FLOOD STUDY FOR REZONING

57-65 TOONGABBIE ROAD, TOONGABBIE

The sites looking from Toongabbie Road

23 June 2015

NTS Consultant Pty Ltd ABN 74 147 725 095
Stormwater and Civil Engineers
16 Tavistock Road
Homebush West NSW 2140
Tel: 0451 667 550

CONTENTS

1 EXECUTIVE SUMMARY

From the investigation, we would conclude as follows;

- According to Upper Parramatta River Catchment Management Study prepare dby the Upper Parramatta River Catchment Trust in March 2006, the site is not affected by the 1% AEP flood event. The current Flood Study also shows the site is not affected by the flood.
- The catchment area is 9.40 ha at the site. The estimated 100 year ARI flow rate is 2.33 m^3/s at Octavia Street.
- The capacity of the Council's 900 mm diameter pipe at Octavia Street is estimated as 2.06 m^3/s pipe flowing full using Manning's equation. The estimated overland flow rate along Octavia Street is approximately 1.33 m^3/s assuming 50% pipe blockage.
- According to the Council's Hydraulic Categories Map, Toongabbie Road near the properties is affected by the flood fringe (1%). The properties are not affected by the 100 year flood. The major overland flows are conveyed by Octavia Street.
- According to Council's Provisional Flood Hazard Categories Map, the sites are affected by Low Hazard (PMF). They are not affected by the 100 year ARI flood.
- The flood risk is negligible on Toongabbie Road near the site.
- Based on the above points, the lands can be rezoned for development activities.
- The flood study was carried out with limited survey information. Therefore, the estimated flood level levels are considered as approximate. The flood level information would be sufficient for the rezoning purpose.

2.0 INTRODUCTION

At the request of the owner, NTS Consulting Engineer has inspected the site on 14 June 2015 and addressed the flooding issues.

The site lies within the local government area of Holroyd City Council. Council's stormwater trunk drainage system (900 mm diameter pipe) runs through Octavia Street.

The land is 1.5% sloping down to the rear Park.

3 STUDY OBJECTIVES

The objectives of the study are to carry out a Flood Study Report in accordance with Council's requirements that are summarised below:

a) All habitable floor levels shall be above the 100 year ARI flood level plus a free board depending on the catchment area; and
b) All non habitable floor levels shall be above the 100 year ARI flood level plus a free board of 150mm

Council's general requirements are:

- Hydrology by Probabilistic Rational Method;
- Hydraulics modelling by HEC-RAS;
- Pipe 50% blocked;
- Cross Sections to extend at least 10 metres upstream and downstream of the site;
- Cross Sections at 5 metre interval;
- Velocity x depth ratio does not exceed 0.4;and
- Dry evacuation route is provided for any proposed dwellings along the driveway from the street.

4 HYDROLOGY AND HYDRAULICS ANALYSIS

a) Catchment definition

The catchment area is approximately 9.40 hectares at the site. The catchment area is mainly surrounded by residential buildings. The stormwater runoff from this catchment is collected and conveyed by the Council's trunk drainage system. Refer Appendix A for the catchment delineation map.

b) Hydrology

The catchment area was determined from the contour map. The probabilistic rational method was used to estimate the 100 year Average Recurrence Interval (ARI) flow rate.

The estimated 100 year ARI flow rates at Octavia Street is 2.33 m^3/s. The details are given in Appendix A

c) Hydraulics

The capacity of Council's 900 diameter pipe traversing through Octavia Street estimated as 2.06 m^3/s assuming pipe flowing full. The Manning's equation was used to estimate the capacity of the pipe. It was assumed the existing pipe was 50% blocked in the hydraulic analysis The detail calculations are given in Appendix A.

The survey was carried out for the purpose of modelling. They are not detailed and therefore, the estimated flood levels are considered as approximate only.

HEC RAS hydraulic model was used to determine the100 year ARI flood levels for the existing conditions.

According to Upper Parramatta River Catchment Management Study prepare dby the Upper Parramatta River Catchment Trust in March 2006, the site is not affected by the 1% AEP flood event.

HEC RAS models was setup for the existing conditions at the site to determine the flood levels and floor levels. The overland flow rates through properties were determined by subtracting the pipe (50%) and road flows from the catchment flow.
The subject sites are located outside the 100 year ARI (Average Recurrence Interval) flood extents and therefore, proposed dwellings development modelling is not warranted.
The estimated 100 year ARI flood levels for the existing conditions are summarised below.

Table: 100 year ARI (Average Recurrence Interval) Flood Levels for the existing Conditions

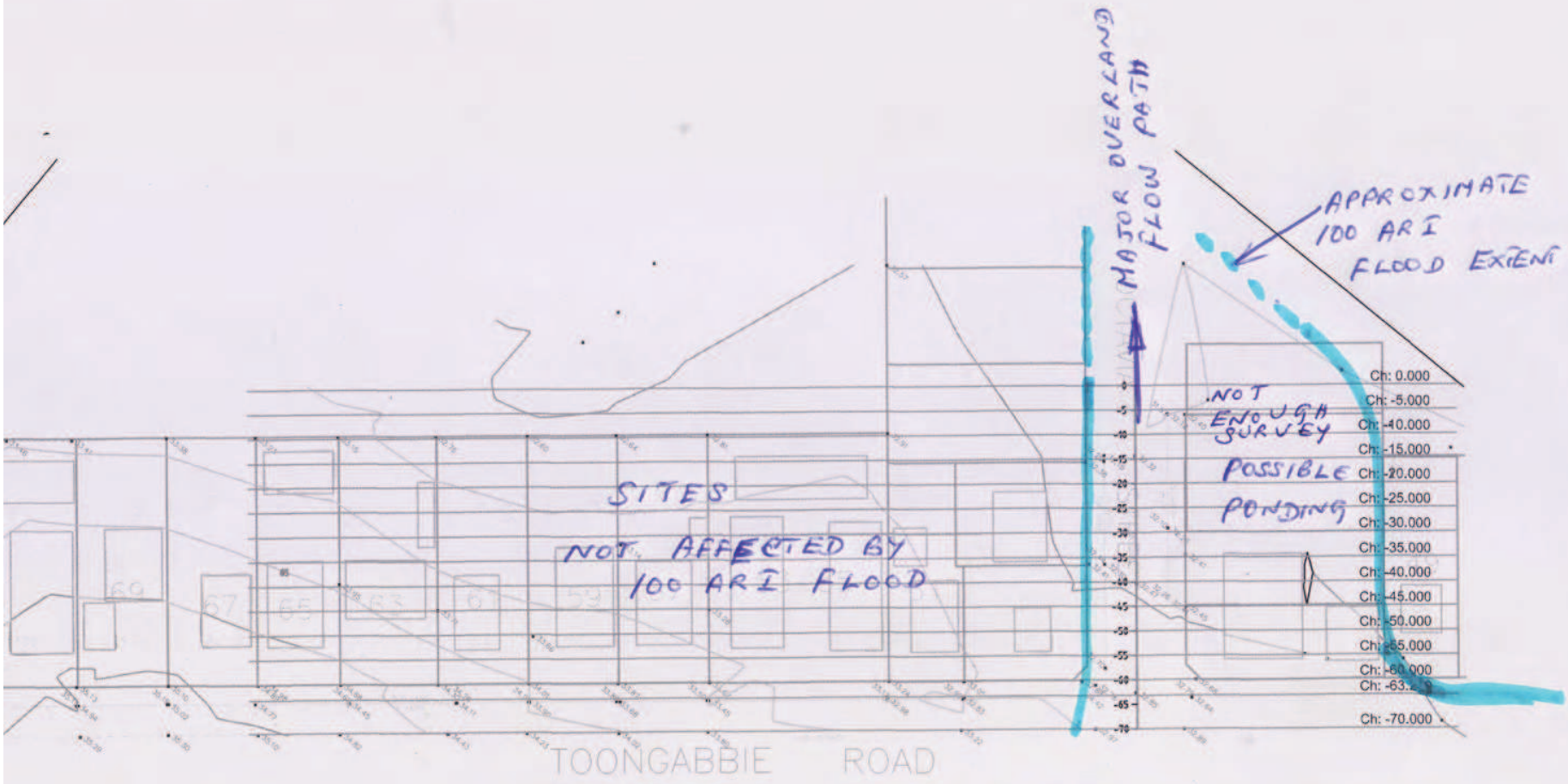
Location	100 ARI Flood Level (Existing Condition) Site catchment m AHD	Comments
Ch 70	33.03	Toongabbie Rd
Ch 63.25	32.89	Toongabbie Rd
Ch 60	32.85	Property Boundary
Ch 55	32.49	Site is not affected by flood
Ch 50	32.54	Site is not affected by flood
Ch 45	32.50	Site is not affected by flood
Ch 40	32.43	Site is not affected by flood
Ch 35	32.34	Site is not affected by flood
Ch 30	32.27	Site is not affected by flood
Ch 25	32.23	Site is not affected by flood
Ch 20	32.15	Site is not affected by flood
Ch 15	32.12	Site is not affected by flood
Ch 10	32.10	Downstream of site
Ch 5	32.08	Downstream of site
Ch 0	32.04	Downstream of site

