



**NORTHROP**

**BLOCK 3 SECTION 65 Campbell ACT  
ACADAMY CLOSE  
FLOOD IMPACT STUDY**

**DEFENCE  
HOUSING  
AUSTRALIA**

**REPORT  
VERSION 2**

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Version 2

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Dear Jonathan

**Re: BLOCK 3 SECTION 65 CAMPBELL ACT  
Flood Impact Study**

Our flood impact study for the above block is enclosed. The scope of the report addresses:

- Provision of a review of the Property's likelihood of flood and overland flow events based on prevailing site levels in the context of the flood levels experienced in the general area to form an opinion on the likelihood of the property being affected by flooding in the future, and the possible impact of flooding in specific flood events (1 in 20 year, 1 in 50 year and 1 in 100 year Annual Exceedance events).
- Our analysis and findings are based upon a site visit of the block in question and the upstream catchment, our working knowledge of the area, LIDAR survey of the area obtained from the ACT Government and detailed flood modelling undertaken with XP Storm.
- In our report we provide commentary on the frequency and severity of flood and overland flow events and provide indicative commentary on the Property.

If you have any questions please contact the undersigned.

Yours faithfully,

**Northrop Consulting Engineers**



Joey Wiltshire  
Civil Engineer

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## Executive Summary

Northrop Consulting Engineers were engaged by the Defence Housing to undertake a Flood Impact Study on Block 3, Section 65 Campbell. The site is located within Designated National Capital Authority land known as the “Australian Defence Force Academy, Royal Military College Duntroon, and Campbell Park Precinct”.

The Block did contain 22 single dwellings including the internal circulation road known as Academy Close; however these dwellings have since been demolished/ decommissioned and the Block is considered as vacate and undeveloped.

The existing council (TCCS) maintained stormwater infrastructure around the site was investigated around the site to determine the suitability and locational requirements of a new 375mm stormwater tie for the Block.

The existing catchment was investigated and the amount of water entering Block 3 was determined and used to undertake several flood models.

XP-storm was used to undertake flood models for the 1%, 5% and 10% AEP rainfall events from which the potential inundation of Block 3 was observed and commented upon.

The 1% AEP event was also used to determine the minimum floor levels required across any lots which were found to become inundated though the inclusion of an additional 500mm of freeboard above the 1% AEP water level.

Commentary is also provided on the onsite works required in order to assist in minimising onsite ponding, direct flows into new in-ground stormwater for the minor 10% AEP event and to guide the major 1% AEP event North towards Fairbairn Ave

The works described in this report are necessary to alleviate the flooding impact on the proposed lots to be constructed. These works are being documented as part of the design package for the sites development, as such these plans (Civil, Architectural and Landscape) should be read in conjunction with this report.



## 1. INTRODUCTION

Northrop Consulting Engineers were engaged by Defence Housing Australia to review the flooding potential of the Block 3 Section 65 Campbell which was, until recently several single dwellings including the internal circulation road known as Academy Close. These dwellings have since been demolished/ decommissioned and the Block is considered as vacate and undeveloped



**Figure 1 – Locality Plan, Block 3 Section 65 Campbell**

The scope of our investigation addresses:

- Provision of a review of the Property's likelihood of flood and overland flow events based on Existing site levels in the context of the flood levels experienced in the general area to form an opinion on the likelihood of the property being affected by flooding in the future, and the possible impact of flooding in specific flood events (10% AEP, 5% AEP and 1% AEP rainfall event).
- Our analysis and findings are based upon a site visit of the block in question and the upstream catchment, our working knowledge of the area, existing survey data (dated 11/11/2008), 2004 Contour Data provided on ACTMAPI and preliminary modelling undertaken with XP Storm.
- In our report we provide commentary on the severity of flood events and overland flow paths observed and provide indicative commentary on the affect this may have on future dwellings within the Property.

## 2. EXISTING SITE FEATURES

### 2.1 Site description, location and topography;

Block 3 is 25,354m<sup>2</sup> in area. It is located approximately 3km east of the Canberra CBD (Civic) and approximately 2km North East of the nearest body of water (Lake Burley Griffin). The block once contained 22 Single Dwellings and the internal circulation road. The dwellings have since been demolished, however the existing roadway (previously known as Academy Close) and site services still remain and are proposed as being reconstructed/ Relocated as part of the sites re-development. The block is bordered to the North by Fairbairn Ave, to the North West by Truscott St and Urban open space to the South and South East with Northcott Drive to the South East past this urban open space. The Block generally falls from South to North at a grade of  $\approx 6\%$  with the high and low points of the Block having an RL of approximately 614m and 601m respectfully.

