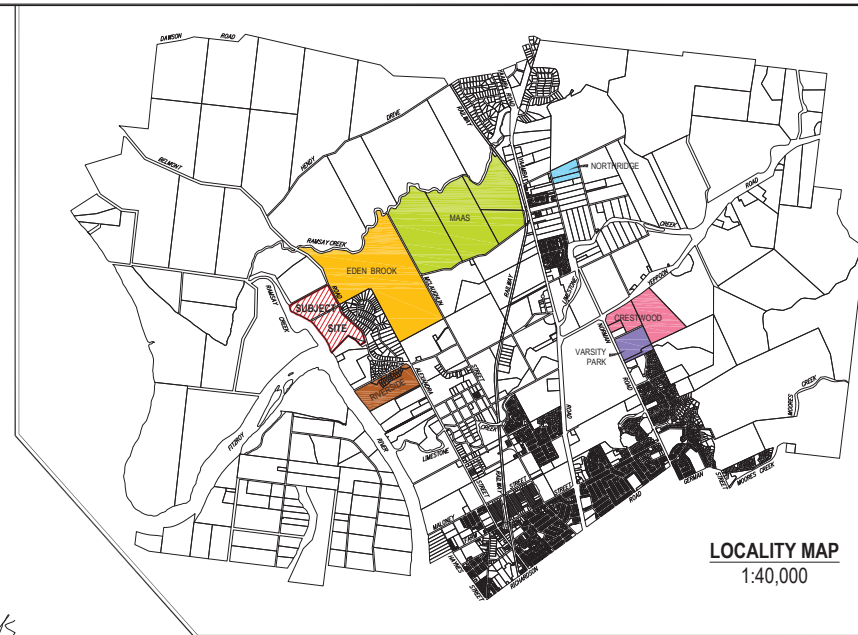
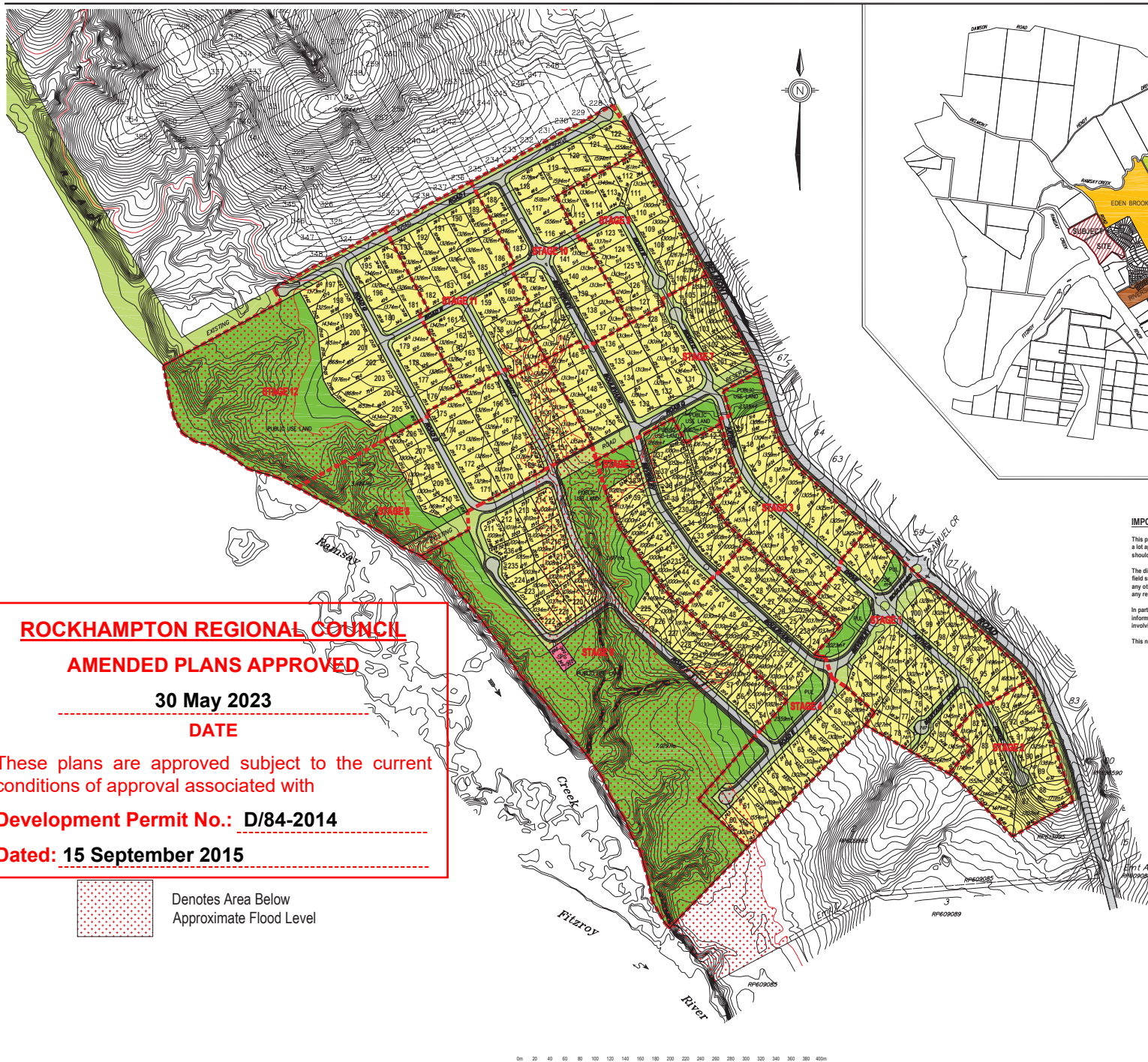




M. Birkbeck

project
**Riverside Waters Estate
Stages 1-12
Belmont Road, Parkhurst**

plan of
**Reconfiguration Plan
(237 Lots + Public Use Land)**

Lot 102 on RP860099
& Lot 129 on PL4021

Iga
Rockhampton Regional Council

rev	date	details	authoriser
A	8-10-2018	Initial Issue	RJKF
B	4-02-2019	Layout amended, subject Lot 2 removed	RJKF
C	26-05-2021	Layout (6 lots added) & staging amended	RJKF
D	3-06-2021	Lots 104-107 & 126-129 amended	RJKF
E	21-03-2023	Stgs 4-6,8 amended (add 8 lots, amend 3 lots)	RJKF
F	6-05-2023	Stage 5 add 1 lot, amend 8 lots & PUL	RJKF

created



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sheet no.
1 of 1
plan no.
7066-01-ROL



ROCKHAMPTON REGIONAL COUNCIL
AMENDED PLANS APPROVED

24 October 2019
DATE

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/84-2014

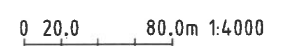
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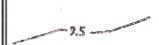
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GLENMORE HOLDINGS (AUST) PTY LTD
RIVERSIDE WATERS
STAGES 1 to 12
BELMONT RD, ROCKHAMPTON
OVERALL LANDSCAPE CONCEPT SKETCH

DWG No. 17-004/SK02 **A**

DO NOT SCALE - IF IN DOUBT ASK

LANDSCAPE LEGEND

-  Hydromulching coverage to proposed allotments (Refer future civil OPW approval)
-  Turf & Hydroseeding areas
-  Vegetated stormwater swales / channels (Refer future civil OPW approval)
-  Garden areas
-  Existing vegetation along natural inlets to be retained and enhanced
-  Existing vegetation to be preserved
-  Stormwater quality bio-retention area (Refer future civil OPW approval)
-  Existing surface contours
-  Design surface contours
-  Proposed Fitzroy River Q10 flood level (To be confirmed by future civil OPW approval)
-  Proposed Fitzroy River Q100 flood level (To be confirmed by future civil OPW approval)



SCALES

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GLENMORE HOLDINGS (AUST) PTY LTD

**RIVERSIDE WATERS
STAGES 1 to 12
BELMONT RD, ROCKHAMPTON
LANDSCAPE
SKETCH - 2**

DWG No. 17-004/SK04 A
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STREET/PARKLAND TREE LEGEND

- Accent Tree Planting (Example - Lilly Pilly Resilience)
- Evergreen Street Tree (Example - Tuckeroo)
- Evergreen Street Tree (Example - Weeping Lilly Pilly)
- Accent Tree Planting (Example - Buckinghamia)
- Feature Tree Planting (Example - Ficus Hillii)
- Feature Tree Planting (Example - Melaleuca)

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ROCKHAMPTON REGIONAL COUNCIL

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24 October 2019

DATE

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Dated: 15 September 2015

LANDSCAPE FEATURES LEGEND

1. ESTATE ENTRANCE ROUNDABOUT - Landscaping to consist of low height flowering plants.
2. ESTATE FEATURE WALL - Entrance statement to consist of a welcoming wall displaying the estate signage/logo surrounded by low height flowering plants and feature accent trees.
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5. BOUNDARY FENCING - Allotments backing onto Belmont Rd & Open Space/Parkland to have boundary fencing in accordance with the local authority requirements.
6. VERGE GARDEN AREA - Vegetation screening along the boundary fencing of Belmont Rd.
7. CONCRETE FOOTPATH - 1.2m (min.) wide concrete footpath in accordance with the local authority requirements.
8. TIMBER BOLLARD - Hardwood timber bollard in accordance with the Capricorn Municipal Development Guidelines standard drawings.
9. OUTDOOR EXERCISE STATION - Dual outdoor exercise station mounted to concrete slab covered with approved synthetic grass.
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- Feature Tree Planting (Example - Melaleuca)

LANDSCAPE LEGEND

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ROCKHAMPTON REGIONAL COUNCIL

AMENDED PLANS APPROVED

24 October 2019.

DATE

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/84-2014

Dated: 15 September 2015



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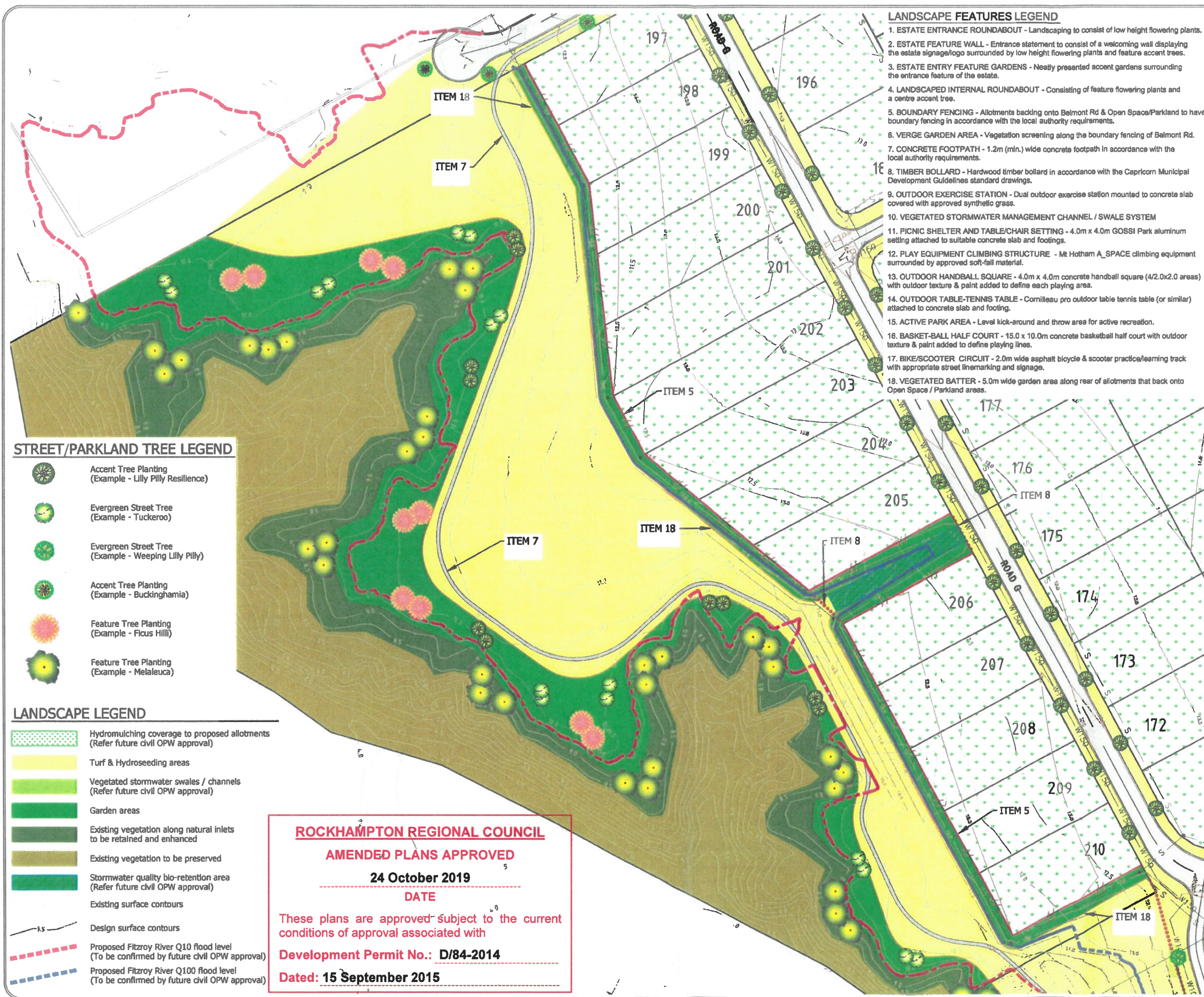
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RIVERSIDE WATERS
STAGES 1 to 12
BELMONT RD, ROCKHAMPTON
LANDSCAPE
SKETCH - 4

DWG No. 17-004/SK06 A

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- LANDSCAPE FEATURES LEGEND**
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ROCKHAMPTON REGIONAL COUNCIL
AMENDED PLANS APPROVED
24 October 2019
DATE
These plans are approved subject to the current conditions of approval associated with
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Dated: 15 September 2015

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No.	DATE	REMARKS
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GLENMORE HOLDINGS (AUST) PTY LTD
RIVERSIDE WATERS STAGES 1 to 12
BELMONT RD, ROCKHAMPTON
LANDSCAPE SKETCH - 7
DWG No. 17-004/SK09 **A**
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CONCEPTUAL STORMWATER MANAGEMENT PLAN



Proposed Residential Subdivision
Lot 102 on RP860099 and Lot 129 on PI402
54-102 and 263 Belmont Road, Parkhurst

Glenmore Holdings (Aust) Pty Ltd

12 September 2019

File No: K4887-003-A

ROCKHAMPTON REGIONAL COUNCIL

ADDITIONAL PLANS APPROVED

24 October 2019

DATE

These plans are approved and now incorporated into the approved suite of plans subject to the current conditions of approval associated with

Development Permit No.: D/84-2014

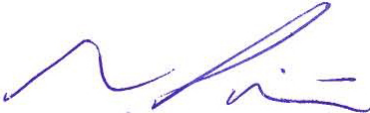
Dated: 15 September 2015

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DOCUMENT CONTROL SHEET

Title:	CONCEPTUAL STORMWATER MANAGEMENT PLAN
Document No:	K4887-0003
Original Date of Issue:	23 August 2019
Project Manager:	Aaron Pianta
Author:	Sarah Kirsch
Client:	Glenmore Holdings (Aust) Pty Ltd
Client Contact:	Russell Schirmer (Contour Consulting)
Client Reference:	54-102& 263 Belmont Road, Parkhurst
Synopsis:	This Conceptual Stormwater Management Plan describes the existing site characteristics, and corresponding stormwater quantity and quality management controls to be implemented during the construction and operational phase of the development.

Reviewed by RPEQ	Reg. No.	Signed	Date
Aaron Pianta	10423		23 August 2019

Revision/Checking History			
Revision No	Date	Checked By	Issued By
Draft	23 August 2019	Blake Stephens	Sarah Kirsch
A	12 September 2019	Blake Stephens	Sarah Kirsch

Distribution		
Recipient	No of Copies	Method
Contour Consulting – Russell Schirmer	1	PDF

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APPENDICES

Appendix A	Contour Consulting, <i>Overall Landscape Concept Sketch</i> (Ref: 17-004/SK02)
Appendix B	Knobel Engineers, <i>Pre Development Catchment Plan</i> (Ref: K4887/P001/A)
Appendix C	Knobel Engineers, <i>Post Development Catchment Plan</i> (Ref: K4887/P002/A)
Appendix D	Knobel Engineers, <i>Stormwater Sub Catchment Plan</i> (Ref: K4887/P005/A)
Appendix E	Knobel Engineers, <i>Stormwater Management Plan</i> (Ref: K4887/P003/A)
Appendix F	Knobel Engineers, <i>Sediment and Erosion Control Plan</i> (Ref: K4506/P004/A)
Appendix G	Knobel Engineers, <i>Sediment Basin Plan</i> (Ref: SK01)
Appendix H	Knobel Engineers, <i>Preliminary Pre Development Flood Storage Plan</i> (Ref: K4506/P006/A)
	Knobel Engineers, <i>Preliminary Post Development Flood Storage Plan</i> (Ref: K4506/P007/A)

1.0 INTRODUCTION

1.1 Background

Knobel Engineers has been commissioned by Glenmore Holdings (Aust) Pty Ltd to prepare an amended *Conceptual Stormwater Management Plan* (CSWMP), to support a development application for the Material Change of Use and Reconfiguring of a Lot (2 Lots into 222 Lots) at 54-102 and 263 Belmont Road, Parkhurst.

The original CSWMP was prepared by Brown Consulting (Ref: R12394 – Stormwater Management Report) dated December 2014.

This CSWMP has been provided in response to an Information Request (IR) dated 26 March 2019 (Ref: D/84 -2014) which requests an updated “Stormwater Quality Report” and “Stormwater Management Report” to reflect the revised layout accompanying the current development permit. This report includes both the stormwater management and stormwater quality components requested from the IR.

In preparing this CSWMP Knobel Engineers has considered the management of quality and quantity of stormwater during both construction and operational phases, including sediment and erosion controls.

1.2 Objectives

This CSWMP details the planning, layout and design of the stormwater management infrastructure for both the construction and operational phases of this development.

This CSWMP aims to:

- Establish the required performance criteria for the proposed stormwater quantity and quality improvement systems;
- Provide a design of stormwater infrastructure including stormwater quality improvement devices;
- Ensure the quality of stormwater discharging from the proposed development does not adversely impact on the water quality and ecological values of downstream watercourses;
- Ensure stormwater runoff is conveyed through the site to a lawful point of discharge (LPOD) in accordance with QUDM; and
- Provide reporting and monitoring mechanisms whereby the performance of this system can be measured enabling identification of corrective actions/alterations required to ensure the above mentioned objectives are maintained.

This CSWMP has been prepared in accordance with the IEAust *Australian Runoff Quality: Guide to Water Sensitive Urban Design*, Queensland State Planning Policy 2017, IPWEA *Queensland Urban Drainage Manual Fourth Edition (2017)*, Rockhampton Regional Council SC6.18 City– Stormwater management planning scheme and Design Guideline D5 –Capricorn Municipal Development Guideline.

1.3 Description of the Subject Site

1.3.1 Location

The subject site is located adjacent to Belmont Road in the suburb of Parkhurst and is situated along the Fitzroy River. The site has frontage to Belmont Road to the north east and backs onto the Fitzroy River, which runs along the site’s western boundary. The subject site comprises of Lot 102 on RP860099 and Lot 92 on SP224420 and covers a combined area of 53.5 ha, with details as summarised in Table 1 below and as located in Figure 1.

Table 1: Site Description

Developer	Lot and Property Description	Street Address
Contour Consulting	Lot 102 on RP86009 & Lot 129 on PL4021	54-102 and 263 Belmont Road, Parkhurst

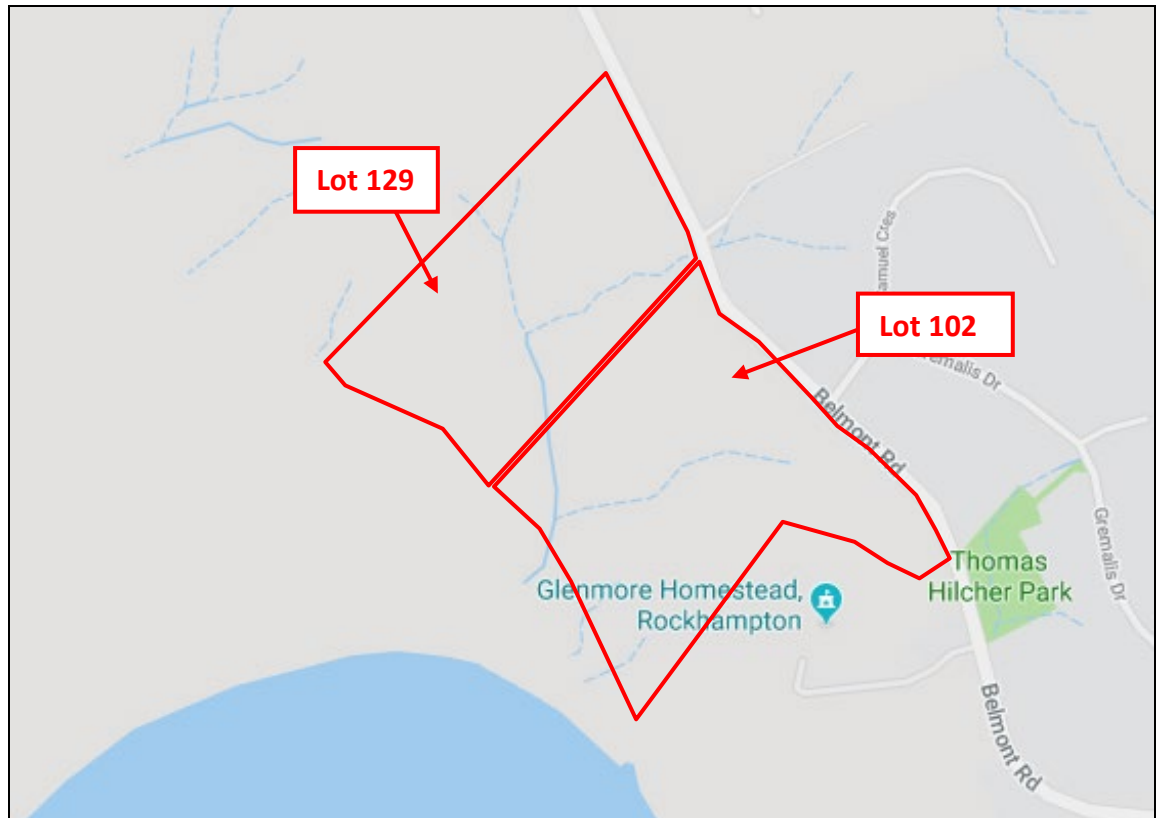


Figure 1: Site Location Plan (sourced from nearpmaps)

1.3.2 Site Topography

The subject site ultimately grades down to the southwest towards the junction of Ramsey Creek and the Fitzroy River. Spot heights on site range from RL 33 m AHD along the east boundary of the site to RL 4 m AHD along the banks of the Ramsey Creek/Fitzroy River junction with the grades varying throughout the site. There is an existing natural drainage path which runs through the middle of the subject site that discharges into the Ramsey Creek/Fitzroy River junction. Stormwater from the northeast and northwest of the subject site drain naturally into this channel which forms the major overland flow path for the pre development scenario.

1.3.3 Vegetation and Land Use

The Lots within the subject site are currently classified as being rural lots and mainly comprise of vacant land with average vegetation and grass coverage. A singular dwelling situated in the far eastern corner of the proposed development area is the only building within the subject development site. There are rural residential lots opposite to the subject site with the region to the south east being classified as special purpose land. Refer to Figure 2 for the aerial image of the subject site.



Figure 2: Aerial Photograph of the Site (sourced from CoGC City Plan Interactive mapping)

1.3.4 Description of Proposed Development

The proposed development for the site consists of a Material Change of Use for the Reconfiguration of a Lot from 2 into 222 Lots. Access to the site will be gained via Belmont Road to the north east, at the intersection of Samuel crescent and Belmont Road. There is a proposed internal road network which will connect different stages of the development. The average lot size for the proposed dwellings are greater than 1,000m² and as such are consistent with the surrounding land uses/zonings.

Figure 3 shows the proposed layout for the 222 Lot subdivision. For further detail refer to Contour Consulting, *Overall Landscape Concept Sketch* (Ref: 17-004/SK02) in Appendix A.

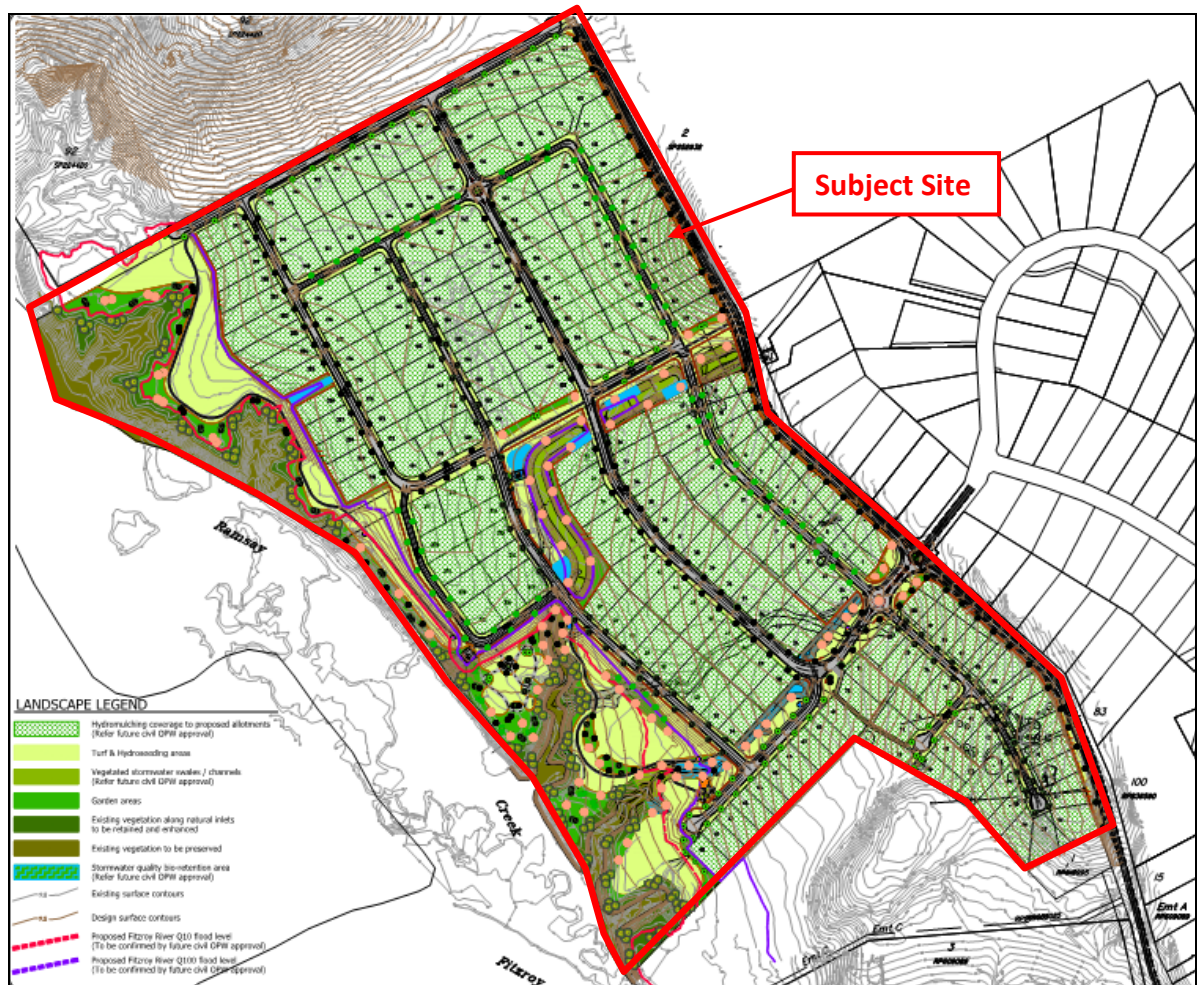


Figure 3: Proposed Layout (modified from Contour Consulting Staging Plan)

1.4 Rainfall

Rainfall intensity data has been obtained from the Australian Bureau of Meteorology's 2016 Design IFD Rainfall System. The data has been extracted for the nearest grid cell at Latitude 23.3125 (S) and Longitude 150.4875 (E). The IFD data and average rainfall intensities used in this report are in accordance with the procedures outlined in IEAust, Australian Rainfall and Runoff.

2.0 SITE HYDROLOGY AND HYDRAULICS

2.1 Background

The subject site is located along the Fitzroy River and is situated within its flood storage area. Due to the considerably large storage area of the Fitzroy River Catchment when compared to the subject site, an increase to the site runoff from the proposed development will have insignificant impact on the storage volume of the Fitzroy River Catchment. Furthermore, both its critical duration, time to peak and its peak flow rate of the subject site catchment is anticipated to be considerably less than that of the Fitzroy River Catchment and as such, the peak times of the catchments will not coincide.

As there will be no significant difference or worsening to the flood storage volume or flood levels of the Fitzroy River as a result of the increase in peak flows rates generated from the subject site, it is deemed that there is no benefit in providing a stormwater detention system for the proposed residential development.

The following section will analyse the pre and post development flow rates for the entire development and any influencing external catchments. The post development flow rates will be utilised to size the minor and major drainage infrastructure of the development.

The following sections define the parameters of the site's post development hydraulics. The Rational Method has been applied to define flow rates at and through the subject site. The Rational Method (Section 4.3 of the Queensland Urban Drainage Manual - QUDM 2017) is flexible in its data requirements and is able to produce satisfactory estimates of peak site discharges based on the following data input:

- specific intensity frequency duration (IFD) data;
- length/type of flow path;
- contributing catchment areas; and
- coefficient of discharge.

2.2 Pre Development Internal Catchments

2.2.1 Catchment Definition and Lawful Point of Discharge

In the following sections, the subject site references the combined lot area of Lot 102 and Lot 129, which covers an area of 53.5 ha.

The pre development subject site has been analysed as three (3) internal catchments for the pre development scenario based on the existing flow regime of the site. The Stormwater catchments for the pre development site have been termed Internal A, Internal B, and Internal C.

Internal Catchment A has an area of 11.73 ha and drains stormwater to the southwest into the Ramsey Creek/Fitzroy River junction. The Ramsey Creek/Fitzroy River Junction wraps around the south western site boundary and forms the Lawful Point of Discharge (LPOD) for pre development Internal Catchment A.

Internal Catchment B has an area of 40.78 ha and naturally drains towards the existing drainage channel that runs centrally through the subject site. Stormwater is conveyed from the eastern and western portions of the catchment into this channel. This channel outlets to the Ramsey Creek/Fitzroy River Junction, which represents the LPOD for pre development Internal Catchment B.

Internal Catchment C has an area of 1ha and sheds stormwater towards the south of its catchment and into a neighbouring residential lot, which represents the catchments existing point of discharge (EPOD). The ultimate LPOD for the catchment is also the Ramsey Creek/Fitzroy River Junction.

The catchment areas and LPODs for the subject site are shown on Knobel Engineers, *Pre Development Catchment Plan* (Ref: K4887/P001/A) included as Appendix B.

2.2.2 Coefficient of Runoff

The pre development coefficient of runoff (C year) for each catchment was determined based on the fraction impervious method specified in QUDM. The pre developed site is currently vacant land and as such has no impervious surfaces. In accordance with QUDM Table 4.5.4, the C_{10} value was determined by the catchment land description and the one hour ten year rainfall intensity (${}^1I_{10}$) of 65.8 mm/hr for the site. Assuming good grass coverage and medium soil permeability, a C_{10} value of 0.66 has been adopted for all pre development catchments. With reference to QUDM Table 4.5.2, applying the frequency factors for the standard storms of 2, 10, 20 and 100 years results in the following post development coefficients of runoff as shown in Table 2:

Table 2: Pre Development Coefficient of Runoff

Catchment	C_2	C_{10}	C_{20}	C_{100}
Internal A/B/C	0.56	0.66	0.69	0.79

2.2.3 Time of Concentration

The time of concentration for each pre development catchment has been calculated in accordance with QUDM section 4.6.6 – Overland Flow. Friend's Equation ($t = (107n L^{0.333})/S^{0.2}$) has been used to calculate the initial travel time using sheet flow with the remaining travel time being concentrated natural flows

through small rills and channels. Please refer to Table 3 below for the calculated time of concentration for each pre developed catchment.

Table 3: Pre Development Time of Concentration

Catchment	Catchment Area (ha)	Catchment Properties	Time of concentration		
			Overland flow Friend's Equation	Concentrated Overland Flow Figure 4.8	Total t_c
Internal A	11.73	Average grassed surface	Horton's (n) = 0.045 L = 100 m Slope = 1% t = 22.3 mins	L = 270m Fall = 9 m $\Delta = 3$ t = 9 mins	31.3 mins
Internal B	40.78	Average grassed surface	Horton's (n) = 0.045 L = 100m Slope = 7% t = 15.2 mins	L = 700m Fall = 19.5 m $\Delta = 5$ t = 15 mins	30.2 mins
Internal C	1.00	Average grassed surface	Horton's (n) = 0.045 L = 120 m Slope = 8.3% t = 15.5 mins	NA	15.5 mins

2.2.4 Design Flow Rates

Design storm flow rates have been calculated for standard storms with an ARI of 2, 10, 20 and 100 years for the pre development case using design rainfall intensities from the Bureau of Meteorology. The Rational Method ($Q = 2.78 \times 10^{-3}$ CIA) has been used to calculate the required design flow rates for the subject site. The pre development peak flows for the subject site are presented in Table 4.

Table 4: Pre Development Flow Rate

Internal A					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.56	0.66	0.69	0.79
Area of Catchment (ha)	A	11.73	11.73	11.73	11.73
Average Rainfall Intensity (mm/h)	I	62.90	98.41	113.39	150.45
Peak Flow Rate (m ³ /s)	Q	1.15	2.12	2.56	3.89
Internal B					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.56	0.66	0.69	0.79
Area of Catchment (ha)	A	40.78	40.78	40.78	40.78
Average Rainfall Intensity (mm/h)	I	64.3	100.63	115.94	153.81
Peak Flow Rate (m ³ /s)	Q	4.09	7.53	9.11	13.81
Internal C					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.56	0.66	0.69	0.79
Area of Catchment (ha)	A	1.00	1.00	1.00	1.00

Average Rainfall Intensity (mm/h)	I	90.50	141.13	162.52	215.18
Peak Flow Rate (m ³ /s)	Q	0.142	0.260	0.314	0.475
TOTAL Peak Flow Rate (m ³ /s)	Q _t	5.38	9.91	11.99	18.17

2.3 Pre Development External Catchments

2.3.1 Catchment Definition and Lawful Point of Discharge

The subject site and the surrounding area were examined to determine if any external catchments will contribute flows into the subject site.

Based on the existing infrastructure, contours and levels of the regions surrounding the subject site, there have been five (5) external catchments identified which discharge stormwater into the subject site. The external catchments have been termed External Catchment A-E.

External Catchment A comprises of vacant land and is situated to the west of Internal Catchment A/B and has an area of 6.15 ha. Stormwater from this catchment discharges across the western site boundary of Internal Catchment A/B, which represents the existing point of discharge for the external catchment.

External Catchment B comprises of vacant land and is situated to the north of Internal Catchment B and has an area of 6.89 ha. Stormwater from this catchment drains towards Belmont Road, where there is a sag point in the road. At present, flows from External Catchment B discharge into the subject site (internal pre development Catchment B) underneath Belmont Road, through a headwall with (1200 x 450) twin box culverts.

External Catchment C consists of rural residential lots to the northeast of the subject site and comprises of both vacant land and rural residential lots. The external catchment is situated to the east of Internal Catchment B and has an area of 12.31 ha. Stormwater from this catchment drains towards another sag point along Belmont Road where it then enters an existing stormwater pipe and drainage channel running through the subject site. The existing drainage channel represents the existing point of discharge for External Catchment C.

External Catchment D is situated to the east of Internal Catchment B and consists primarily of rural residential lots with a contributing catchment area of 12.47 ha. Stormwater collected in this catchment drains towards Samuel Crescent, which connects into Belmont Road. Major and minor flows from External Catchment D are conveyed along Belmont Road, along the natural grade of the road to the northwest and discharges into the existing central drainage channel running through the subject site.

External Catchment E is situated to the south east of Internal Catchment B and has a catchment area of 3.93ha. The catchment consists primarily of vacant land, with the exception of two (2) existing residential lots situated in the north east corner of the catchment. Stormwater collected in External Catchment E drains along the southern boundary of Internal Catchment B, where it eventually outlets into the Ramsey Creek/Fitzroy River Junction.

Refer to Knobel Engineers, Pre Development Catchment Plan (Ref: K4887/P001/A) for further information on the pre development catchment layout.

2.3.2 Coefficient of Runoff

The external catchment coefficient of runoff (C year) was determined based on fraction impervious (f_i) method as specified in QUDM and Capricorn Municipal Development Guideline - Stormwater Drainage Design D5 - Table D05.06.1 – Fraction Impervious for Development Categories.

External Catchments A, B and E consist of vacant land and as such have no impervious surfaces. In accordance with QUDM Table 4.5.4, the C₁₀ value was determined by the catchment land description and the one hour ten year rainfall intensity (¹I₁₀) of 65.8 mm/hr for the site. Assuming good grass coverage and medium soil permeability, a C₁₀ value of 0.66 has been adopted for all pre development catchments.

External Catchment C has been classified as a rural residential zone under the Rockhampton Rock-e-plan interactive mapping system. The coefficient of runoff has been determined using the Stormwater Drainage Design D5 - Table D05.06.1 – Fraction Impervious for Development Categories.

Based on rural lots of (2-5 dwelling per ha) a fraction impervious of 0.20 has been assumed for the pre development catchment. Using a one hour, ten year rainfall intensity ($^1I_{10}$) of 65.8 mm/hr, a C_{10} value of 0.71 has been adopted for each post development catchment.

External Catchment D has been classified as low residential zone under the Rockhampton Rock-e-plan interactive mapping system. The coefficient of runoff has been determined using the Stormwater Drainage Design D5 - Table D05.06.1 – Fraction Impervious for Development Categories based on a lot size of 750 m². Using a fraction impervious of 0.55, a one hour ten year rainfall intensity ($^1I_{10}$) of 65.8 mm/hr, a C_{10} value of 0.79 has been adopted for each post development catchment.

With reference to QUDM Table 4.5.2, applying the frequency factors for the standard storms of 2, 10, 20 and 100 years results in the following pre development coefficients of runoff as shown in Table 5.

Table 5: Pre Development External Catchment Coefficient of Runoff

Catchment	C_2	C_{10}	C_{20}	C_{100}
EXT A, B, E	0.56	0.66	0.69	0.79
EXT C	0.60	0.71	0.75	0.85
EXT D	0.67	0.79	0.83	0.95

2.3.3 Time of Concentration

The time of concentration has been calculated in accordance with QUDM section 4.6.6 – Overland Flow. Friend's Equation ($t = (107n L^{0.333})/S^{0.2}$) has been used to calculate the initial travel time using sheet flow and the remaining distance being calculated as concentrated natural flows using Figure 4.8. Please refer to Table 6 for the calculated time of concentration for each external catchment.

Table 6: External Catchment Time of Concentration

Catchment	Catchment Area (ha)	Catchment Properties	Time of concentration		
			Overland flow Friend's Equation	Concentrated Overland Flow Figure 4.8	Total t_c
EXT A	6.15	Average grassed surfaces	Horton's (n) = 0.045 L = 100 m Slope = 10.0% t = 14min	L = 150m Fall = 24 m $\Delta = 3$ t = 3 mins	17 mins
EXT B	6.89	Average grassed surfaces	Horton's (n) = 0.045 L = 100 m Slope = 15.0% t = 12.8 min	L = 250m Fall = 12 m $\Delta = 3$ t = 6 mins	18.8 mins
EXT C	12.31	Average grassed surfaces	Horton's (n) = 0.045 L = 100 m Slope = 13.0% t = 13.36 min	L = 320m Fall = 14 m $\Delta = 3$ t = 6 mins	19.36 mins
EXT D	12.47	Developed	Standard roof to inlet time of 5 mins	L = 682 m Fall = 41 m $\Delta = 1$ t = 3 mins	8 mins
EXT E	3.93	Average grassed surfaces	Horton's (n) = 0.045 L = 100 m Slope = 3.0% t = 17.91 min	L = 300m Fall = 12 m $\Delta = 3$ t = 6 mins	23.91 mins

2.3.4 Design Flow Rates

Design storm flow rates have been calculated for standard storms with an ARI of 2, 10, 20 and 100 years for the external catchment case using design rainfall intensities from the Bureau of Meteorology. The Rational Method ($Q = 2.78 \times 10^{-3}$ CIA) has been used to calculate the required design flow rates for the subject site.

The calculated pre and post development peak flows for the external catchment are presented in Table 7.