d) Plans on which the assessment is made

- Council's approximate drainage layout map with contours;
- Council's Flood Levels letter to the owner dated 23 June 2015; and
- Survey plan supplied by the owner.

5 REFERENCES

- Australian Rainfall and Runoff, 2008, Institution of Engineers, Australia.
- NSW Floodplain Development Manual, 2005.



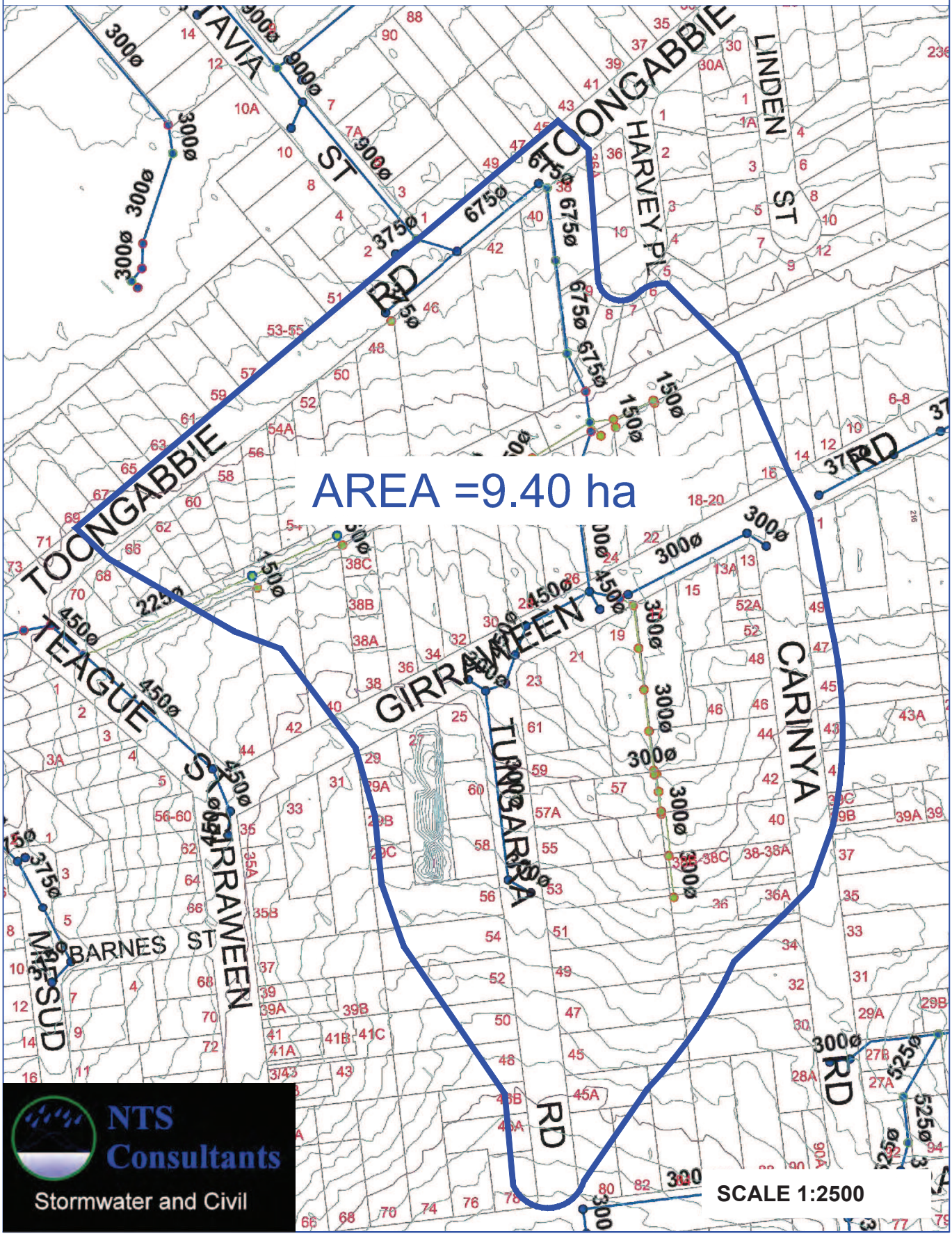
57- 65 TOONGABBIE ROAD EXISTING

The areal map of the site.

APPENDIX A

HYDROLOGY AND HYDRAULICS CALCULATIONS

51-65 TOONGABBIE ROAD, TOONGABBIE
CATCHMENT AREA MAP



Intensity-Frequency-Duration Table

Location: 33.800S 150.950E NEAR.. 57 Toongabbie Road Toongabbie Issued: 23/6/2015

Rainfall intensity in mm/h for various durations and Average Recurrence Interval

Average Recurrence Interval

Duration	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	81.1	104	132	149	170	199	220
6Mins	75.9	97.5	124	139	160	186	206
10Mins	62.1	79.8	102	114	131	152	169
20Mins	45.4	58.1	73.9	82.8	94.8	110	122
30Mins	36.9	47.2	60.0	67.2	76.9	89.5	99.0
1Hr	25.0	32.1	40.8	45.8	52.4	61.1	67.7
2Hrs	16.5	21.2	27.1	30.5	35.0	41.0	45.4
3Hrs	12.8	16.5	21.2	24.0	27.6	32.3	35.9
6Hrs	8.33	10.8	14.0	15.8	18.3	21.5	24.0
12Hrs	5.41	7.01	9.19	10.5	12.2	14.4	16.1
24Hrs	3.49	4.55	6.03	6.90	8.05	9.56	10.7
48Hrs	2.19	2.87	3.85	4.44	5.20	6.22	7.00
72Hrs	1.62	2.13	2.88	3.34	3.92	4.71	5.32

(Raw data: 32.13, 7.02, 2.13, 60.89, 14.36, 4.71, skew=0.00, F2=4.3, F50=15.83)

Calculation of Overland Flow Times - Chapter 14 AR&R
57-65 Toongabbie Road Toongabbie

$t=6.94(L.n^*)^{0.6} / I^{0.4}.S^{0.3}$

Where t is the overland flow time - minutes
L is the flow length - metres
n* is a surface roughness or retardance coefficient - 0.01 to .4
I is the rainfall intensity - mm/h
S is the slope - m/m