To the South of the block is the open urban grassed area (Block 4 Section 65 Campbell) which grades North towards Block 3 and is bordered the East by Northcott Drive. The West of the Block the site is bounded by a well-established Residential area of Campbell.

Block 3 is located towards the upper end of the catchment. The catchment drains from South to North. From the Contouring information provided on ACTMAPI the top of the catchment is located approximately 650m South West of Block 3 within Block 1 Section 65 Campbell which peaks at a relative level of 651m above sea level. The topography in this area drops steeply (grades in excess of 10-15%) and flattens around the adjoining Block 4 at surface grades of 5%-10% which continues onto and through Block 3 (the site of interest). Once past the site the catchment continues onto Fairbairn Avenue and continues flowing South East and eventual drains into Woolshed Creek and then South West into the Molonglo River.





**Figure 2 – General Overland Flow in the Relation to Block 3 Section 65 Campbell**

## 2.2 Vegetation, trees and landscaping

To the South of the Site there are several mature trees with the density increasing the further south west you go into Block 4. The site itself contains a few mature trees some of which are proposed to be retained as part of the site's works.

The existing on-site vegetation which is proposed to be retained is unlikely to have any impact on overland flow paths due to the sparse spacing of vegetation.



## 2.3 Existing stormwater infrastructure

Historic plans of the storm water mains within and around the subject site have been obtained. An extract of the network plan is shown below in figure 3.

In summary the existing plans obtained of the Municipal stormwater network includes;

- Existing 300mm and 375mm pipework within the Block which is considered as decommissioned (all of which will be exhumed as part of the sites redevelopment);
- There is an existing 375mm diameter stormwater tie located off the North Western boundary of Block 3
- An existing 300mm Main to the North running parallel to Fairbairn Ave
- The main on Fairbairn Ave drains South East towards and existing headwall just east of Northcott Drive at which point it becomes overland flow contained within a swale



**Figure 3 – Historic Storm Water Main Municipal Network Plan**

A site visit was undertaken to ascertain the location of the existing council main. During the site visit the location of 2 of the maintenance pits were found to be located generally along the mains alignment noted on the existing network plan. When the inside of the maintenance pits were inspected it was found the existing main was approximately 2.8m deep (near the North-West corner of the site) to 2.6m deep (near the North –East corner of the site). The existing main also appears to have been upgraded and was found to be at least a 375mm in diameter and may been even larger in size (unable to determine exact size onsite). During detailed design additional survey should be undertaken to determine the exact invert of this main as well as its size and pipe type.

From the information obtained, it is proposed to install a new 375mm tie into the existing main at the North-Eastern corner of the site which is the low point of Block 3.

## 2.4 Easements

No Easements on the ACTMAPi website are shown as affecting block 3 stormwater or otherwise.



## 2.5 Stormwater tie

As noted in Section 1.3 above the site drains to a tie located at the North-western corner of the block. The tie appears to be 375mm in diameter, however the information obtained is historic in nature and was not located onsite as such we were not able to access the tie to confirm it

As noted previously all existing stormwater onsite will be exhumed and a new tie is proposed in the North Eastern corner which will connect into the existing Council stormwater main which runs parallel to Fairbairn Avenue.