Table 7: External Catchments – Pre Development Peak Flow Rates

External Catchment A					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.56	0.66	0.69	0.79
Area of Catchment (ha)	A	6.15	6.15	6.15	6.15
Average Rainfall Intensity (mm/h)	I	86.65	135.14	155.64	206.14
Peak Flow Rate (m³/s)	Q	0.832	1.526	1.845	2.793
External Catchment B					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.56	0.66	0.69	0.79
Area of Catchment (ha)	A	6.89	6.89	6.89	6.89
Average Rainfall Intensity (mm/h)	I	82.40	128.55	148.06	196.16
Peak Flow Rate (m³/s)	Q	0.886	1.626	1.966	2.977
External Catchment C					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.60	0.71	0.75	0.85
Area of Catchment (ha)	A	12.31	12.31	12.31	12.31
Average Rainfall Intensity (mm/h)	I	81.60	127.31	146.64	194.29
Peak Flow Rate (m³/s)	Q	1.686	3.094	3.742	5.666
External Catchment D					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	12.47	12.47	12.47	12.47
Average Rainfall Intensity (mm/h)	I	115.25	179.79	206.75	272.80
Peak Flow Rate (m³/s)	Q	2.684	4.926	5.948	8.969
External Catchment E					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.56	0.66	0.69	0.79
Area of Catchment (ha)	A	3.93	3.93	3.93	3.93
Average Rainfall Intensity (mm/h)	I	73.19	144.30	131.67	174.56
Peak Flow Rate (m³/s)	Q	0.449	0.825	0.997	1.511

2.4 Post Development Internal Catchments

2.4.1 Catchment Definition and Lawful Point of Discharge

The post development scenario has been analysed as six (6) internal catchments and are described as Post Development Catchments A-F. The delineation of the post development catchments have been based on the design earthworks contours, (supplied by Contour Consulting) for the site, existing overland flow paths running through the subject site and the location of the proposed bio-retention basins.

Post Development Catchment A consists of lots 60-100 to the east of the subject site and has a contributing area of 8.69 ha. This catchment will discharge stormwater towards the southwest through overland and piped flow. The overland flow will be collected and conveyed along the proposed road and discharge to the south of the lot. The minor flows will be collected in a series of pits and pipes and discharged to the proposed bio-retention basins running along the western boundary of the catchment for treatment.

Post Development Catchment B consists of lots 1-51 in the central portion of the subject site and has a contributing area of 9.845 ha. The overland flow will be collected and conveyed along the proposed road network and discharge into the existing drainage channel running through the subject site. The minor flows will be collected in a series of pits and pipes and discharged to the proposed bio-retention basins running along the west of the catchment for treatment.

Post Development Catchment C consists of lots 101-160 and 185-187 to the west of the subject site and has a contributing area of 12.3 ha. The overland flow will be collected and conveyed along the proposed road network towards the existing drainage channel running through the subject site. The minor flows will be collected in a series of pits and pipes and discharged to the proposed bio-retention basins to the east of the catchment for treatment.

Post Development Catchment D consists of lots 161,179, 181 -184, 188-196 and 201-210 to the southwest of the subject site and has a contributing area of 10.4 ha. This catchment will discharge stormwater towards the southwest through overland and piped flow. The overland flow will be collected and conveyed along the proposed road towards a drainage channel at the south of the subject site. The minor flows will be collected in a series of pits and pipes and discharged to the proposed bio-retention basins to the south of the catchment for treatment.

Post development Catchment E consists of the southern portion of the site (remaining portion thus totalling up the site area) that remains undeveloped and has a catchment area of 12.35 ha. Stormwater collected in this catchment will drain naturally as sheet flow into the junction of Ramsey Creek and the Fitzroy River. Note that Catchment E collects the stormwater from Catchments A-D.

Post Development Catchment F consists of lots 197-199 to the southwest of the subject site and has a contributing area of 0.56 ha. The major overland flow will drain naturally as sheet flow into the undeveloped land in Catchment E. The minor flows will be collected in a series of pits and pipes and discharged to the proposed bio-retention basins to the west of the catchment for treatment.

Note that the total site area has slightly increased in the post development scenario due to the acquisition of land to the west of the subject site for the development of a new access driveway.

The ultimate LPOD for all post development catchments is the junction of Ramsey Creek and the Fitzroy River. The catchment areas and LPODs for the subject site are shown on Knobel Engineers, *Post Development Catchment Plan* (Ref: K4887/P002/A) included as Appendix C.

2.4.2 Coefficient of Runoff

The coefficient of runoff (C year) for the post development catchments was determined based on the fraction impervious method specified in QUDM and the Capricorn Municipal Development Guideline - Stormwater Drainage Design D5 - Table D05.06.1 – Fraction Impervious for Development Categories.

Post Development Catchments A-D and F have been classified as low residential zones under the Rockhampton Rock-e-plan interactive mapping system. The coefficient of runoff has been determined using the Stormwater Drainage Design D5 - Table D05.06.1 – Fraction Impervious for Development Categories based on a lot size of 750 m². Using a fraction impervious of 0.55 and a one hour, ten year rainfall intensity (¹I₁₀) of 65.8 mm/hr, a C₁₀ value of 0.79 has been adopted for each post development catchment.

Post Development Catchment E remains undeveloped and as such has no impervious surfaces. In accordance with QUDM Table 4.5.4, the C_{10} value was determined by the catchment land description and the one hour ten year rainfall intensity (I_{10}) of 65.8 mm/hr for the site. Assuming good grass coverage and medium soil permeability, a C_{10} value of 0.66 has been adopted for this catchment.

With reference to QUDM Table 4.5.2, applying the frequency factors for the standard storms of 2, 10, 20 and 100 years results in the following post development coefficients of runoff as shown in Table 8:

Table 8: Post Development Coefficient of Runoff

Catchment	C_2	C_{10}	C_{20}	C_{100}
Post Development A-D, F	0.67	0.79	0.83	0.95
Post Development E	0.56	0.66	0.69	0.79

2.4.3 Time of Concentration

The time of concentration for post developed catchments A-D and F has been calculated in accordance with QUDM section 4.6.6 – Overland Flow, Table 4.6.3 – Recommended roof drainage system travel times and Figure 4.8 –Flow travel time in pipes and channels.

For Post Development Catchment E the time of concentration has been calculated in accordance with QUDM section 4.6.6 – Overland Flow. Friend's Equation ($t = (107n L^{0.333})/S^{0.2}$) has been used to calculate the initial travel time using sheet flow with the remaining travel time being concentrated natural flows through small rills and channels. Please refer to Table 9 for the calculated time of concentration for each post developed catchment.

Table 9: Post Development Time of Concentration

Catchment	Catchment Area (ha)	Catchment Properties	Time of concentration		
			Overland flow Friend's Equation	Concentrated Overland Flow Figure 4.8	Total t_c
A	8.693	Developed	Standard roof to inlet time of 5 mins	L = 400m Fall = 9.6 m $\Delta = 1$ t = 5 mins	10
B	9.845	Developed	Standard roof to inlet time of 5 mins	L = 350 m Fall = 6 m $\Delta = 1$ t = 4 mins	9
C	12.328	Developed	Standard roof to inlet time of 5 mins	L = 400 m Fall = 3 m $\Delta = 1$ t = 7 mins	12
D	10.401	Developed	Standard roof to inlet time of 5 mins	L = 220 m Fall = 2.5 m $\Delta = 1$ t = 4 mins	9
E	12.358	Average grassed surface	Horton's (n) = 0.045 L = 100 m Slope = 3.25% t = 17.6 mins	L = 130 m Fall = 5.3 m $\Delta = 3$ t = 3 mins	20.6 mins
F	0.560	Developed	Standard roof to inlet time of 5 mins	L = 80 m Fall = 1 m $\Delta = 1$ t = 2 mins	7

2.4.4 Design Flow Rates

Design storm flow rates have been calculated for standard storms with an ARI of 2, 10, 20 and 100 years for the post development catchments using design rainfall intensities from the Bureau of Meteorology. The Rational Method ($Q = 2.78 \times 10^{-3} CIA$) has been used to calculate the required design flow rates for the subject site. The post development peak flows for the subject site are presented in Table 10.

Table 10: Post Development Flow Rate

Post Development A					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	8.693	8.693	8.693	8.693
Average Rainfall Intensity (mm/h)	I	107.49	167.62	192.87	254.87
Peak Flow Rate (m ³ /s)	Q	1.744	3.200	3.867	5.839
Post Development B					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	9.845	9.845	9.845	9.845
Average Rainfall Intensity (mm/h)	I	111.25	173.51	199.60	263.58
Peak Flow Rate (m ³ /s)	Q	2.045	3.751	4.531	6.839
Post Development C					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	12.328	12.328	12.328	12.328
Average Rainfall Intensity (mm/h)	I	100.65	156.93	180.64	238.94
Peak Flow Rate (m ³ /s)	Q	2.316	4.249	5.135	7.763
Post Development D					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	10.401	10.401	10.401	10.401
Average Rainfall Intensity (mm/h)	I	111.25	173.51	199.60	263.58
Peak Flow Rate (m ³ /s)	Q	2.160	3.963	4.787	7.225
Post Development E					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.56	0.66	0.69	0.79
Area of Catchment (ha)	A	12.358	12.358	12.358	12.358

Average Rainfall Intensity (mm/h)	I	79.11	123.45	142.20	188.44
Peak Flow Rate (m³/s)	Q	1.525	2.799	3.386	5.127
Post Development F					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	0.560	0.560	0.560	0.560
Average Rainfall Intensity (mm/h)	I	119.50	186.47	214.34	282.53
Peak Flow Rate (m³/s)	Q	0.104	0.192	0.231	0.348
TOTAL Peak Flow Rate (m³/s)	Qt	9.894	18.154	21.937	33.141

Note, the total peak flow is summation of all separate post development catchments and has been undertaken as a comparison only.

2.5 Post Development External Catchments

In the post development scenario, the external catchments have been analysed to account for any future development that may occur. It has been assumed that External Catchments A, B, C and E will be developed to low density residential lots, which is consistent with surrounding land classifications. Post Development Catchment D is already developed and as such the pre-existing condition for this catchment has been maintained in the following assessment. Analysing the peak flow rates under this development conditions will ensure that the proposed stormwater infrastructure for the subject site can safely convey the flows from the external catchment in the occurrence of development.

2.5.1 Catchment Definition and Lawful Point of Discharge

The location and size of the external catchments in the post development conditions are the same as described in the pre development description in section 2.3.1.

Note there are current development applications for residential subdivisions of External Catchments A, B and C. This information has been considered throughout the report and any hydraulic analysis of external catchments flows to ensure an accurate assessment of the influencing flow rates into the subject site.

The flows from External Catchment E will not enter into any of the proposed residential allotments in the developed scenario. The earthworks along the south eastern boundary adjacent to External Catchment E indicates a bund which directs stormwater along the site boundary to discharge into Ramsey Creek/Fitzroy River Junction. This arrangement maintains the pre development flow regime and causes no impact on the subject site or neighbouring lots.

2.5.2 Coefficient of Runoff

The coefficient of runoff (C year) for the post development external catchments was determined based on the Capricorn Municipal Development Guideline - Stormwater Drainage Design D5 - Table D05.06.1 – Fraction Impervious for Development Categories.

All external catchments have been classified as low residential zones under the Rockhampton Rock-e-plan interactive mapping system. The coefficient of runoff has been determined using the Stormwater Drainage Design D5 - Table D05.06.1 – Fraction Impervious for Development Categories based on a lot size of 750 m². Using a fraction impervious of 0.55 and a one hour, ten year rainfall intensity (¹I₁₀) of 65.8 mm/hr, a C₁₀ value of 0.79 has been adopted for each post development catchment.

2.5.3 Time of Concentration

The time of concentration for the catchment has been determined using QUDM Table 4.6.2 – Recommended standard inlet times for urban residential catchments. This method has been adopted as the developed layout of the external catchments is unknown and therefore specific inlet times cannot be calculated accurately. Assuming an average slope of 3% to 6% for the post developed external catchment, a time of concentration of 13 mins has been adopted. Note that as External Catchment D is already developed, a time of concentration of 8 mins has been maintained for this catchment.

2.5.4 Design Flow Rates

Design storm flow rates have been calculated for standard storms with an ARI of 2, 10, 20 and 100 years for the post development catchments using design rainfall intensities from the Bureau of Meteorology. The Rational Method ($Q = 2.78 \times 10^{-3}$ CIA) has been used to calculate the required design flow rates for the subject site. The post development (unmitigated) peak flow estimates for the external catchments are presented in Table 11.

Table 11: External Catchments – Post Development Peak Flow Rates

External Catchment A					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	6.15	6.15	6.15	6.15
Average Rainfall Intensity (mm/h)	I	97.54	152.08	175.08	231.67
Peak Flow Rate (m ³ /s)	Q	1.121	2.055	2.485	3.757
External Catchment B					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	6.89	6.89	6.89	6.89
Average Rainfall Intensity (mm/h)	I	97.54	152.08	175.08	231.67
Peak Flow Rate (m ³ /s)	Q	1.255	2.302	2.783	4.208
External Catchment C					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	12.31	12.31	12.31	12.31
Average Rainfall Intensity (mm/h)	I	97.54	152.08	175.08	231.67
Peak Flow Rate (m ³ /s)	Q	2.242	4.112	4.971	7.517
External Catchment D					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	12.47	12.47	12.47	12.47
Average Rainfall Intensity (mm/h)	I	115.25	179.79	206.75	272.80
Peak Flow Rate (m ³ /s)	Q	2.684	4.926	5.948	8.969
External Catchment E					
Average Recurrence Interval	ARI	2	10	20	100
Coefficient of Runoff	C	0.67	0.79	0.83	0.95
Area of Catchment (ha)	A	3.93	3.93	3.93	3.93
Average Rainfall Intensity (mm/h)	I	97.54	152.08	175.08	231.67
Peak Flow Rate (m ³ /s)	Q	0.716	1.313	1.588	2.401

3.0 OVERLAND FLOW ASSESSMENT

As outlined previously, there are number of external catchments which direct flow into the subject site. These flows require appropriate management and routing through the proposed development to ensure no adverse impacts on the proposed development and surrounding properties

A combination of open conveyance channels and piped drainage has been provided in the location of major overland flows paths within the subject site to safely intercept and convey stormwater from the influencing external catchments through the development. Drainage infrastructure has been designed in accordance with Capricorn Municipal Development Guideline - *Stormwater Drainage Design D5*.

External Catchment A

A conveyance channel has been proposed to manage the flows discharging into the site from External Catchment A. The channel has been assessed for the pre development catchment scenario as there is a current development application for the sub-division and development of External Catchment. As part of this development, only pre development flow rates will be permitted to be discharged into the subject site.

In the pre development condition, the channel capacity has been designed to accommodate the Q100 flow rate from the catchment. The channel is to run from north to south along the western extent of the subject site and intercept stormwater prior to flows entering the development. Note that if the developed layout of External Catchment A directs overland flow away from the site subject, the purpose of the conveyance channel becomes redundant and the channel can be decommissioned.

External Catchment B

The overland flow from External Catchment B is to be collected in a piped drainage system and conveyed into the subject site and into the main conveyance channel running through the development. Note that there is an active development approval in place for External Catchment B which is currently under construction. As part of this development application, there is an approval condition which specifies that only pre development flows are to be discharged underneath Belmont Road into the subject site. Assuming that this development adheres to this condition, the capacity of the pipe system for External Catchment B has been sized to accommodate the pre development flows only, due to the assumption appropriate detention has been provided upstream.

At present, flows from External Catchment B discharge into the subject site (internal Catchment C) underneath Belmont Road, through a headwall with (1200 x 450) twin box culverts. These culverts are proposed to connect into the internal drainage network (designed by others) and conveyed through the development into the main conveyance channel running through the subject site. An easement is to be provided over these pipes in accordance with Capricorn Municipal Development Guideline - *Stormwater Drainage Design D5*. The easement is to provide a route for overland flows in the event of pipe blockage.

Stormwater discharging from External Catchment B has been assumed as “clean water” having undergone water quality treatment from the current development in External Catchment B. It is noted that this clean water will be mixed with the untreated runoff from internal catchments from this development and ultimately be conveyed into the bio retention basins designed for the subject site. To control this, the pipes discharging into the proposed bio-retention basins are to be sized to convey only the Q3 month flows from the internal catchments of the site. Further detail on this is provided in Section 6.0 of this report.

Internal Catchment C – D

A channel has been designed in the south west corner of the development in Internal Catchment D, to collect the Q100 flows from internal sub catchment C1 and C2. The channel is situated in between Lots 205 and 206 and will convey flows into Internal Catchment E. Refer to Knobel Engineers, *Stormwater Sub Catchment Plan* (Ref: 4887/P005/A) for further details of internal sub catchments C1 and C2.

Each channel has been designed (by Contour Consulting) with the maximum allowable batters of 1V:6H and a minimum freeboard of 300 mm. Table 12 provides details of the design parameters of conveyance channels for External Catchment A and Internal channel D. Refer to Section 4.0 for details on the proposed culverts for External Catchment B.

Table 12: Channel Parameters and Capacities

	EXTERNAL A	CHANNEL D
Type	Grass-lined	Grass-lined
Conveyance capacity	Q100 pre development flows External Catchment A	Q100 flows from Sub catchment C1, C2,
Slope (%)	1 %	1 %
Base Width (m)	7	8
Flow Depth (m)	0.65 (including 300mm freeboard)	0.75 (including 300mm freeboard)
Side Slope	1 in 6	1 in 6
Top Width (m)	15	14.6
Design Capacity (m²/s)	3.05	3.68
Required Capacity (m ³ /s)	2.095	3.31

As demonstrated in Table 12, the proposed infrastructure can safely convey the required flows from external catchments while maintaining the necessary 300mm of freeboard to surrounding roads and properties.

4.0 MAJOR CHANNEL FLOW ASSESSMENT

The capacity of the major conveyance channel running through the centre of the subject site has been assessed at critical sections to ensure that the proposed development can cater for the Q100 overland flows generated from both the external and internal catchments being drained into this channel. The road sections along the main conveyance channel have also been assessed to ensure compliance with QUDM Table 7.4.5 – Flow limits for ‘transverse’ flow during MAJOR STORM during the Q100 event.

4.1 Hydraulic Model

A hydraulic computer model has been developed to assess the capacity of the main conveyance channel and critical road sections along this channel. The culvert and drainage easement for External Catchment B has also been assessment. The model assesses whether the channels and proposed culverts are adequately sized to accommodate the flows from internal and external catchments and that road sections have the required immunity to be compliant with local and state guidelines.

Modelling software XP-SWMM has been selected for the hydrologic and hydraulic analysis. Details of the model set-up, channel design and model results are summarised in the following sections for each critical section.

4.2 Model Set-up

Rainfall data for the subject site has been obtained from the Australian Bureau of Meteorology’s 2016 Design IFD Rainfall System. The data has been extracted for the nearest grid cell at Latitude 23.3125 (S) and Longitude 150.4875 (E). The IFD data and average rainfall intensities used in this report are in accordance with the procedures outlined in IEAust, Australian Rainfall and Runoff. Several storm events have been included in the modelling with durations ranging from 10 min to 3hrs.

4.3 Model Validation

A single node has been designated in the hydrologic portion of the model for each catchment that contributes runoff into the main conveyance channel. The influencing catchments include, external catchments B-C and internal sub-catchments 1-3. Refer to Knobel Engineers, *Stormwater Sub catchment Plan* (Ref: K4887/P005/A) for further details on catchment details. Figure 4 details the setup for the hydraulic and hydrologic model.

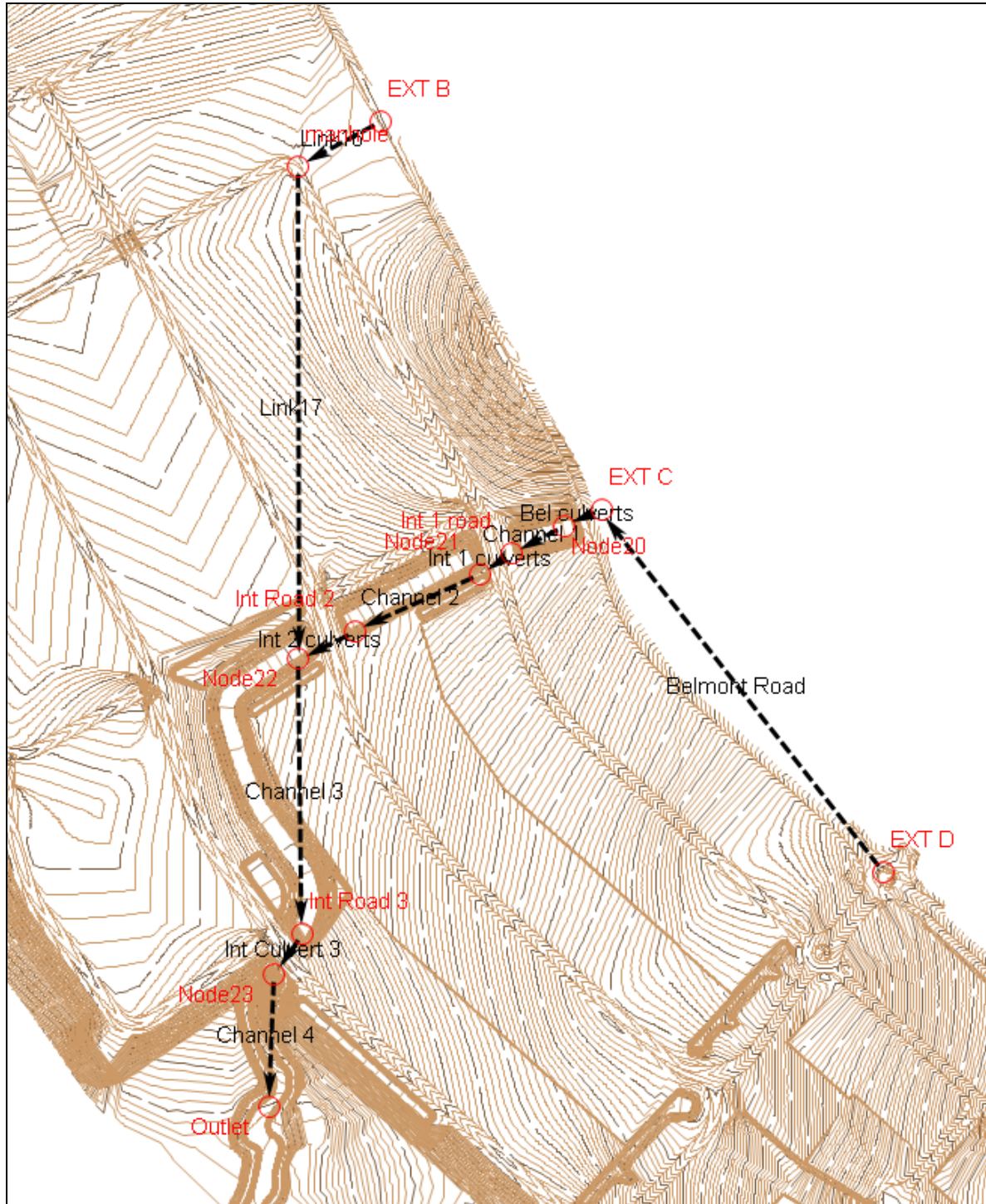


Figure 4: XPSWMM Hydraulic Model Layout

4.4 Assumptions of Hydraulic Model

Due to unavailable survey for Belmont Road and External Catchments contributing to the main conveyance channel, a range of assumptions have been made in determining the location and volume of runoff entering the channel.

External Catchment D has been modelled to drain into the upstream end of the central conveyance channel near Belmont Road. This has been assumed as there is road drainage infrastructure on the upstream side of Belmont Road and a crown in the road which would prevent stormwater from overtopping into the subject site. The culverts under Belmont Road at the upstream end of the conveyance channel have been modelled as twin 1050 mm culverts.

External Catchment B has been modelled as entering the conveyance channel as piped flow as per the stormwater strategy adopted to manage external flows for this catchment.

Pre development flows have been assumed for External Catchment B and C as per the existing development application for these catchments that stipulates that only pre development flows can be discharged into the subject site.

4.5 Hydraulic Parameters of Model

The proposed channels, culverts and weirs modelled at each critical section along the conveyance channel have been determined based off the extracted sections from the design contours provided from Contour Consulting.

The main conveyance channel has been modelled as four (4) separate links between each internal road section. The profile of the channel in each link has been assigned from the design contours provided by Contour Consulting. The average profile of the channel (channel 1-4, see Figure 4) has a general arrangement of a base width of 10m, batters of 1V:6H and total height of 1.8m. The channels have been designed so that the minor flows are contained within the section and that overtopping only occurs in a major storm.

At each road crossing along the main channel, culverts have been modelled to convey flows underneath the road. The size of the culverts have been determined such that the quantity of flows overtopping the road are in compliance with QUDM. The profile of the road has been modelled as a natural channel to simulate a spill over point in major events. Tables 13 – 16 detail the adopted infrastructure for each internal road crossing.

Table 13: Internal Road Crossing 1 Hydraulic Parameters

Location:	Internal Road Crossing 1
Culvert size:	2 x 1050mm
UPIL:	12.8m
DSIL:	12.5m
Length:	36m
Grade:	0.83%
Road surface level (spill over point):	14.7m

Table 14: Internal Road Crossing 2 Hydraulic Parameters

Location:	Internal Road Crossing 2
Culvert size:	2 x 1050 mm
UPIL:	11.3 m
DSIL:	11.1 m
Length:	34 m
Grade:	0.6%
Road surface level (spill over point):	13.2 m

Table 15: Internal Road Crossing 3 Hydraulic Parameters

Location:	Internal Road Crossing 3
Culvert size:	2 x 1200 mm
UPIL:	9.7 m
DSIL:	9.1 m
Length:	36 m
Grade:	1.6%
Road surface level (spill over point):	12 m

Table 16: External Catchment B Easement Crossing

Location:	External Catchment B Easement Crossing
Culvert size:	2 x 900 mm
UPIL:	14.45 m
DSIL:	13.85 m
Length:	60 m
Grade:	1%
Road surface level (spill over point):	15.5 m

Note that the above culvert parameters have been assigned from the design contours provided by Contour Consulting and are subject to change during the detailed design process.

4.6 Results of Hydraulic Model

For each internal road crossing, the water level, velocity and depth of flow on the road section have been analysed. In accordance with QUDM Table 7.4.5 – Flow limits for ‘transverse’ flows during MAJOR STORM, the flow over the road is to have a maximum depth of 250mm and have a depth*velocity product smaller than 0.4m²/s. Table X-X detail the results at each internal Road crossing in the Q100 major event.

Table 17: Results Internal Road Crossing 1

Internal Road Crossing 1:		
Efficiency of culverts:	100%	50%
Peak Flow in culverts (m³/s)	5.83	2.948
Peak Flow over road (m³/s)	3.19	6.07
Q100 water level	14.79	14.83
Depth of flow over road (m)	0.09	0.130
Velocity of flow over road (m/s)	0.72	0.91
D*V	0.0648	0.12

Table 18: Results Internal Road Crossing 2

Internal Road Crossing 2:		
Efficiency of culverts:	100%	50%
Peak Flow in culverts (m³/s)	5.62	2.86
Peak Flow over road (m³/s)	5.503	8.527
Q100 water level	13.31	13.34
Depth of flow over road (m)	0.11	0.14
Velocity of flow over road (m/s)	0.80	0.9
D*V	0.088	0.13

Table 19: Results Internal Road Crossing 3

Internal Road Crossing 3:		
Efficiency of culverts:	100%	50%
Peak Flow in culverts (m³/s)	8.77	4.55
Peak Flow over road (m³/s)	6.32	12.40
Q100 water level	12.17	12.24
Depth of flow over road (m)	0.17	0.24
Velocity of flow over road (m/s)	1.01	1.29
D*V	0.17	0.31

Table 20: External Catchment B Easement

External Catchment B Easement Crossing		
Efficiency of culverts:	100%	50%
Peak Flow in culverts (m³/s)	2.37	2.01
Peak Flow over road (m³/s)	0	0.358
Q100 water level	15.07	15.69
Depth of flow over road (m)	0	0.19
Velocity of flow over road (m/s)	0	0.70
D*V	0	0.133

As demonstrated in the tables above, the depth and depth*velocity product for each internal road crossing is in accordance with the requirement of QUDM in the events of both full culvert efficiency and 50% blockage. The results indicate that the flow regime over the road sections is within an acceptable limit and that the channels and culverts are adequately sized to convey internal and external flows through the subject site.

It is to be noted that although the results in Table 20 show compliance with QUDM, it is crucial that the all lots are designed to have immunity from the Q100 water levels experienced in the conveyance channel during a major rainfall event. A minimum of 300mm of freeboard above the Q100 water level is to be provided to the finished floor level of surrounding lots.

5.0 WATER QUALITY ASSESSMENT

5.1 Background

The development of land has the potential to increase the pollutant loads within stormwater runoff and downstream watercourses. During the construction phase of the development disturbance to the vegetation on the site has the potential to significantly increase sediment loads entering downstream watercourses. The operational phase of the development will change the land use potentially increasing the amount of sediments and nutrients washing from the site.

The following sections describe the predicted increase in pollutant loads generated by the proposed development and treatment devices to mitigate the potential increases.

5.2 Construction Phase

A high risk of stormwater pollution will occur from the site during the construction phase due to erosion and sediment transportation off site to the receiving environment. The majority of this risk results from construction activities disturbing the site and exposing areas of soil to the direct erosive influence of the environment.

The following section outlines the procedures necessary to minimise erosion and control sediment during construction in accordance with the *International Erosion Control Association (IECA) Best Practice ESC Document*.

5.2.1 Key Pollutants

The key pollutants have been identified for the Construction Phase of this development.

Table 21: Key Pollutants, Construction Phase

Pollutant	Sources
Litter	Paper, construction packaging, food packaging, cement bags, material off cuts.
Sediment	Exposed soils and stockpiles during earthworks and building works.
Hydrocarbons	Fuel and oil spills, leaks from construction equipment and temporary car park areas.
Toxic Materials	Cement slurry, asphalt primer, solvents, cleaning agents, and wash waters (e.g., from tile works).
Acids or Alkaline substances	Acid sulphate soils, cement slurry and wash waters.

5.2.2 Performance Criteria

The following site discharge pollutant criteria have been adopted for water quality monitoring during the construction phase of the development.

Table 22: Construction Phase, Water Quality Performance Criteria

Pollutant	Criteria
Total Suspended Solids	80% hydrological effectiveness to 50mg/L
pH	6.5 – 8.5
Dissolved Oxygen	90 th %ile >80% saturation or 6mg/L
Hydrocarbons	No visible sheen on receiving waters
Litter	No visible litter washed from site.
Cations and Anions	As recommended by Acid Sulphate Soil Management Plan (If Applicable to Development).
Contaminants	Dispose of waste containing contaminants at authorised facilities.

5.2.3 Sediment and Erosion Controls

Sediment and Erosion Control devices (S&EC) employed on the site shall be designed and constructed in accordance with the *International Erosion Control Association (IECA) Best Practice ESC Document* as shown on Knobel Engineers, *Sediment and Erosion Control Plan* (Ref: K4887/P004/A) included as Appendix F. The following devices and management measures are proposed:

Pre-Construction

- Stabilised site access/exit on Belmont Road;
- Sediment fences to be located along downstream contours;
- Sediment basins to be installed in accordance with Knobel Engineers, *Sediment Basin Plan* (Ref: SK01)
- Dust fencing to be installed if required; and
- Educate site personnel to the requirements of Erosion and Sediment Control Plan.

Initial Construction – Bulk Earthworks

- Maintain construction access/exit, sediment fencing, dust fences and all other existing controls as required;
- Construct diversion drains to convey disturbed site run-off to the temporary sediment traps;
- Construct clean water diversion drain to divert runoff from external catchment A; and
- Confine construction activities to stages to minimise areas of disturbance at any given time.

Second Stage Construction

- Maintain construction access/exit, sediment fencing, dust fences, diversion drain and all other existing controls as required;
- Progressively revegetate finished areas where applicable;
- Divert runoff from un-disturbed areas around disturbed areas; and
- Drainage structure protection around field inlets and gully pits.

During construction, all areas of exposed soils allowing dust generation are to be suitably treated. Treatments will include covering the soil and watering. Road accesses are to be regularly cleaned to prevent the transmission of soil on vehicle wheels and eliminate any build-up of typical road dirt and tyre dusts from delivery vehicles.

Adequate waste disposal facilities are to be provided and maintained on the site to cater for all waste materials such as litter, hydrocarbons, toxic materials, acids or alkaline substances.

5.2.4 Water Quality Monitoring and Inspections

To ensure that the water quality objectives are being met during the construction phase of the development water quality monitoring shall be conducted. Water quality monitoring shall use a calibrated probe or sampling and testing at a NATA registered laboratory.

Location: Monitoring Stations MS1 shown on Knobel Engineers, *Sediment and Erosion Control Plan* (Ref: K4887/P004/A).

Parameters: Site discharge criteria.

Frequency: Following at least 30 mm of rainfall in a 24 hour period.

The contractor shall be responsible for the inspection and maintenance of all sediment and erosion control devices. Additional controls and review of existing controls shall be undertaken in response to the results of the above-mentioned monitoring program.

5.2.5 Reporting

An inspection report shall be written by a suitably qualified and experienced scientist/engineer following each water quality monitoring episode. The report shall include at least the following information:

- Name, address and real property description for the development site;
- Council file reference number (if known);
- Monitoring locations;
- Performance criteria;
- Results for each monitoring location, identifying any breaches of performance criteria;
- Recommended corrective actions to be taken and additional sediment and erosion controls, if required; and
- Inspection reports shall be provided to the contractor for their action and compilation in an on-site register.

If the above mentioned performance criteria are exceeded and results from the downstream monitoring stations show significant deterioration from upstream results (if applicable), the contractor shall implement all recommendation of the inspection report within one (1) working day of receipt of the report.

5.3 Operational Phase

The following sections provide details of the stormwater quality improvement devices (SQID's) proposed for the operational phase of the development. Knobel Engineers, *Stormwater Management Plan* (Ref: K4887/P003/A) included as Appendix D illustrates the size and location of the proposed SQID's.

To assess the quantities of pollutants discharging from the site the water quality modelling package MUSIC v6.3 has been applied. MUSIC Modelling Parameters and delineated data have been sourced from Water by Design, *MUSIC Modelling Guidelines*. A MUSIC model has been set up using Rainfall Station 39083 for Rockhampton using a date range 1999 – 2010 with a 6 minute time step.

5.3.1 Stormwater Quality Objectives

To protect the water quality of the downstream watercourses the following water quality objective has been applied to stormwater runoff from the site in accordance with Capricorn Municipal Development Guidelines, *Stormwater Drainage Design D5 – D05.21.01*.

Best Management Practices (BMP) are required to be demonstrated for all development applications within Rockhampton Regional Council. The following load reduction targets must be achieved when assessing the post-development treatment train (comparison of unmitigated developed case versus developed mitigated case).

- 80% reduction in Total Suspended Sediment (TSS)
- 60% reduction in Total Phosphorus (TP)
- 45% reduction in Total Nitrogen (TN)
- 90% reduction in litter (sized 5 mm or greater)

5.3.2 Stormwater Quality Improvement Devices

Due to the site being located in a region that has environmental and ecological significance, a Water Sensitive Urban Design (WSUD) approach has been adopted for the site. Bio-retention systems have been proposed as the most suitable SQID's to treat runoff from the subject site as it can readily be integrated into the proposed landscaping and revegetation works. There are separate bio-retention basins proposed for Post Development Catchment A-D and F. Note that as Post Development Catchment E remains undeveloped, no bio-retention basin has been proposed for this catchment.

The MUSIC catchment areas have been based off the post development catchments described in Section 2.5 of this report. The road areas have been obtained from the proposed road network detailed in the post development layout. The roof areas have been calculated based on an assumed 350 m² roof area and the number of lots within the catchment. The ground surface is the remaining area and has been modelled as 15% impervious in accordance with Table 3.6 of Water by Design, *MUSIC Modelling Guidelines*.

Bio-retention basins are required to treat the Q3 month flow generated from their influencing catchments. The Q3 month flow rate for each catchment is provided in Table 23 for reference and to assist in sizing the drainage infrastructure (i.e., diversion structure) that discharges into each bio-retention basin.

Table 23: Q3 Month Runoff

Water Quality Catchment	Catchment Area (m ²)	Q3 Month Runoff (m ³ /s)
A	8.693	0.737
B	9.845	0.864
C	12.328	0.979
D	10.401	0.913
F	0.560	0.044

The contributing roof, road and ground areas for each post development catchment are listed below.

Post Development Catchment A:

- Roof – 1.40 ha
- Road – 0.686 ha
- Ground – 6.608 ha

Post Development Catchment B:

- Roof – 2.065 ha
- Road – 0.248 ha
- Ground – 7.531 ha

Post Development Catchment C:

- Roof – 2.24 ha
- Road – 0.996 ha
- Ground – 9.093 ha

Post Development Catchment D:

- Roof – 1.925 ha
- Road – 1.091 ha
- Ground – 7.385 ha

Post Development Catchment F:

- Roof – 0.105 ha
- Road – 0.05 ha
- Ground – 0.4048 ha

For assessment purposes only, each post development catchment has been modelled to discharge into a singular bio-retention device for treatment. This has been carried out to allow the total required treatment area for each catchment to be determined. The layout of the proposed bio-retention basins for each catchment are depicted on Knobel Engineers, *Stormwater Management Plan* (Ref: K4887/P003/A) included as Appendix D.

The final location and arrangement of bio-retention basins within the catchments will be determined at detailed design stage.

A diagram of the operational treatment train can be seen in Figure 5.

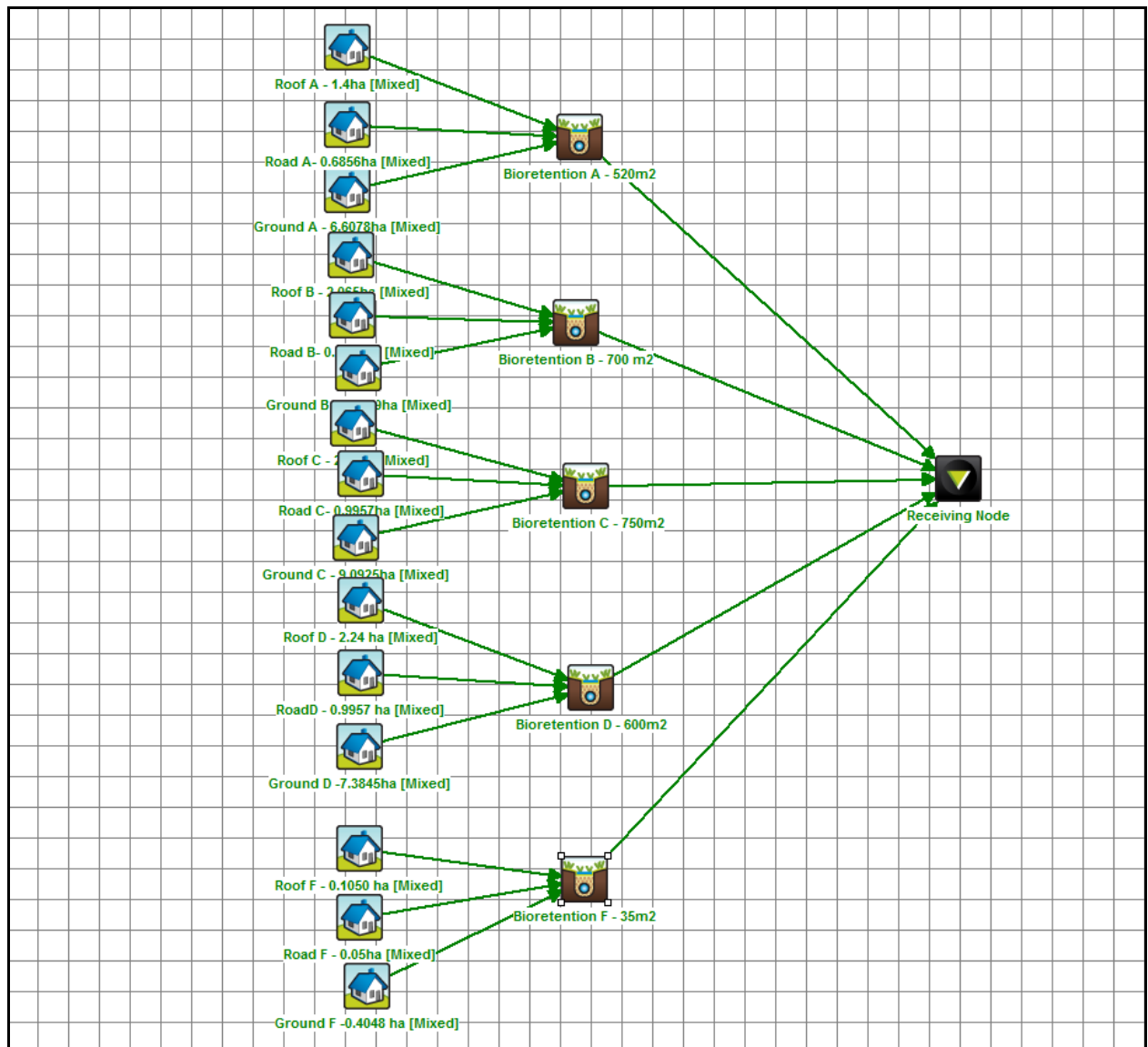


Figure 5: Operational Phase Treatment Train for Site

5.3.3 Design Parameters of the Stormwater Quality Improvement System

Detailed design of the stormwater treatment train shall be in accordance with the WSUD, Technical Design Guidelines for South East Queensland – Version 1 (June 2006).