L	580
n*	0.05
S	0.022
$tI^{0.4}$	**164.46**

Duration	Average Recurrence Interval(years)				
(mins)	**2**	**5**	**10**	**20**	**100**
10	79.8	102	114	131	169
15	69.0	88.0	98.4	113.0	146.0
20	58.1	73.9	82.8	94.8	110.5
26	51.6	65.6	73.4	84.1	103.6
30	47.2	60.0	67.2	76.9	99.0

Value of $t.I^{0.4}$ corresponding to Above intensities

Duration	Average Recurrence Interval(years)				
(mins)	**2**	**5**	**10**	**20**	**100**
10	57.7	63.6	66.5	70.3	77.8
15	81.6	89.9	94.0	99.4	110.1
20	101.6	111.8	117.0	123.5	131.3
26	125.9	138.6	145.0	153.1	**166.4**
30	140.2	154.3	161.5	170.4	188.5

Catchment: 57-65 Toongabbie Road Toongabbie

Estimation of Flowrates by Rational Method

The calculations are based on the procedure given in Chapter 14, AR&R, Volume 1, 1987

$^{10}I_1 = 45.8$ $C^1_{10} = 0.37664$

Runoff Coefficients

Section	Area ha	Imp-Fraction	Impervious Area ha	C_{10}	C_2	C_5	C_{20}	C_{100}
57 Toongabbie	9.4	0.65	6.11	0.717	0.609	0.681	0.753	0.860

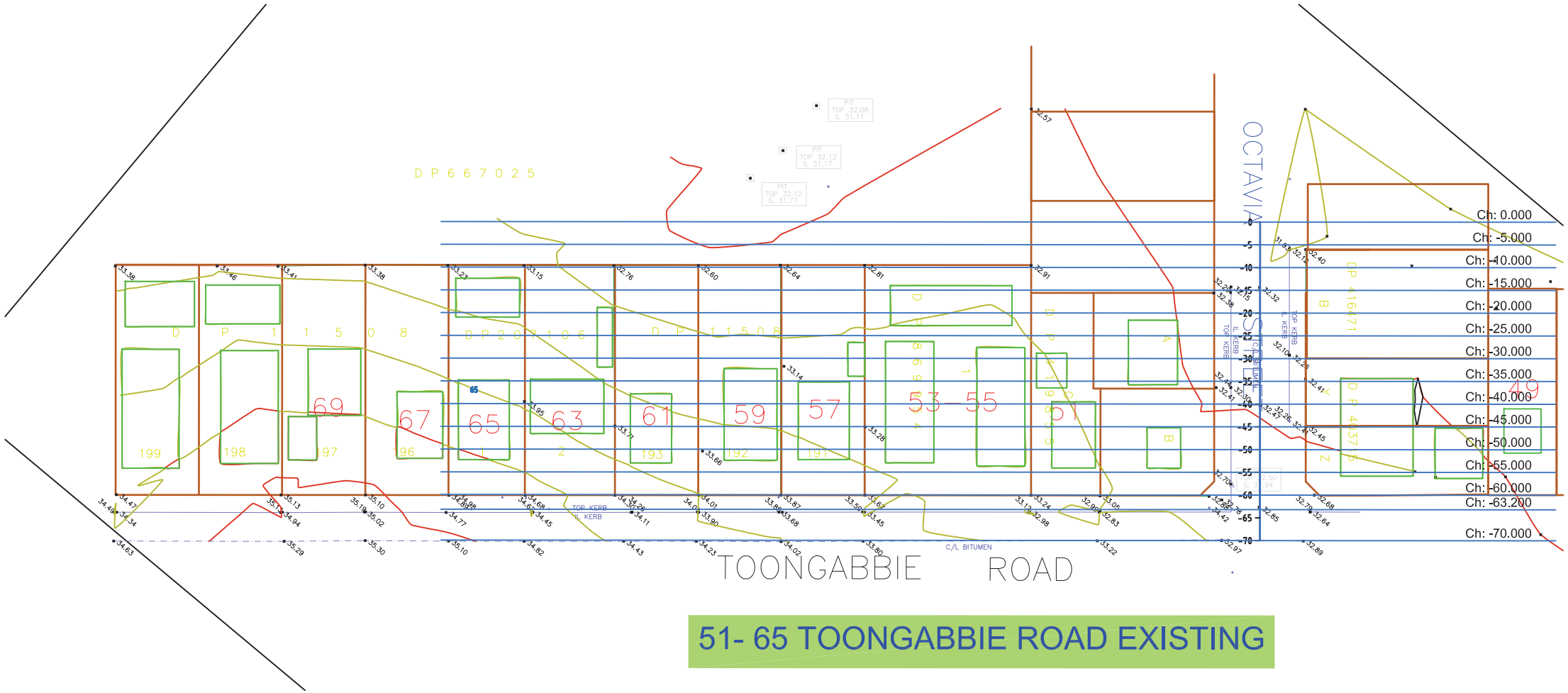
Design Flow Rates for Various Duration

Section	Time of Conc.(t_c) Minutes	I_2 mm/h	Q_2 m^3/s	I_5 mm/h	Q_5 m^3/s	I_{10} mm/h	Q_{10} m^3/s	I_{20} mm/h	Q_{20} m^3/s	I_{100} mm/h	Q_{100} m^3/s
57 Toongabbie	26	51.6	0.82	65.6	1.17	73.4	1.37	84.1	1.65	103.6	**2.33**