## 2.6 Localised flood potential

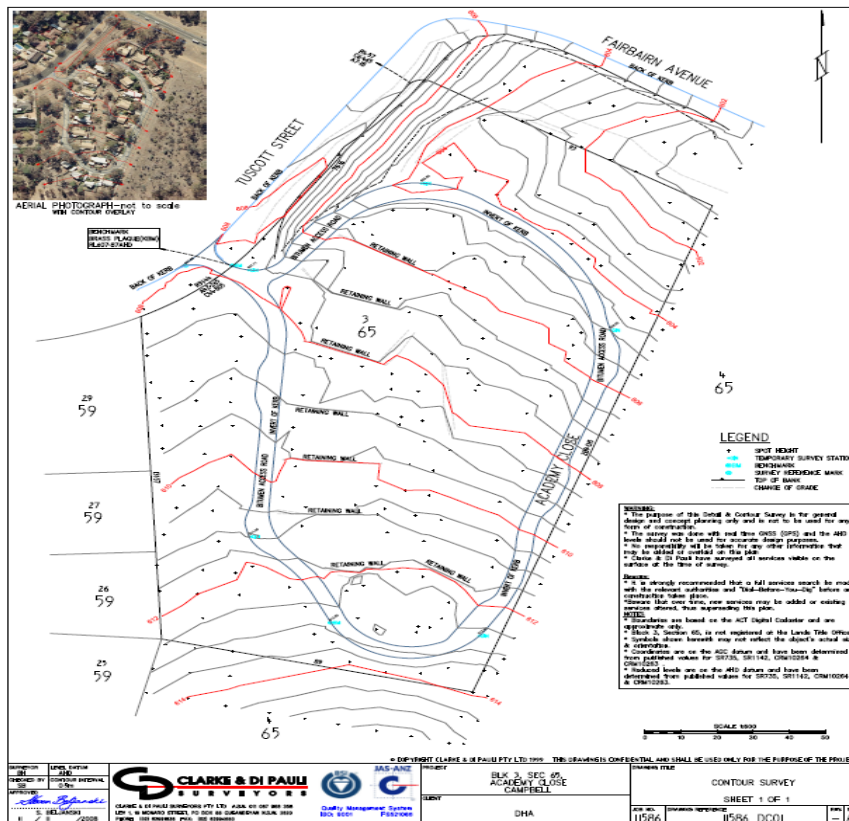
As the block is considered as undeveloped with consistent falls south to north at a moderate grade ( $\approx 6\%$ ) it is unlikely that any localised Flood potential will occur as the entire site is being redeveloped including new overland flow paths to avoid localised depressions.

There was a series of retaining walls in place due to the existing dwellings which have since been demolished. The demolition of these dwellings has removed the need for these retaining walls; as such they have not been considered within this Flood impact study with only the existing topography being considered.

Below are images showing the existing block topography and existing overland flow paths around the site.



**Figure 5 – Western Boundary of Block 3 facing north**





### 3. FLOOD MODELLING

#### 3.1 Catchment Analysis

As noted previously there is one major catchment which flows through the site. This catchment is approximately 3.5 Hectares in size before it flows north into Block 3. For this Flood Impact study a conservative approach has been taken assuming that all of the existing residences located on the Western Boundary of Block 4 have an impermeable barrier located on their boundary (fencing, bunds, etc.) which directs all overland flows north towards Block 3.

The approximate size and shape of this catchment is shown in the below figure. This catchment was used for in the Flood model in determining the Flowrate of the overland flow entering Block 3.



**Figure 8 –catchment which flows towards Block 3**

#### 3.2 Runoff Estimate

The runoff generated by the catchment entering Block 3 has been estimated using the DRAINS software in accordance with Australian Rainfall and Runoff 2016 guidelines. The results are shown in Table 1 below.

Annual Exceedance Probability	Peak Flow Rate	Peak Median Storm
10%	0.408m <sup>3</sup> /sec	20 Minutes
5%	0.535m <sup>3</sup> /sec	20 Minutes
1%	0.816m <sup>3</sup> /sec	15 Minutes