BIO-RETENTION BASINS

A bio-retention basin is designed to pond stormwater allowing it to percolate through a layer of filter media, typically sandy loam. Runoff passing through the filter media is collected with a perforated pipe discharging to the downstream drainage infrastructure. The Bio-retention basins shall be located to treat all stormwater from the development area. The inlet of the bio-retention basin is to be equipped with a sediment forebay to allow a control point at the entrance to the bio for maintenance and removal of sediment accumulation. It will also dissipate flows reducing pipe exit velocity and limit the occurrence of potential scour of the sensitive downstream constructed bio-retention media surface.

All bio-retention basins have been modelled with the same parameters with the only change being the filter and surface area for each device. For each specific bio-retention basin, the filter area and surface area have been modelled as the same value to ensure a conservative design approach at the conceptual stage. The bio-retention basins have been modelled with the following properties:

ALL BASINS:

- Filter media Sandy Loam;
5 – 10% Organic Content in accordance with AS1289.4.1.1;
Average D50 0.45 mm;
Ksat 200 mm/hr;
TN Content = 400 mg/kg
Orthophosphate Content = 30 mg/kg
- Filter media depth 0.40 m;
- Drainage layer 0.20 m;
- Extended detention depth 0.30 m;
- Seepage 0 mm/hr;

BASIN A

- Filter Area 520 m²;
- Surface Area 520 m².

BASIN B

- Filter Area 700 m²;
- Surface Area 700 m².

BASIN C

- Filter Area 750 m²;
- Surface Area 750 m².

BASIN D

- Filter Area 600 m²;
- Surface Area 600 m².

BASIN F

- Filter Area 35 m²;
- Surface Area 35 m².

5.3.4 Post Development Modelling Results - Mitigated

The stormwater quality improvement device (SQID) will reduce the amount of sediments and nutrients discharging from the proposed residential development. Table 24 illustrate the effectiveness of the SQID's in each treatment train to each of the LPODs. Note that as all stormwater from the development outlet to the one consolidated LPOD, the treatment train effectiveness shown below is for the entire site.

Table 24: Treatment Train Effectiveness

Parameter	Post	Post Mitigated	Reduction	Water Quality Objectives
Flow (ML/yr)	106	101	4.8 %	-
TSS (kg/yr)	16800	3320	80.3 %	80 %
TP (kg/yr)	35.4	9.82	72.2 %	60 %
TN (kg/yr)	221	115	48 %	45 %
Gross Pollutants (kg/yr)	3050	0	100 %	90 %

The results demonstrate that the proposed SQID meet the intended water quality objectives for suspended solids, phosphorous and nitrogen levels for the entire development.

6.0 OPERATIONAL PHASE MAINTENANCE REQUIREMENTS

The proposed stormwater management devices will require maintenance and monitoring to ensure that they function as designed. The following section provides an outline of the necessary maintenance tasks for the proposed devices.

6.1 Bio-retention Basin Maintenance

The most intensive period of maintenance is during the plant establishment period (first two years) when weed removal and replanting may be required. It is also the time when large loads of sediments could impact on plant growth particularly in developing catchments with poor building controls.

Maintenance is primarily concerned with:

- Maintenance of flow to and through the bio-retention basin;
- Maintaining vegetation;
- Preventing undesired overgrowth vegetation from taking over the bio-retention basin;
- Removal of accumulated sediments; and
- Litter and debris removal.

Vegetation maintenance will include:

- Fertilising plants;
- Removal of noxious plants or weeds; and
- Re-establishment of plants that die.

Sediments accumulated at the inlets need to be monitored. Depending on the catchment activities the deposition of sediment can tend to smother plants and reduce the ponding volume available. Should excessive sediment build-up it will impact on the plant health and require removal before it reduces the infiltration rate of the filter media. The proposed SQIDs will require regular maintenance and monitoring to ensure that they function as designed.

Table 25: Bio-retention Basin Maintenance Schedule

Bio-retention Basin Maintenance Checklist			
Inspection Frequency: 3 Monthly	Date of Visit:		
Location:			
Description:			
Site Visibility:			
Inspection Items	Yes	No	Action Required (Details)
Sediment accumulation at inflow points?			
Litter basin?			
Erosion at inlet or other key structures (e.g. crossovers)?			
Traffic damage present?			
Evidence of dumping (Building waste, oils etc)?			
Vegetation condition satisfactory (density, weeds etc)?			
Replanting required?			
Mowing required?			
Clogging of drainage points (sediment or debris)?			
Evidence of ponding?			
Damage/vandalism to structures present?			
Surface clogging visible?			
Drainage system inspected?			
Resettling of system required?			
Comments:			

7.0 FLOOD STORAGE ASSESSMENT

7.1 Flood Storage

As mentioned previously, the subject site is located alongside the Fitzroy River, with a small portion of the development being situated in the Fitzroy Rivers flood fringe area. A portion of the subject site is located within the Q100 flood event extent and must therefore be appropriately managed to ensure that any residential allotments have adequate flood immunity.

The council flood model for the subject site was obtained in order to perform a flood storage volume check for the pre and post development layout. The model contains the inundation areas and peak water surface levels from the Fitzroy River in a Q100 flood event.

The model was interrogated to extract the Q100 water level for the subject site, which was found to be 11.8 m AHD. The proposed development will maintain the existing flood storage total of 490,283 m³ on site below the designated flood level (DFL) of 11.8 m AHD.

Flood storage compensation for the post-development case has been achieved by sculpting and increasing the volume around the southern portion of the site and within the main conveyance channel which runs through the centre of the subject site. The post development contours achieve a flood storage volume of 490,776 m³ for the subject site, which results in a surplus of 493 m³ below the DFL. Therefore, the proposed development will provide adequate compensatory flood storage for the site.

Refer to Knobel Engineers, *Preliminary Pre Development Flood Storage Plan* (Ref: K4887/P006/A) and Knobel Engineers, *Preliminary Post Development Flood Storage Plan* (Ref: K4887/P007/A) in Appendix H for further information.

7.2 Minimum Floor Levels

All residential allotments are to have adequate flood immunity in the Q100 event, which is to be achieved by setting finished floor levels a minimum of 300 mm above the DFL of 11.8 m AHD. In addition to this, the allotments situated along the main conveyance channel are to achieve 300 mm freeboard above the Q100 water level reached in the conveyance channel. Refer to Section 4.0 for information on the Q100 water levels reached at critical locations along the conveyance channel.

8.0 CONCLUSIONS

Knobel Engineers has been commissioned by Glenmore Holdings (Aust) Pty Ltd to prepare an amended *Conceptual Stormwater Management Plan* (CSWMP), to support a development application for the Material Change of Use and Reconfiguring of a Lot (2 Lots into 222 Lots) at 54-102 and 263 Belmont Road, Parkhurst. This CSWMP addresses the conceptual planning, layout and design of the stormwater quality and quantity management infrastructure for both the construction and operational phases of this development.

Hydraulic analysis demonstrated that the development will increase peak flow rates discharging from the site, however due to the location of the development within the Fitzroy River Catchment, stormwater detention will provide no noticeable impact to the hydraulics of the catchment and has therefore not been implemented for the development.

A hydraulic model built using the XPSWMM software program was utilised to assess the capacity of the major conveyance channel and impacted internal road sections within the developed site. Results indicated that the proposed infrastructure can safely convey the Q100 flows from contributing internal and external catchments through the subject site while adhering to QUDM transverse road flow requirements.

Knobel Engineers has adopted a water sensitive urban design (WSUD) approach to managing the stormwater runoff from the proposed development by treating stormwater runoff within separate bio-retention basins for each post development catchment. A total of 2,605 m² of bioretention filter area is required to treat stormwater runoff from the entire subject site and satisfy water quality objectives for Rockhampton Regional Council. A monitoring and maintenance plan for the basins has been included. A sediment and erosion control plan is provided for the construction phase of the development and shall be implemented by the contractor and developer.

APPENDIX

A

Contour Consulting
Overall Landscape Concept Sketch
(Ref: 17-004/SK02)

APPENDIX



SCALES

0 20.0 80.0m 1:4000

REVISION / ISSUE REGISTER

No.	DATE	REMARKS
A	07/19	For Review

DESIGN

RS

DRAWN

RS

LANDSCAPE LEGEND

- Hydromulching coverage to proposed allotments (Refer future civil OPW approval)
- Turf & Hydroseeding areas
- Vegetated stormwater swales / channels (Refer future civil OPW approval)
- Garden areas
- Existing vegetation along natural inlets to be retained and enhanced
- Existing vegetation to be preserved
- Stormwater quality bio-retention area (Refer future civil OPW approval)
- Existing surface contours
- Design surface contours
- Proposed Fitzroy River Q10 flood level (To be confirmed by future civil OPW approval)
- Proposed Fitzroy River Q100 flood level (To be confirmed by future civil OPW approval)

GLENMORE HOLDINGS (AUST) PTY LTD

**RIVERSIDE WATERS
STAGES 1 to 12
BELMONT RD, ROCKHAMPTON
OVERALL LANDSCAPE
CONCEPT SKETCH**

DWG No. 17-004/SK02 **A**

DO NOT SCALE - IF IN DOUBT ASK

B

Knobel Engineers
Pre Development Catchment Plan
(Ref: K4887/P001/A)

APPENDIX

C

Knobel Engineers
Post Development Catchment Plan
(Ref: K4887/P002/A)

LEGEND

- SITE BOUNDARY
- STORMWATER CATCHMENT BOUNDARY
- (A)

STORMWATER CATCHMENT I.D.
- EXT A

EXTERNAL STORMWATER CATCHMENT I.D.
- LPOD

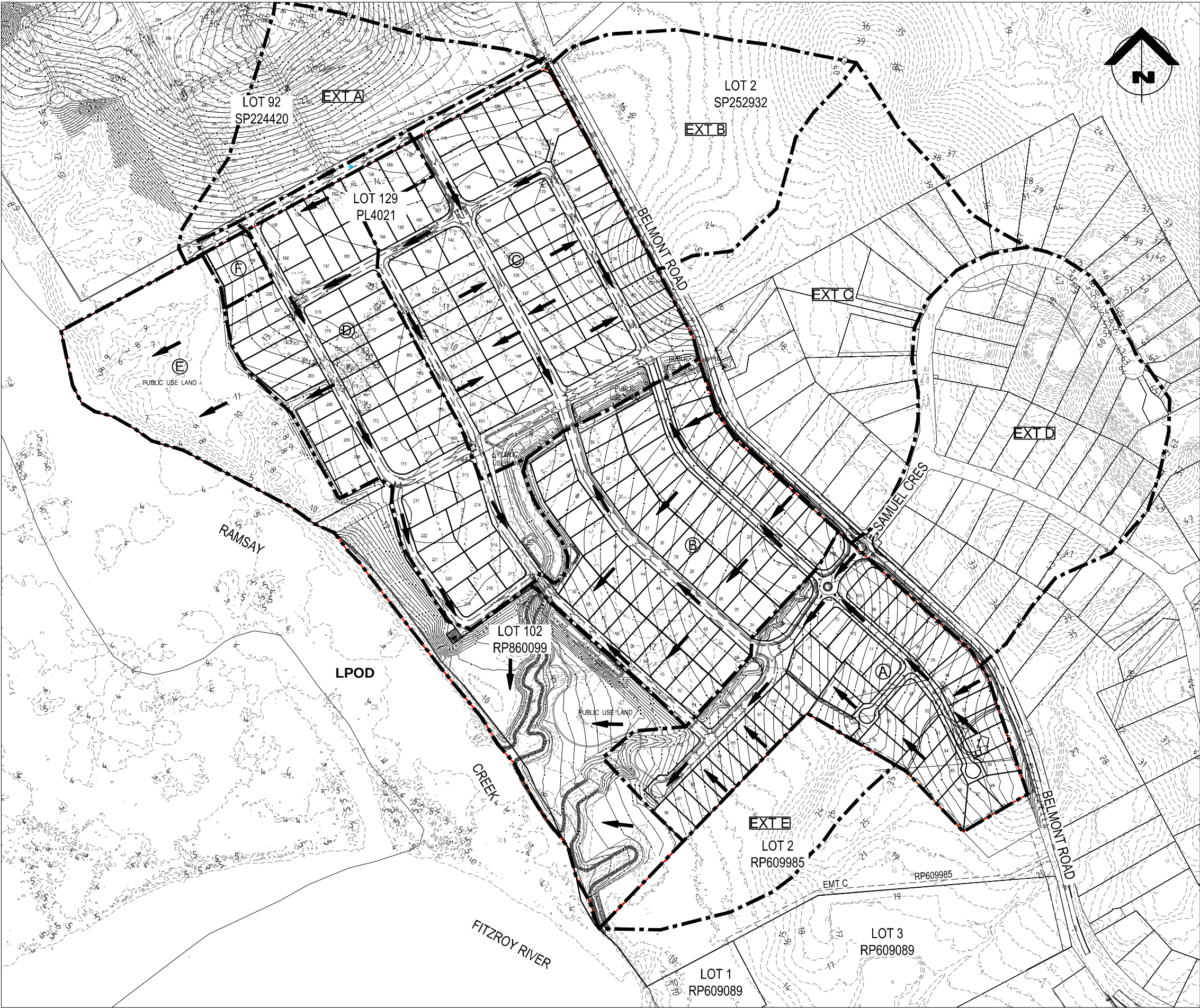
LAWFUL POINT OF DISCHARGE
- PROPOSED FLOW DIRECTION

POST DEVELOPMENT STORMWATER CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
A	8.693
B	9.845
C	12.328
D	10.401
E	12.358
F	0.560
TOTAL	54

EXTERNAL STORMWATER CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
EXT A	6.154
EXT B	6.892
EXT C	12.312
EXT D	12.476
EXT E	3.932
TOTAL	41.766

CONTRACTOR TO DETERMINE AND
LOCATE ALL EXISTING SERVICES PRIOR
TO COMMENCEMENT OF WORKS

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APPENDIX

D

Knobel Engineers
Stormwater Sub-Catchment Plan
(Ref: K4887/P005/A)

LEGEND

- SITE BOUNDARY
- STORMWATER CATCHMENT BOUNDARY
- A

STORMWATER CATCHMENT I.D.
- INTA

STORMWATER CATCHMENT I.D.
- EXTA

EXTERNAL STORMWATER CATCHMENT I.D.
- LPOD

LAWFUL POINT OF DISCHARGE
- PROPOSED FLOW DIRECTION

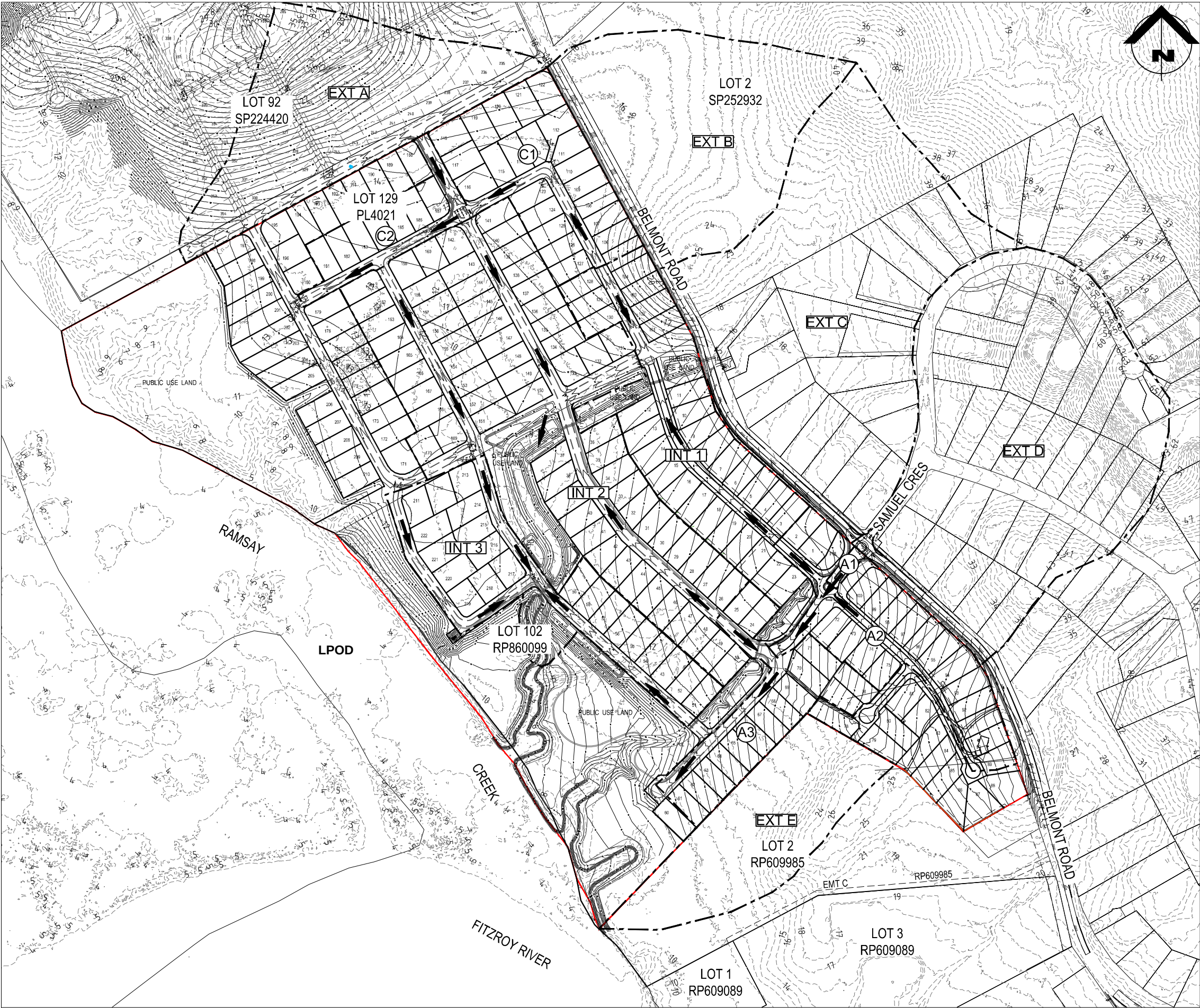
STORMWATER SUB-CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
A1	0.093
A2	3.336
A3	2.516
C1	3.581
C2	1.517
INT 1	5.105
INT 2	12.01
INT 3	4.503

EXTERNAL STORMWATER CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
EXT A	6.154
EXT B	6.892
EXT C	12.312
EXT D	12.476
EXT E	3.932
TOTAL	41.766

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

STORMWATER SUB-CATCHMENT DISCHARGE TABLE	
STORMWATER CATCHMENT ID	DISCHARGE LOCATION
A1, A2, A3	CATCHMENT A
INT 1, INT 2, INT 3	MAIN CONVEYANCE CHANNEL
C1, C2	CHANNEL D

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					CLIENT GLENMORE HOLDINGS (AUST) PTY LTD	DESIGN SK	DRAWN DKC	APPROVED	TITLE STORMWATER SUB CATCHMENT PLAN	PROJECT NO. K4887
					PROJECT RIVERSIDE WATERS ESTATE 54-102 AND 263 BELMONT ROAD PARKHURST QLD 4702				SCALE 1:12500 AT A1 1:25000 AT A3	DWG NO. P005
										ISSUE A
ISSUE No.	DATE	AMENDMENT								

APPENDIX

E

Knobel Engineers
Stormwater Management Plan
(Ref: K4887/P003/A)

LEGEND

- STORMWATER CATCHMENT BOUNDARY
- STORMWATER CATCHMENT I.D.
- SITE BOUNDARY
- LPOD
- LAWFUL POINT OF DISCHARGE
- PROPOSED STORMWATER PIPE
- CATCHMENT FLOW DIRECTION
- PROPOSED BIORETENTION BASIN
- PROPOSED CHANNEL

BIORETENTION BASIN PARAMETERS TABLE

BASIN I.D	FILTER AREA	EXTENDED DETENTION DEPTH	BATTERS
A	520 m ²	0.3 m	1 in 4
B	700 m ²	0.3 m	1 in 4
C	750 m ²	0.3 m	1 in 4
D	600 m ²	0.3 m	1 in 4
F	35 m ²	0.3 m	1 in 4

BIORETENTION Q3 MONTH FLOW RATE

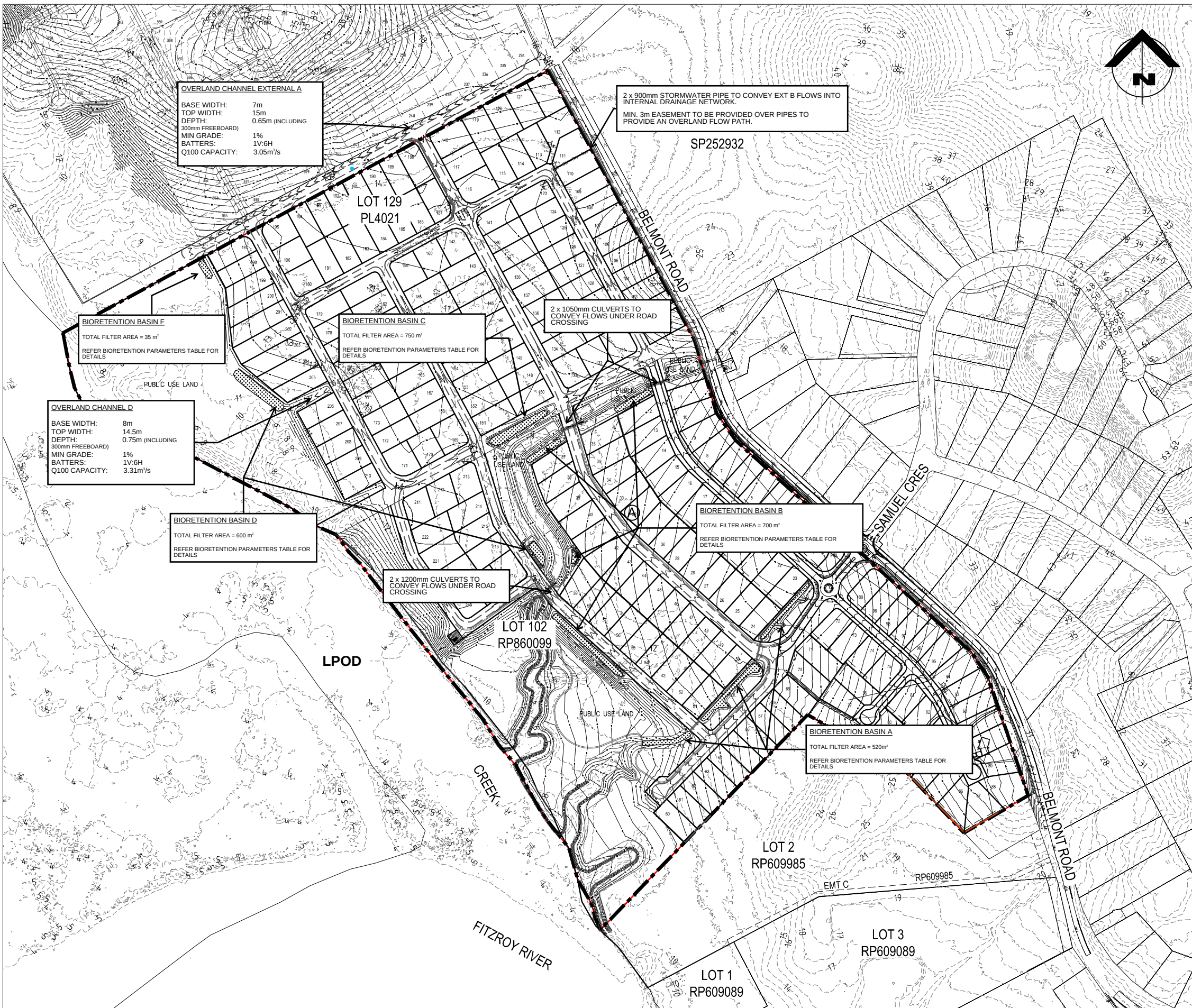
BASIN I.D	CATCHMENT AREA (ha)	Q3 MONTH FLOW RATE (m ³ /s)
A	8.693	0.737
B	9.845	0.864
C	12.328	0.979
D	10.401	0.913
F	0.560	0.044

STORMWATER MANAGEMENT NOTES

- INTERNAL STORMWATER DRAINAGE DESIGNED BY OTHERS.
- Q3 MONTH FLOWS TO BE DISCHARGED INTO BIORETENTION BASIN.
- SEDIMENT FOREBAYS AND MAINTENANCE TRACKS TO BE IMPLEMENTED AT EACH BIORETENTION BASIN INLET.
- SCOUR PROTECTION TO BE PROVIDED AROUND CULVERT INLETS AND OUTLETS.
- FINISHED FLOOR LEVELS OF ALLOTMENTS TO BE 300mm ABOVE THE Q100 WATER LEVELS.

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

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			PROJECT RIVERSIDE WATERS ESTATE 54-102 AND 263 BELMONT ROAD PARKHURST QLD 4702											DWG NO. P003
ISSUE No. DATE AMENDMENT			GOLD COAST BRISBANE BALLINA ROCKHAMPTON										SCALE 1:12500 AT A1 1:25000 AT A3	ISSUE A

APPENDIX

F

Knobel Engineers *Sediment and Erosion Control Plan* (Ref: K4887/P004/A)

LEGEND

- SITE BOUNDARY
- SF

SEDIMENT FENCE
- SEP

STABILISED ENTRY/EXIT POINT
- MS1

WATER QUALITY MONITORING STATION
- DSP

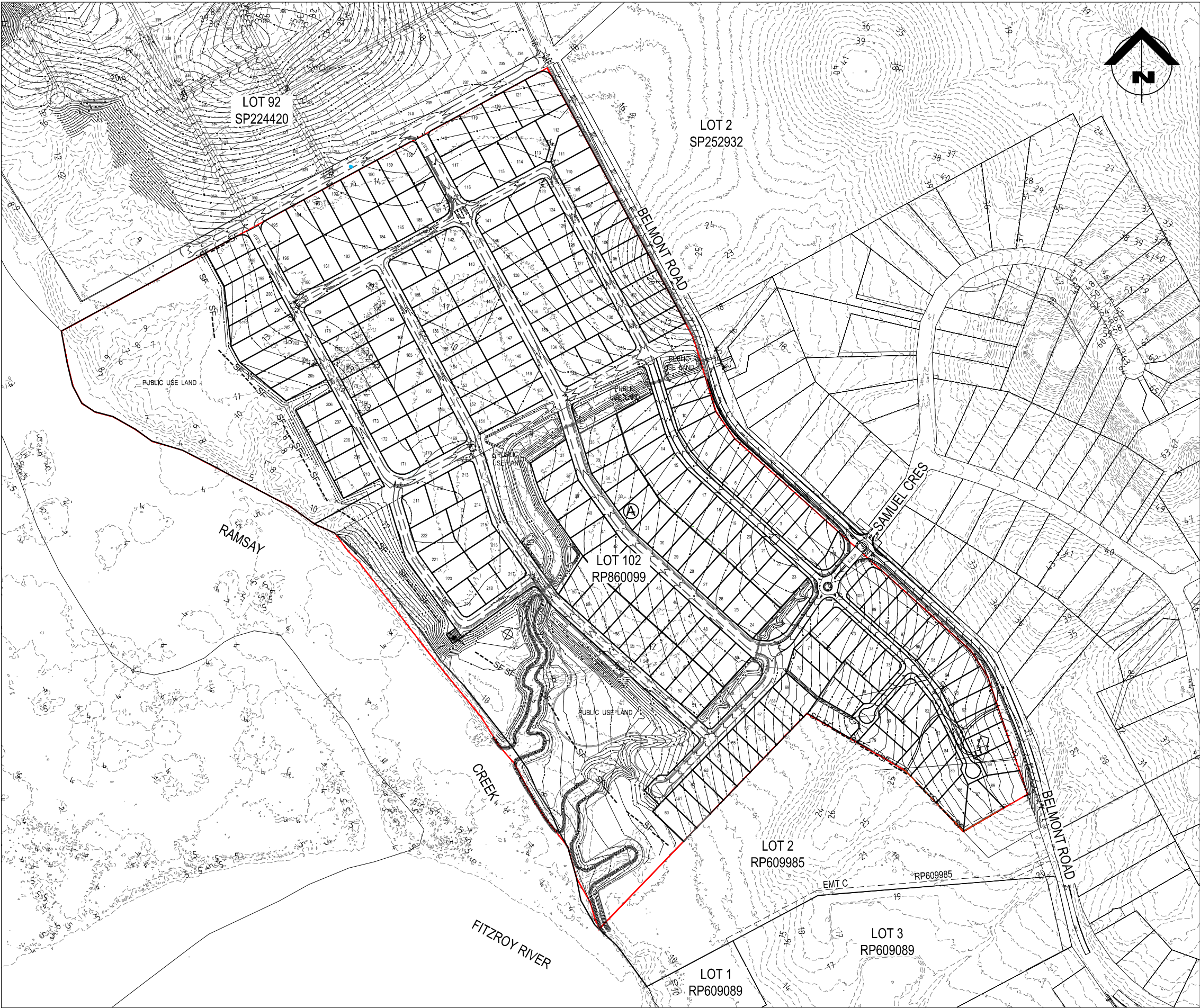
DRAINAGE STRUCTURE PROTECTION

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TO COMMENCEMENT OF WORKS

SEDIMENT & EROSION CONTROL NOTES

1. REFER TO KNOBEL ENGINEERS SK01 FOR SEDIMENT BASIN LAYOUT.
2. DRAINAGE STRUCTURE PROTECTION TO BE IMPLEMENTED AROUND ALL CONSTRUCTED DRAINAGE INFRASTRUCTURE.

REPORT ISSUE
NOT FOR CONSTRUCTION



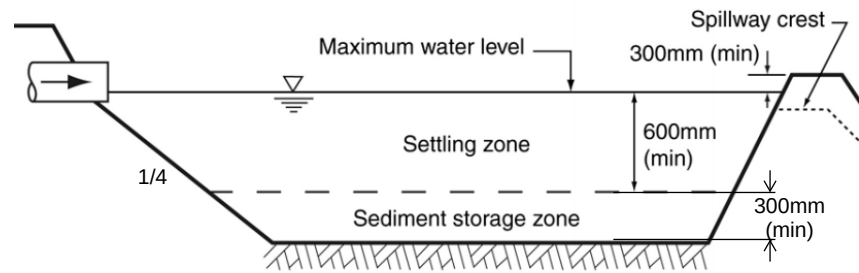
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APPENDIX

G

Knobel Engineers
Sediment Basin Plan
(Ref: SK01)

PROJECT NUMBER:	K4887
SKECTH NO:	SK01
DESCRIPTION:	SEDIMENT BASIN PLAN
DATE:	07/05/2019



LEGEND

FLOW DIRECTION



WATER QUALITY
MONITORING
STATION



SEDIMENT BASIN 8

Catchment Area= 1.402 ha
Surface Area (top) = 991m²
Settling Volume = 580m³ at 0.6m depth
Storage Volume = 290m³ at 0.3m depth
Basin Volume (total) = 871 m³
Emergency Spillway = 10m width at 0.9m from basin invert

SEDIMENT BASIN 6

Catchment Area= 1.259 ha
Surface Area (top) = 881m²
Settling Volume = 521m³ at 0.6m depth
Storage Volume = 261m³ at 0.3m depth
Total Volume = 781 m³
Emergency Spillway = 9m width at 0.9m from basin invert

SEDIMENT BASIN 7

Catchment Area= 1.562 ha
Surface Area (top) = 1,107m²
Settling Volume = 647m³ at 0.6m depth
Storage Volume = 323m³ at 0.3m depth
Total Volume = 970 m³
Emergency Spillway = 10m width at 0.9m from basin invert

SEDIMENT BASIN 5

Catchment Area= 0.472 ha
Surface Area (top) = 422m²
Settling Volume = 195m³ at 0.6m depth
Storage Volume = 98m³ at 0.3m depth
Total Volume = 293 m³
Emergency Spillway = 3m width at 0.9m from basin invert

SEDIMENT BASIN 4

Catchment Area= 2.517 ha
Surface Area (top) = 1,630m²
Settling Volume = 1,042m³ at 0.6m depth
Storage Volume = 521m³ at 0.3m depth
Total Volume = 1,563m³
Emergency Spillway = 15m width at 0.9m from basin invert

SEDIMENT BASIN 1

Catchment Area= 2.601ha
Surface Area (top) = 1630m²
Settling Volume = 1,077m³ at 0.6m depth
Storage Volume = 538m³ at 0.3m depth
Total Volume = 1,615m³
Emergency Spillway = 16m width at 0.9m from basin invert

SEDIMENT BASIN 3

Catchment Area= 1.739 ha
Surface Area (top) = 1,228m²
Settling Volume = 720m³ at 0.6m depth
Storage Volume = 360m³ at 0.3m depth
Total Volume (total) = 1,080 m³
Emergency Spillway = 10m width at 0.9m from basin invert

SEDIMENT BASIN 2

Catchment Area= 3.633 ha
Surface Area (top) = 2,250m²
Settling Volume = 1,504m³ at 0.6m depth
Storage Volume = 752m³ at 0.3m depth
Total Volume = 2,256m³
Emergency Spillway = 15m width at 0.9m from basin invert



APPENDIX

H

Knobel Engineers

Preliminary Pre Development Flood Storage Plan

(Ref: K4887/P006/A)

Preliminary Post Development Flood Storage Plan

(Ref: K4887/P007/A)

LEGEND

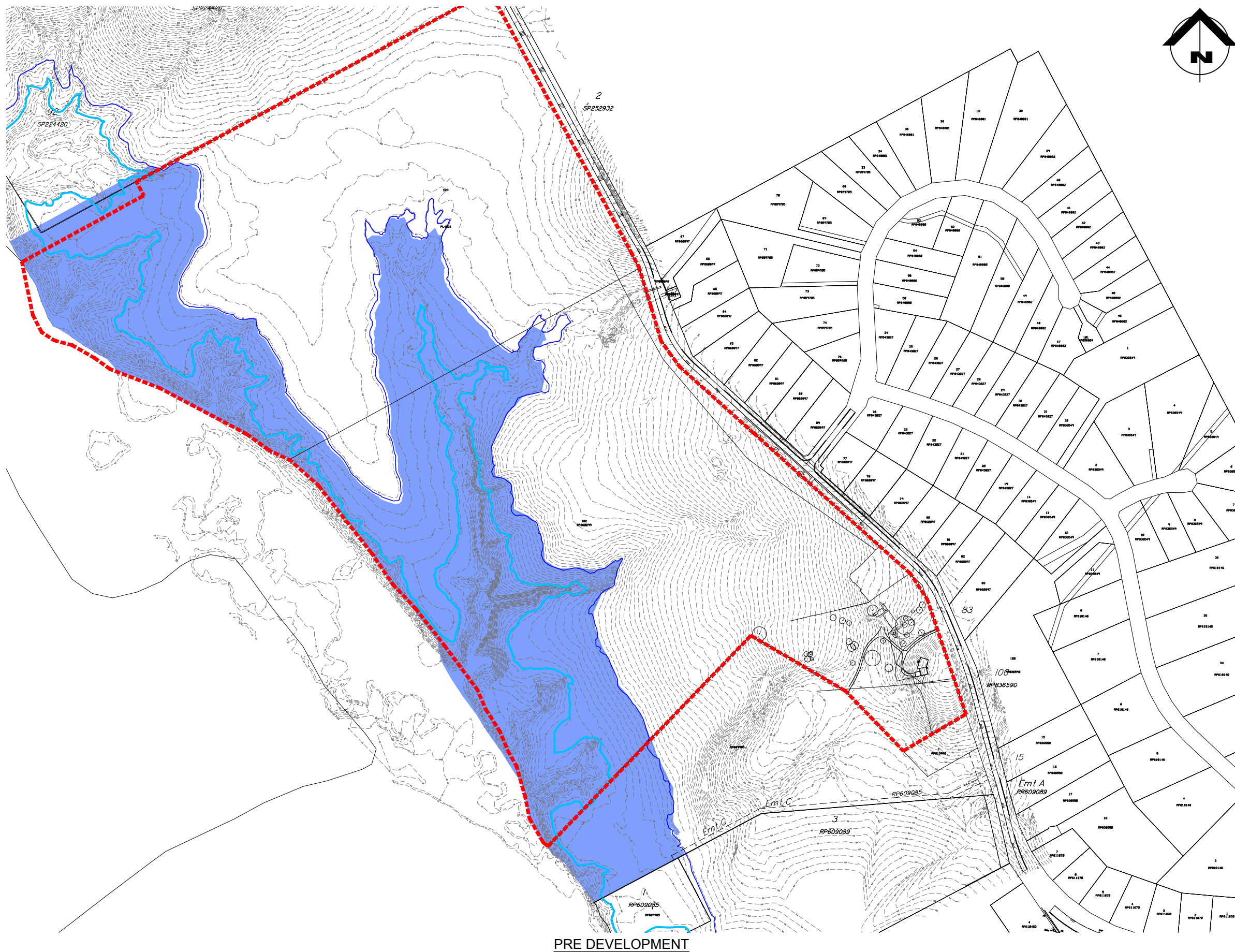
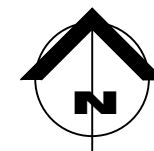
-  FLOODED AREA
-  SITE BOUNDARY
-  EXISTING SURFACE CONTOURS
-  FLOW DIRECTION

PRELIMINARY FLOOD STORAGE VOLUME CALCULATIONS

EXISTING CASE	
PRE DEVELOPMENT Q ₁₀₀ FLOOD STORAGE TO RL 11.80m A.H.D	490283m ³

NOTES:

- DESIGNATED Q₁₀₀ FLOOD LEVEL (DFL) 11.80m A.H.D
- FLOOD STORAGE CALCULATION HAS CONSIDERED THE EXTENT OF SITE SURVEY IN BOTH PRE/POST SCENARIOS.



PRE DEVELOPMENT

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CLIENT
GLENMORE HOLDINGS (AUST) PTY LTD

PROJECT
RIVERSIDE WATERS ESTATE
54-102 AND 263 BELMONT ROAD
PARKHURST QLD 4702

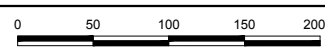
DESIGN
SK

DRAWN
EG

APPROVED

TITLE
PRELIMINARY PRE DEVELOPMENT
FLOOD STORAGE PLAN

SCALE 1:2500 AT A1
1:5000 AT A3



PROJECT NO.

K4887

DWG NO.

P006

ISSUE

A

ISSUE NO.	DATE	AMENDMENT
A	12-09-19	ISSUED FOR REPORT

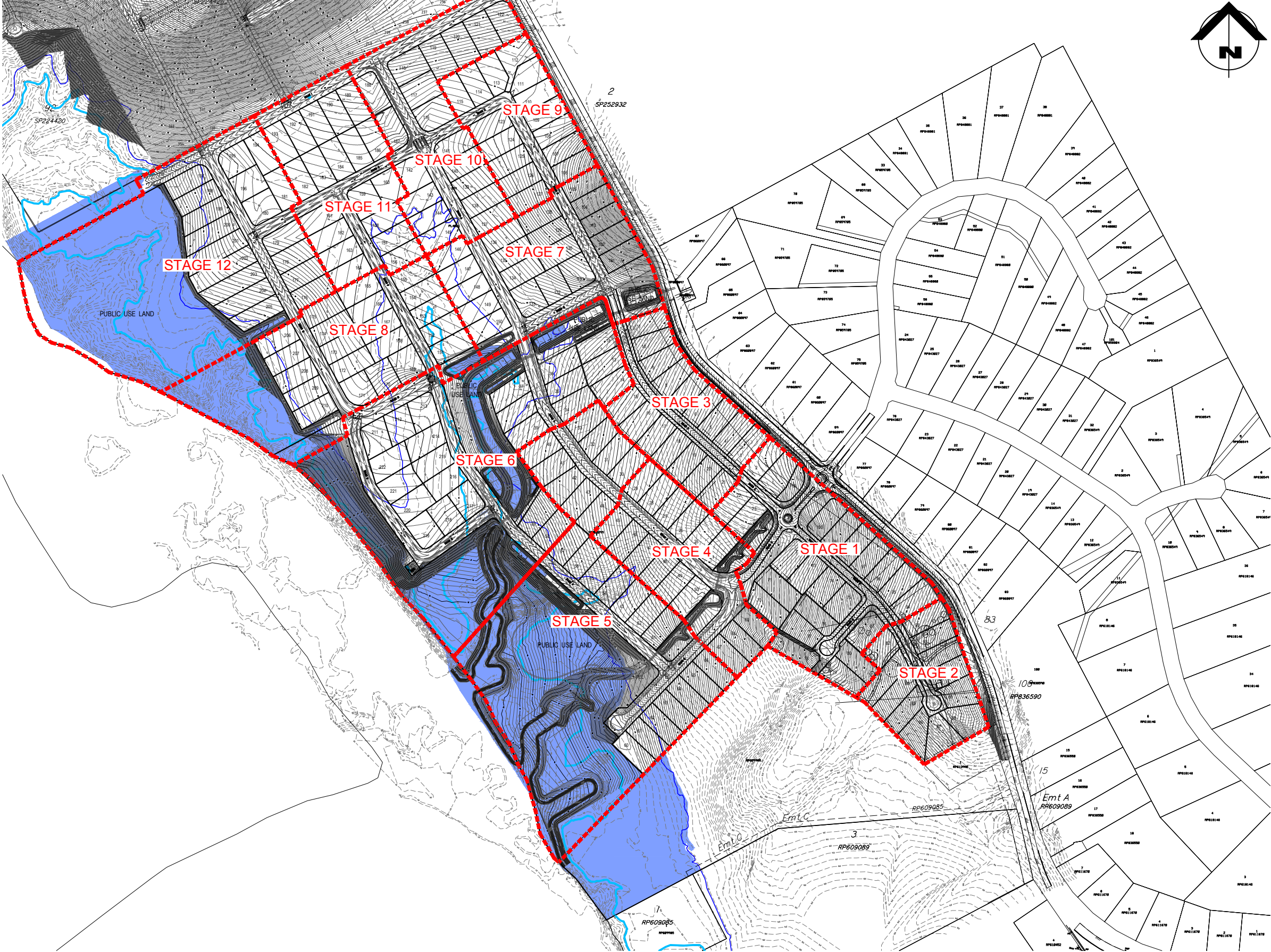
LEGEND

- FLOODED AREA
- SITE BOUNDARY
- 80.0

EXISTING SURFACE CONTOURS
- FLOW DIRECTION

PRELIMINARY FLOOD STORAGE VOLUME CALCULATIONS		
EXISTING CASE		
PRE DEVELOPMENT Q ₁₀₀ FLOOD STORAGE TO RL 11.80m A.H.D		490283m ³
DEVELOPED CASE		
POST DEVELOPMENT Q ₁₀₀ FLOOD STORAGE TO RL 11.80m A.H.D		490776m ³

- NOTES:
- DESIGNATED Q₁₀₀ FLOOD LEVEL (DFL) 11.80m A.H.D
 - FLOOD STORAGE CALCULATION HAS CONSIDERED THE EXTENT OF SITE SURVEY IN BOTH PRE/POST SCENARIOS.