Pipe Flowing Full - Capacity

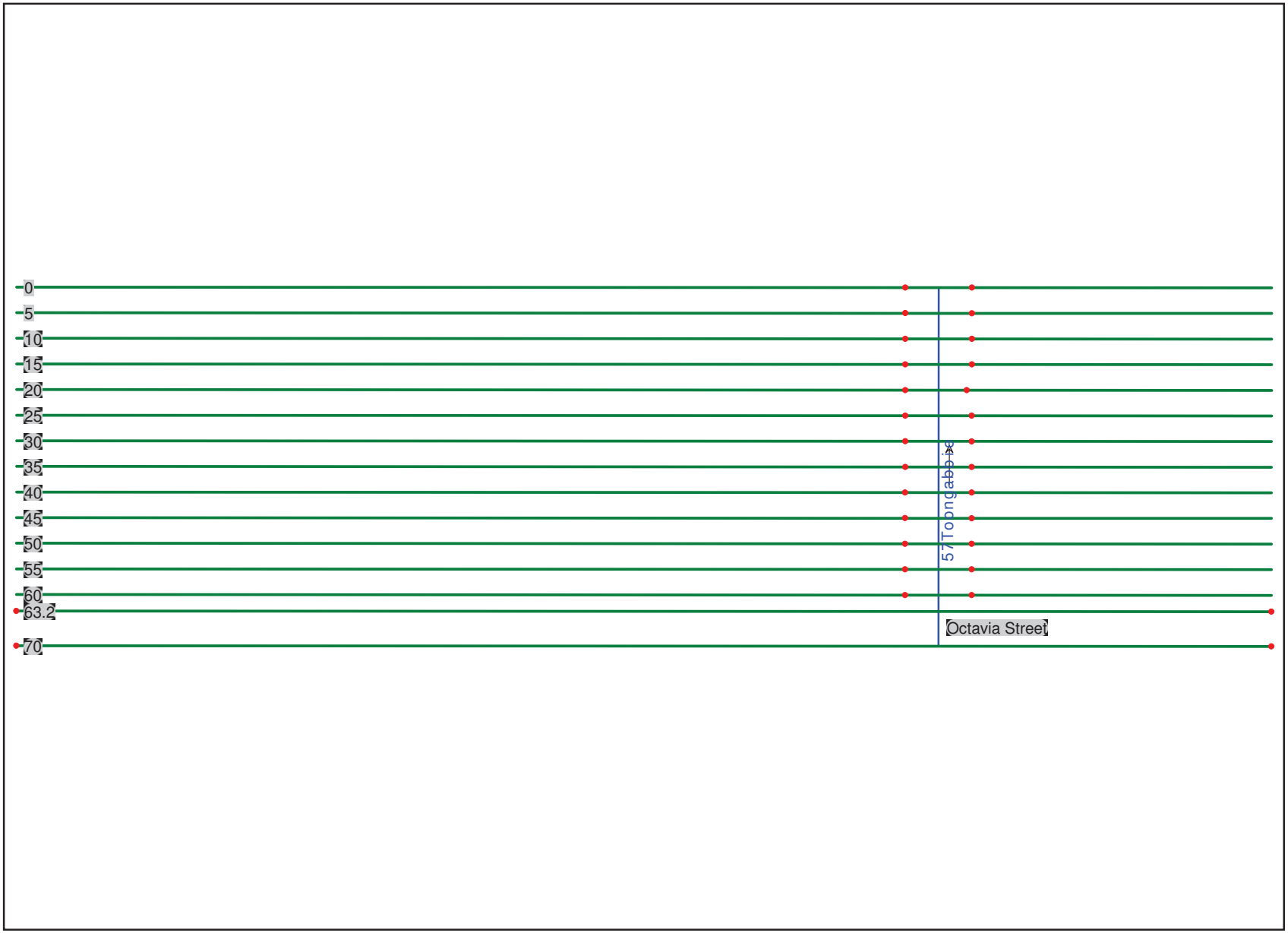
57-65 Toongabbie Road Toongabbie

Pipe Diameter - mm	**900**	
Mannings Roughness (.0011 - .014)	0.014	
Pipe Slope - m/m Eg. 1% = .01	0.015	
Pipe Flow(m3/s)	**2.060**	
Assuming 50% blockage - Flow rate during major storm event=	**1.030**	**m3/s**