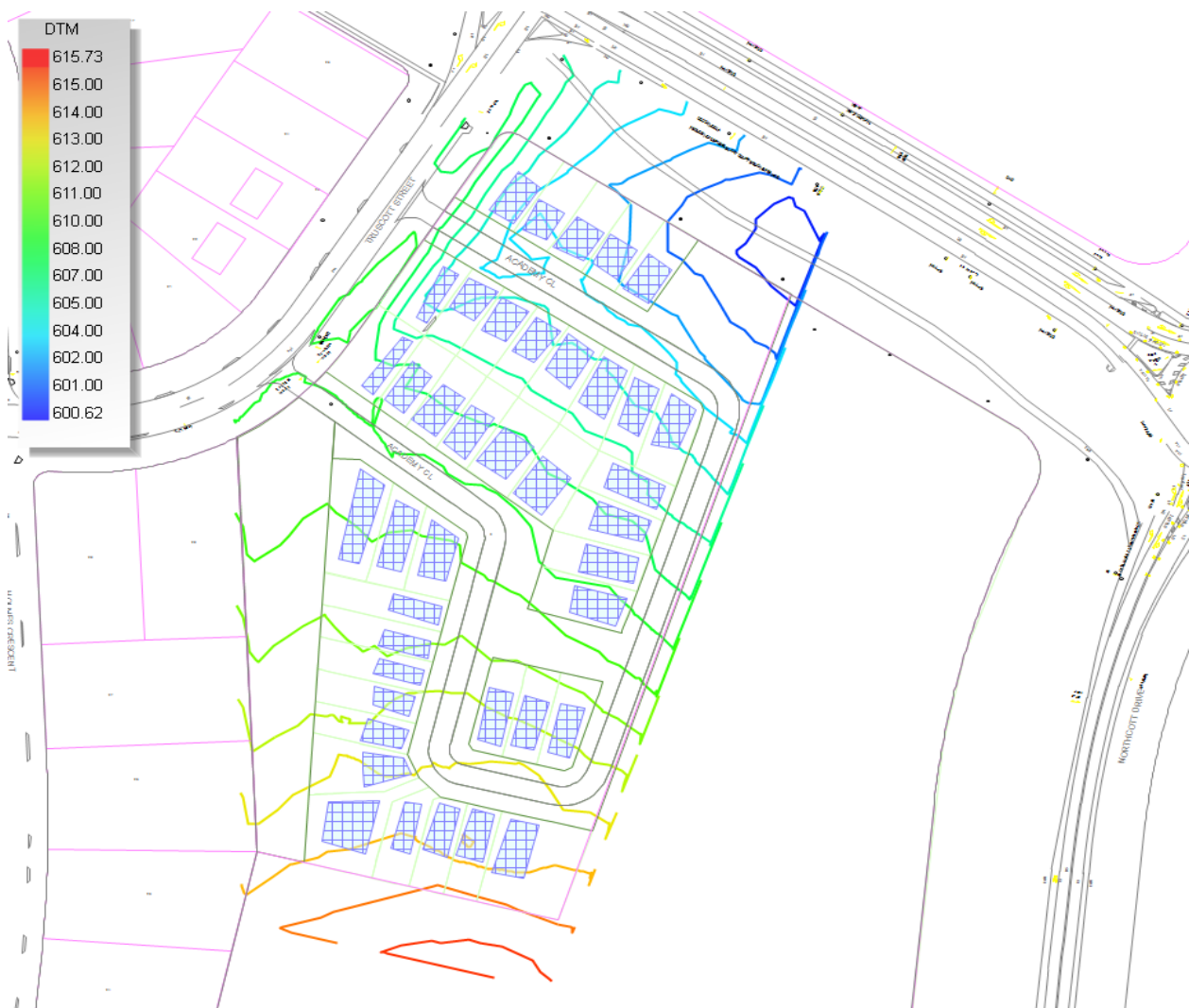
**Table 1 – Runoff Estimates**

### 3.3 Flood Modelling

The run-off estimates were used to produce synthetic hydrographs which have been used in XP-Storm to model the 2-dimensional flow of surface water across Block 3. For the model we have assumed that any existing Stormwater within or around Block 3 has a 100% blockage factor (either blocked or no longer in use) and has not considered this model.

A digital terrain model was developed for the catchments using the existing Clarke & Di Pauli Survey data and checked against the ACTMAPi Contours to confirm their validity. Even though the survey data was obtained in 2008, the only change to the site since this date was the removal of 22 dwellings from the site which were not picked up in the original survey, as such the original survey appears to be valid and able to be used for the intended flood modelling purposes.