POST DEVELOPMENT

REPORT ISSUE
NOT FOR CONSTRUCTION

CONTRACTOR TO DETERMINE AND
LOCATE ALL EXISTING SERVICES PRIOR
TO COMMENCEMENT OF WORKS

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					PROJECT RIVERSIDE WATERS ESTATE 54-102 AND 263 BELMONT ROAD PARKHURST QLD 4702						DWG NO. P007	ISSUE A		
A	12-09-19	ISSUED FOR REPORT							SCALE 1:2500 AT A1 1:5000 AT A3 050100150200m					
ISSUE No.	DATE	AMENDMENT												



Infrastructure Report

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/84-2014

Dated: 15 September 2015

Riverside Estate

Belmont Road, Parkhurst

Revision C

December 2014

R12394

Prepared for Glenmore Holding (AUST) Pty Ltd

Urban Development - Rockhampton



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2014

DOCUMENT CONTROL

Infrastructure Report – December 2014

Issue	Date	Issue Details	Author	Checked	Approved
A	11/13	Infrastructure Report	PJ	JD	Jeff Davey - RPEQ 8386
B	12/13	Infrastructure Report	PJ	JD	Jeff Davey - RPEQ 8386
C	12/14	Infrastructure Report	MD	KL	Graham Scott - RPEQ 2412



Table of Contents

1.	Introduction/Background	1
2.	Site Characteristics and Staging.....	2
3.	Good Practice Urban Design Principles	3
4.	Proposed Development and Preliminary Bulk Earthwork Levels.....	4
5.	Wastewater Treatment/Sewerage Reticulation.....	5
6.	Water Supply	6
7.	Stormwater Management	6
8.	Waste and Recycling Collection.....	7
9.	Traffic Report, Access and Internal Road Network	7
10.	Electrical and Telecommunication.....	9
11.	Conclusion	9

APPENDICES

Appendix A	Existing Site Conditions and Proposed Stages
Appendix B	Proposed Plan of Development Plan with Stages
Appendix C	Preliminary Bulk Earthworks Surface Levels
Appendix D	Existing and Proposed Sewerage Reticulation Plan
Appendix E	Existing and Proposed Water Supply Plan
Appendix F	Proposed Stormwater Catchments
Appendix G	Proposed Road Hierarchy Plan, Roundabout Details, Road Longsections and Cross-Section Details
Appendix H	Proposed Electrical Plan



1. Introduction/Background

Brown Consulting (QLD) Pty Ltd has been engaged to prepare the following Infrastructure Services Report which will address the Civil Engineering Infrastructure associated with the proposed development of Lot 102 RP 860099, Lot 129 PL 4021 and Lot 2 RP 609985 known as Belmont Road, Parkhurst.

The total area of the site is approximately 59 hectares and currently exists as undeveloped parcels of land.

The existing site conditions and proposed stages are detailed on the **CSG Drawing No. 5892-01-CPT** and are included as Appendix A.

This report will present a general overview on the Infrastructure that exists in the immediate area and where any upgrading or augmenting needs to be undertaken to ensure that the development can be a logical and sequential extension of the suburban area, especially the existing developed stages of Riverside Estate, which will enhance the existing residential area of Rockhampton City, without causing any adverse effects to existing and future infrastructure.

This report will address Bulk Earthworks, Stormwater Drainage, Water Supply and Sewerage Reticulation, Proposed Road Hierarchy, Roundabout Details, Road Longsections and Cross-Section Details; as well as Electrical and Telecommunication Services.



2. Site Characteristics and Staging

The proposed development will be an extension of the existing Riverside Estate along the western side of Belmont Road and is located on the northern side of Rockhampton and abuts Ramsey Creek and the Fitzroy River.

Figure.1 below shows the approximate location of the proposed development.



Figure.1: Approximate Site Location (Source Google Maps)

As previously discussed, the development site is best described by the Real Property Descriptions, Lot 102 RP 860099, Lot 129 PL 4021 and Lot 2 RP 609985.

The area consists of approximately 59 ha of potential urban residential development.

The proposal is for a 201 lot residential development to be over 14 stages (please refer to Appendices A and B). These stages comprise of different sized residential allotments, with an average size of 1500m². This reflects the



lot size of the existing Riverside Estate and will provide a community development catering for the diverse family environment.

3. Good Practice Urban Design Principles

The proposed development has been master-planned to incorporate best practices for urban developments, which are as follows:

- A mixture of gentle grade blocks, sloping allotments and elevated allotments will be incorporated into the proposed development. This ensures that the majority of the community is catered for from first home owners, to investors to luxury dwellings.
- Two accesses to Belmont Road (which will be upgraded to a Major Collector Road) for the entire development with suitable approaches and sight distances. No allotments in the proposed subdivision will gain direct access from Belmont Road.
- Loop/ring and short cul-de-sac's roads are used throughout the layout providing short, safe access and manoeuvrability around the development.
- Pedestrian links are strategically positioned throughout the development joining roadways, while providing good access to amenities within the development and also to external roadway networks.
- Stormwater drainage strategies will be incorporated and consist of natural vegetated swales and channels and bio-retention systems, providing low maintenance stormwater polishing and ensuring runoff is managed and discharged with minimal impact to the environment, whilst adding to the appearance of the development.



4. Proposed Development and Preliminary Bulk Earthwork Levels

The proposed development is to establish a combination of 201 Residential lots with a generous area of 14.12 hectares of Public Use Land (PUL).

The proposed Plan of Development (POD) has been illustrated on CSG Drawing No. 5892-01-CPT and is included as Appendix B.

In considering this POD, preliminary surface levels throughout the site have been determined to blend in, as much as possible, with the natural surface level.

Preliminary surface levels have been illustrated on Brown Consulting Sketches R12394 - Earthworks Plans (Sheets 1 and 2) and has been included as Appendix C.

Siteworks for the development will consist of the following stages:

- Clearing and grubbing
- Bulk earthworks
- Underground services installation
- Roadworks and stormwater drainage works
- Final detailed works
- Vegetation establishment and landscaping

All stockpiles are to be segregated into topsoil, construction soils, pavements and protected with appropriate silt traps and fences. All stockpiles are to be accessed from the upstream side to reduce erosion and maintain consistency throughout the project construction phase.

Erosion control measures are to be implemented during construction in accordance with the Capricorn Municipal Development Guidelines requirements. All erosion control measures are to be closely monitored by the Principal Contractor and re-established after all rain events or due to any vandalism.



5. Wastewater Treatment/Sewerage Reticulation

Following discussions with Fitzroy River Water, existing “As Constructed” information was obtained pertaining to the sewerage reticulation in the Parkhurst area.

There is an existing sewerage pump station (SP038) on the north-eastern side Belmont Road. A rising main then transfers the sewage to a receiving manhole in parkland along Belmont Road.

A Ø150mm uPVC gravity main then transfers the sewage from this manhole into Fitzroy River Water’s sewerage network.

Stages 9A, 9B and 10 of the development (ie. 45 Lots) propose to generate approximately 48.6 ET. This sewage is intended to gravitate into the existing infrastructure, with no upgrading proposed. However, to minimise Bulk Earthworks and to eliminate the requirement of a lift station, or to construct the internal sewage pump station in the initial stage of development, only Stages 9A, 9B and 10 can discharge into the existing infrastructure.

To cater for Stages 11A to 16B; a Sewerage Pump Station is proposed to be constructed, within the downstream portions of the Public Use Land complemented with a rising sewerage main connecting this pump station with the “wet well”.

The proposed internal sewerage network has been illustrated on Brown Consulting Sketches R12394 – Sewerage Reticulation Plans (Sheets 1 and 2). Please refer to Appendix D.

A detailed Wastewater Management Report has been prepared and is included separately, to assist with this Development Application.

Following the approval of this Development Application, a more detailed design will be undertaken in conjunction with detailed discussions with Fitzroy River Water (FRW) officers to confirm existing capacity of sewerage network required to service the staged development of Riverside Estate.



6. Water Supply

There is an existing Ø100mm AC main located in the eastern verge of Belmont Road, which services the existing residential developments, in close proximity to the subject site.

The proposed development does not intend to connect to this water main.

It is proposed to extend a Ø300mm uPVC water main from the Parkhurst water supply, which is approximately 550m downstream of the proposed entrance to the development. From there, a Ø200mm uPVC water main will service the development, generally in accordance with the proposed internal water reticulation network that has been prepared for the development of the properties. This network has been illustrated on Brown Consulting Sketches R12394 – Water Reticulation Plan Sheets 1 and 2 (please refer to Appendix E).

The ultimate building designs which will be submitted to Council, at a later date, are to comply with Council's Water Supply Policy.

All internal allotments will be serviced by new reticulation mains situated in all new road reserves and designed to provide good loop connections throughout the site. Internal fire hydrants will be installed on all new watermains at 80m centres and in accordance with the requirements of the Capricorn Municipal Development Guidelines.

In accordance with RRC policy for water supply to development's Class 1-10, the maximum water draw-off from Council's system will be in accordance with Council's policy.

Similar to the Wastewater report, a detailed Water Report has been written and is included separately.

7. Stormwater Management

The aim of the stormwater strategy is to try to maintain the natural flowpaths that flow through the development site with minimal realignment. Water quantity and quality objectives are to be met in accordance with the QUDM, CMDG & Healthy Waterways ensuring the surrounding environment, allotments and infrastructure are not adversely affected due to this residential subdivision.

Please refer to the Stormwater Management Report and Stormwater Quality Report for details regarding water quantity and quality measures to be implemented in the development works.



The Stormwater Management Report will deal with compensatory “cut and fill” measures, that are to be undertaken for the development of the site.

The sub-catchments for the management of stormwater is illustrated on Brown Consulting Sketch R12394 – Stormwater Catchments and is included as Appendix F.

8. Waste and Recycling Collection

Waste and Recycling collection for the proposed development is to occur in accordance with the Rockhampton Regional Council Planning Scheme, through a minimum of the following service frequencies:

- » Weekly collections for general domestic waste, and
- » Fortnightly connections for recyclable wastes.

These services are currently existing for adjacent residential allotments situated along the eastern side of Belmont Road.

9. Traffic Report, Access and Internal Road Network

A separate Traffic Report has been undertaken for this proposed development. This report, which will be included as part of the Development Application, will address background traffic conditions near the site, the likely traffic generation of the development proposal, existing and future traffic conditions, internal road configuration and proposed access arrangements.

Access into the proposed development will be via two intersections with Belmont Road. The main intersection access will be via a four leg roundabout, located at the junction of the existing Belmont Road / Samuel Crescent “T” Intersection. This upgrading to Belmont Road will provide a traffic calming device and a more efficient entry and exit from both the proposed development and existing residential dwellings within Samuel Crescent. As well as this new four leg roundabout, access into the development will be made available through a T intersection between Road I and Belmont Road, located approximately 735m North-West along Belmont Road from Samuel Crescent.

In addition, the four leg roundabout access point has suitable approaches and sight distances in both directions for the proposed development and existing residences in Samuel Crescent. These sight distances meet the requirements for a 60km/hr major collector roadway for Belmont Road. All sight distance requirements are in accordance with the Road Planning Design Manual (RPDM). The intersection of Road I and Belmont Road is to be located in a similar location to the former William Palfrey Drive and Belmont Road intersection which had suitable sight distance which will be maintained for this new intersection.

A proposed internal road hierarchy is included as Brown Consulting Sketch R12394 – Road Hierarchy (please refer to Appendix G).



The proposed internal road network has been designed in accordance with Rockhampton Regional Council's requirements, widths specified within the Capricorn Municipal Development Guidelines (CMDG) and recommendations contained within Queensland Streets.

Belmont Road currently has a varying road reserve width, which is anticipated to be upgraded to a Major Urban Collector road as part of additional residential subdivisions being constructed north of this development site (ie. Eden Brook).

Road A of this proposed residential subdivision will be constructed as a Minor Urban Collector road from the intersection of Belmont Road to the intersection of Road I within the development. For this portion of the road, Road A will be constructed at 7.5m wide carriageway (invert to invert) in an 18.0m wide road reserve. One 1.2m pedestrian pathway will be constructed for the Minor Urban Collector section of Road A in accordance with the Capricorn Municipal Development Guidelines. To ensure good connectivity and suitable links to external road networks, Road I from chainage 0.000 to chainage 164.940 (Road A intersection) will also be constructed as a Minor Urban Collector road which links the development to Belmont Road. This portion of Road I will be 7.5m wide (invert to invert) in a 20.0m wide road reserve with a 1.2m pedestrian pathway to provide suitable amenities for pedestrian traffic.

Road B has been designed as an Urban Access Street and to a standard as per the requirements of the Capricorn Municipal Development Guidelines (CMDG). It will be constructed as a 7.5m wide (invert to invert) in a 16.0m wide road reserve. No pedestrian pathways will be constructed between these chainages in accordance with the Capricorn Municipal Development Guidelines.

As an Urban Access Street has the capacity to service up to 75 allotments, this will allow future stages to connect into the proposed road network for this development with no issues relating to traffic volumes generated from this development.

Roads C and G have been designed as both an Urban Access Street and an Urban Access, dependent upon the catchment that it serves and is compliant with the requirements of the Capricorn Municipal Development Guidelines (CMDG). Initially Road C will be constructed as a 7.5m wide (invert to invert) in a 16.0m wide road reserve. Road C will transition to an Urban Access Place until it intersects with Road A. No pedestrian pathways will be constructed in accordance with the Capricorn Municipal Development Guidelines.

Roads F and H will be constructed as an Urban Access Streets in accordance with the Capricorn Municipal Development Guidelines. Road F will be constructed at 7.5m wide (invert to invert) in a minimum 16.0m wide road reserve and Road H will be 7.5m wide (invert to invert) in a 20.0m wide road reserve. No pathway is required for these streets. Road I from chainage 164.940 (Road A intersection) to the end cul-de-sac will also be constructed as an Urban Access Street as 7.5m wide (invert to invert) within a 20.0m wide road reserve.

Roads D and E will be constructed as an Urban Access Places in accordance with the Capricorn Municipal Development Guidelines. All of these aforementioned roadways service under 25 allotments and have a traffic flow no greater than 250 AADT. Road D and E will be constructed at 5.5m wide (invert to invert) with Road D having a minimum 16.0m wide road reserve and Road E a 20.0m wide road reserve. No pathway is required for these road carriageways.

The longsections and cross-sections of these streets are also included in Appendix G.

In addition, the proposed roundabout to be constructed at the intersection of Belmont Road and Samuel Crescent, is also illustrated in Appendix G.



10. Electrical and Telecommunication

Existing overhead electrical and underground telecommunication services are currently available along the Eastern side of Belmont Road, which can provide appropriate connections for the proposed development.

The electrical services will need a new pole constructed in between the existing vegetation within the Belmont Road verge and a turret constructed near the new vehicular ingress/egress.

The telecommunication services for the entire development will be via an underground conduit, that emanates from a telecommunications pit, just outside the north east corner of the property.

Proposed connections to the units have been illustrated on Brown Consulting Sketch R12394 and included as Appendix H.

11. Conclusion

There appears to be no engineering infrastructure difficulties with the proposed extension of Riverside Estate along Belmont Road, Parkhurst. A review of the services proposed for this development and their impact on surrounding services, indicate that there is no impediment to development.

There is a workable design strategy for traffic and access, stormwater drainage, sewerage reticulation, water supply, electricity and telecommunications. Minor alterations in design may eventuate from future applications, however the fundamentals of the design strategy ensures that service provisions will not pose a serious constraint to development.

Preliminary analyses of the Water Supply confirm that they can service Stages 9A, 9B and 10 of the proposed development.

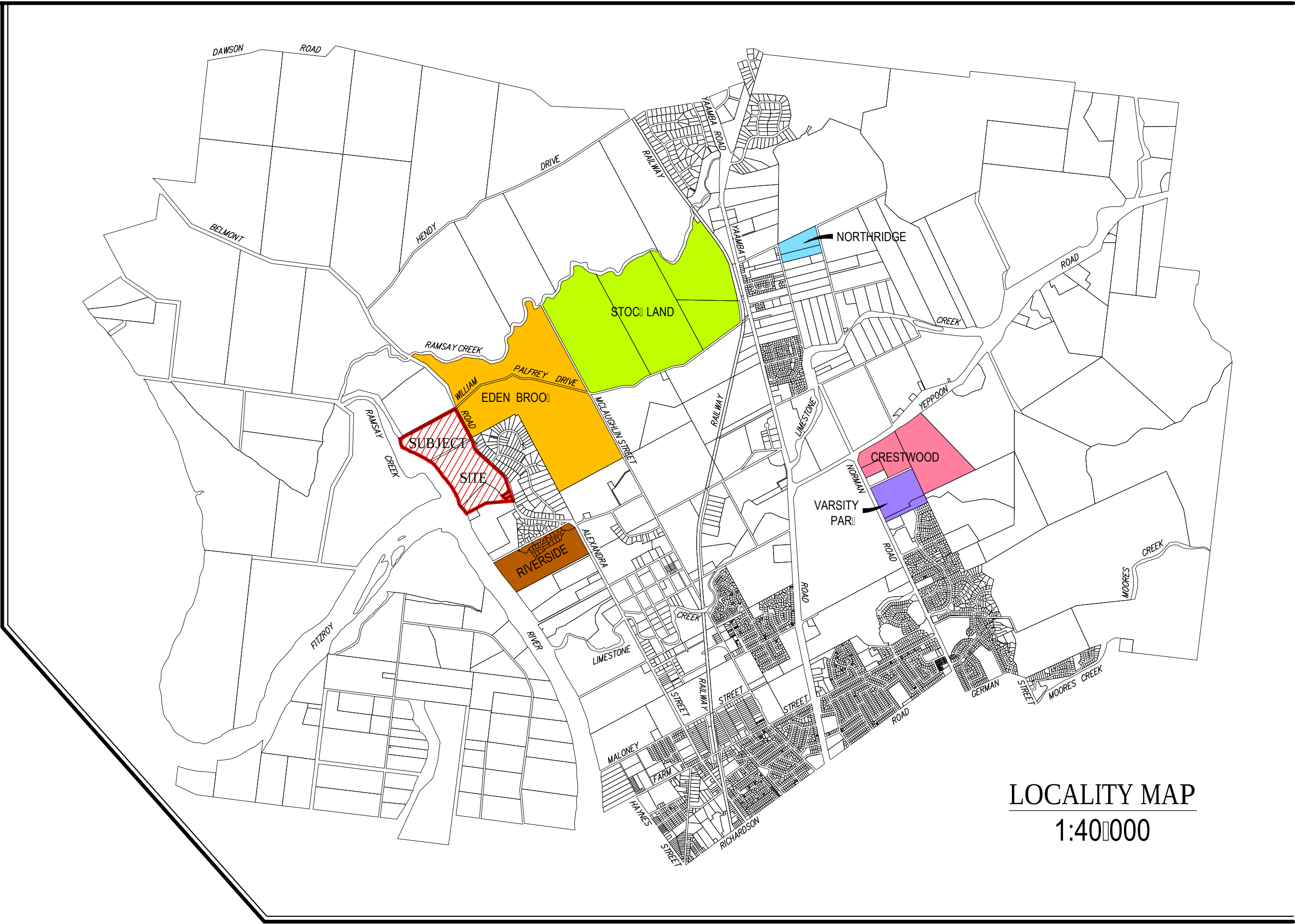
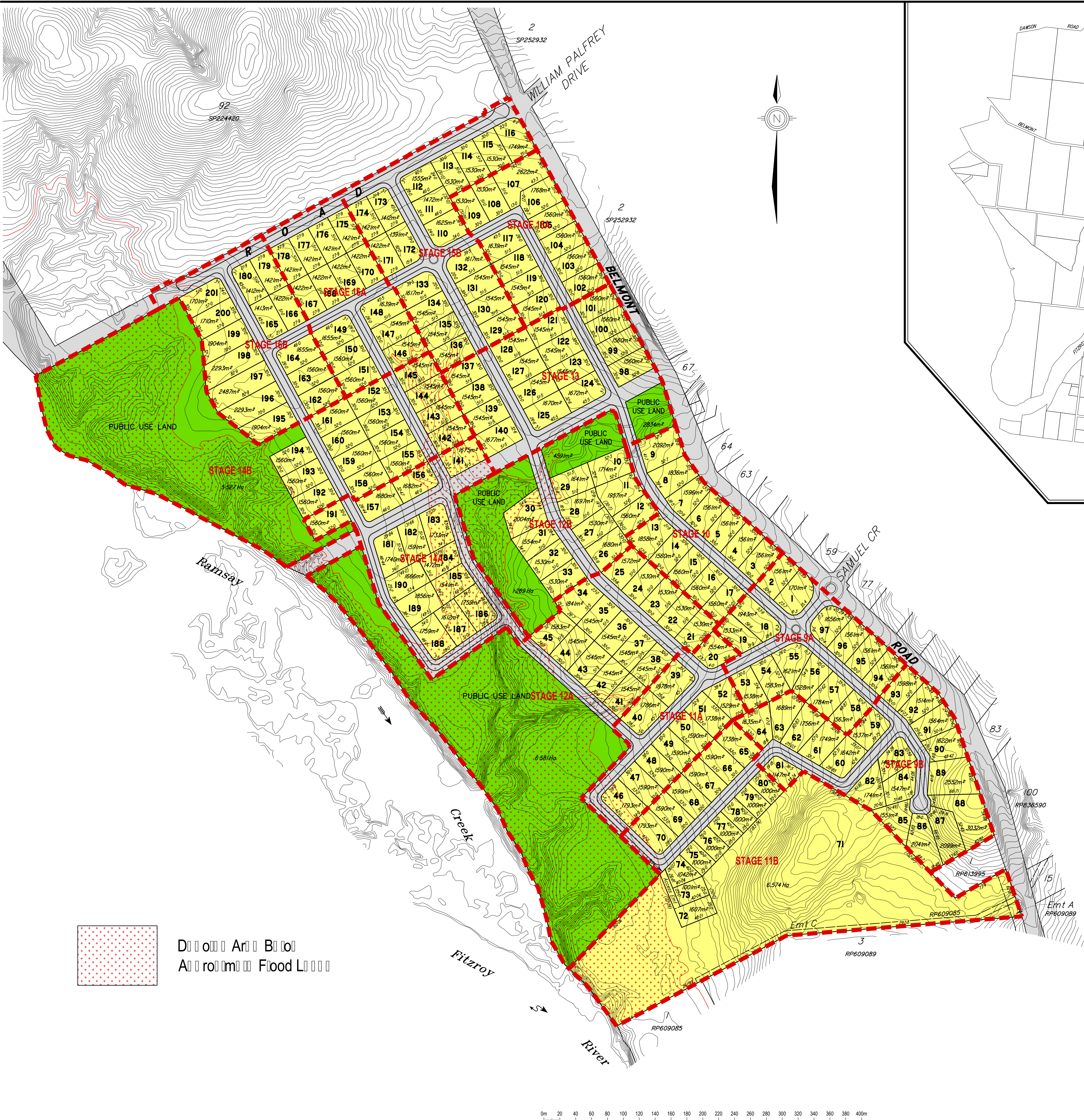
A preliminary review of the existing sewerage network confirms that they can only service Stages 9A, 9B and 10 of the proposed development; due to proposed bulk earthwork levels and grades throughout the development, without constructing an internal sewage pump station. To cater for the ultimate 201 lot development, a sewerage pump station will need to be constructed within the development, accompanied by a “wet well” for storage. A rising sewerage main will then transport the sewage to the “wet well” that was constructed as part of the initial stages of development.



Appendices



Appendix A Existing Site Conditions and Proposed Stages



IMPORTANT NOTE

This plan was prepared exclusively for M. Birkbeck for discussion purposes only and should not be used for any other purpose.

The areas shown hereon are subject to field survey and also to the requirements of council and any other authority which may have requirements under any relevant legislation.

In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.

This note is an integral part of this plan.

M. Birkbeck

**Belmont Road
Parkhurst
Riverside Estate
Stages 9-16**

**Concept Plan
(201 Lots + Public Use Land)**

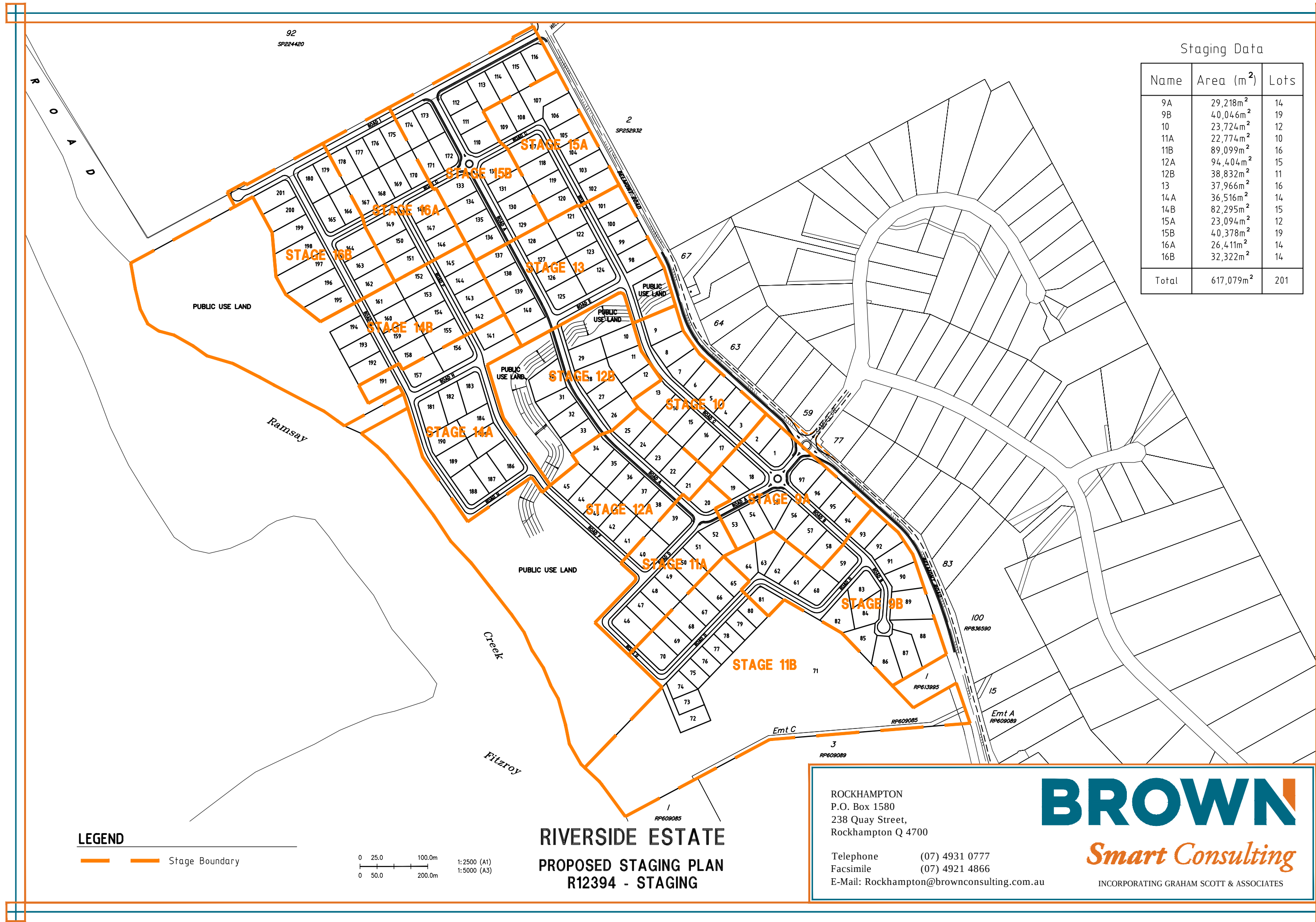
Lot 102 on RP860099,
Lot 129 on PL4021 & Lot 2 on RP609985
Parish of Murchison
County of Livingstone

Rockhampton Regional Council		
no	date	description
A	16-05-2013	Initial Concept Plan
B	13-08-2013	Revised Concept Plan
C	30-08-2013	Revised Concept Plan
D	12-10-2013	Revised Concept Plan
E	13-11-2013	Revised Concept Plan
F	6-12-2013	Revised Concept Plan
G	10-12-2013	Revised Concept Plan

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rockhampton qld 4700
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F 07 4922 2716
Email: csq@csq.com.au
Web: www.csq.com.au



Appendix B Proposed Plan of Development with Stages



Staging Data		
Name	Area (m ²)	Lots
9A	29,218m ²	14
9B	40,046m ²	19
10	23,724m ²	12
11A	22,774m ²	10
11B	89,099m ²	16
12A	94,404m ²	15
12B	38,832m ²	11
13	37,966m ²	16
14A	36,516m ²	14
14B	82,295m ²	15
15A	23,094m ²	12
15B	40,378m ²	19
16A	26,411m ²	14
16B	32,322m ²	14
Total	617,079m ²	201

LEGEND
— Stage Boundary

0 25.0 100.0m
0 50.0 200.0m
1:2500 (A1)
1:5000 (A3)

RIVERSIDE ESTATE
PROPOSED STAGING PLAN
R12394 - STAGING

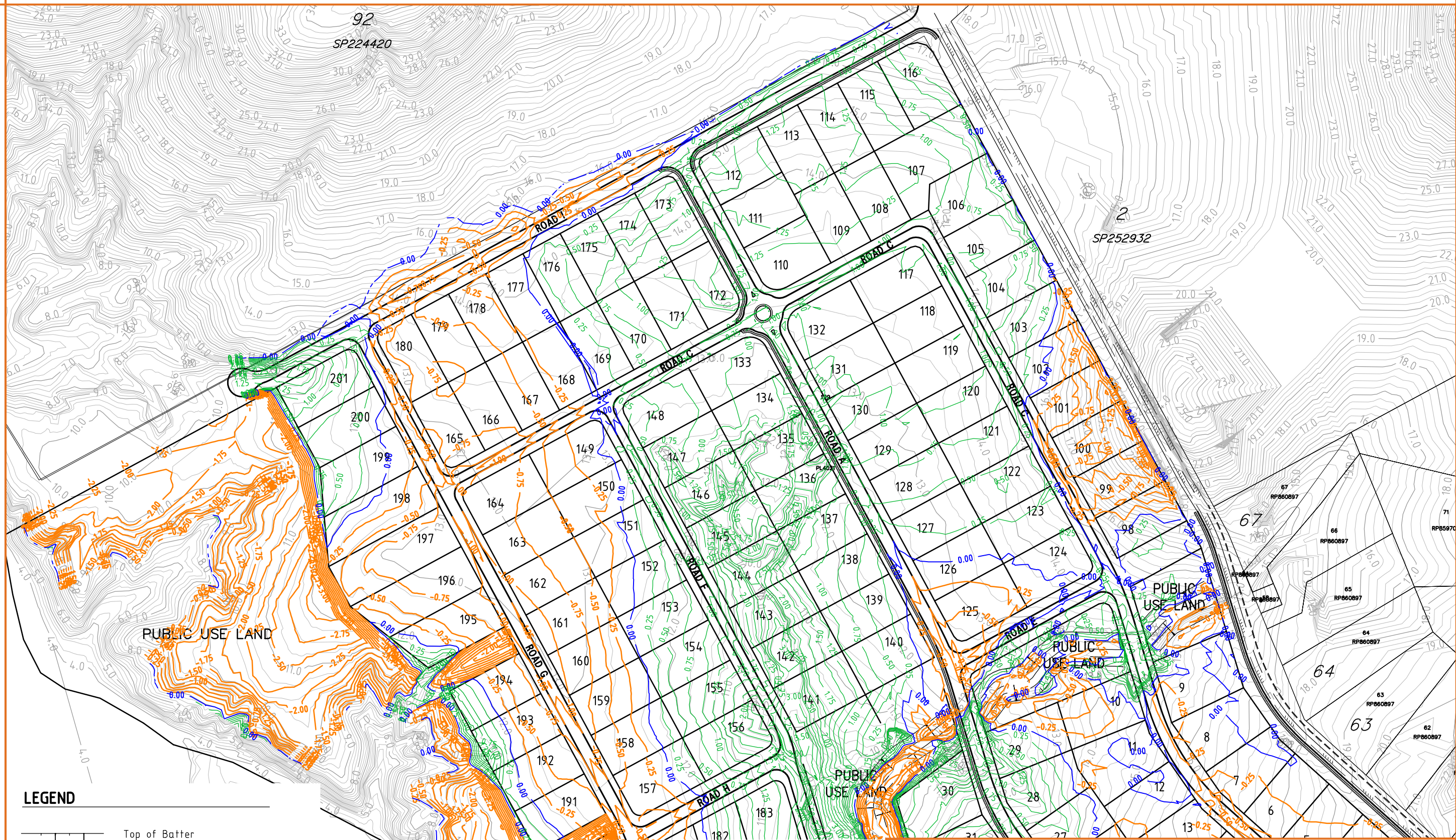
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Appendix C Preliminary Bulk Earthworks Surface Levels



LEGEND

- Top of Batter
- Toe of Batter
- 0.0 Balance contours
- 1.0 Fill contours
- 1.0 Cut contours
- 12.0 Existing Contours

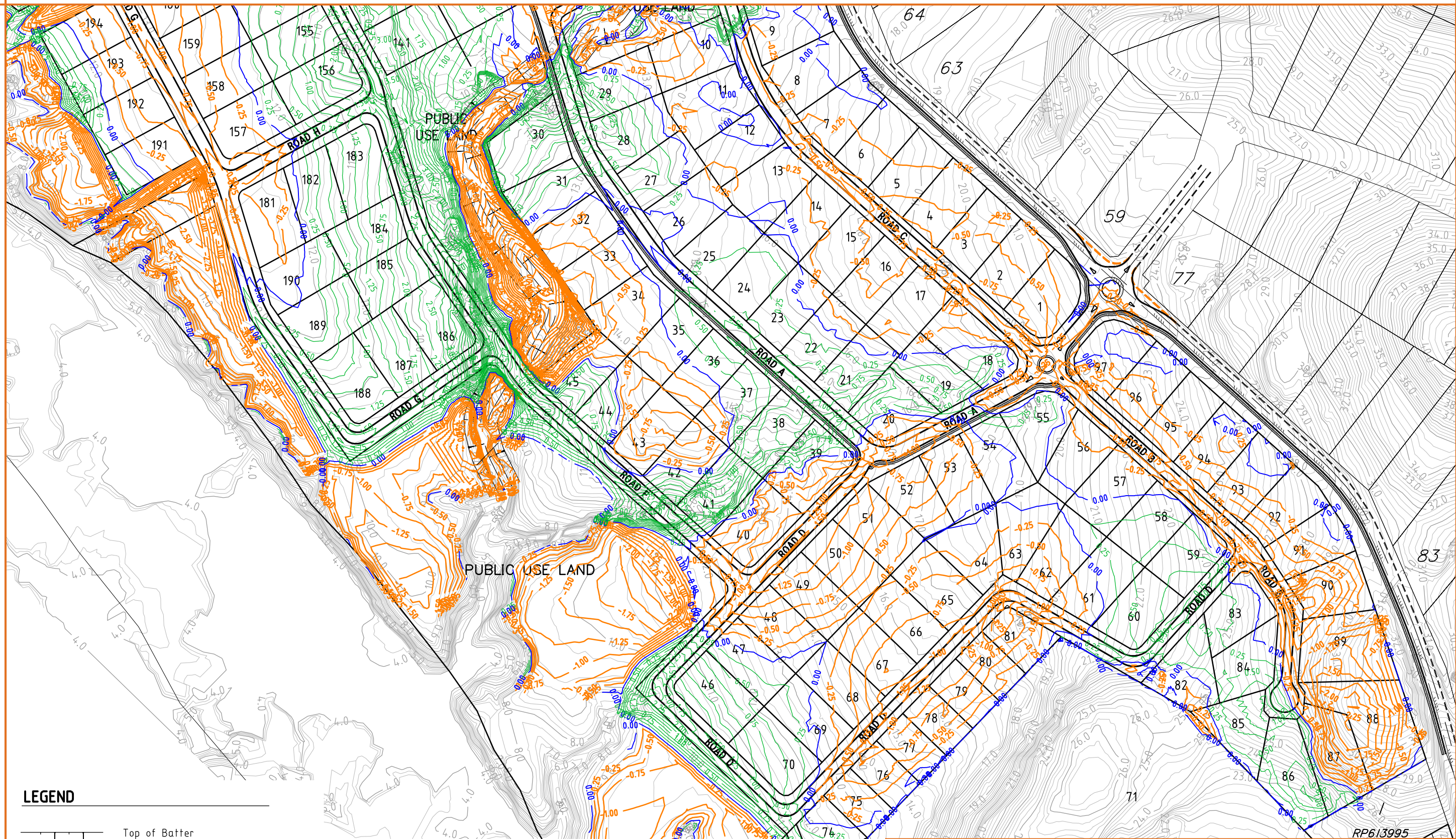
RIVERSIDE ESTATE EARTHWORKS PLAN SHEET 1 OF 2 R12394 - EARTHWORKS

0 6.25 25.0m
12.5 50.0m
1:1250 (A1)
1:2500 (A3)

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LEGEND

- Top of Batter
- Toe of Batter
- Balance contours
- Fill contours
- Cut contours
- Existing Contours

RIVERSIDE ESTATE EARTHWORKS PLAN SHEET 2 OF 2 R12394 - EARTHWORKS

0 6.25 25.0m
0 12.5 50.0m
1:1250 (A1)
1:2500 (A3)

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Appendix D Existing and Proposed Sewerage Reticulation Plan



Legend

Lot 129 on PL4021

Sewer Treatment Plant

Sewer Pump Stations

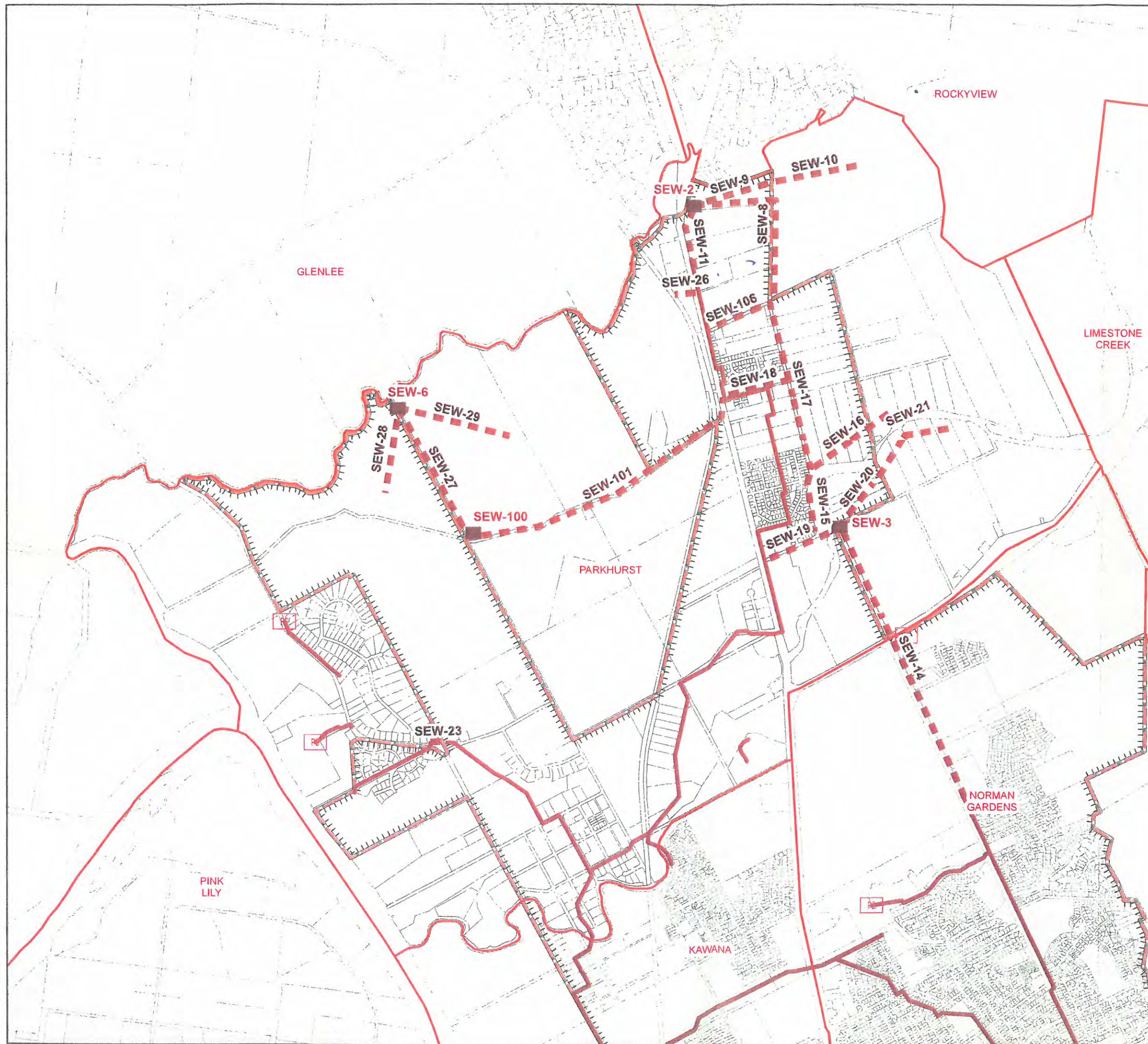
Rising Mains

Reticulation Main

Trunk Main

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Sewer



Trunk Infrastructure - Sewerage

- Locality Boundaries
- Future Sewerage Trunk Infrastructure**
 - Future Pump Station
 - ▲ Future Treatment Plant
 - Future Sewerage Main
- Existing Sewerage Trunk Infrastructure**
 - PS Existing Pump Station
 - STP Existing Treatment Plant
 - Existing Sewerage Trunk Main
 - Cadastral Parcels
 - Priority Infrastructure Area

Note: Priority Infrastructure Area located inside hashed boundary.

