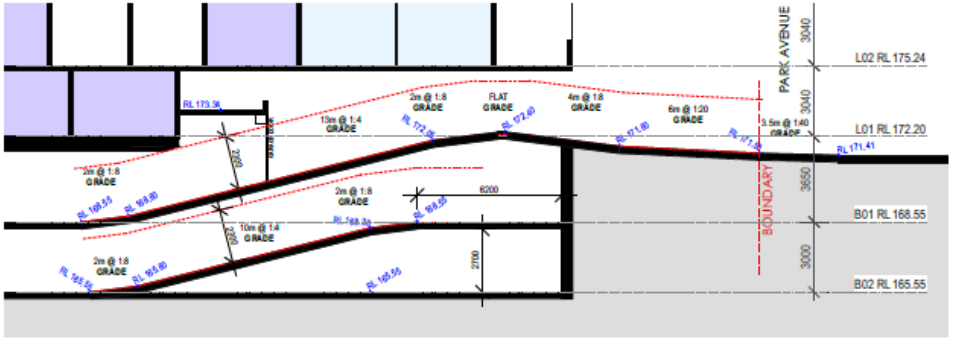


RAMP SECTION - BUILDING C
SCALE 1 :100 @A1



RAMP SECTION - BUILDING E
SCALE 1 :100 @A1

ALEKSANDAR

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