A nominal building size was chosen for each of the 40 lots with the floor level of these buildings being set 500mm above the 1% AEP event providing 500mm of freeboard to each future dwelling



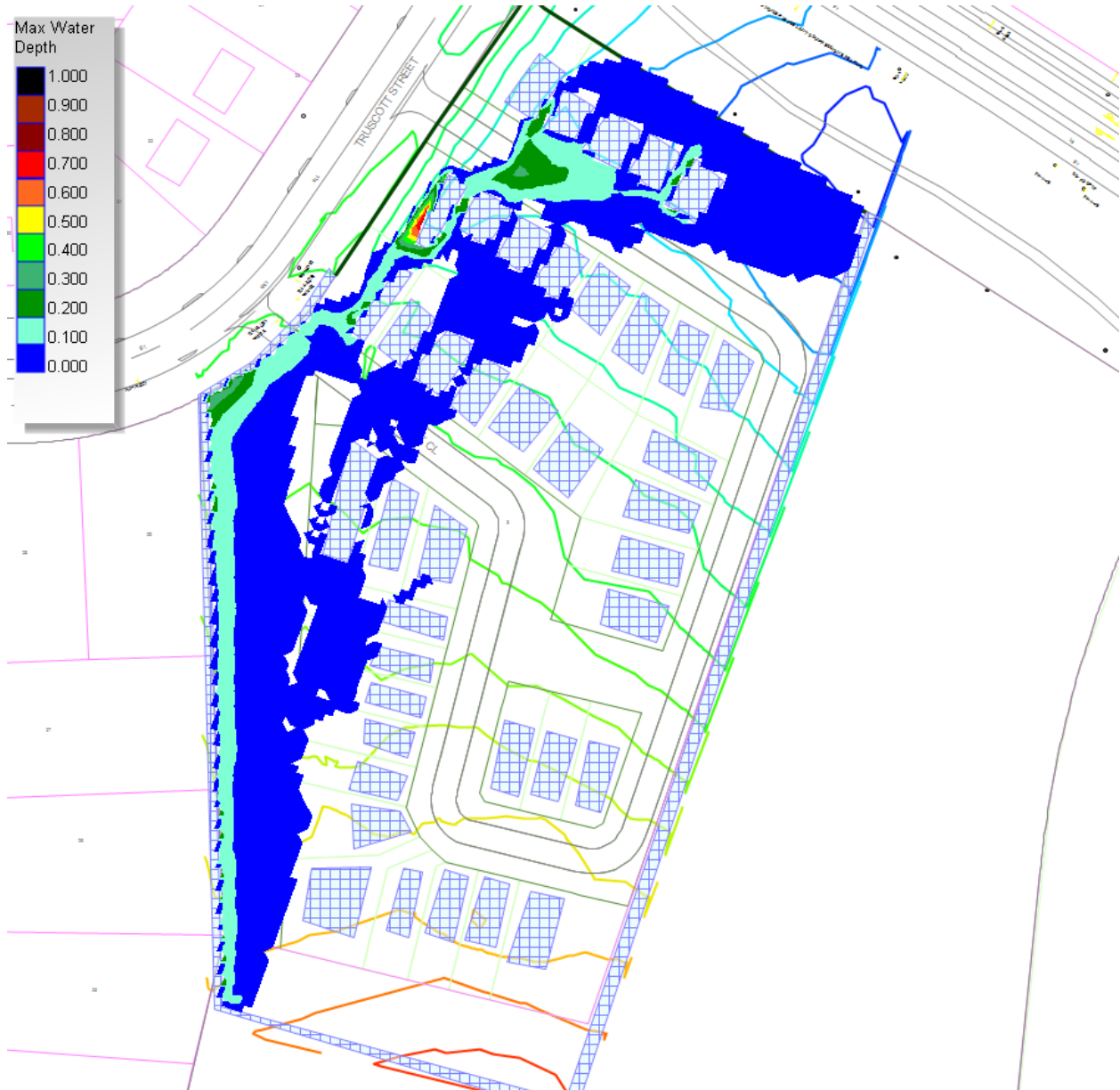
**Figure 9 – XP-Storm Model showing contours and nominal building locations within each lot**



## 3.4 Results

### 3.4.1 1% AEP EVENT

The results of the 1% AEP rainfall event is shown below in figure 10. The results show that Block 3 is somewhat affected.



**Figure 10 - XP-Storm Model Results – 1% AEP event**

The results show that the Western and Northern ends of the block become inundated due to the natural shape of the land with water depths typically ranging from 0mm-400mm (700mm was also observed at a localised low point near the northern driveway). The lots along these boundaries experience surface water ponding; as such these they will need to have minimum floor levels set ensuring that a minimum 500mm of freeboard is provided above the 1% AEP flood level to assist in preventing flood water inundation

The model shows that the lots along the southern boundary and those in the middle to eastern side of the site do not appear to be adversely affected; as such they are unlikely to require additional the additional 500mm of freeboard to nominate future floor levels.