Approx Scale @A3 1:25,000

0 380 760 1,520 Metres

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Map 86-2 PARKHURST Sewerage Network Infrastructure Map

December 2012



LEGEND

- Proposed Sewer & Manhole (Gravity to Existing Pump Station)
- Proposed Sewer & Manhole (Gravity to Proposed Pump Station)
- SR— Proposed Rising Sewer Main
- Proposed Ultimate Sewer Pump Station

RIVERSIDE ESTATE SEWER RETICULATION PLAN - SHEET 1 OF 2 R12394 - SEWER

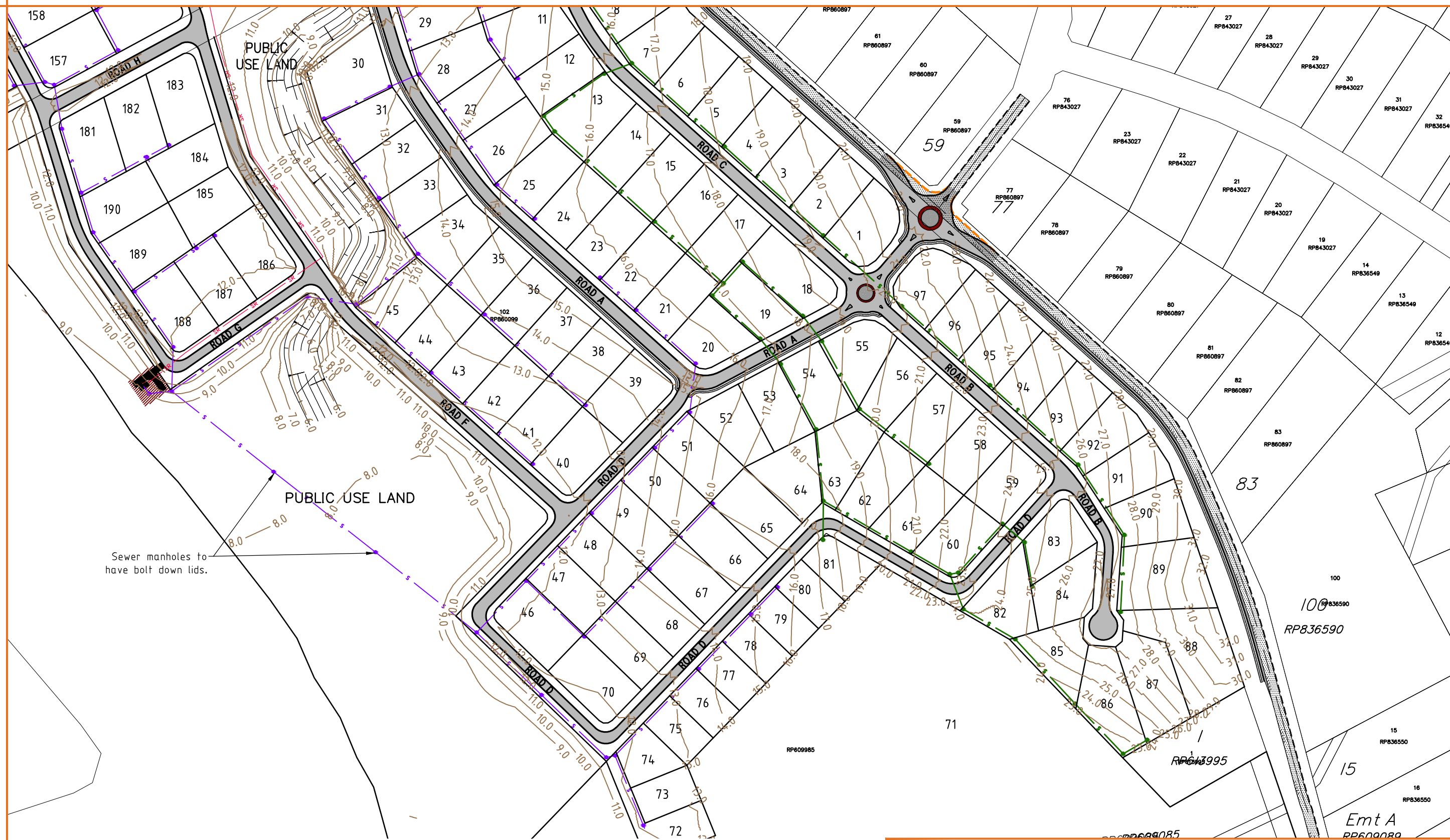
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LEGEND

- Proposed Sewer & Manhole (Gravity to Existing Pump Station)
- Proposed Sewer & Manhole (Gravity to Proposed Pump Station)
- Proposed Rising Sewer Main
- Proposed Ultimate Sewer Pump Station

RIVERSIDE ESTATE
SEWER RETICULATION PLAN - SHEET 2 OF 2
R12394 - SEWER 2

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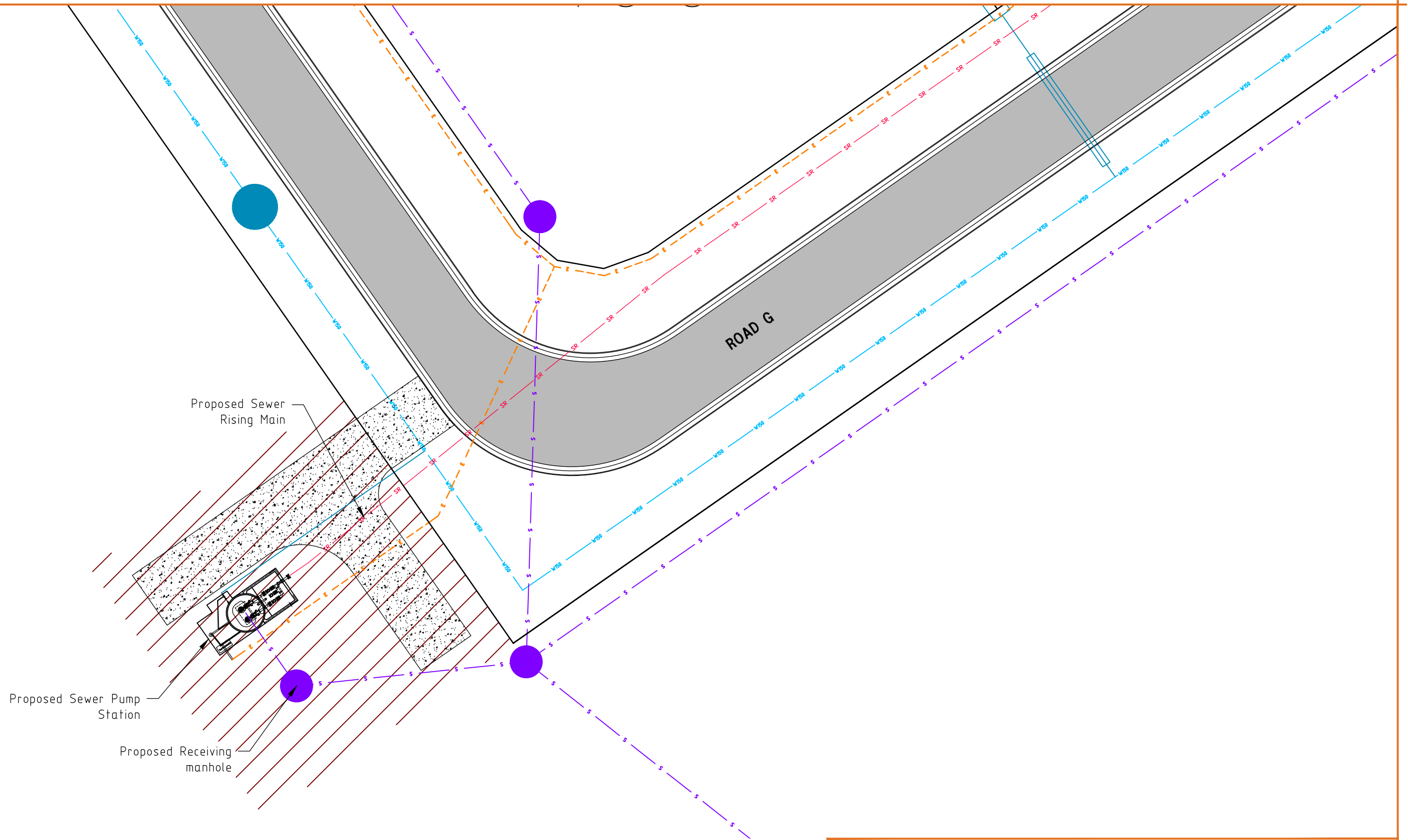


RIVERSIDE ESTATE
SEWERAGE PUMP STATION PLAN
R12394 - EXISTING SEWERAGE PUMP STATION

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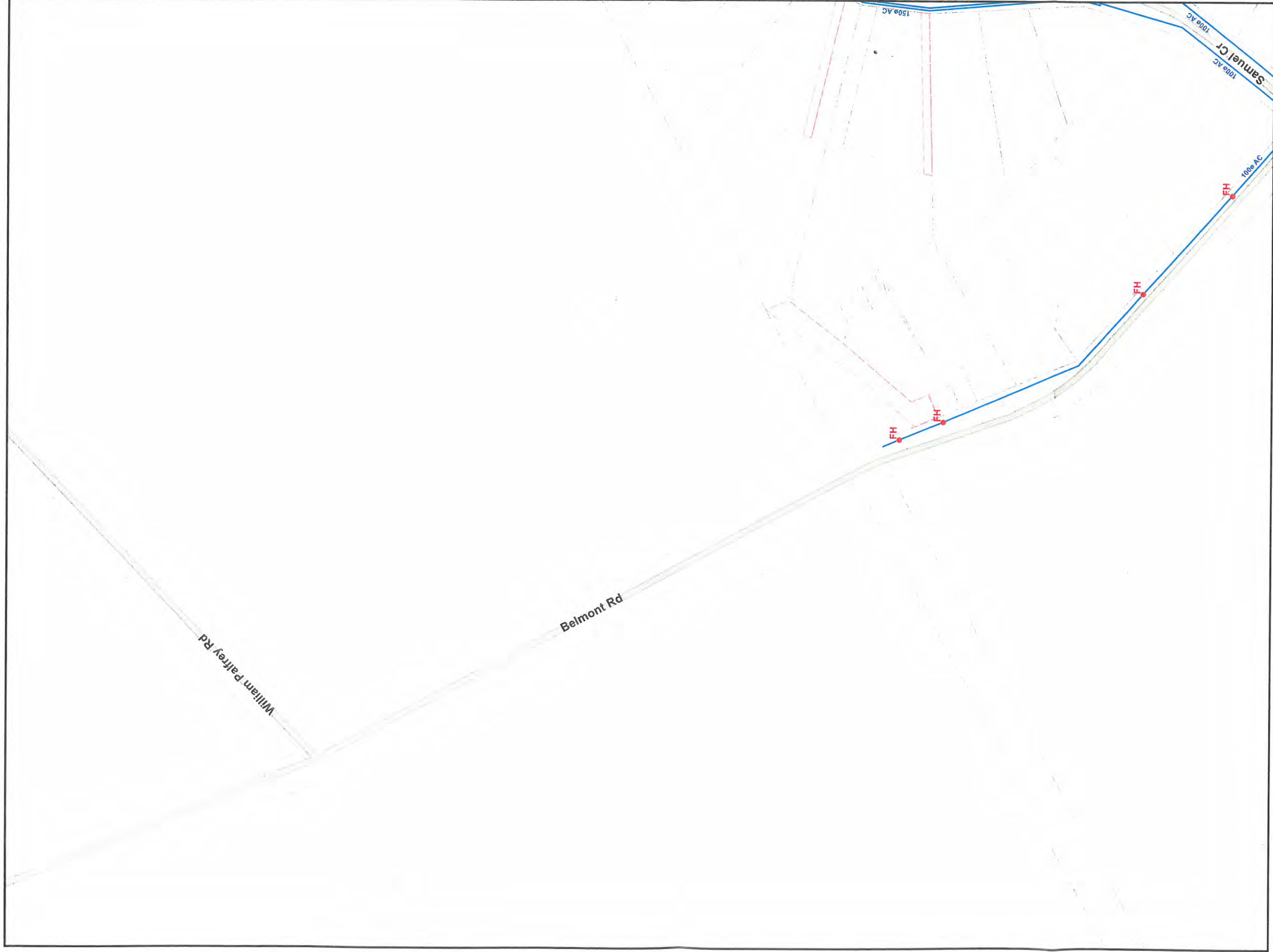
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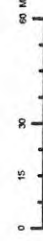


Appendix E Existing and Proposed Water Supply Plan



Water Network Map 8

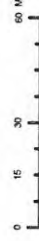
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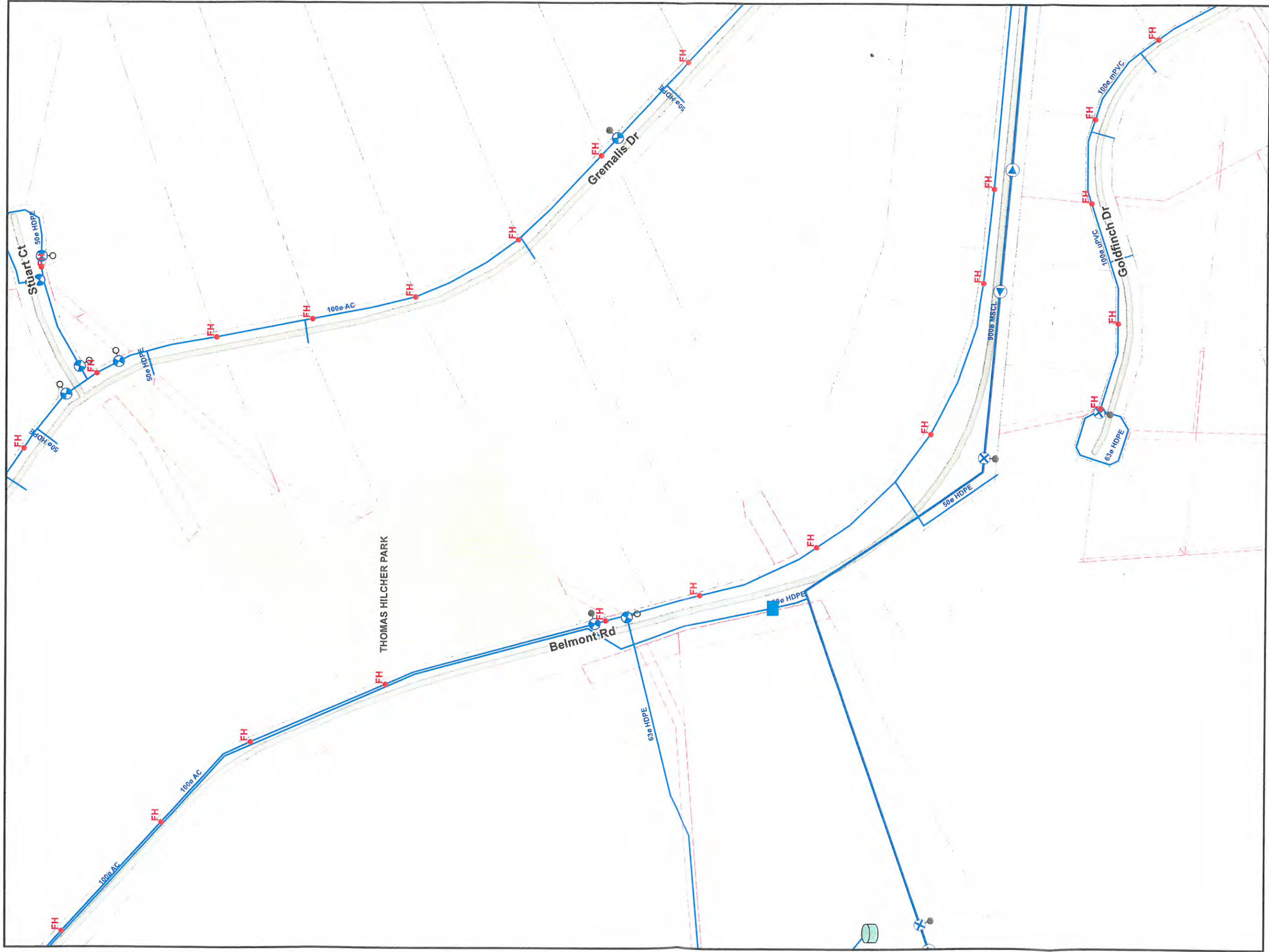


Water Network Map 11

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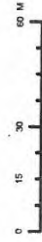


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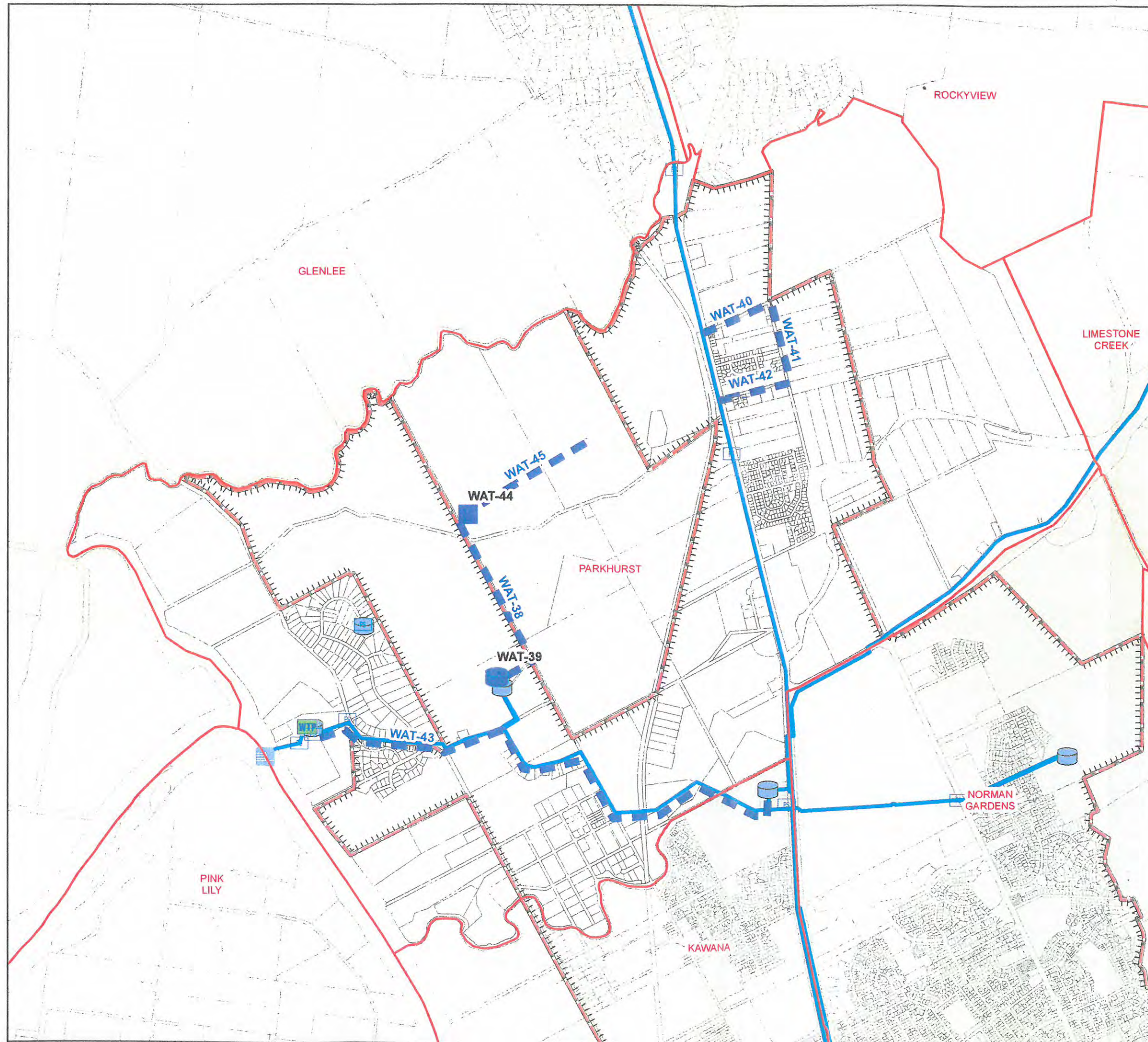


Water Network Map 12

1:2,100 at A3



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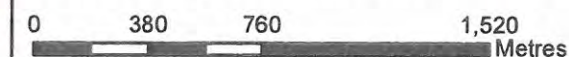


Trunk Infrastructure - Water

- Locality Boundaries
- Future Water Trunk Infrastructure**
 - Future Pump Station
 - Future Treatment Plant
 - Future Water Reservoir
 - Future Water Trunk Main
- Existing Water Trunk Infrastructure**
 - Existing Pump Station
 - Existing Treatment Plant
 - Existing Water Reservoir
 - Existing Water Trunk Main
 - Existing Dams or Bores
 - Cadastral Parcels
 - Priority Infrastructure Area

Note: Priority Infrastructure Area located inside hashed boundary.

Approx Scale @A3 1:25,000



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Map 86-1 PARKHURST Water Network Infrastructure Map

December 2012

92
SP224420

2
SP252932

PUBLIC USE LAND

PUBLIC USE LAND

PUBLIC USE LAND

PUBLIC USE LAND

LEGEND

- W300 New 300ØmPVC Class 16 Watermain
- W200 New 200ØmPVC Class 16 Watermain
- W150 New 150ØmPVC Class 16 Watermain
- W100 New 100ØmPVC Class 16 Watermain
- W Water Service Conduit
- Fire Hydrant - ◇ Sluice Valve/Gate Valve
- FH SV

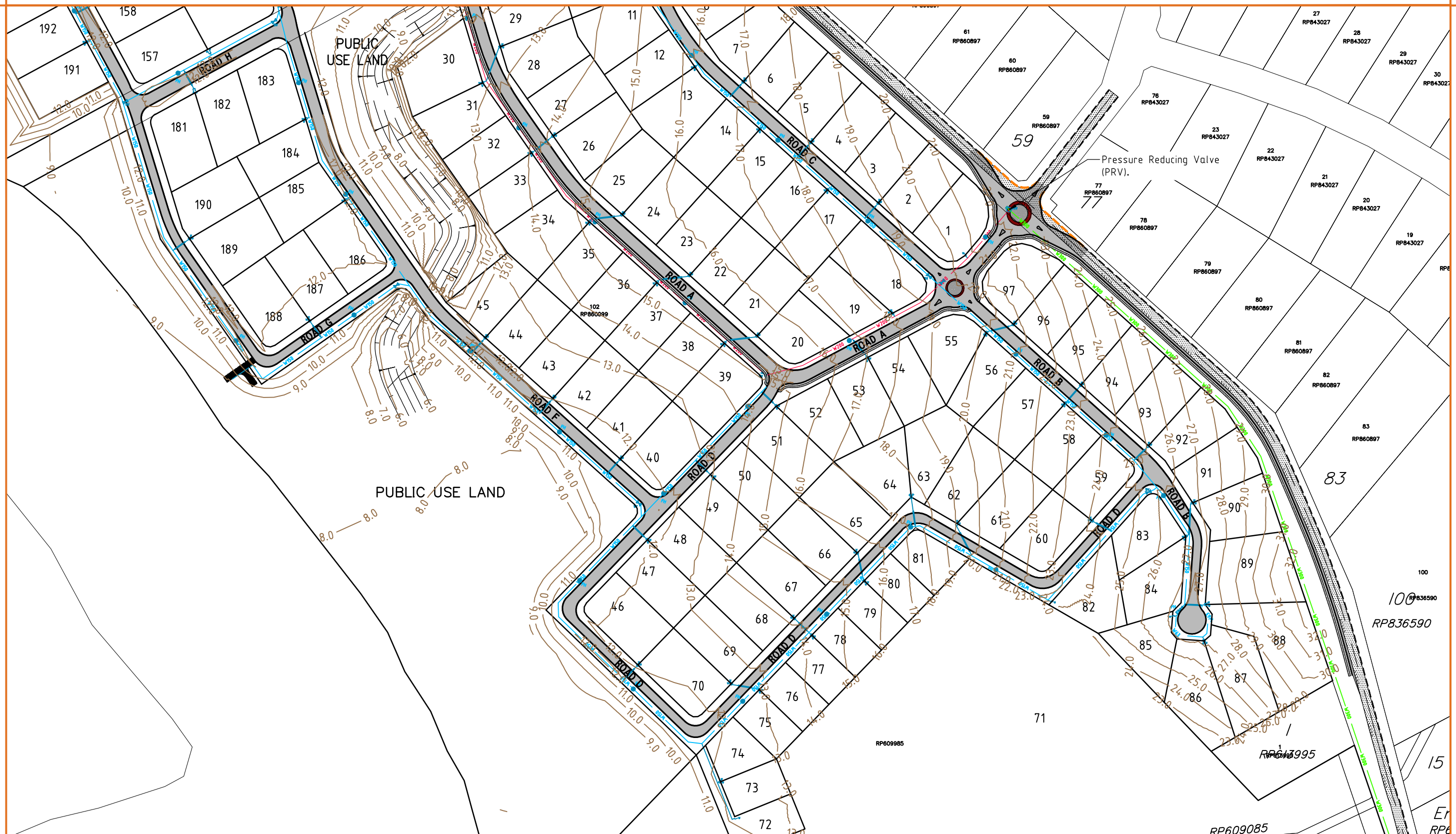
RIVERSIDE ESTATE WATER RETICULATION PLAN - SHEET 1 OF 2 R12394 - WATER

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0 50.0 200.0m
1:2500 (A1)
1:5000 (A3)

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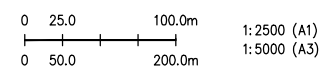
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- LEGEND**
- New 300ØmPVC Class 16 Watermain
 - New 200ØmPVC Class 16 Watermain
 - New 150ØmPVC Class 16 Watermain
 - New 100ØmPVC Class 16 Watermain
 - Water Service Conduit
 - Fire Hydrant - Sluice Valve/Gate Valve

RIVERSIDE ESTATE
WATER RETICULATION PLAN - SHEET 2 OF 2
R12394 - WATER 2



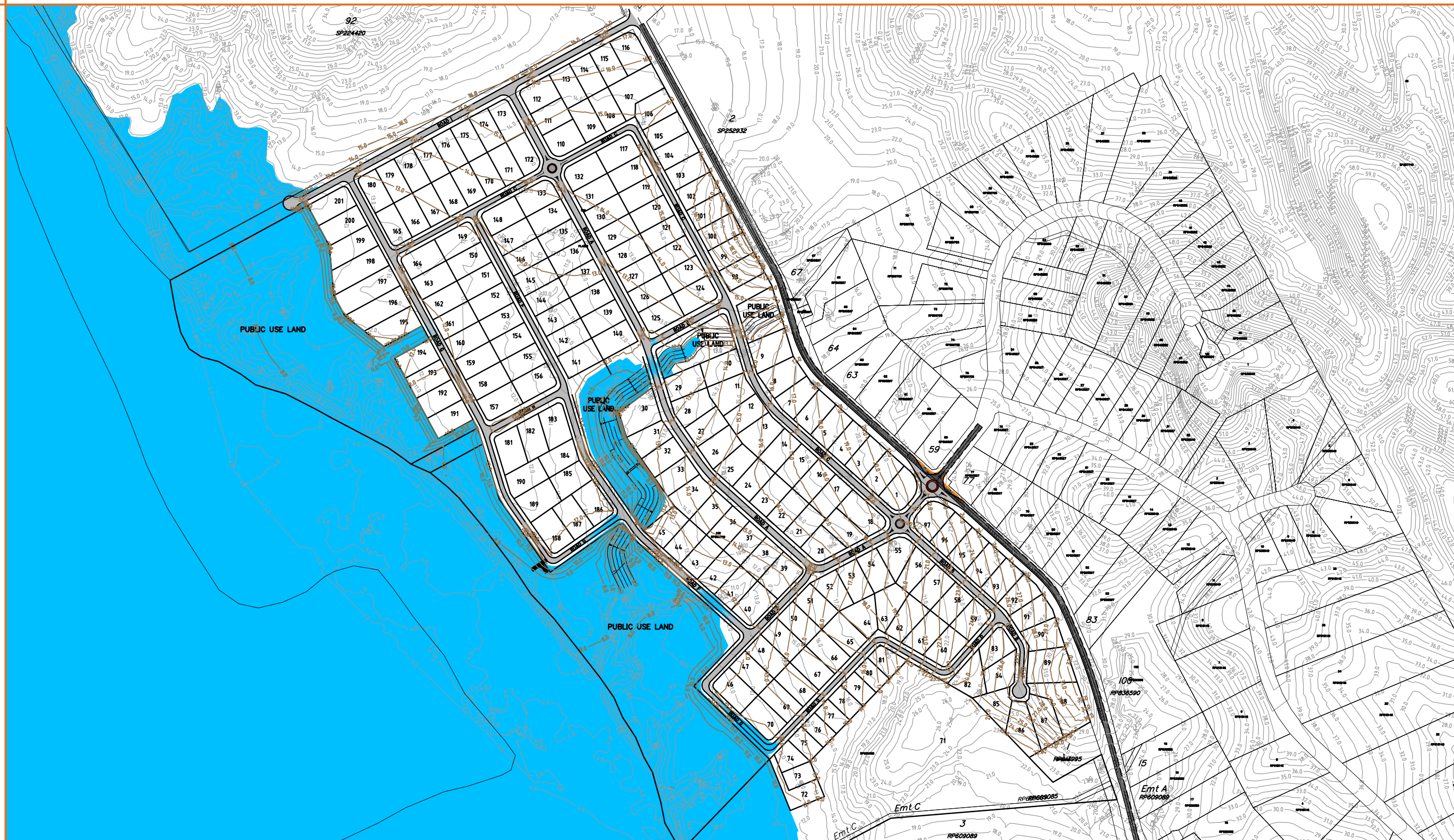
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Appendix F Proposed Stormwater Catchments



RIVERSIDE ESTATE
POST DEVELOPMENT INUNDATION PLAN
R12394 - POST INUNDATION

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1:5000 (A3)

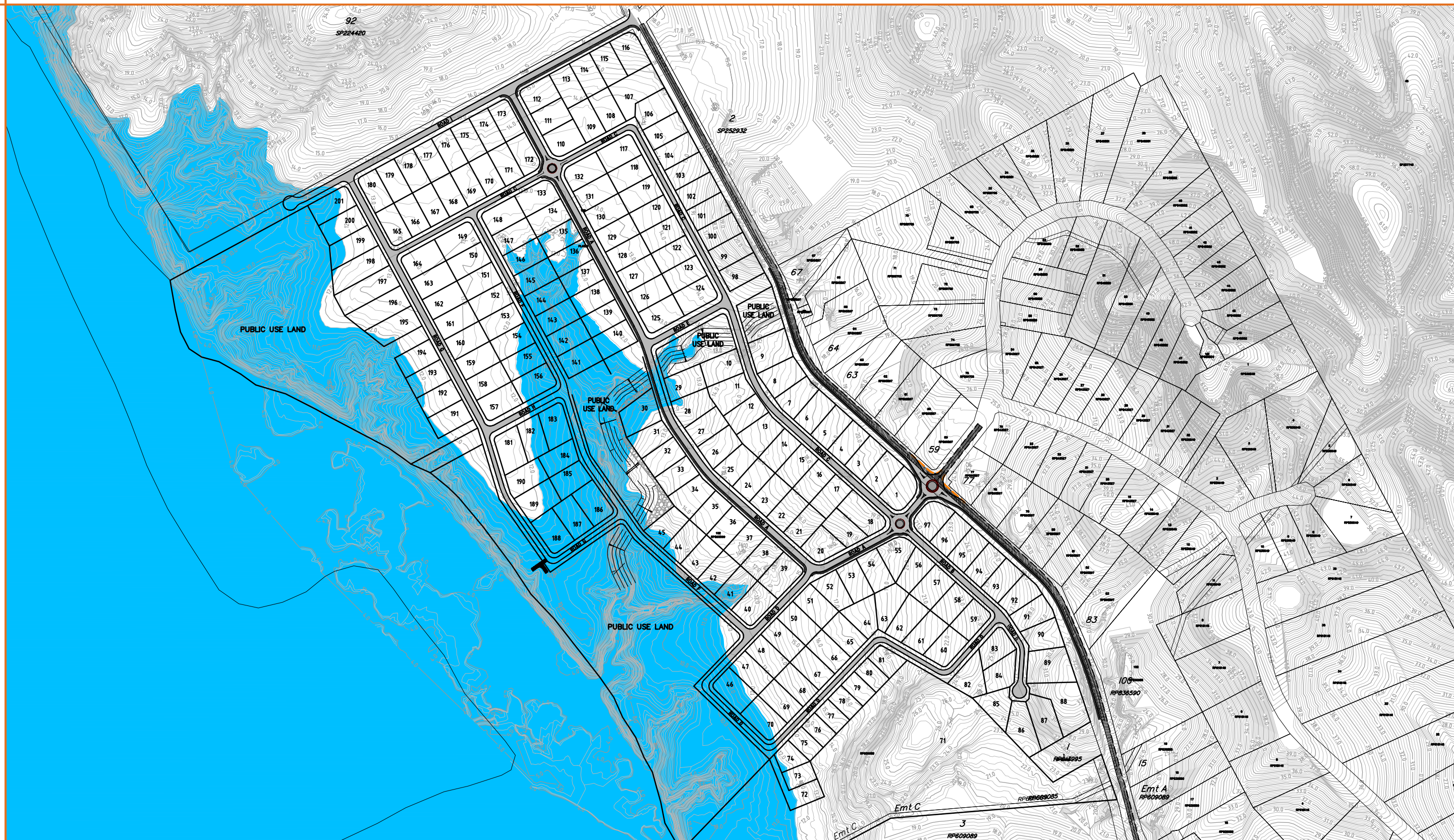
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RIVERSIDE ESTATE
PRE DEVELOPMENT INUNDATION PLAN
R12394 - PRE INUNDATION

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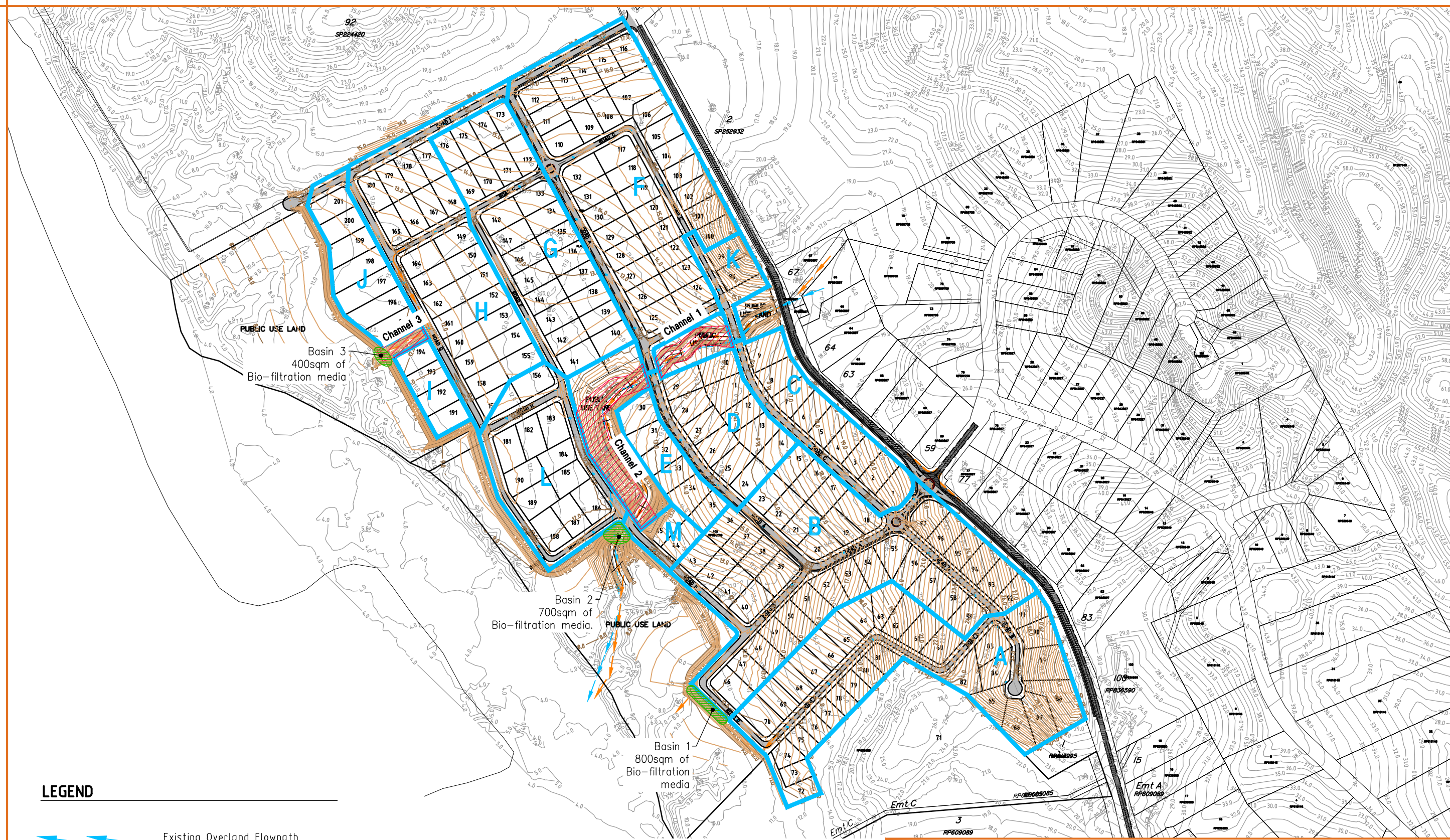
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LEGEND

- Existing Overland Flowpath
- Proposed Overland Flowpath
- Existing Contours
- Proposed Culvert System
- Proposed Bio-retention Basins
- Proposed Rock Protection / Rock Retaining wall