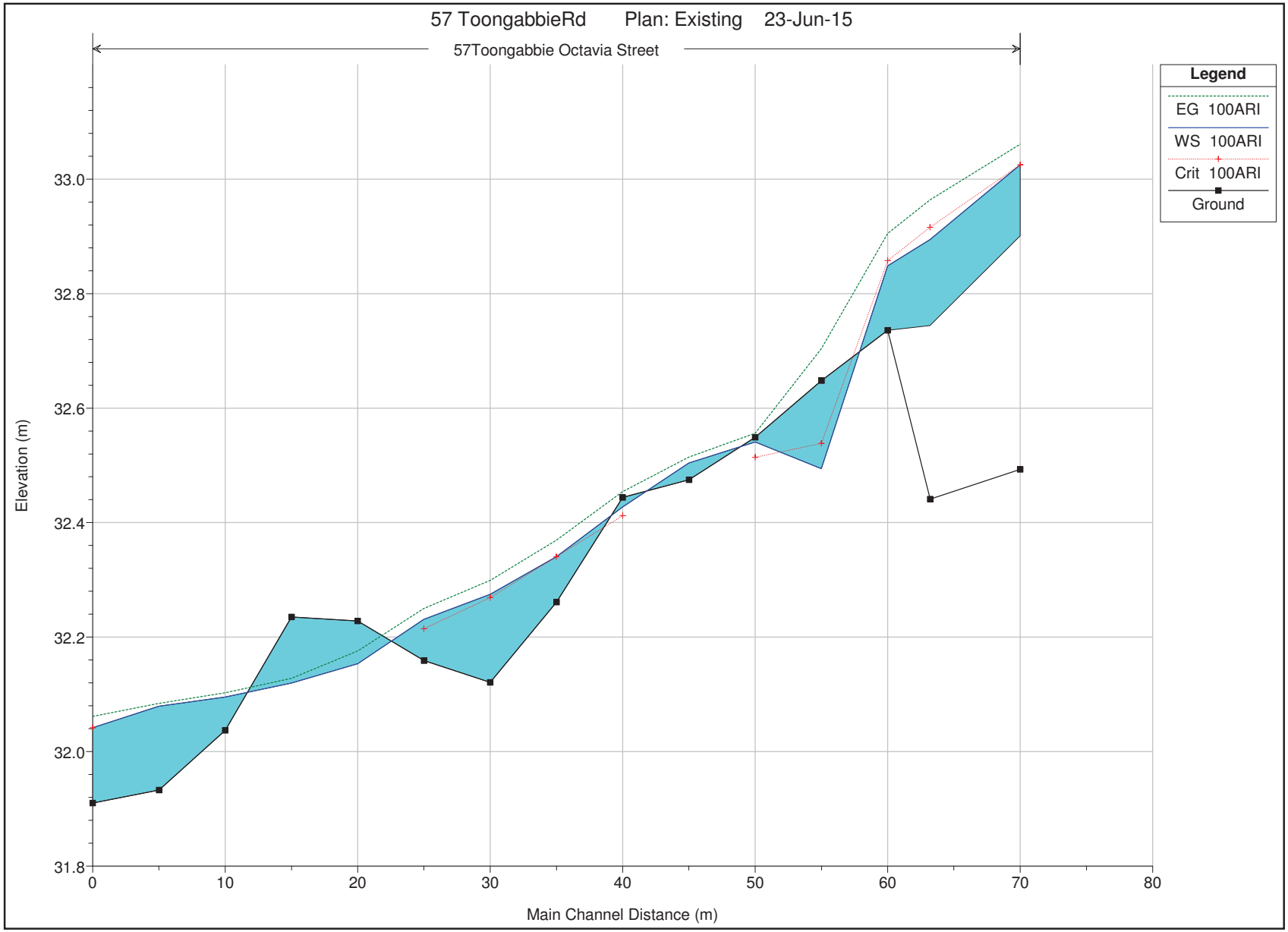
51- 65 TOONGABBIE ROAD EXISTING

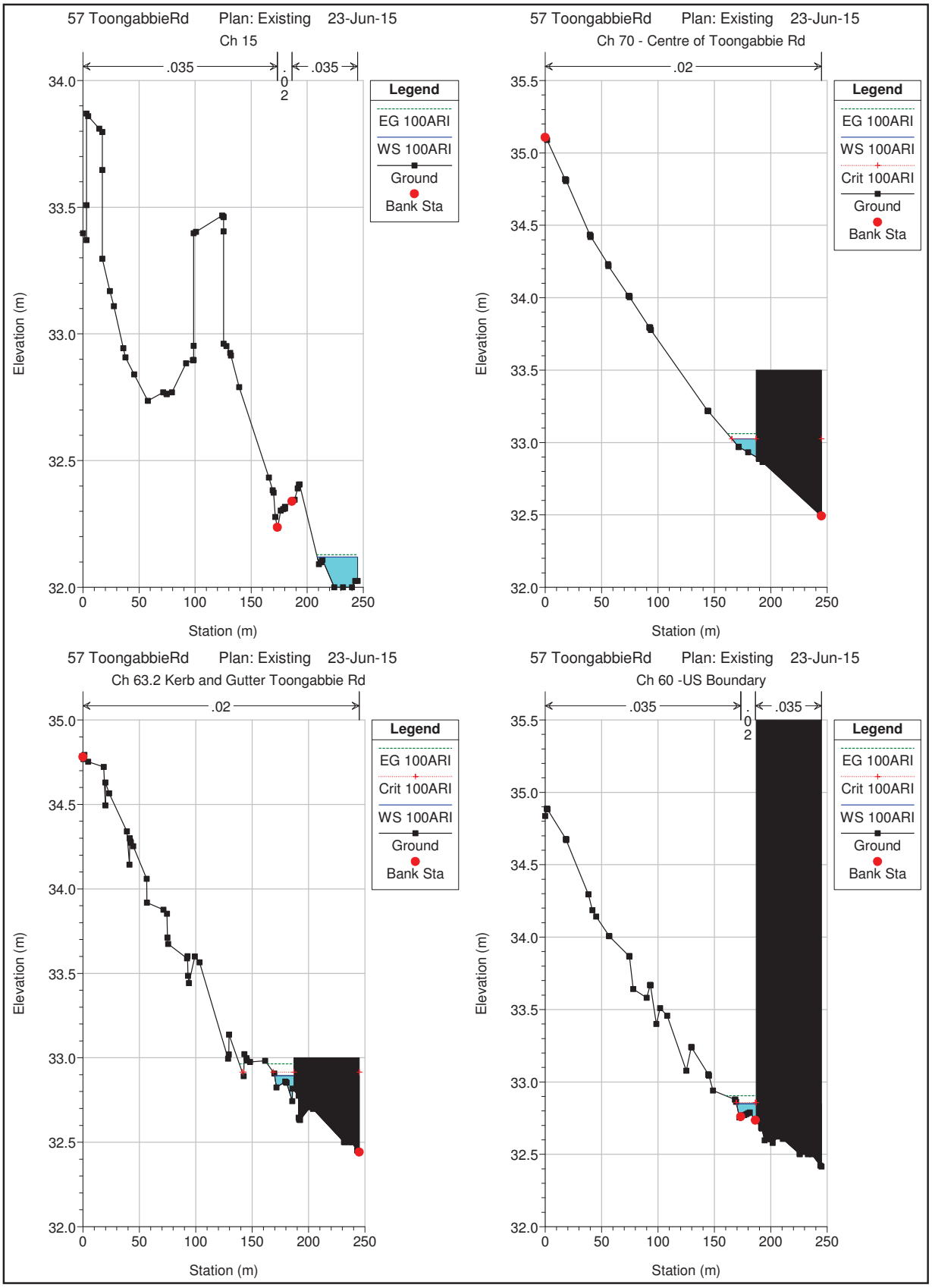

Ch: 0.000
Ch: -5.000
Ch: -10.000
Ch: -15.000
Ch: -20.000
Ch: -25.000
Ch: -30.000
Ch: -35.000
Ch: -40.000
Ch: -45.000
Ch: -50.000
Ch: -55.000
Ch: -60.000
Ch: -63.200
Ch: -70.000
Toongabbie Rd
TOONGABBIE ROAD
OCTAVIA STREET
51- 65 TOONGABBIE ROAD EXISTING


0
5
10
15
20
25
30
35
40
45
50
55
60
63.2
70
57 Toronto
Octavia Street

HEC-RAS Plan: Exist River: 57Toongabbie Reach: Octavia Street Profile: 100ARI

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)	
Octavia Street	70	100ARI	1.30	32.90	33.03	33.03	33.06	0.009427	0.84	1.55	21.47	1.00
Octavia Street	63.2	100ARI	1.30	32.74	32.89	32.92	32.96	0.021127	1.17	1.11	17.24	1.46
Octavia Street	60	100ARI	1.30	32.74	32.85	32.86	32.90	0.014336	1.10	1.32	17.32	1.25
Octavia Street	55	100ARI	1.30	32.65	32.49	32.54	32.70	0.242622		0.64	11.60	0.00
Octavia Street	50	100ARI	1.30	32.55	32.54	32.51	32.56	0.007762		2.37	29.33	0.00
Octavia Street	45	100ARI	1.30	32.47	32.50		32.51	0.008598	0.28	2.92	46.76	0.73
Octavia Street	40	100ARI	1.30	32.44	32.43	32.41	32.45	0.017454		1.79	21.09	0.00
Octavia Street	35	100ARI	1.30	32.26	32.34	32.34	32.37	0.016442	0.92	1.90	33.12	1.26
Octavia Street	30	100ARI	1.30	32.12	32.27	32.27	32.30	0.007142	0.82	2.28	32.24	0.90
Octavia Street	25	100ARI	1.30	32.16	32.23	32.21	32.25	0.012572	0.72	2.14	29.91	1.07
Octavia Street	20	100ARI	1.30	32.23	32.15		32.18	0.016640		1.96	25.54	0.00
Octavia Street	15	100ARI	1.30	32.24	32.12		32.13	0.005304		3.17	36.14	0.00
Octavia Street	10	100ARI	1.30	32.04	32.10		32.10	0.004676	0.32	3.39	41.83	0.60
Octavia Street	5	100ARI	1.30	31.93	32.08		32.08	0.002666	0.45	4.46	58.44	0.53
Octavia Street	0	100ARI	1.30	31.91	32.04	32.04	32.06	0.008666	0.90	2.81	53.27	0.98


57 ToongabbieRd Plan: Existing 23-Jun-15
57Toongabbie Octavia Street
Legend
EG 100ARI
WS 100ARI
Crit 100ARI
Ground
Elevation (m)
33.0
32.8
32.6
32.4
32.2
32.0
31.8
0
10
20
30
40
50
60
70
80
Main Channel Distance (m)


57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 15
.035
.02
.035
Legend
EG 100ARI
WS 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 70 - Centre of Toongabbie Rd
.02
Legend
EG 100ARI
WS 100ARI
Crit 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 63.2 Kerb and Gutter Toongabbie Rd
.02
Legend
EG 100ARI
Crit 100ARI
WS 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 60 -US Boundary
.035
.02
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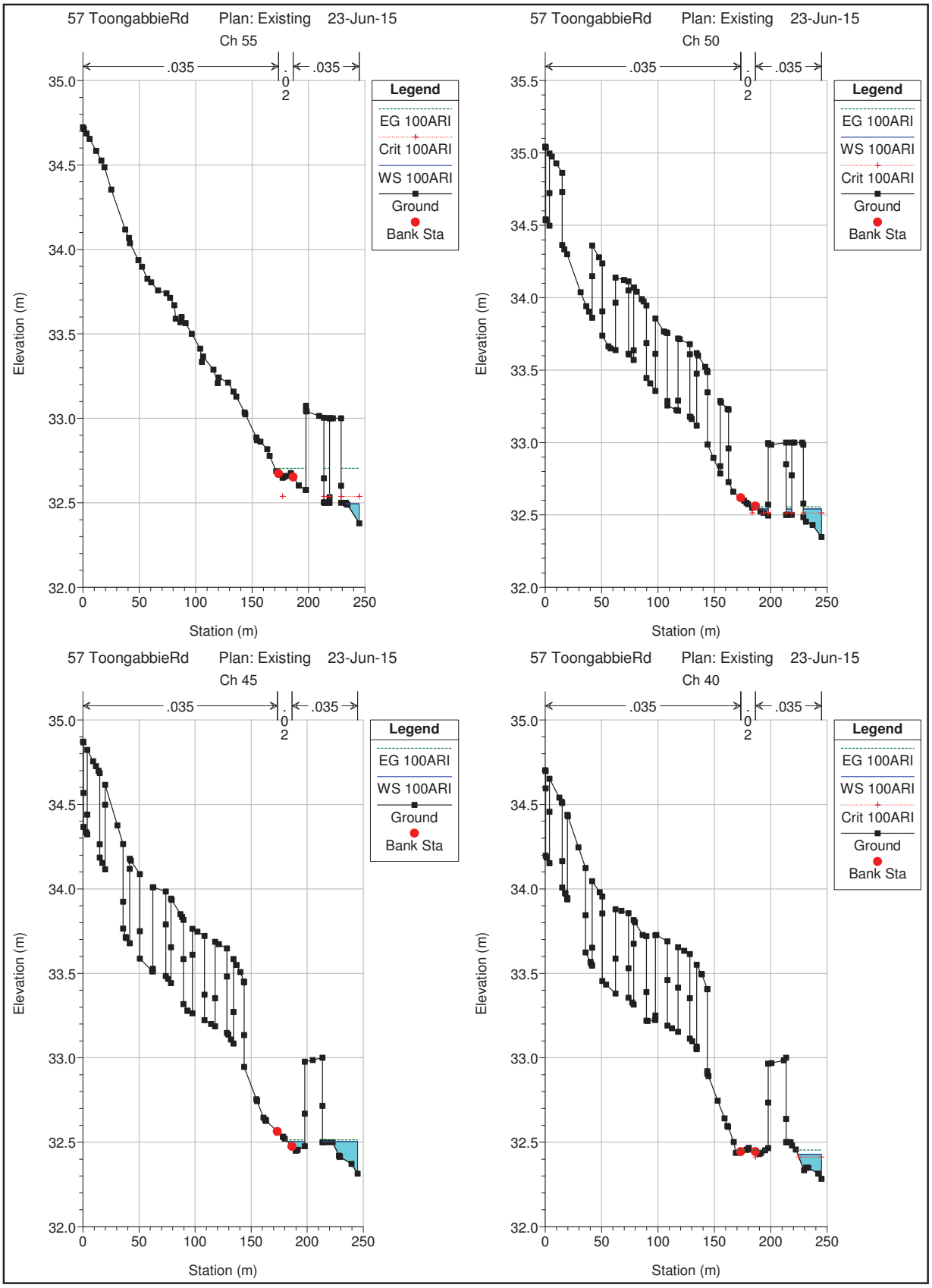
Legend
EG 100ARI
Crit 100ARI
WS 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)