The model demonstrates that the existing overland flow path is along the western boundary towards the northern proposed driveway than North-east towards the location of the existing tie.

Additional grading is proposed to ensure that overland flows are diverted along the new onsite roadway towards the location of the proposed stormwater tie (North-Eastern corner of the block). As the proposed tie location is at the lowest point on the block the grading required will be relatively easy to achieve and will also ensure that in major rainfall events will be contained to the road way and urban open spaces avoiding the need to pass though occupied lots.

A summary of the potential impact of the 1% AEP event on each of the 40 lots is shown in table 2. This table also includes information on the minimum floor levels required on the inundated blocks which require the additional 500mm of freeboard.

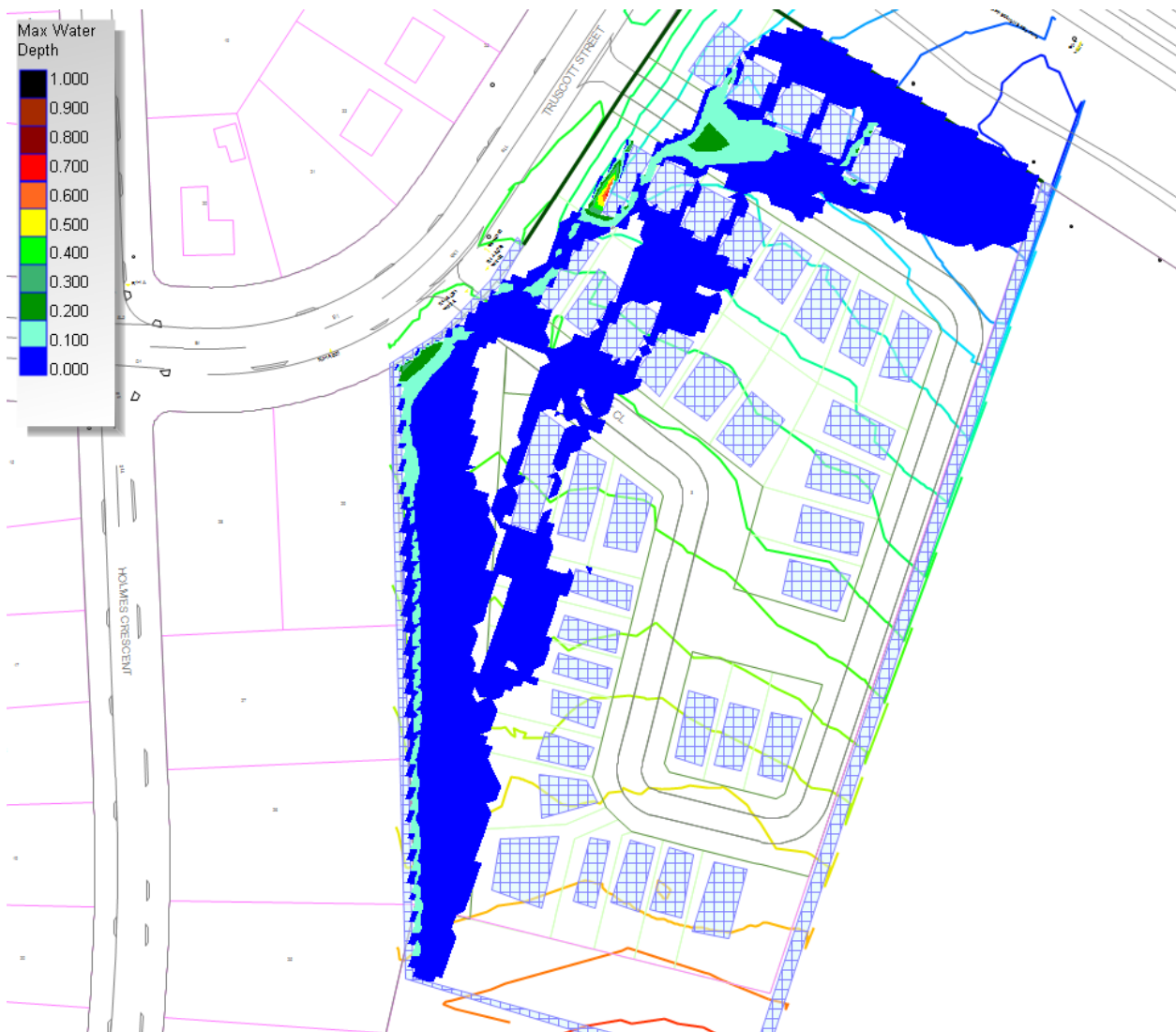


Lot number	Lot affected by 1% AEP event	Min FFL to achieve 500mm freeboard (m)
1	Yes	604.5
2	Yes	604.6
3	Yes	604.5
4	Yes	604.6
5	Yes	603.8
6	Yes	606.3
7	Yes	605.9
8	Yes	605.9
9	Yes	606.2
10	Yes	606.2
11	No	N/A
12	No	N/A
13	No	N/A
14	No	N/A
15	No	N/A
16	No	N/A
17	No	N/A
18	Yes	608.4
19	Yes	608.3
20	Yes	608.3
21	Yes	608.3
22	No	N/A
23	No	N/A
24	No	N/A
25	No	N/A
26	No	N/A
27	No	N/A
28	No	N/A
29	No	N/A
30	No	N/A
31	Yes	613.1
32	Yes	612.5
33	Yes	611.7
34	Yes	611.3
35	Yes	611.0
36	Yes	610.7
37	Yes	610.4
38	Yes	609.9
39	Yes	609.9
40	Yes	610.1

**Table 2 – Freeboard impact of 1% AEP event on the proposed lots**

### 3.4.2 10% AEP EVENT

Results of the 10% AEP event are shown on the below image. In summary this rainfall event follows a very similar flow path (at a lower flow rate and depth) to the major 1% AEP event. Under the TCCS design code it is required for this rainfall event to be contained within the minor stormwater network (in ground network). Therefore pits and pipes have been designed/ sized within Block 3 to ensure that this rainfall event is contained in and directed to the proposed 375mm tie located in the North eastern corner of the site. In addition to this pipework additional WSUD measures will need to be provided in accordance with authority requirements which are discussed within another report.