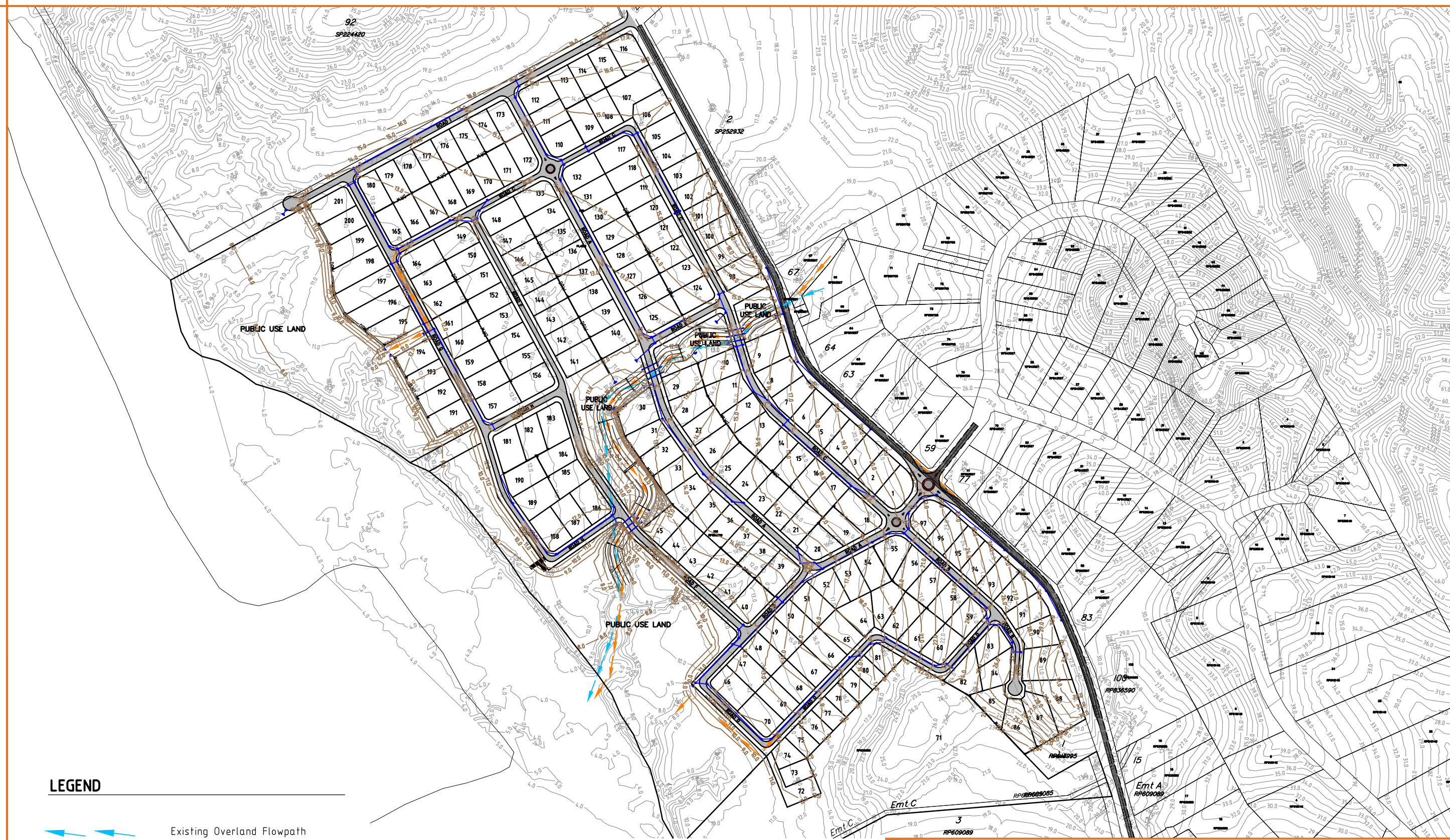
RIVERSIDE ESTATE STORMWATER QUALITY PLAN R12394 - STORMWATER QUALITY

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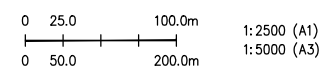
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LEGEND

-  Existing Overland Flowpath
-  Proposed Overland Flowpath
-  Existing Contours
-  Proposed Culvert System
-  Proposed Bio-retention Basins
-  Proposed Rock Protection / Rock Retaining wall

RIVERSIDE ESTATE
STORMWATER
R12394 - STORMWATER



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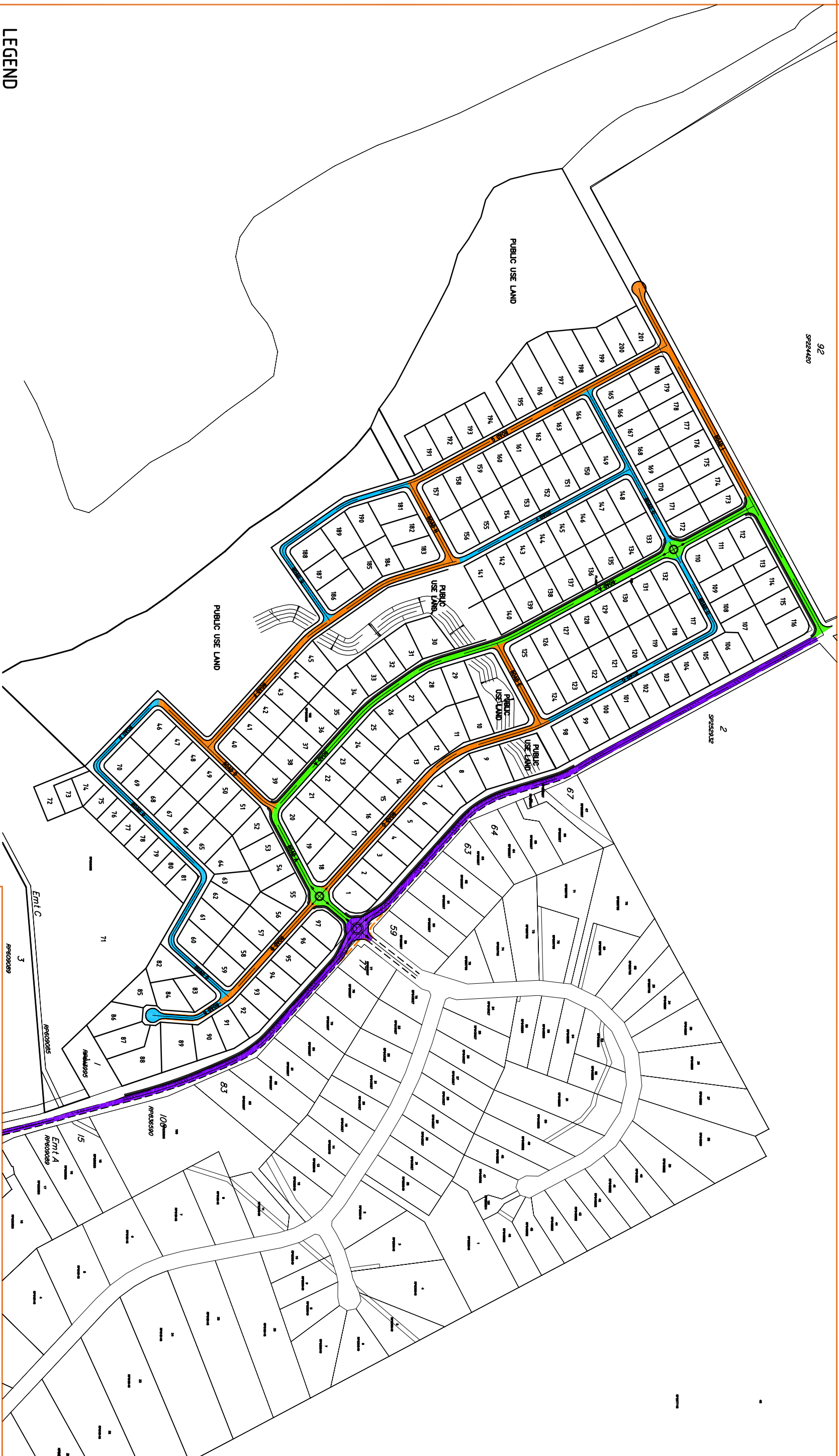
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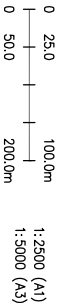
Appendix G Proposed Road Hierarchy Plan, Roundabout Details, Road Longsections and Cross-section Details



LEGEND

- Minor Urban Collector
- Urban Access Street
- Urban Access Place
- Half Width Major Collector (Belmont Road)

RIVERSIDE ESTATE
ROAD HIERARCHY PLAN
R12394 - ROAD HEIRARCHY

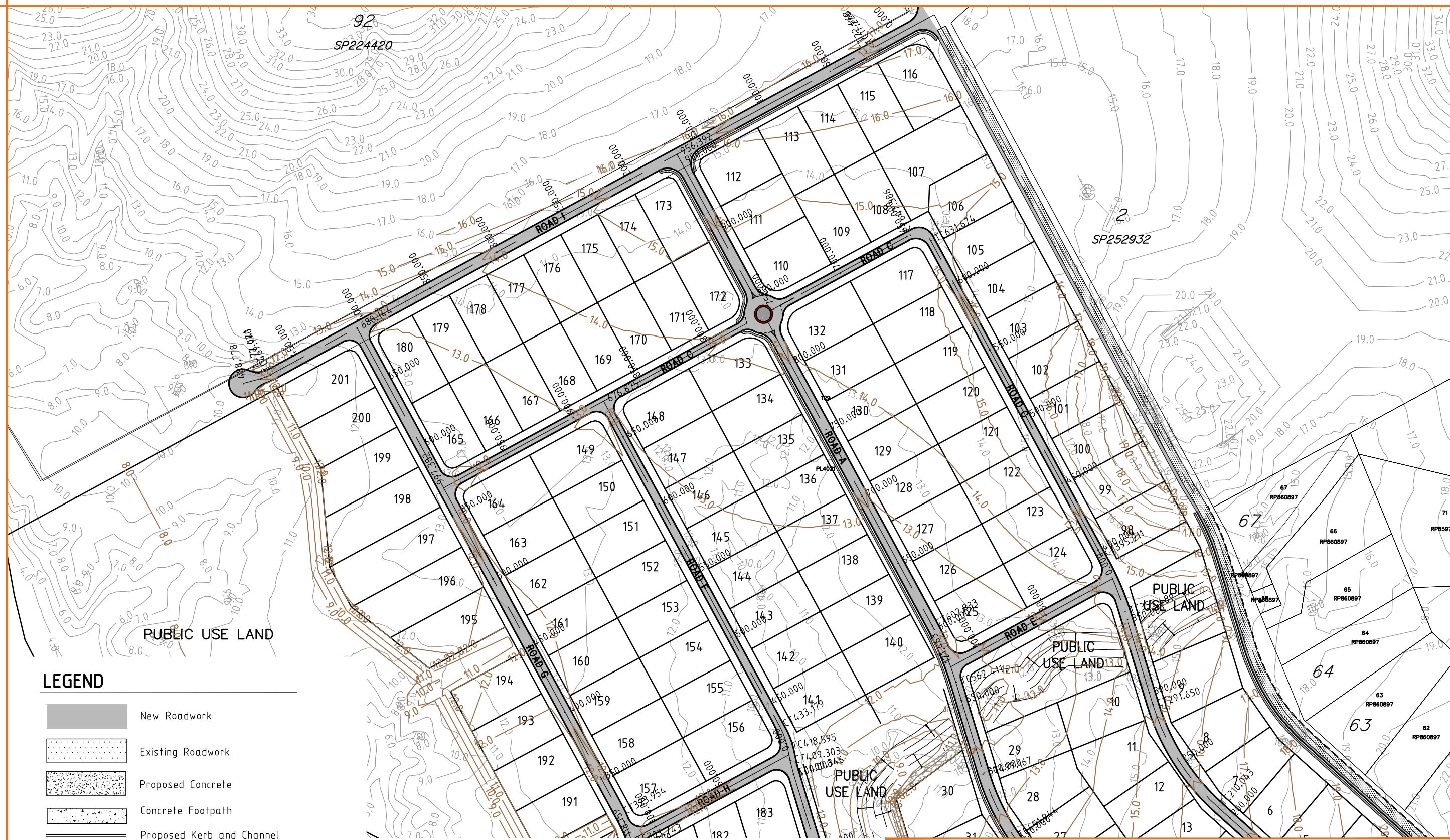


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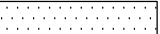
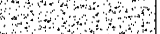
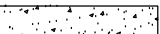
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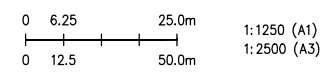
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LEGEND

-  New Roadwork
-  Existing Roadwork
-  Proposed Concrete
-  Concrete Footpath
-  Proposed Kerb and Channel
-  Existing Kerb and Channel
-  Existing Contours
-  Finished Surface Contours

RIVERSIDE ESTATE ROADWORKS PLAN SHEET 1 OF 2 R12394 - ROADWORKS



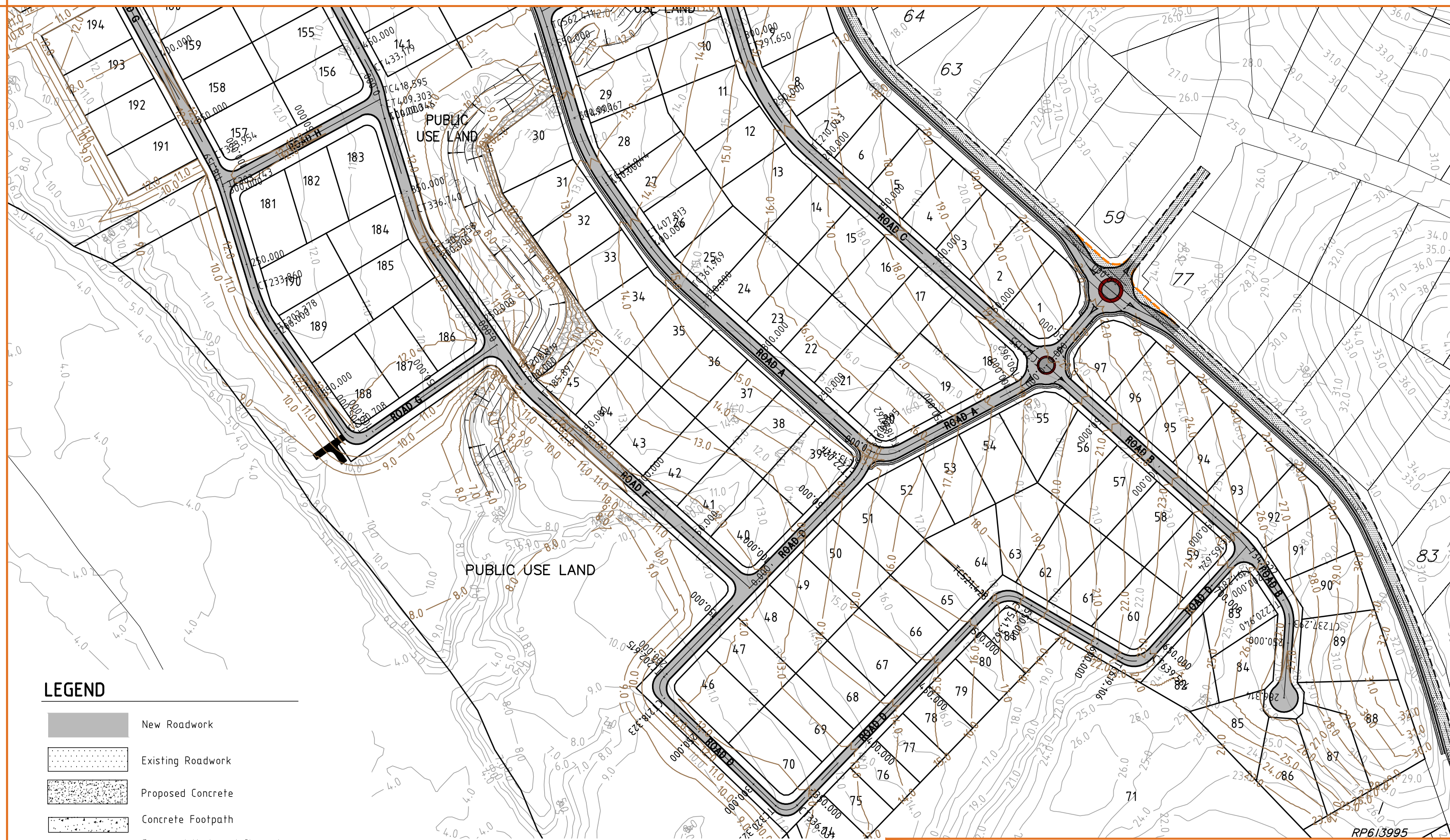
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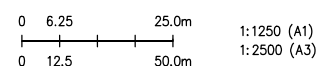
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LEGEND

- New Roadwork
- Existing Roadwork
- Proposed Concrete
- Concrete Footpath
- Proposed Kerb and Channel
- Existing Kerb and Channel
- Existing Contours
- Finished Surface Contours

RIVERSIDE ESTATE ROADWORKS PLAN SHEET 2 OF 2 R12394 - ROADWORKS



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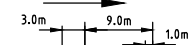
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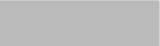
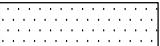
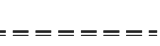
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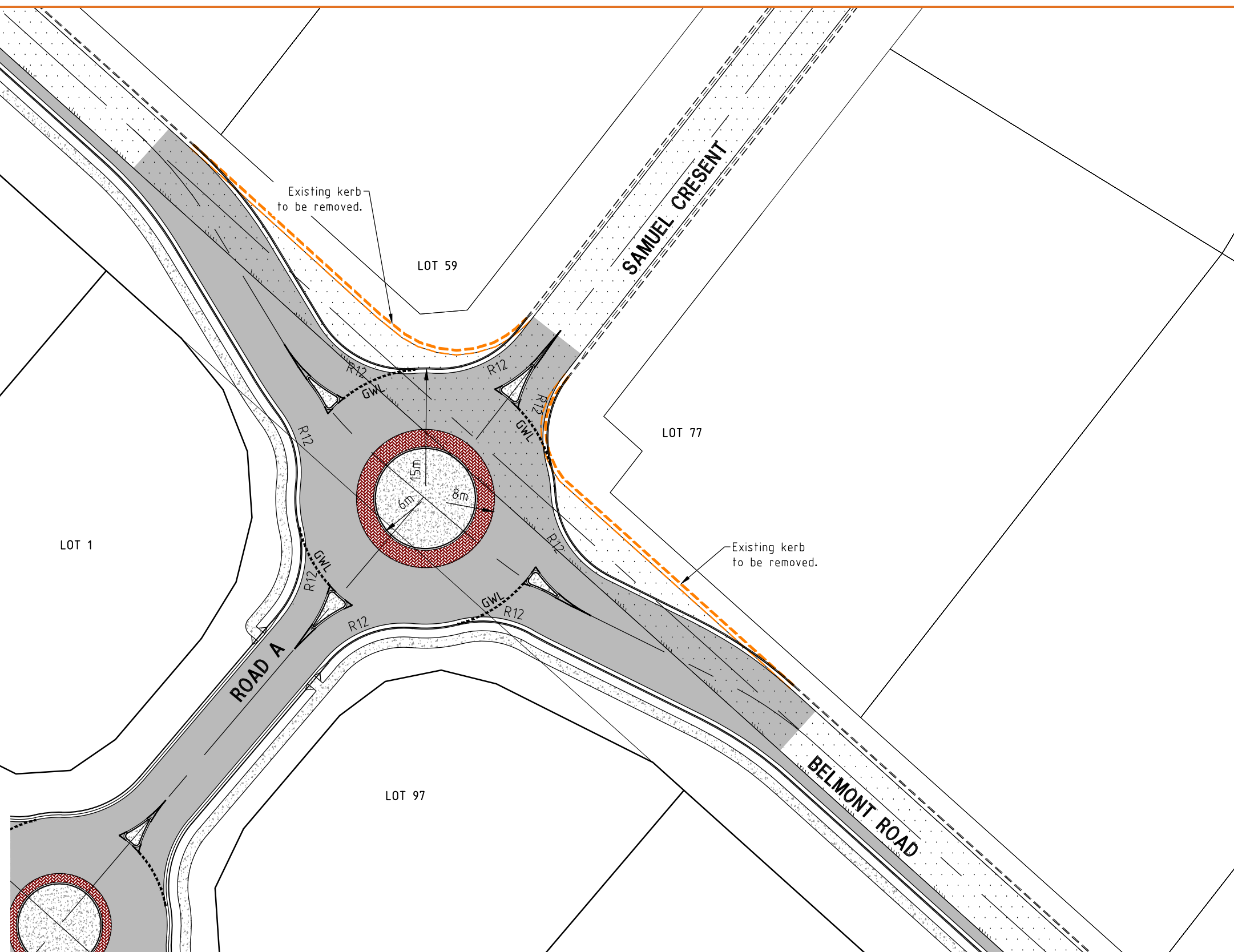
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PAVEMENT MARKING LEGEND

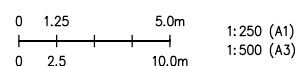
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BLL		80mm
EL	Edge Line	100mm
CL	Continuity Line L=1000, G=3000	100mm
GWL	Give Way Line L=600, G=600	300mm
ULL	Unbroken Lane Line	80mm
SL	Stop Line	300mm
OL	OUT LINE	100mm

LEGEND

	New Roadwork
	Existing Roadwork
	Proposed Concrete
	Concrete Footpath
	Proposed Kerb and Channel
	Existing Kerb and Channel
	Existing Contours
	Finished Surface Contours



RIVERSIDE ESTATE BELMONT ROAD INTERSECTION LAYOUT PLAN R12394 - INTERSECTION LAYOUT



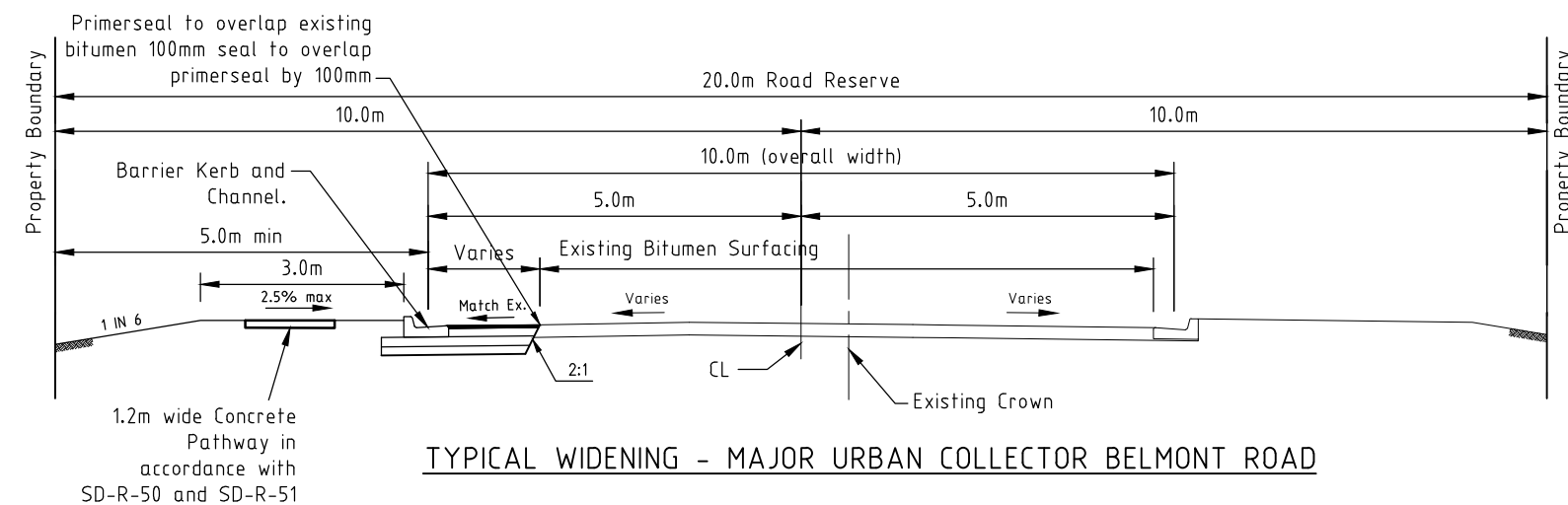
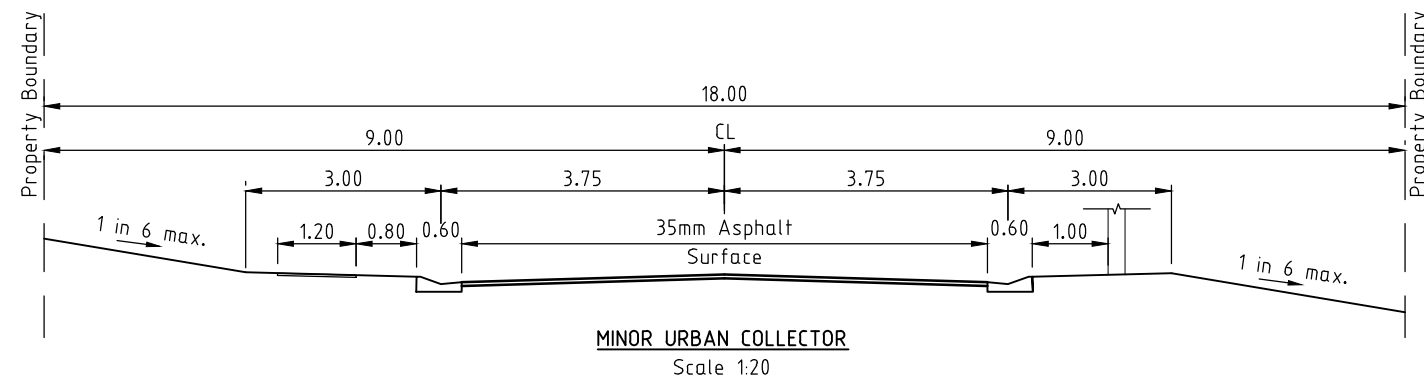
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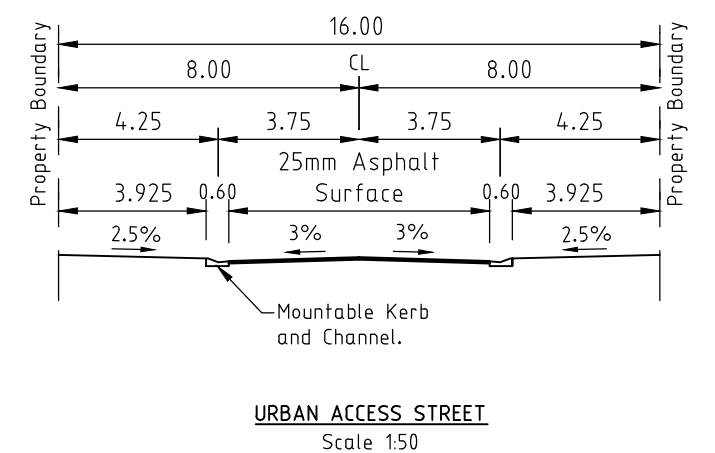
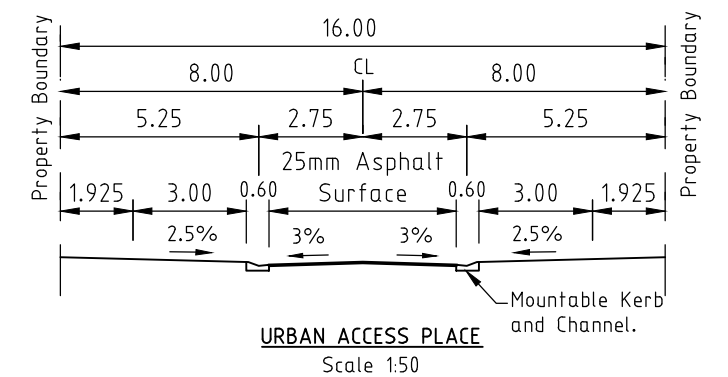
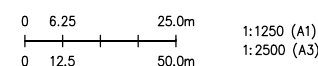
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NOTE: Please refer to Riverside Estate road hierarchy plan.

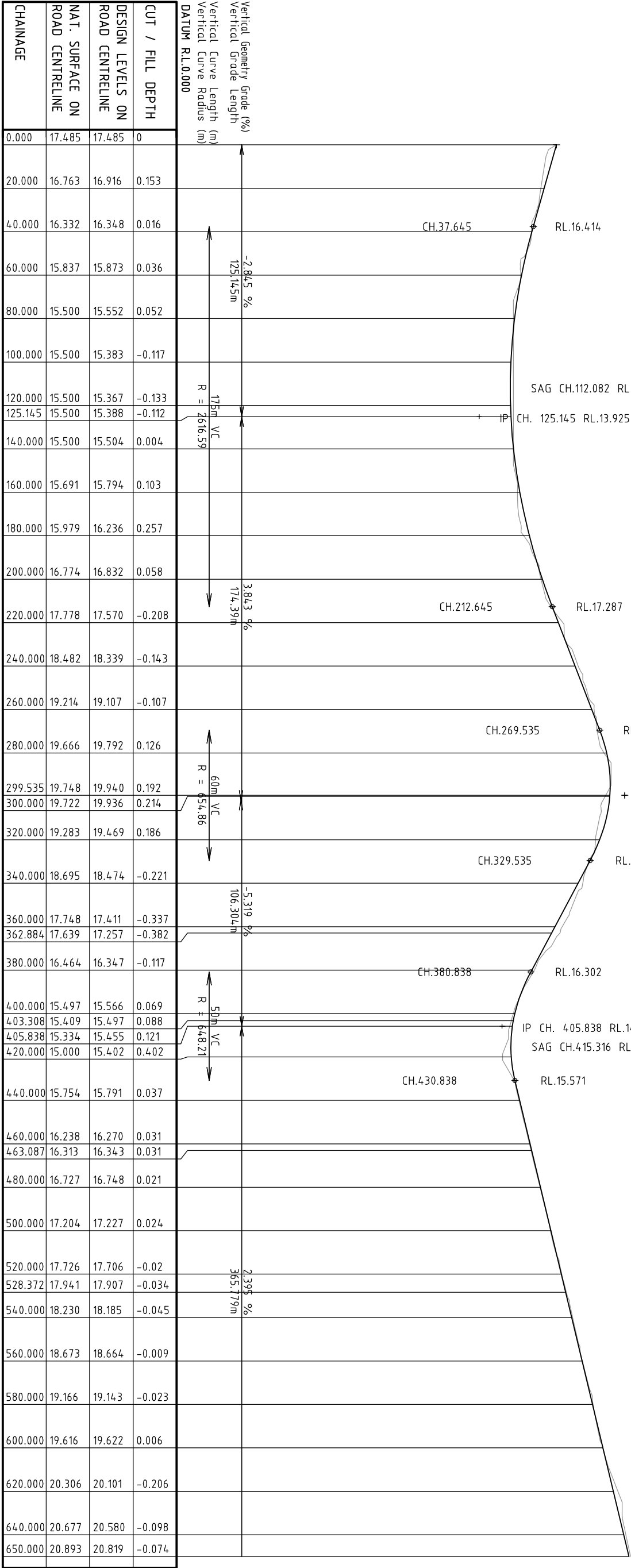
RIVERSIDE ESTATE ROADWORKS DETAILS PLAN R12394 - ROADWORKS DETAILS



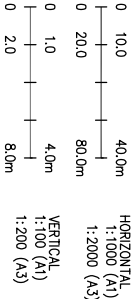
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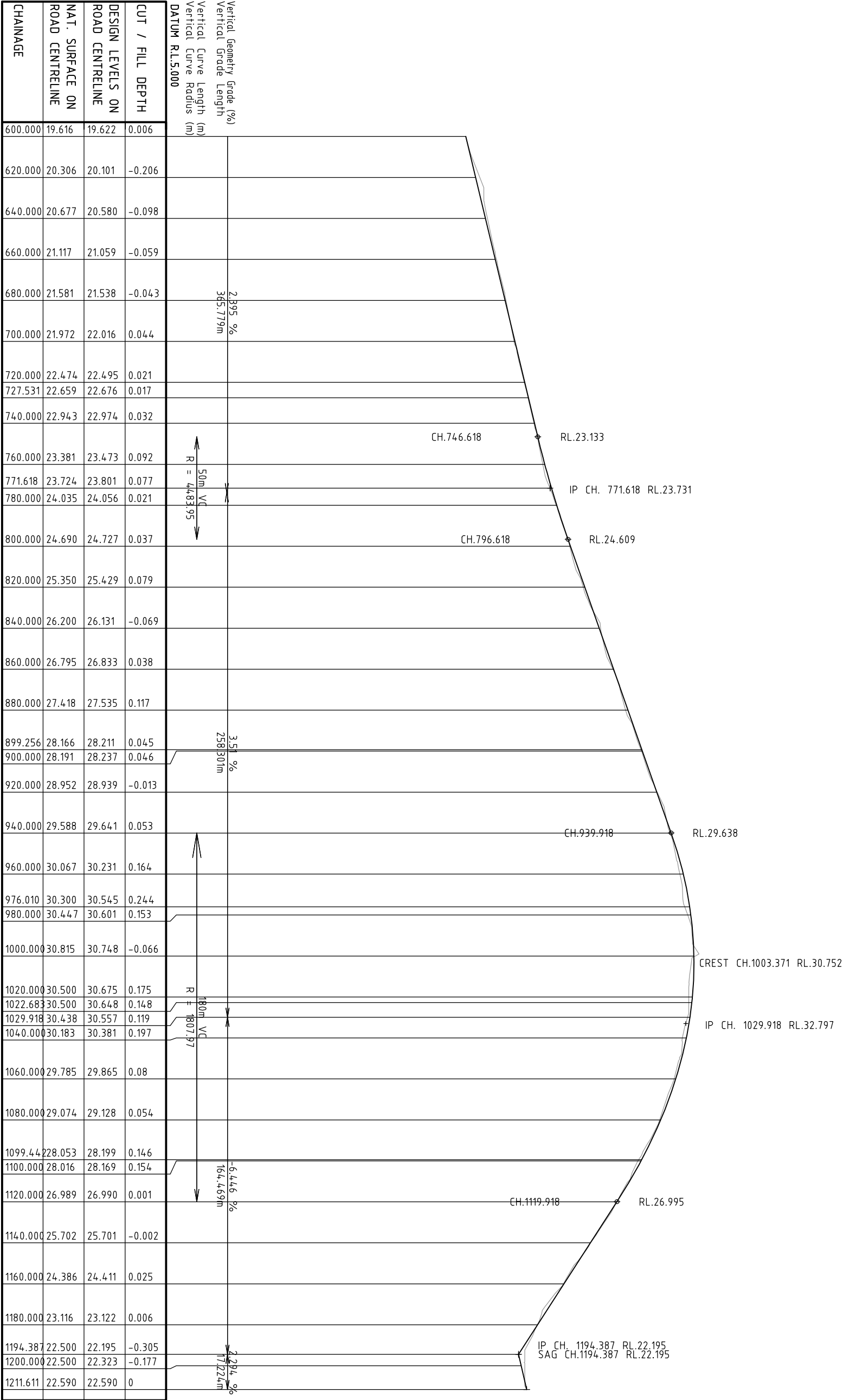
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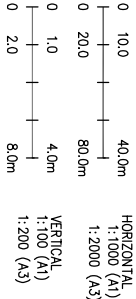


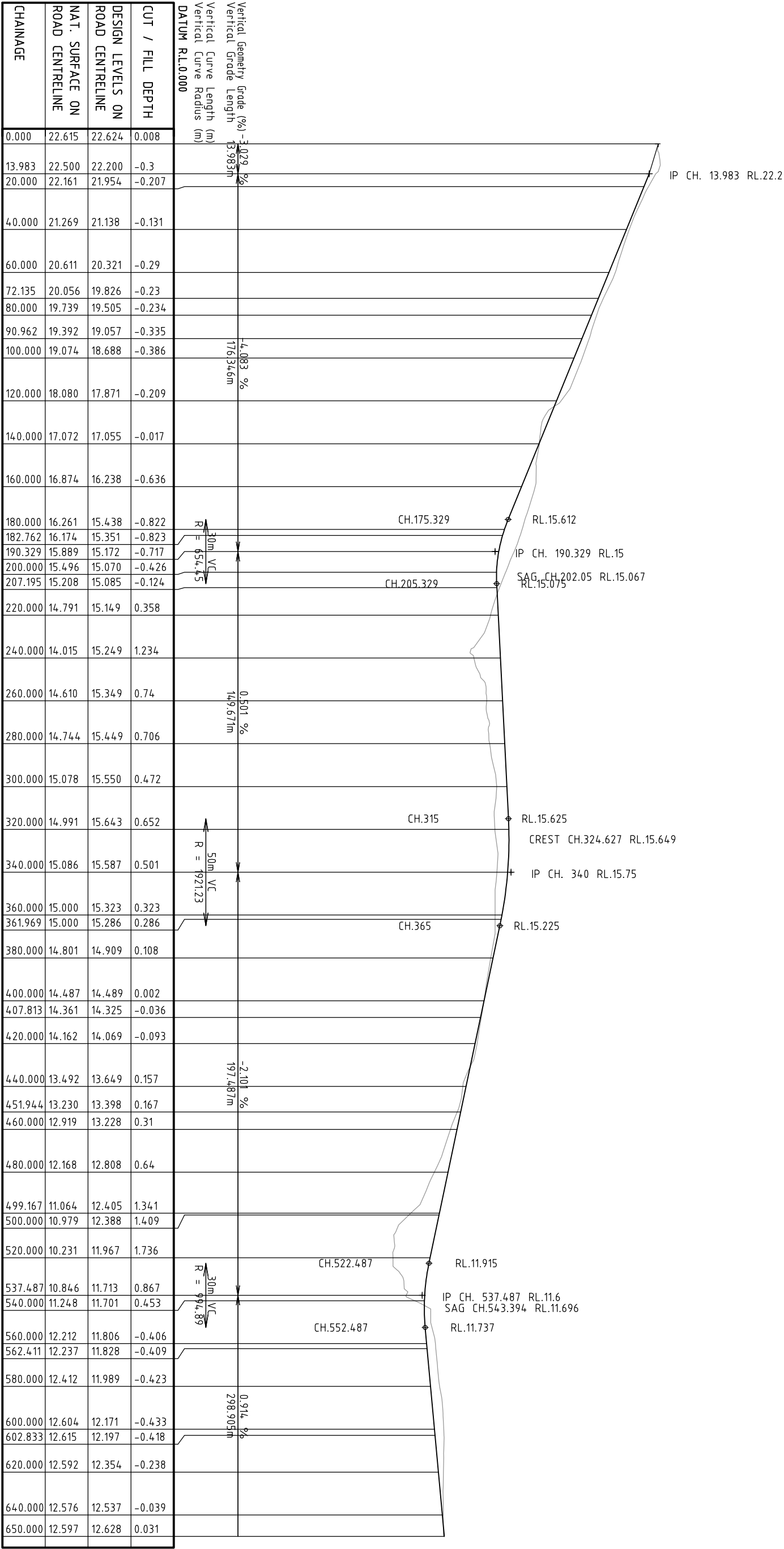
LONGITUDINAL SECTION Belmont Road



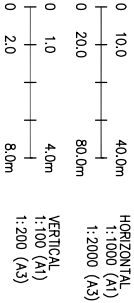


LONGITUDINAL SECTION Belmont Road





LONGITUDINAL SECTION Road A



RIVERSIDE ESTATE

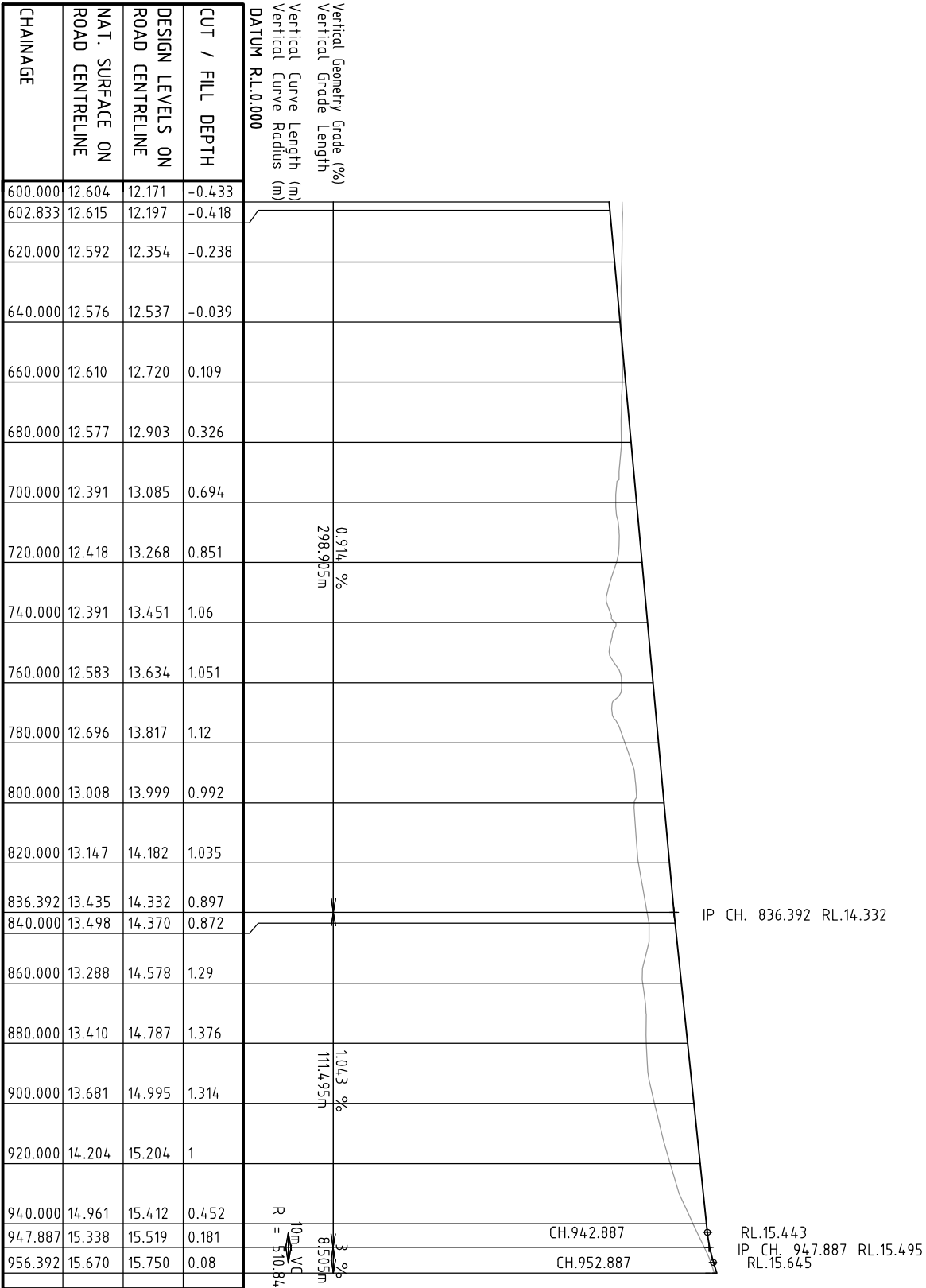
ROAD LONGSECTIONS PLAN SHEET 3 OF 14

R12394 - ROAD LONGSECTIONS

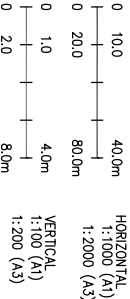
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LONGITUDINAL SECTION Road A