57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 55
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Legend
EG 100ARI
Crit 100ARI
WS 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 50
.035
.02
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Legend
EG 100ARI
WS 100ARI
Crit 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 45
.035
.02
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Legend
EG 100ARI
WS 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 40
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.02
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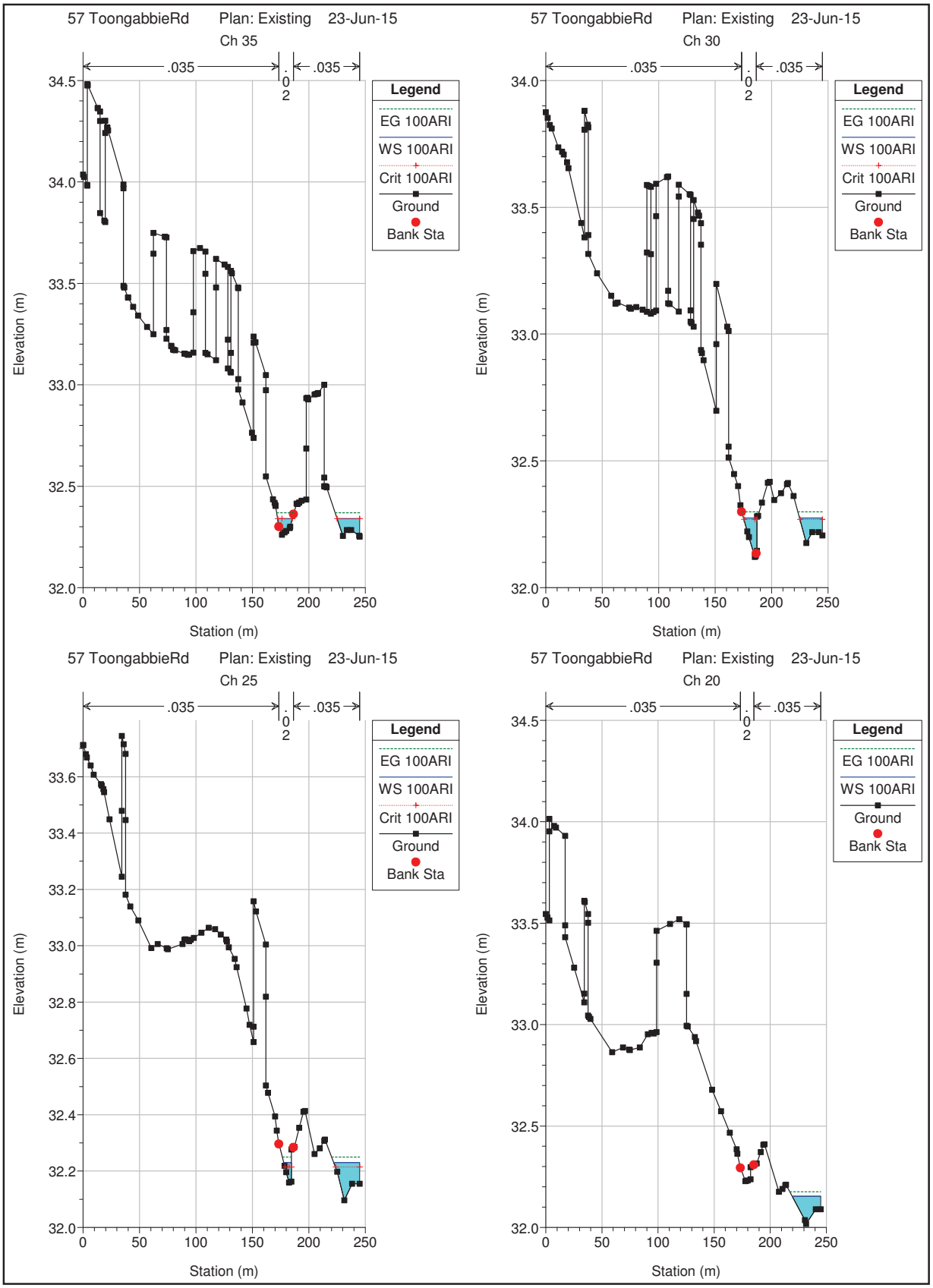
Legend
EG 100ARI
WS 100ARI
Crit 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)