**Figure 11 - XP-Storm Model Results – 10% AEP event**



### 3.4.3 5% AEP EVENT

For additional information, the results of the 5% AEP event were also obtained and are shown on Figure 12. In summary this rainfall event follows a very similar flow path (at a lower flow rate and depth) to the major 1% AEP event. As this rainfall runoff is relatively similar to the overland flow direction and depths of the 1% AEP event, undertaking surface grading to divert the 1% AEP event will also direct the 5% AEP event towards the North eastern corner of the block and away from future dwellings.

In summary the stormwater measures required to contain the 10% AEP event within the new in-ground system and the above ground grading and roads to direct the 1% AEP event away from structures will assist in conveying the 5% AEP event away from future developments on the Lots within Block 3.



**Figure 12 - XP-Storm Model Results – 5% AEP event**

#### 4. CONCLUSION

In conclusion, Block 3 is currently considered as undeveloped and contains surface falls South to North at grades typically around 6%.

The site is located towards the top end of a catchment, this catchment enters the site as an overland flow path at the southern boundary at which point it follows the Western boundary before flowing North onto the southern verge of Fairbairn Avenue.

As part of the site works earthworks and grading will be undertaken to direct this overland flow to the North Eastern corner of the site (away from future lots) out onto the verge of Fairbairn Ave.

New in ground pipework is proposed within Block 3 which will be design and sized in order to contain the 10% AEP rainfall event as per the TCCS standards. This new in ground piping will connect via a new 375mm tie into the existing council main under the southern verge of Fairbairn Avenue.

Several of the proposed Western and Northern lots appear to become inundated in the 1% AEP event as such any future dwellings within these lots will need to be set at least 500mm above the 1% AEP water levels in accordance with the TCCS requirements.

In summary the documentation being provided will assist in keeping the 10% AEP rainfall event within the ground and direct the 1% AEP event away from the future development of lots. Minimum floor levels will be required across a few of the lots in order to maintain the 500mm freeboard above the 1% rainfall event.