RIVERSIDE ESTATE

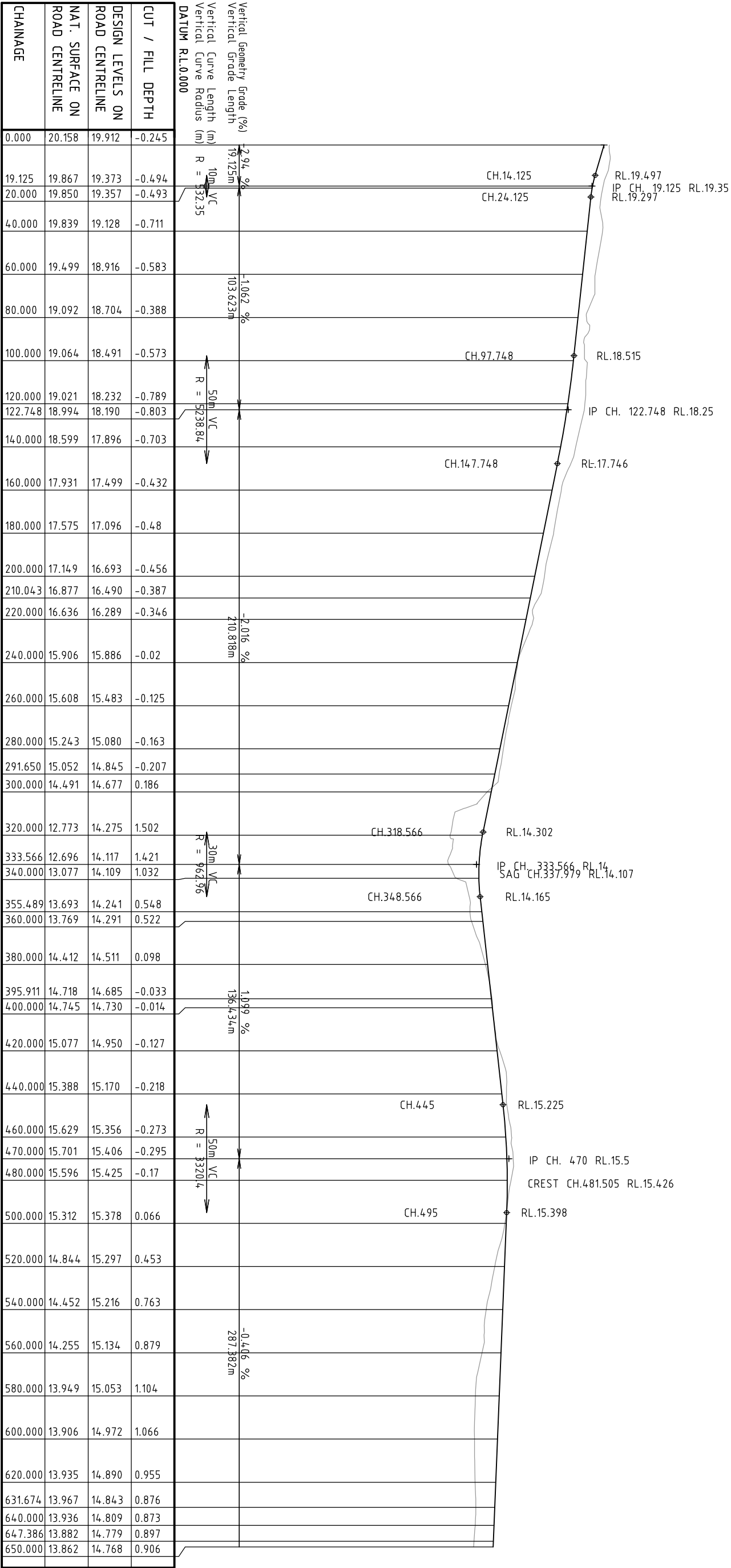
ROAD LONGSECTIONS PLAN SHEET 4 OF 14

R12394 - ROAD LONGSECTIONS

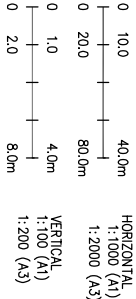
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LONGITUDINAL SECTION Road C



RIVERSIDE ESTATE

ROAD LONGSECTIONS PLAN SHEET 6 OF 14

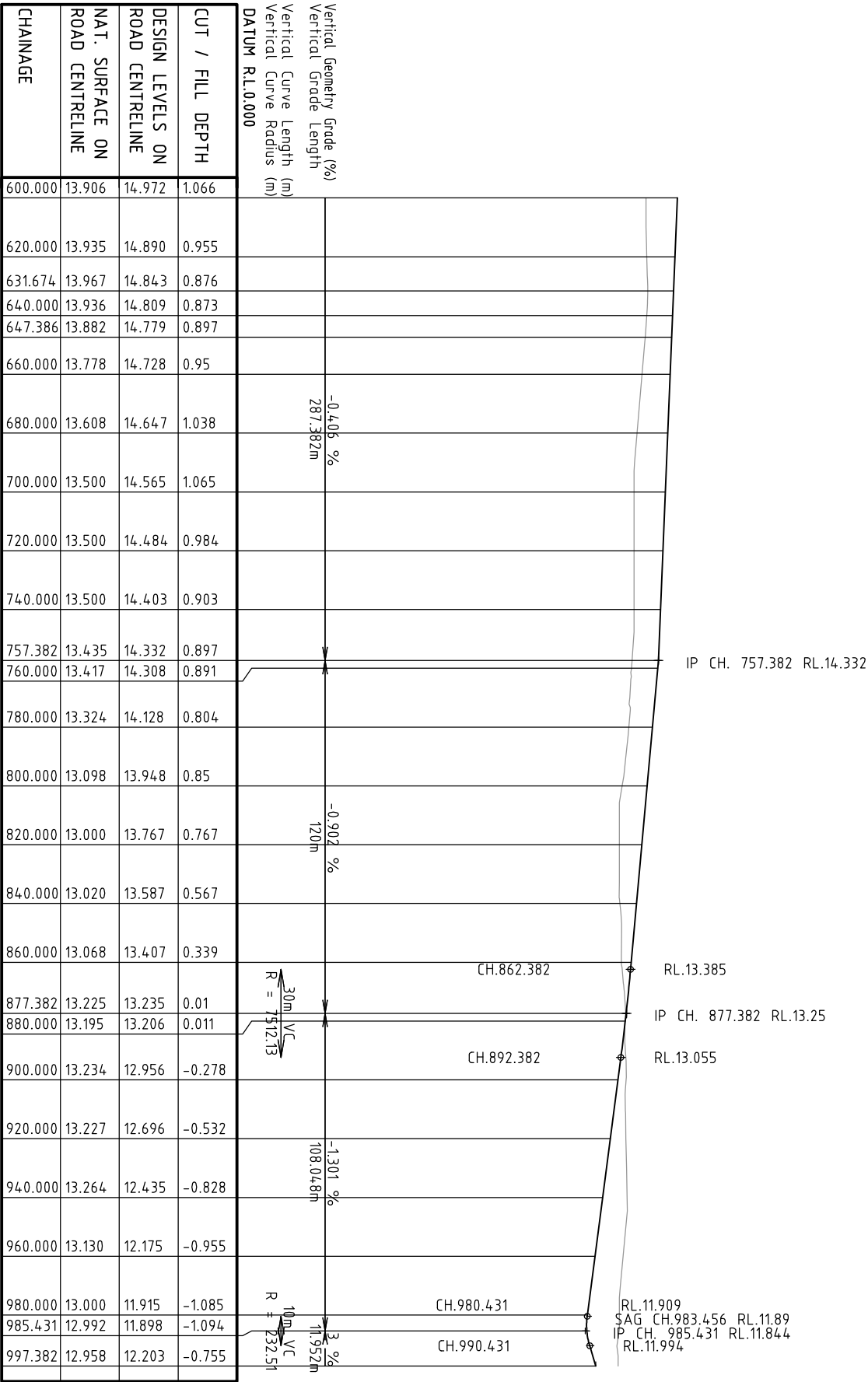
R12394 - ROAD LONGSECTIONS

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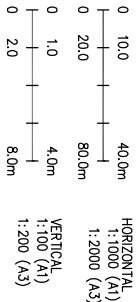
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Facsimile (07) 4921 4866
E-Mail: Rockhampton@brownconsulting.com.au

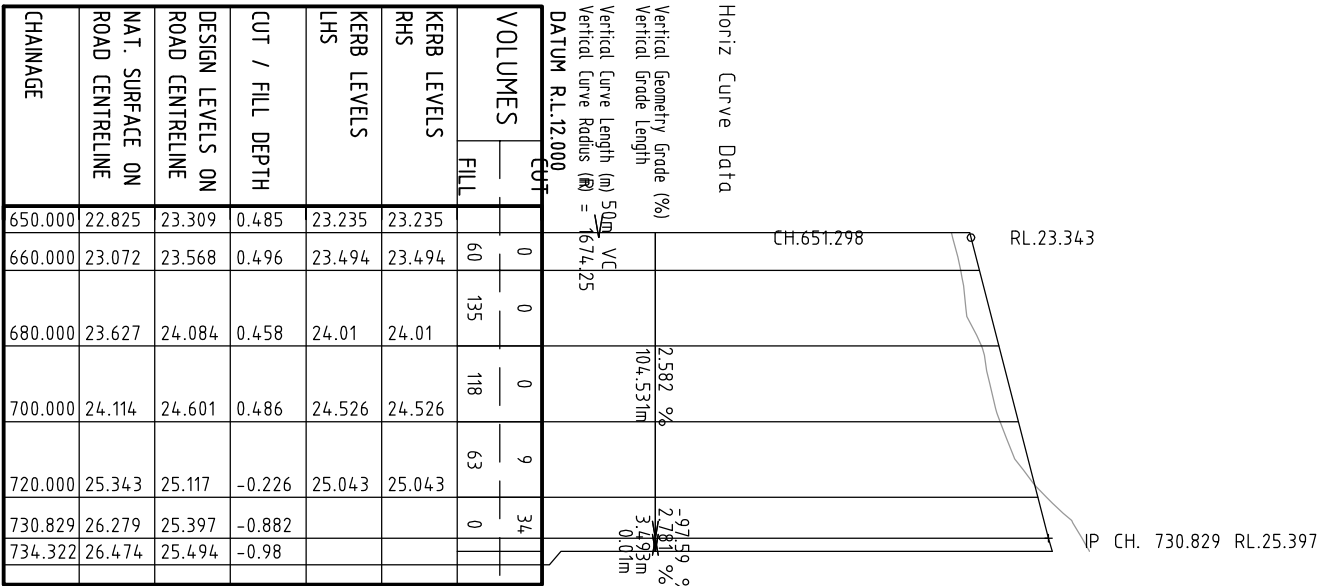


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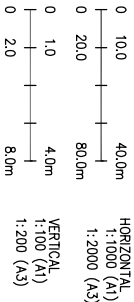


LONGITUDINAL SECTION Road C





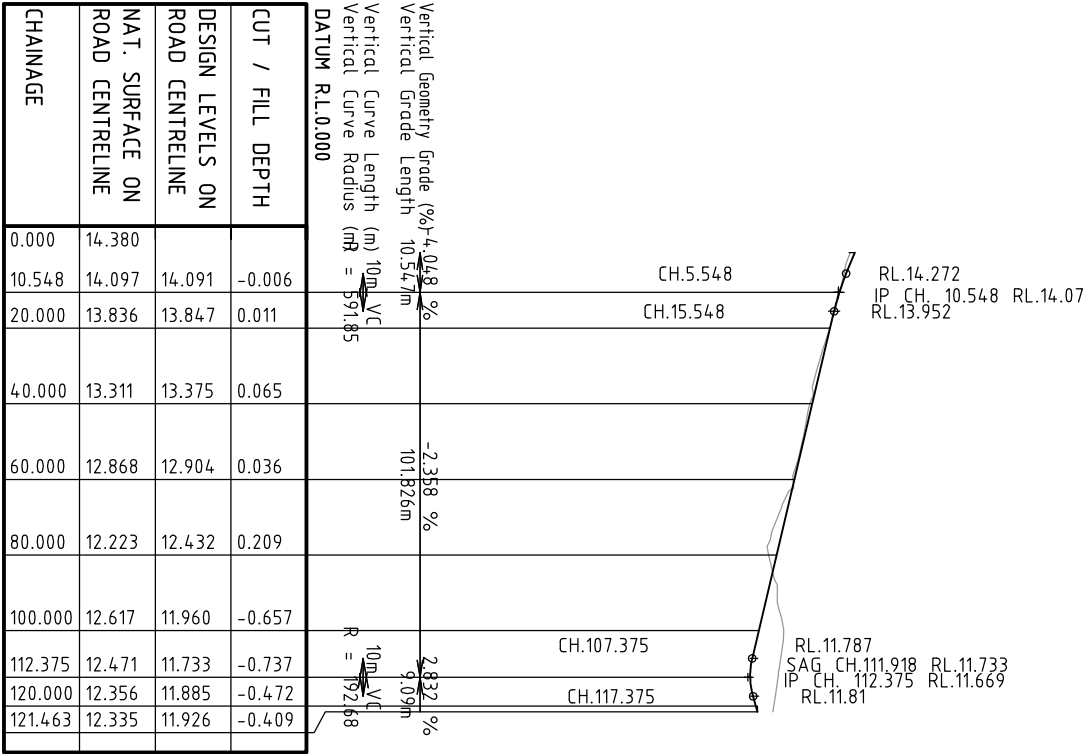
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RIVERSIDE ESTATE

ROAD LONGSECTIONS PLAN SHEET 9 OF 14

R12394 - ROAD LONGSECTIONS



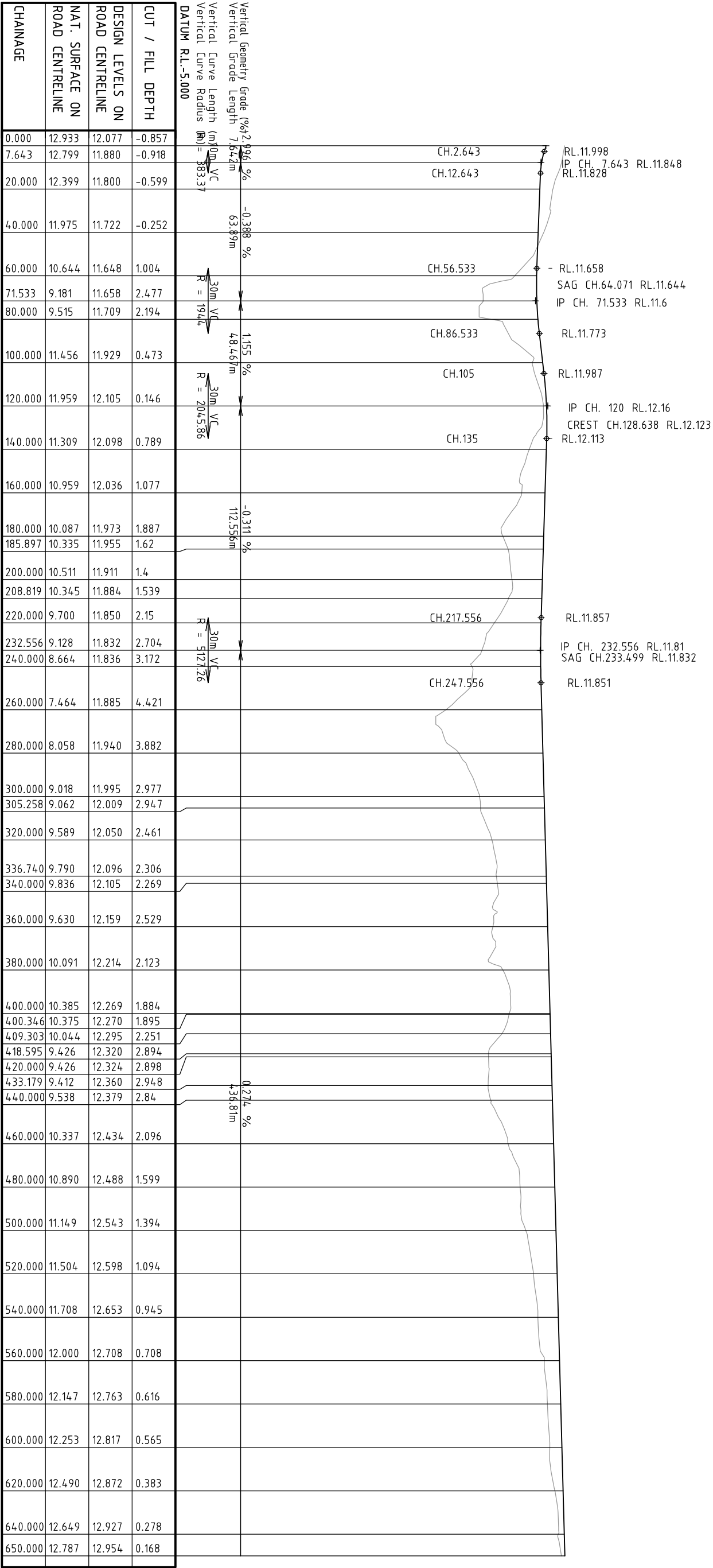
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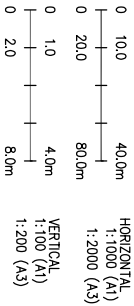
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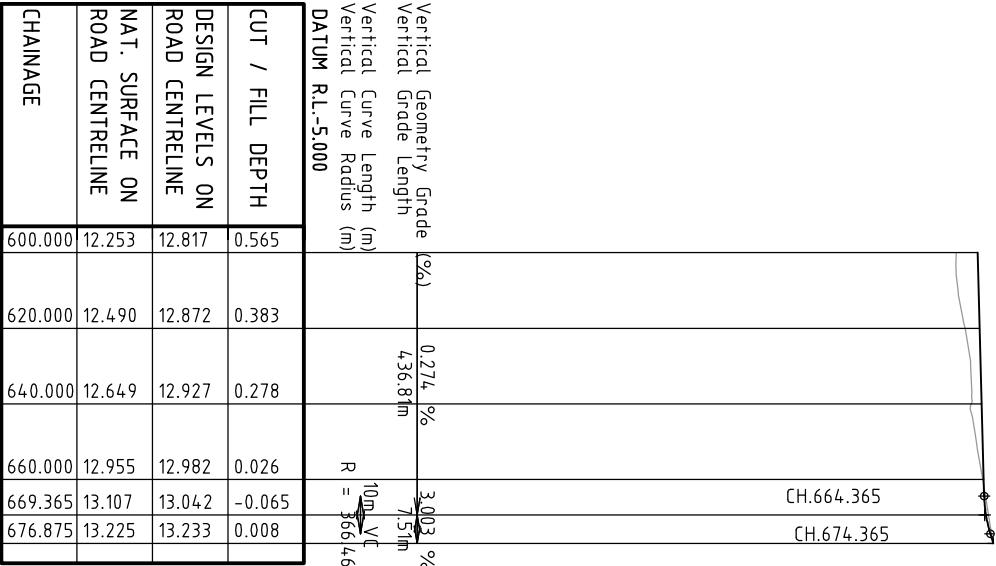
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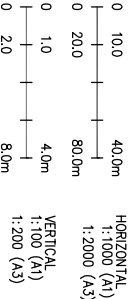
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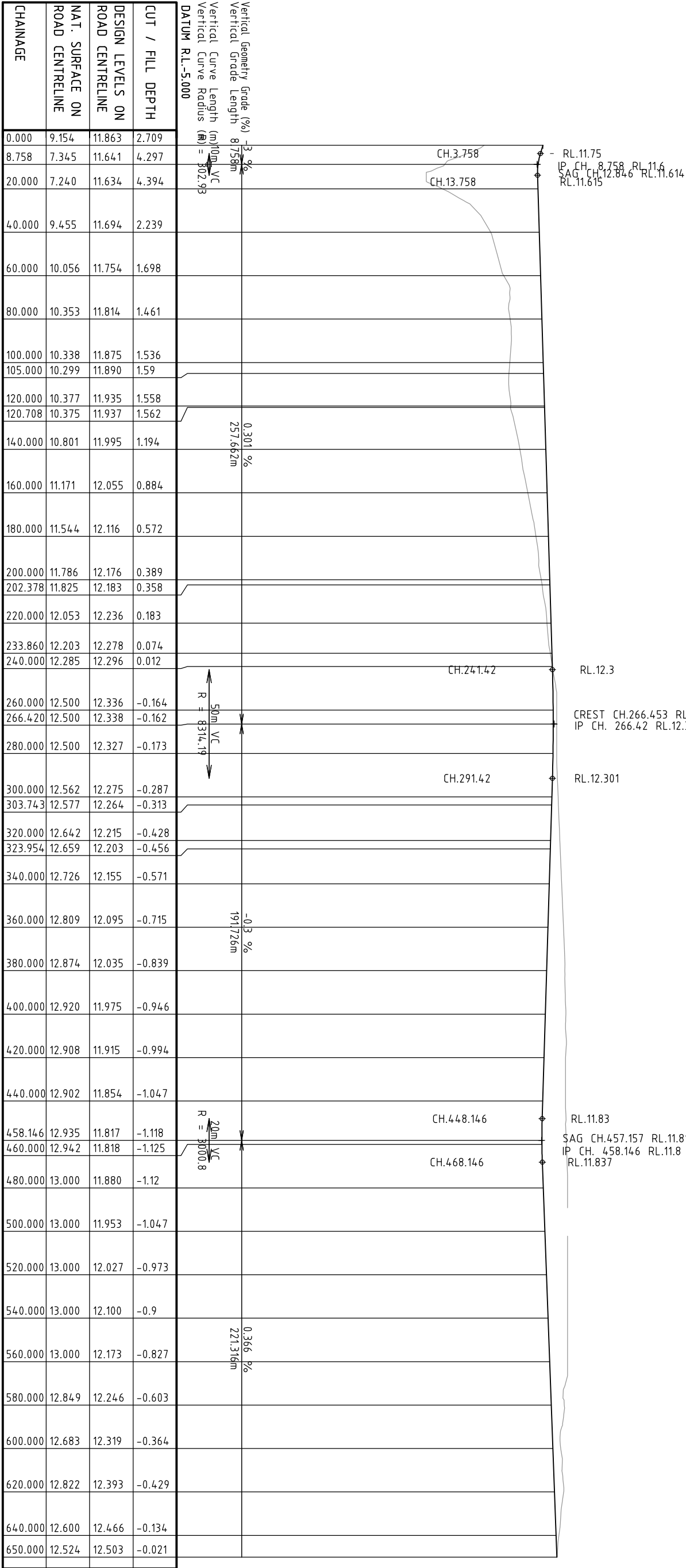


RL.12.994
IP CH. 669.365 RL.13.008
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LONGITUDINAL SECTION Road F

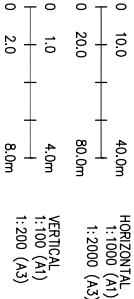




LONGITUDINAL SECTION Road G

RIVERSIDE ESTATE

ROAD LONGSECTIONS PLAN SHEET 12 OF 14
R12394 - ROAD LONGSECTIONS



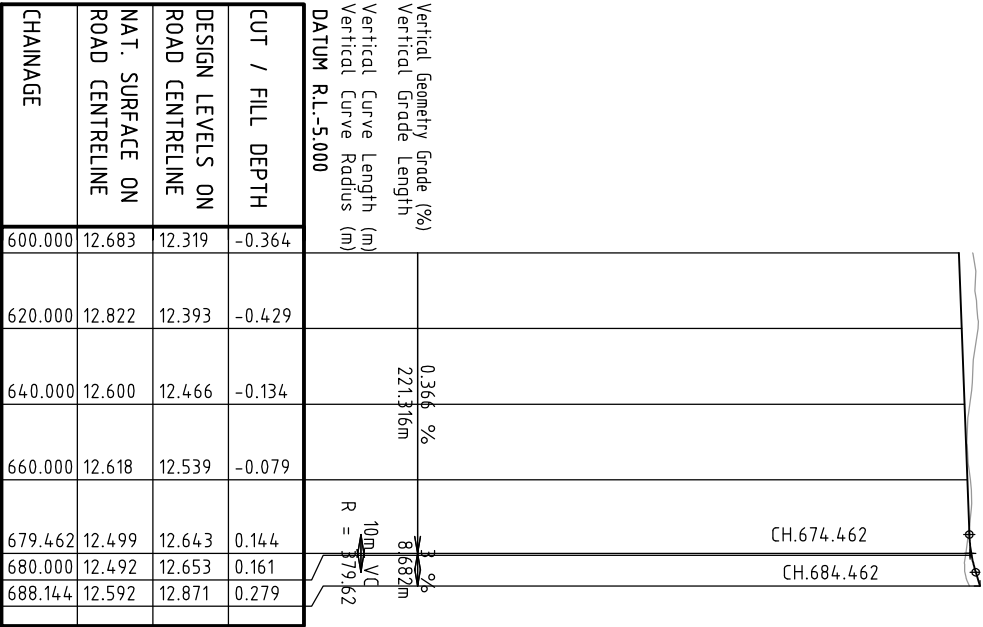
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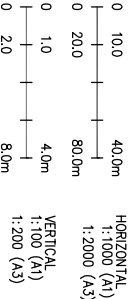
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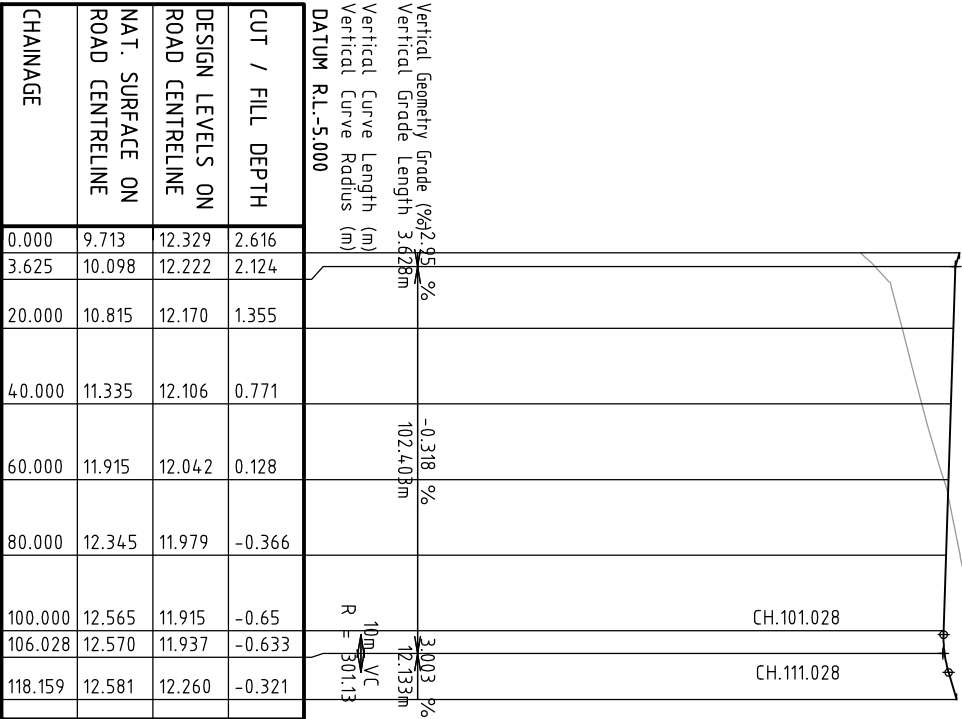


LONGITUDINAL SECTION Road G



RIVERSIDE ESTATE
ROAD LONGSECTIONS PLAN SHEET 13 OF 14
R12394 - ROAD LONGSECTIONS

IP CH. 3.625 RL.12.222



RL.11.912
SAG CH.101.987 RL.11.91
IP CH. 106.028 RL.11.896
RL.12.046

LONGITUDINAL SECTION Road H

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CHAINAGE	NAT. SURFACE ON ROAD CENTRELINE	DESIGN LEVELS ON ROAD CENTRELINE	CUT / FILL DEPTH	DATUM R.L.-5.000	Vertical Curve Length (m)	Vertical Curve Radius (m)	Vertical Geometry Grade (%)	Vertical Grade Length
0.000	17.184	17.250	0.066					
17.226	16.566	17.093	0.527					
20.000	16.473	17.068	0.595					
22.668	16.406	17.044	0.638					
40.000	16.065	16.886	0.821					
60.000	15.674	16.704	1.03					
80.000	15.470	16.522	1.052				-0.909 %	164.94m
100.000	15.440	16.341	0.901					
120.000	15.549	16.159	0.609					
140.000	15.604	15.977	0.373					
160.000	15.610	15.795	0.185					
164.940	15.670	15.750	0.08					
180.000	15.628	15.569	-0.059					
200.000	15.474	15.329	-0.145					
220.000	15.442	15.090	-0.352					
240.000	15.135	14.850	-0.286					
260.000	14.710	14.610	-0.101					
280.000	14.794	14.370	-0.424					
300.000	14.516	14.130	-0.386					
320.000	14.342	13.890	-0.452				-1.2 %	291.776m
340.000	14.228	13.650	-0.578					
360.000	13.966	13.410	-0.556					
380.000	13.687	13.170	-0.517					
400.000	12.754	12.930	0.176					
420.000	12.335	12.690	0.355					
437.871	11.668	12.476	0.808					
440.000	11.535	12.451	0.916					
445.002	11.432	12.391	0.959					
456.710	11.610	12.250	0.64					

LONGITUDINAL SECTION Road 1

HORIZONTAL
1:1000 (A1)
1:2000 (A3)

RIVERSIDE ESTATE

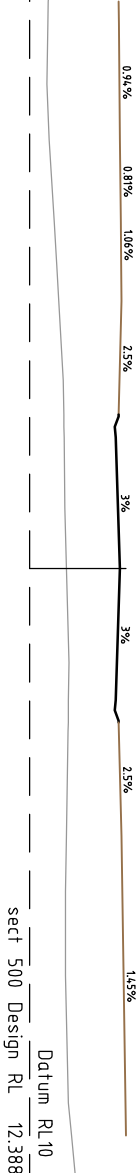
ROAD LONGSECTIONS PLAN SHEET 14 OF 14
R12394 - ROAD LONGSECTIONS

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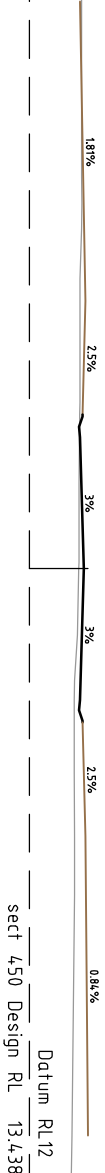
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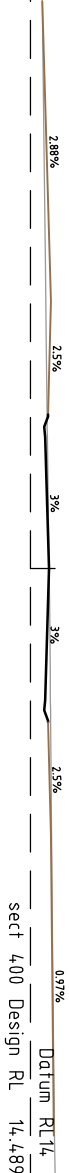
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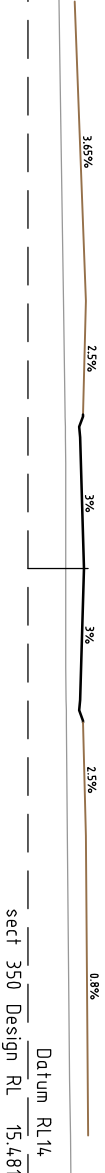
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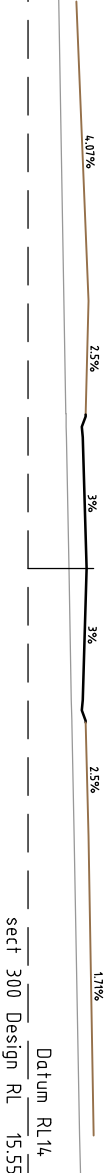
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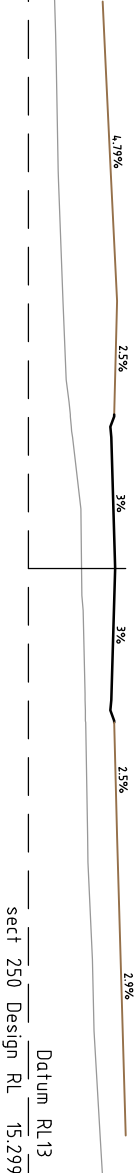
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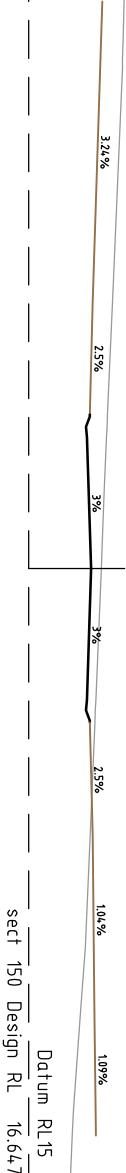
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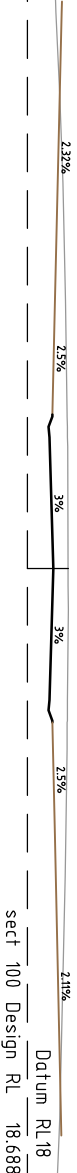
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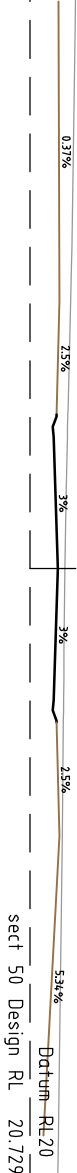
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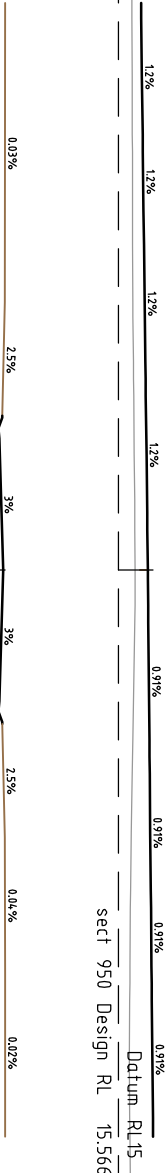
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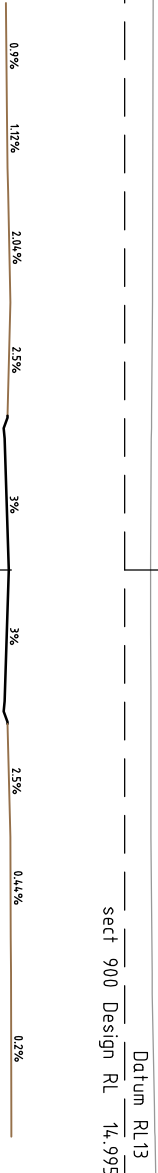
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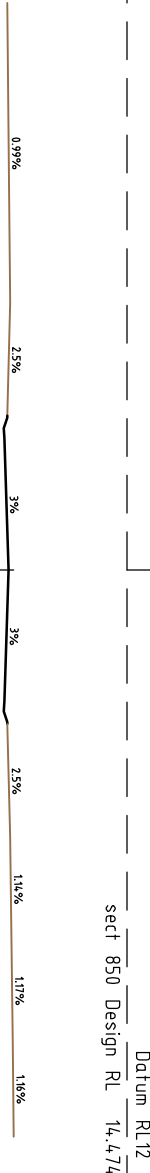
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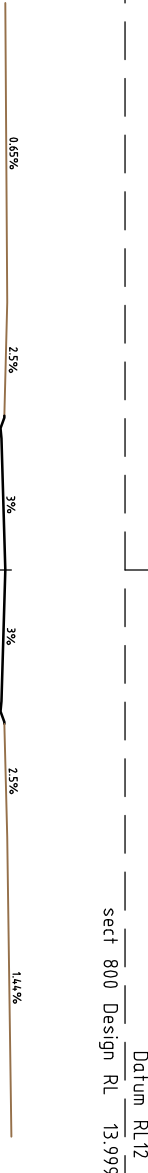
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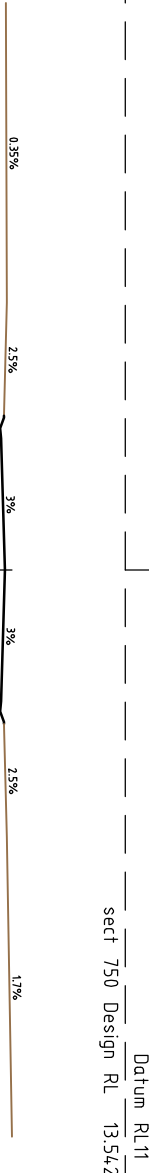
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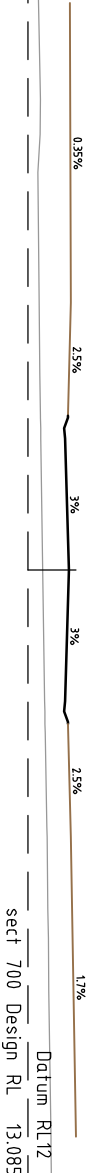
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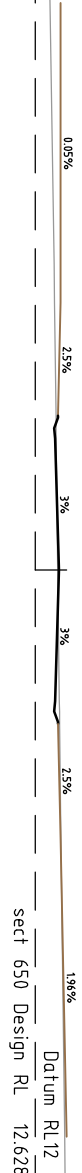
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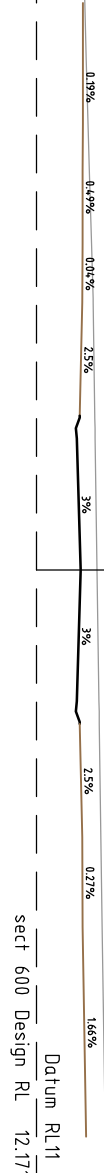
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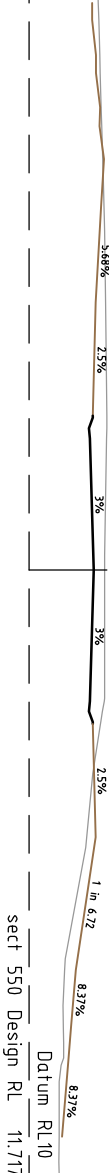
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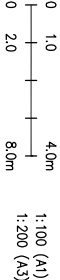