57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 35
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.035
0.2
Legend
EG 100ARI
WS 100ARI
Crit 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 30
.035
.035
0.2
Legend
EG 100ARI
WS 100ARI
Crit 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 25
.035
.035
0.2
Legend
EG 100ARI
WS 100ARI
Crit 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 20
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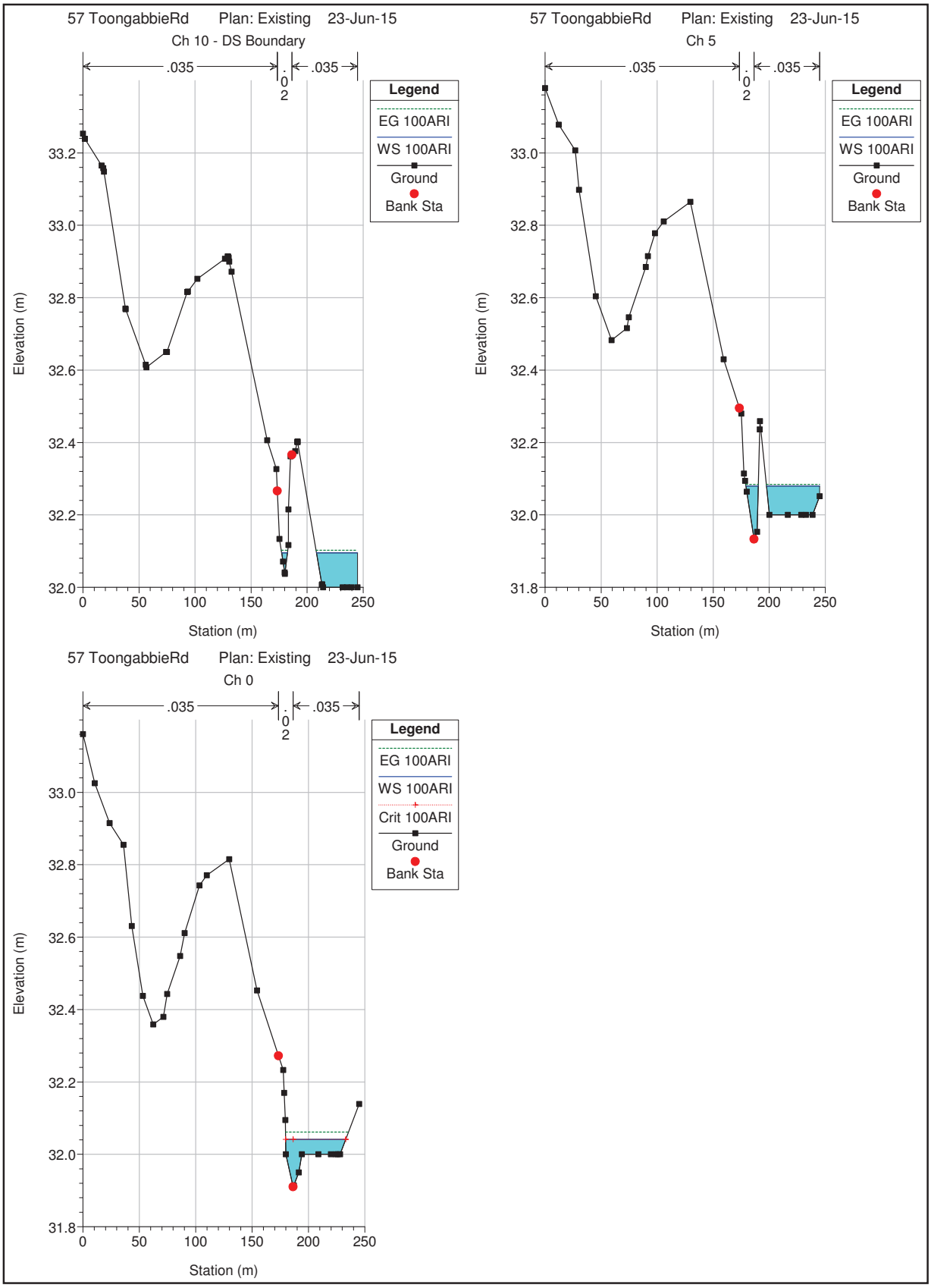
EG 100ARI
WS 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)


57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 10 - DS Boundary
.035
.02
.035
Legend
EG 100ARI
WS 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 5
.035
.02
.035
Legend
EG 100ARI
WS 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)
57 ToongabbieRd Plan: Existing 23-Jun-15
Ch 0
.035
.02
.035
Legend
EG 100ARI
WS 100ARI
Crit 100ARI
Ground
Bank Sta
Elevation (m)
Station (m)

APPENDIX B

PHOTOGRAPHS

57-65 Toongabbie Road, Toongabbie
23 June 2015

Octavia Street -Conveys major overland flows during heavy rain.

Toongabbie Road - subject to gutter flows from property flows.

57-65 Toongabbie Road, Toongabbie
23 June 2015

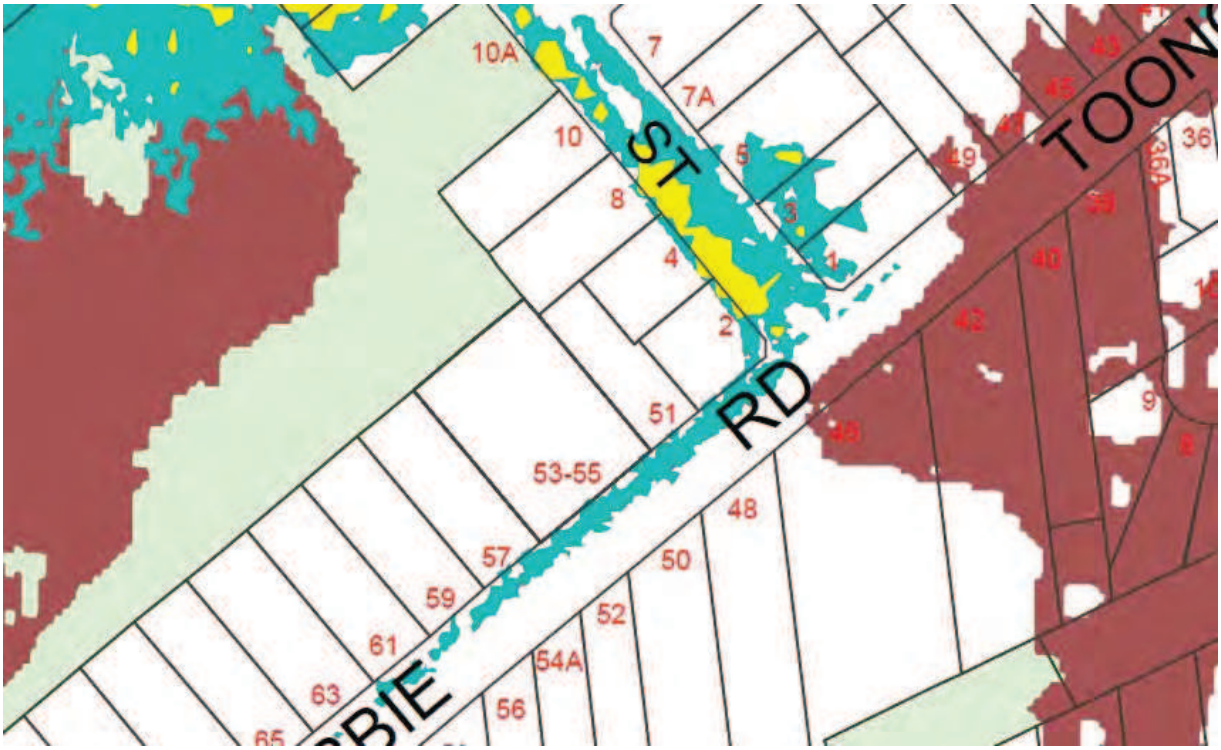
Park - Rear of properties. Partly affected by the main creek flooding.

Rear park - Council's pit in the park

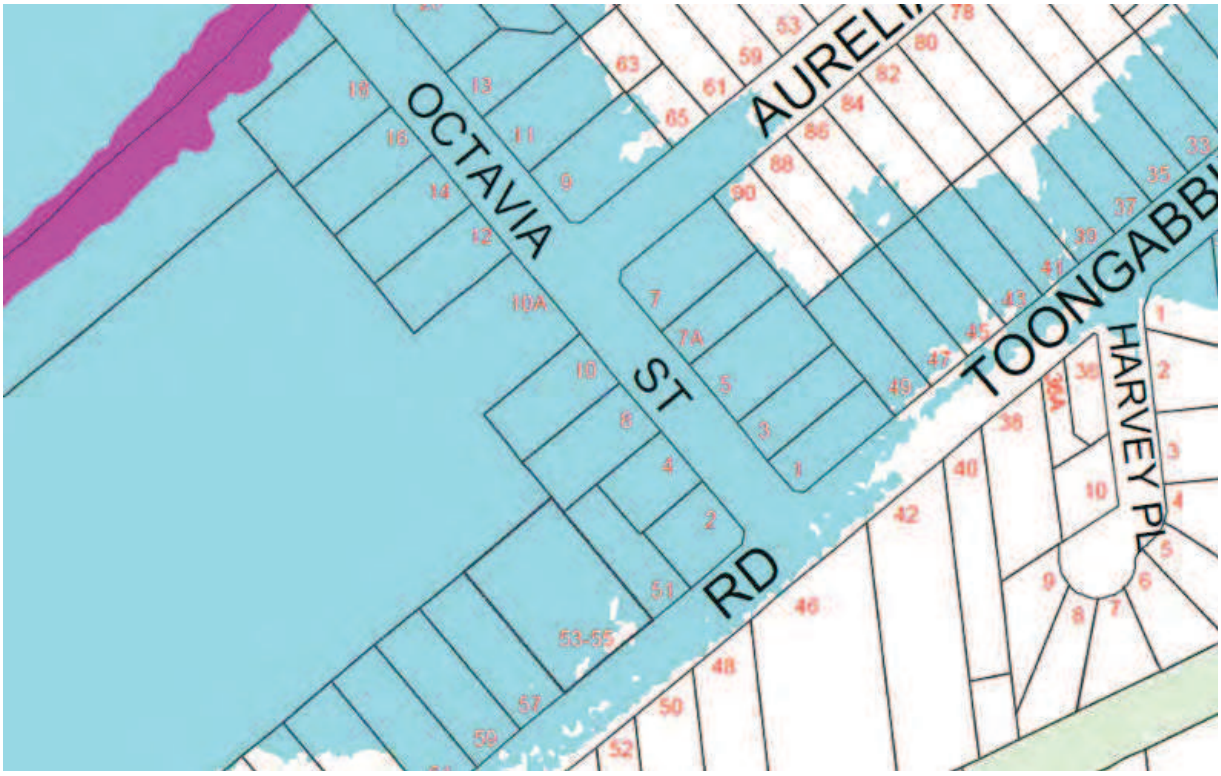
APPENDIX C

COUNCIL'S FLOOD LEVELS MAP

Council's Hydraulic Categories Map - Blue refers to Flood Fringe (1%)



Council's Provisional Flood Hazard - Low Hazard (PMF)



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DX 25408 Merrylands
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ABN 20 661 226 966

Engineering Services

Our Reference: SC7
Contact: R Sario
Telephone: 9840 9874

23 June 2015

Viji Augustus
23 Pittman Place
BELLA VISTA NSW 2153

Dear Sir/Madam

FLOOD LEVELS AT NO 57 TOONGABBIE ROAD, TOONGABBIE
BEING LOT 191 IN DP 11508

I refer to your request dated 17 June 2015, requesting flood information at the above property.

According to the information available to Council from the "Upper Parramatta River Catchment Management Study" prepared by the Upper Parramatta River Catchment Trust in March 2006, the above property is not affected by the 1% Annual Exceedance Probability (AEP) flood. However, it is located within the floor level control area, in which the floor levels of the new buildings are required to be set with sufficient freeboard above the adjacent flood level.

The 1% AEP flood level refers to a flood which has a 1% chance of being equalled or exceeded in any one year. It should be noted that a flood could occur that is more severe than the 1% AEP flood at any time.

The maximum 1% AEP flood level relevant to the subject property has been determined (see the attached plan) to Australian Height Datum (AHD) is:

1. At location A - 33.94 mAHD

Minimum habitable floor levels shall be 0.5m above the flood level at the upstream side of the structure. Minimum non-habitable floor levels (garages, laundry, sheds, etc.) shall be 0.15m above the flood level at the upstream side of the structure.

The relationship between these levels and the ground surface may be determined by a survey of the property undertaken by a Registered Surveyor.

It should be noted that where the development or redevelopment of the property is proposed, reference should be made to the relevant Development Control Plan with regard to flooding and drainage issues. Please include a copy of this letter and map with any Development Application that you may lodge with Council for the subject site.

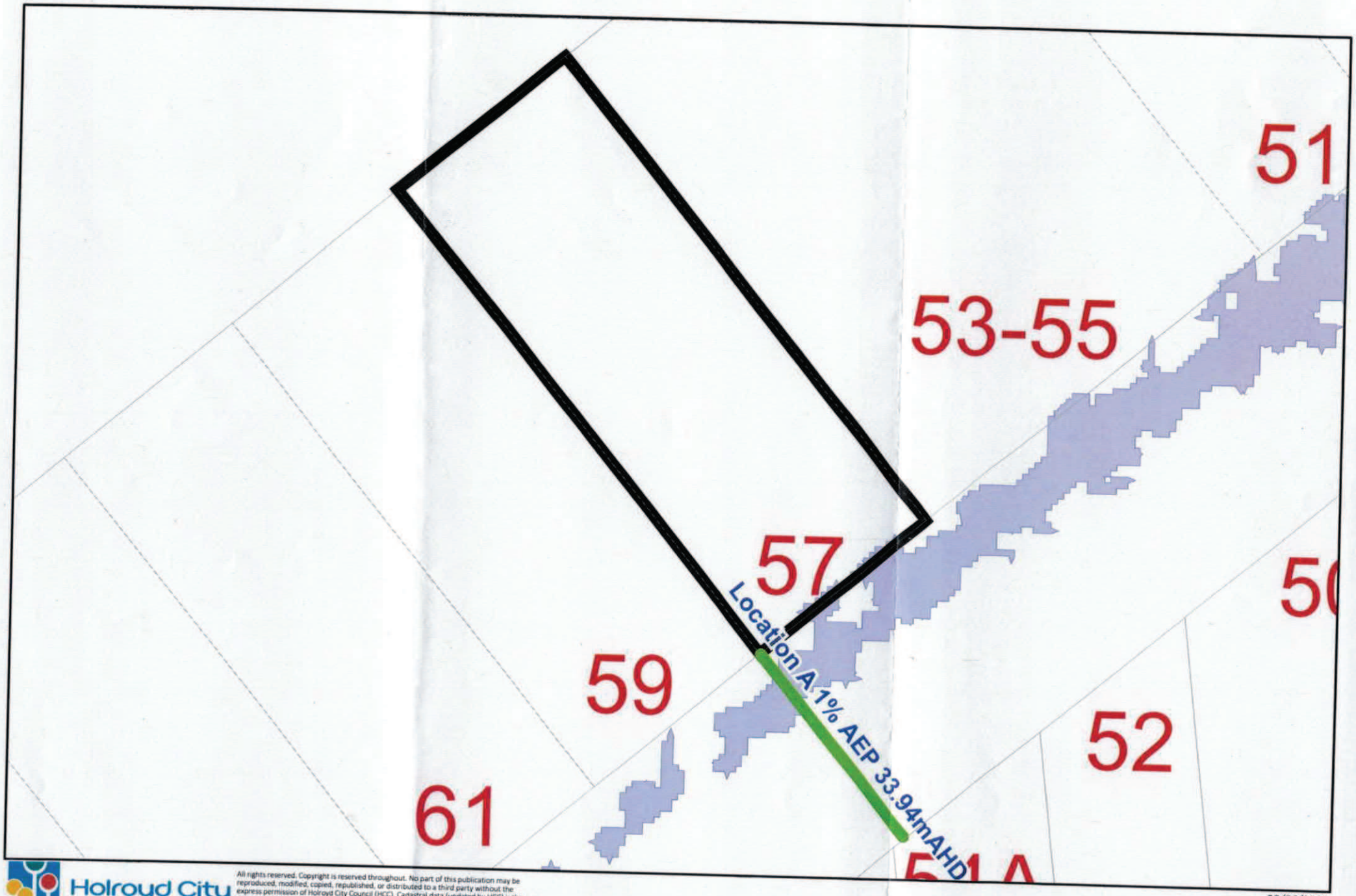
Flood levels are not static due to changing circumstances (e.g. revision of the flood model) and accordingly the above flood level is only valid for six months from the above date.

If you have any questions, please do not hesitate to contact Council's Senior Stormwater Engineer, Mr Mark Evens on 9840 9870 or Council's Drainage Engineer, Mr Rolyn Sario on 9840 9874.

Yours faithfully

Merv Ismay
GENERAL MANAGER

Per:
MANAGER TECHNICAL SERVICES



Holroyd City
a place for everyone

22/06/2015

N

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