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RIVERSIDE ESTATE

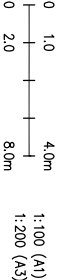
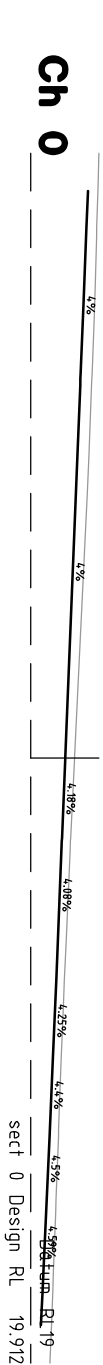
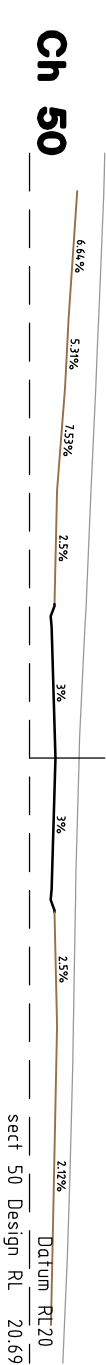
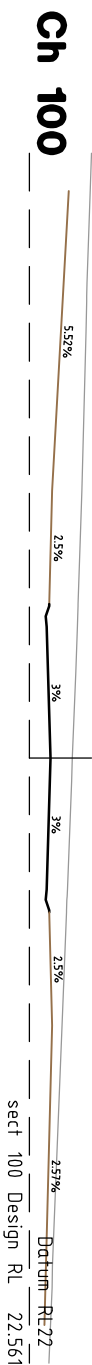
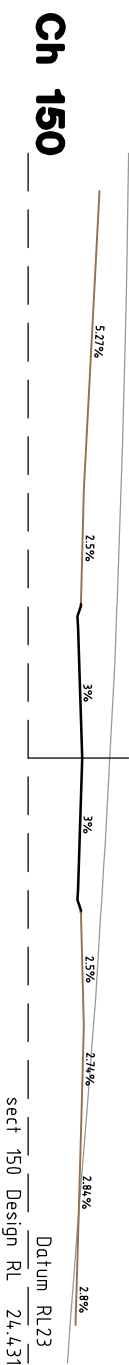
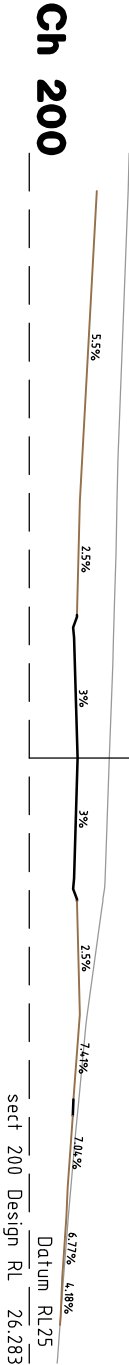
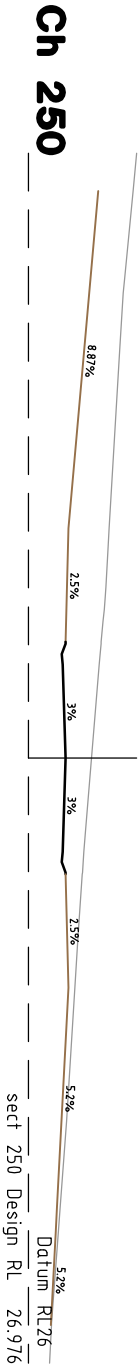
ROAD CROSS SECTION ROAD A
R12394 - ROAD CROSS SECTION 1



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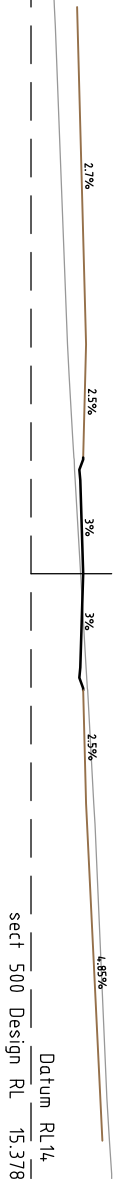


RIVERSIDE ESTATE
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R12394 - ROAD CROSS SECTIONS 2

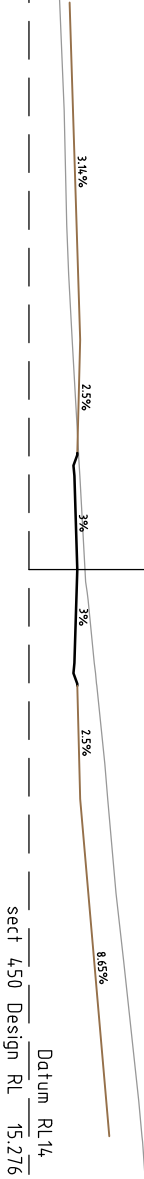
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Rockhampton Q 4700
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Facsimile (07) 4921 4866
E-Mail: Rockhampton@brownconsulting.com.au



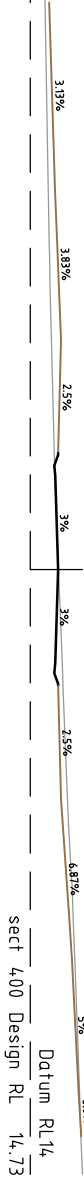
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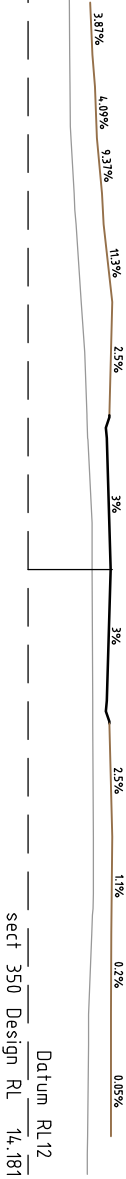
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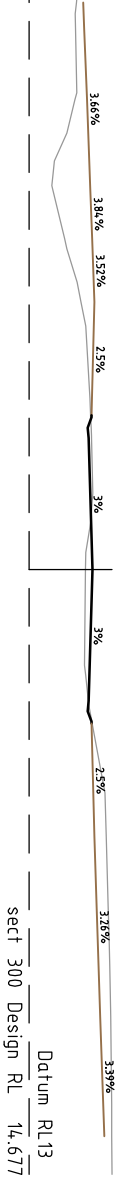
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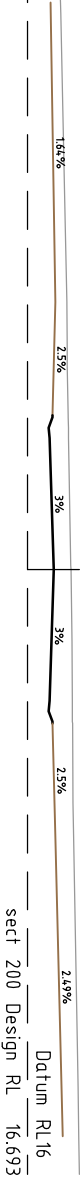
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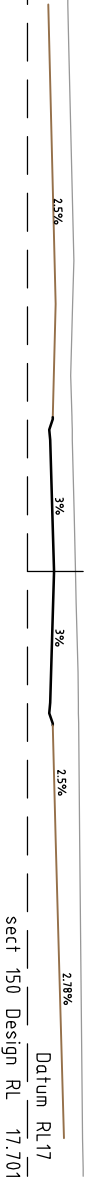
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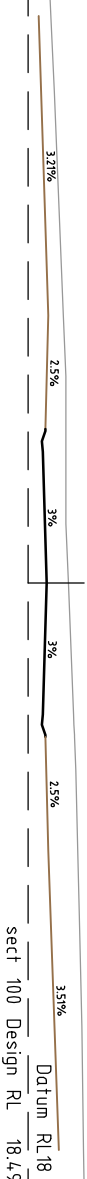
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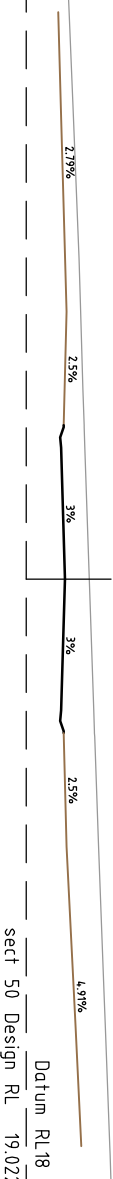
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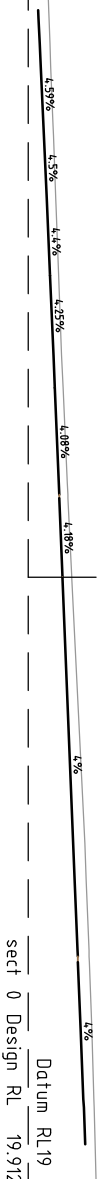
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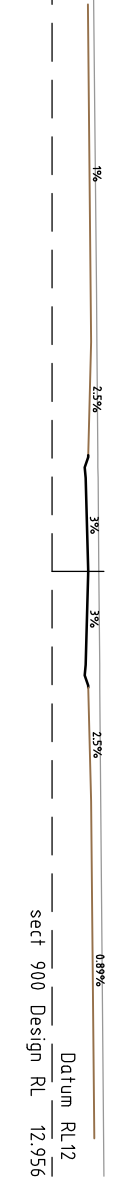
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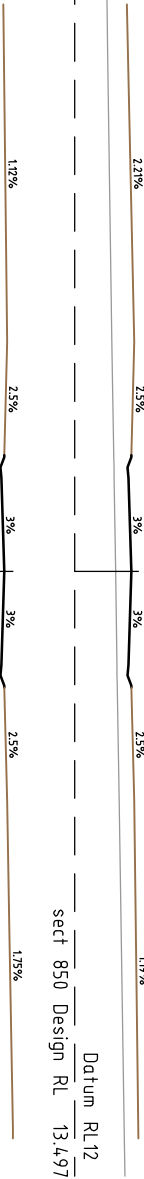
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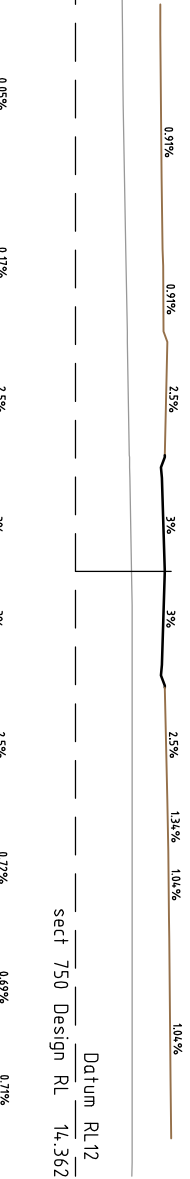
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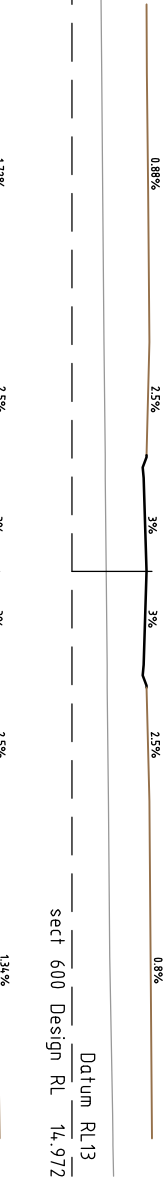
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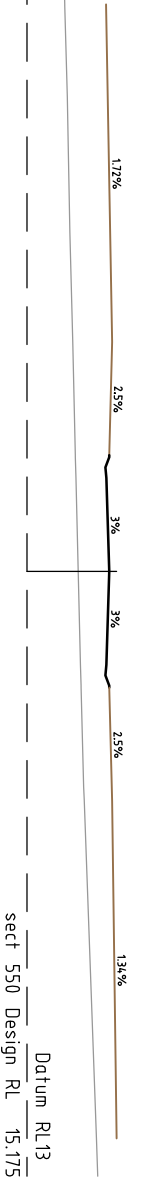
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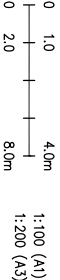


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RIVERSIDE ESTATE

ROAD CROSS SECTION ROAD C
R12394 - ROAD CROSS SECTIONS 3

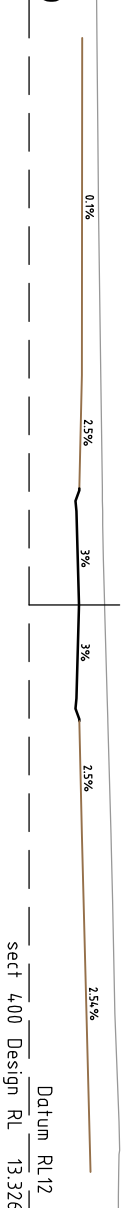


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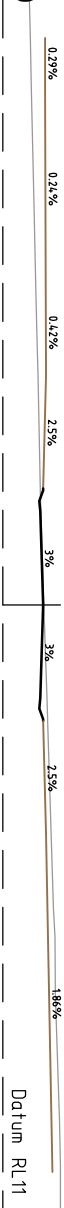
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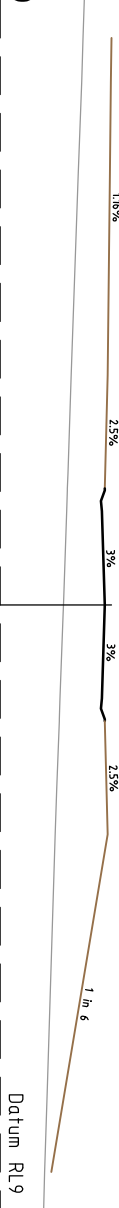
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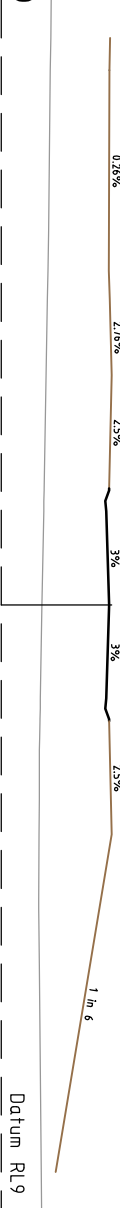
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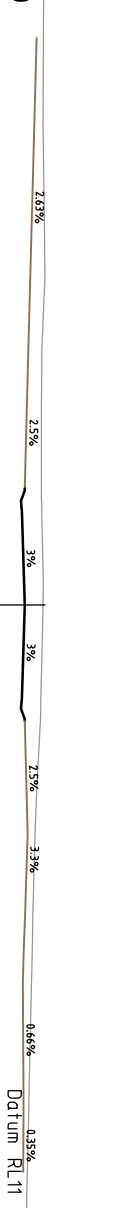
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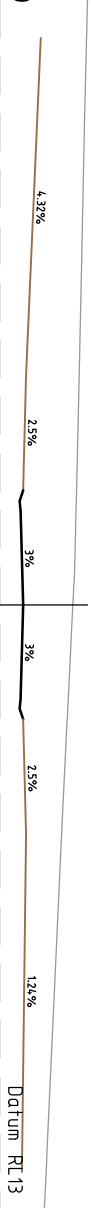
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Ch 50



Ch 0



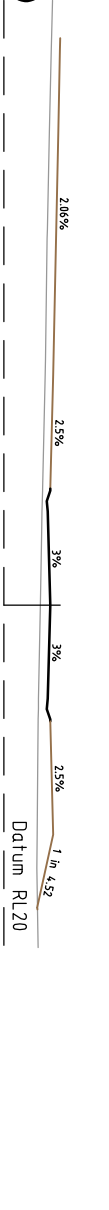
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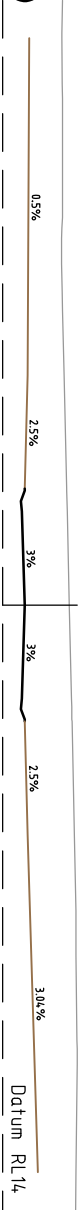
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Ch 450



RIVERSIDE ESTATE

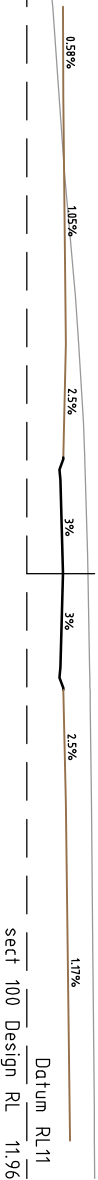
ROAD CROSS SECTION ROAD D
R12394 - ROAD CROSS SECTIONS 4

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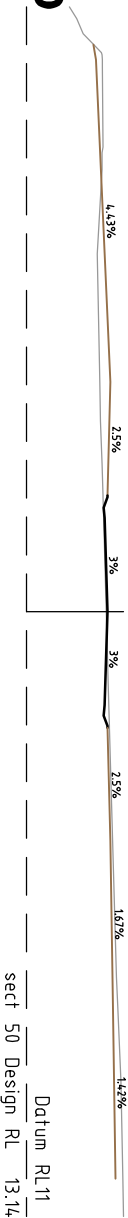
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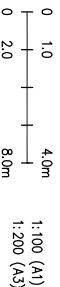
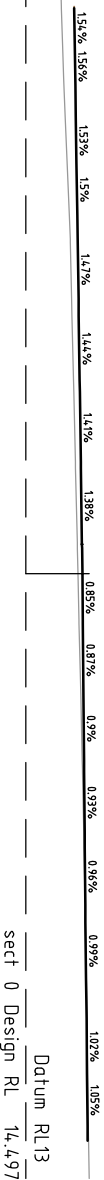
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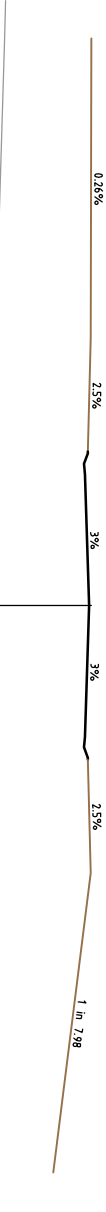


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ROAD CROSS SECTION ROAD E
R12394 - ROAD CROSS SECTIONS 5

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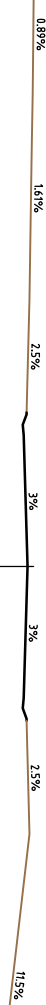
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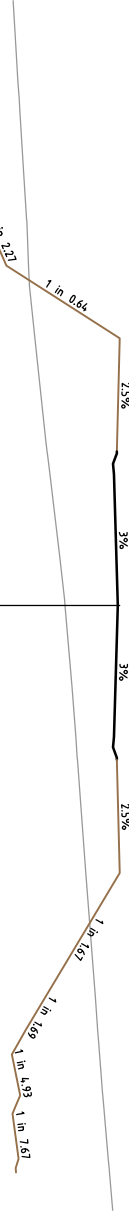
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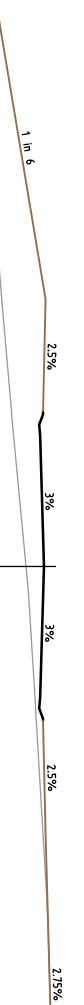
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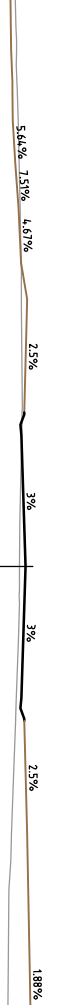
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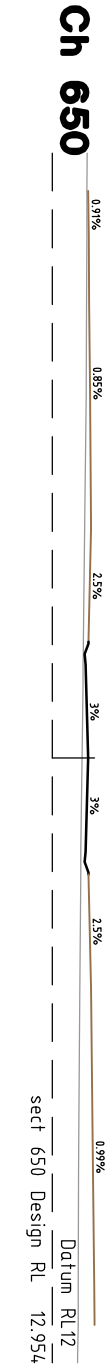
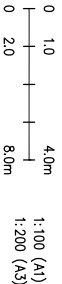
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Ch 550

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Ch 400

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ROAD CROSS SECTION ROAD F
R12394 - ROAD CROSS SECTIONS 6

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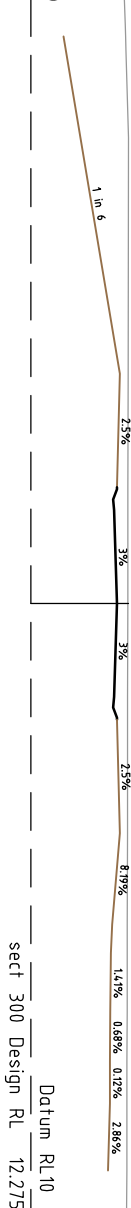
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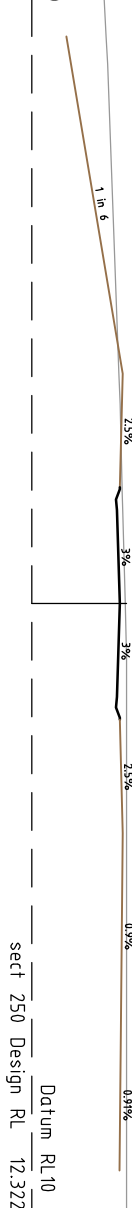
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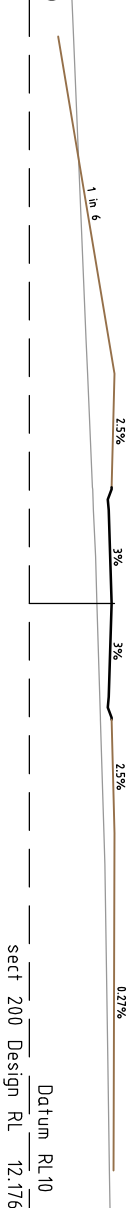
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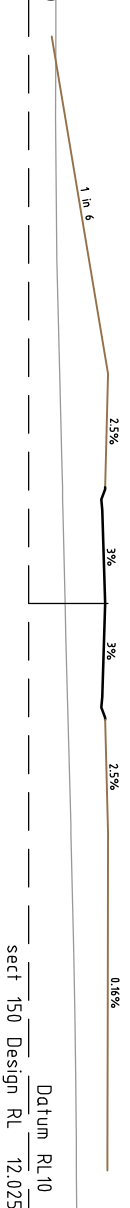
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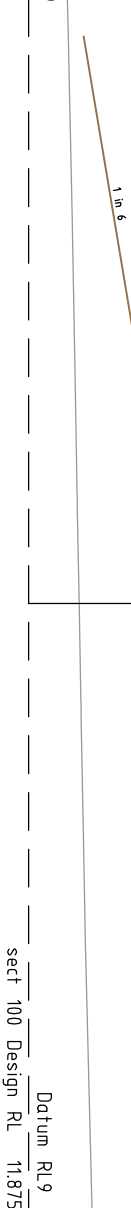
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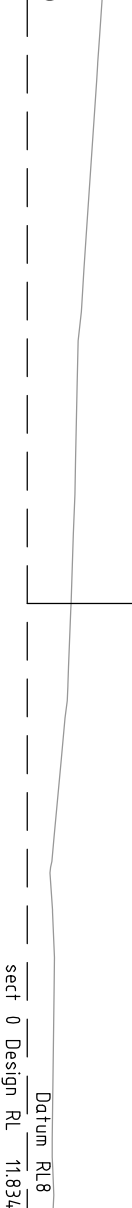
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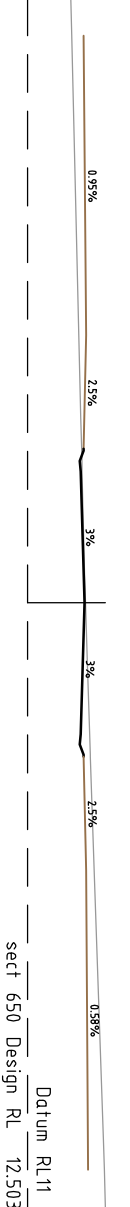
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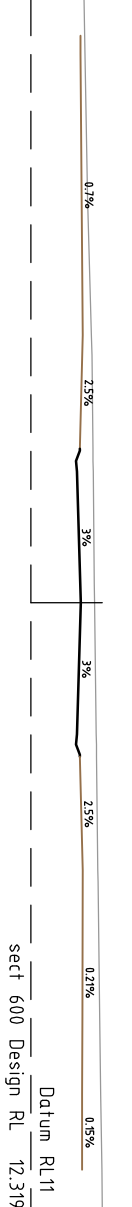
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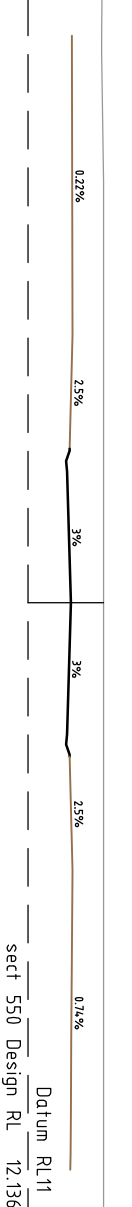
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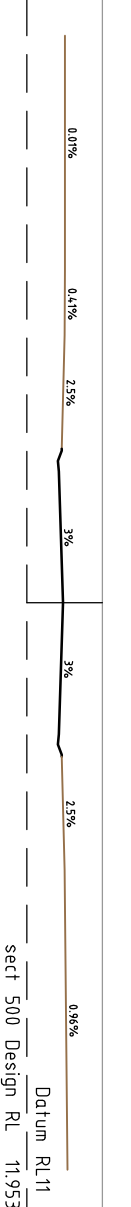
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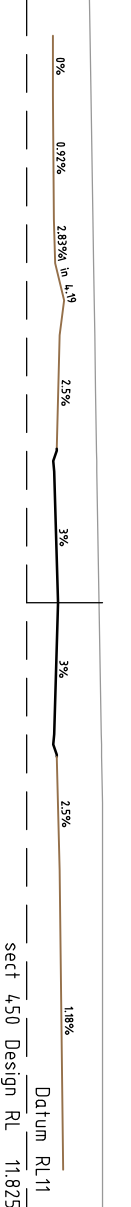
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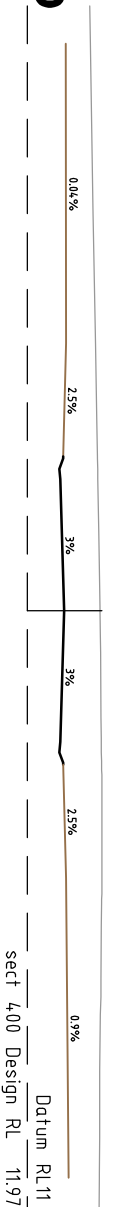
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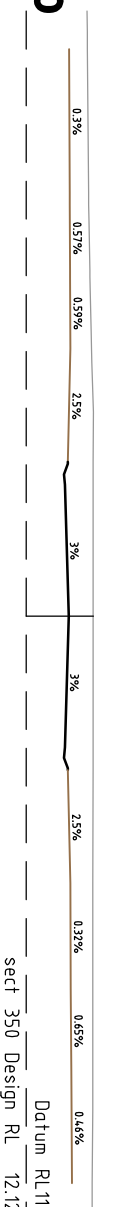
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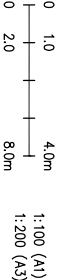


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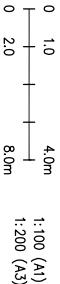
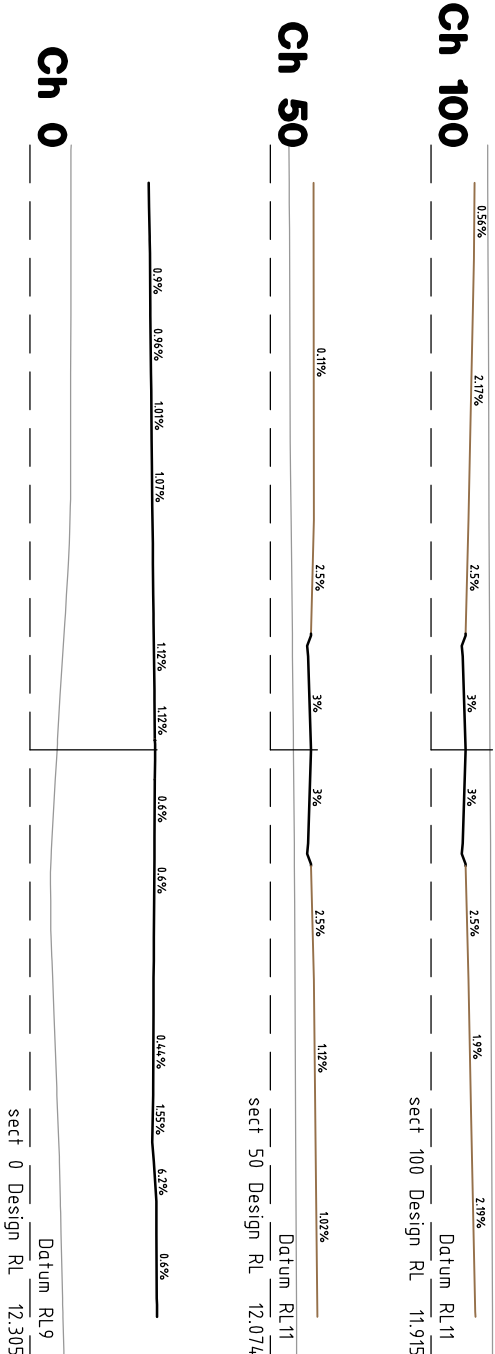
ROAD CROSS SECTION ROAD G
R12394 - ROAD CROSS SECTIONS 7



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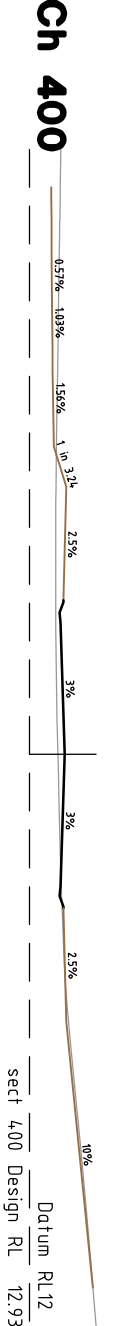
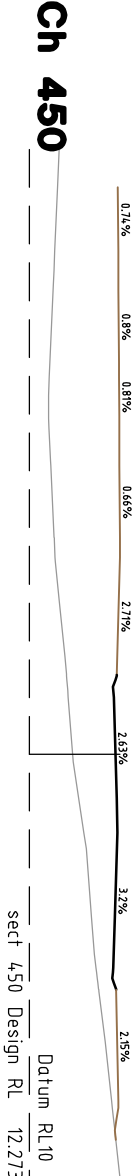
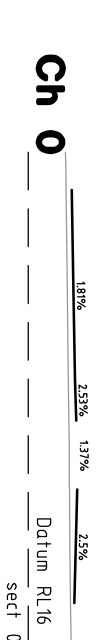
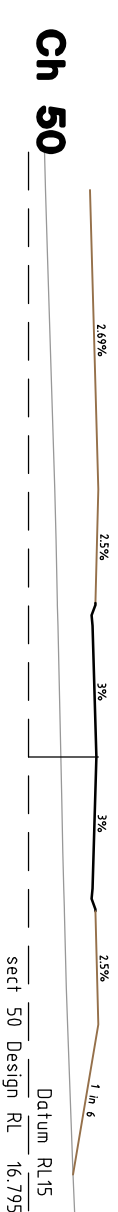
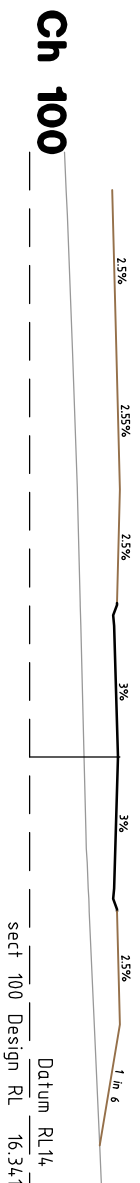
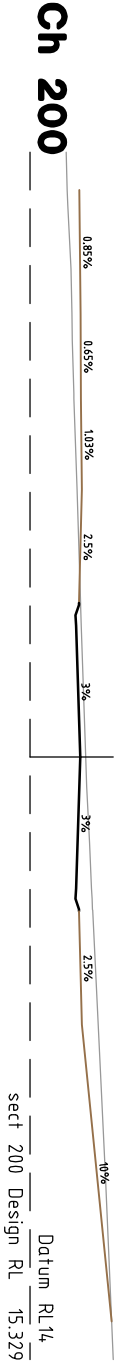
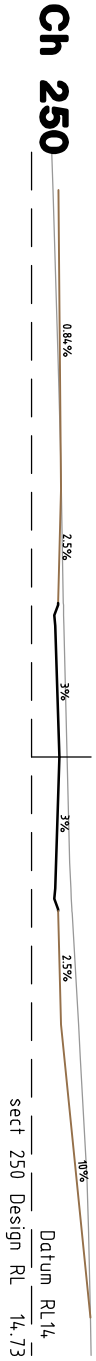
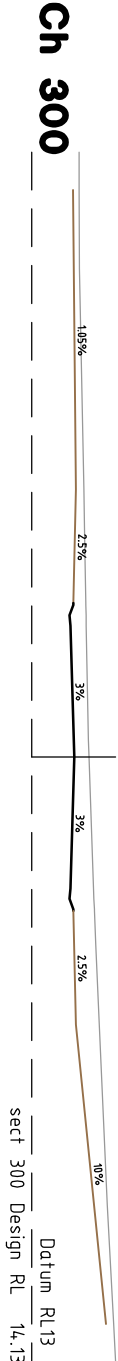
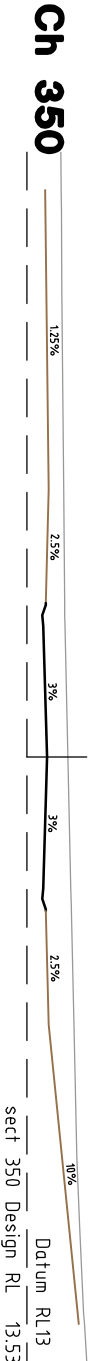


RIVERSIDE ESTATE
ROAD CROSS SECTION ROAD H
R12394 - ROAD CROSS SECTIONS 8

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ROAD CROSS SECTION ROAD 1
R12394 - ROAD CROSS SECTIONS 9

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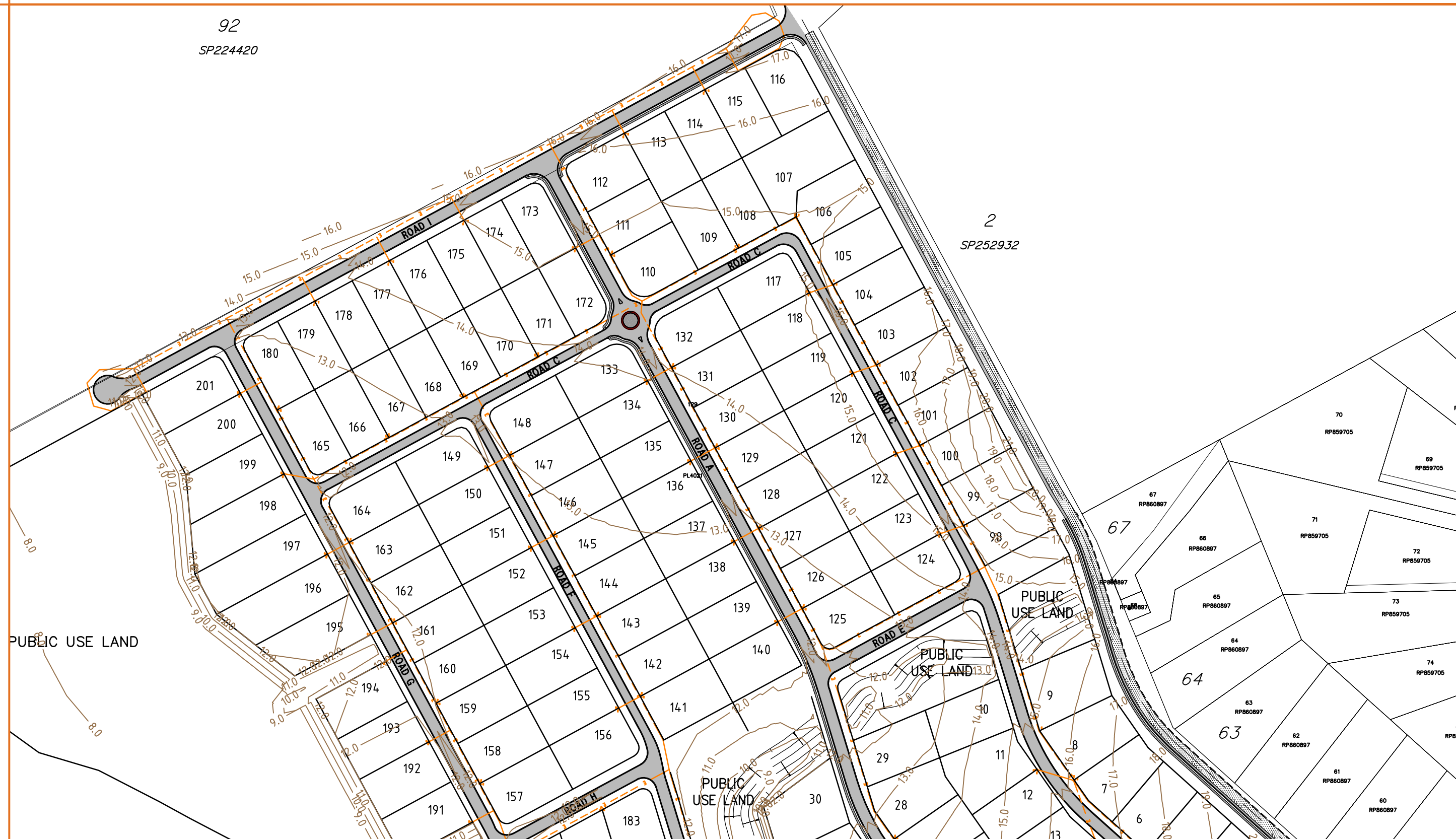
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Appendix H Proposed Electrical Plan

92
SP224420

2
SP252932



LEGEND

- New Electrical Cable with Pillar Box (Preliminary Only)
- Finished Surface Contours

RIVERSIDE ESTATE ELECTRICAL PLAN - SHEET 1 OF 2 R12394 - ELECTRICAL

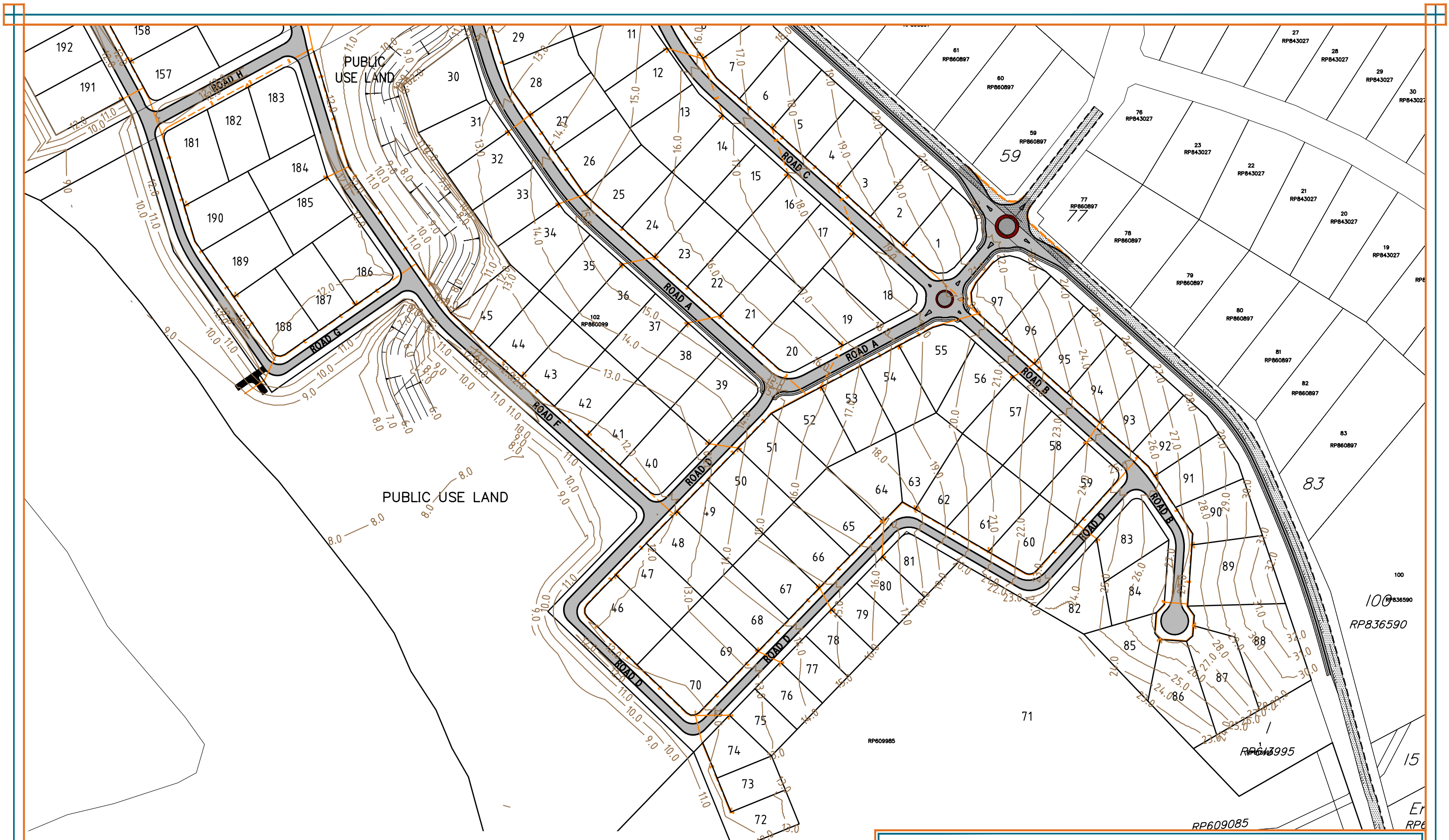
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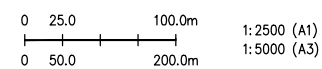
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LEGEND

- New Electrical Cable with Pillar Box (Preliminary Only)
- Finished Surface Contours

RIVERSIDE ESTATE
ELECTRICAL PLAN - SHEET 2 OF 2
R12394 - ELECTRICAL 2



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TRAFFIC IMPACT ASSESSMENT REPORT

PREPARED FOR Glenmore Holdings (Aust) Pty
Ltd

12 DECEMBER 2014
R12394
ORIGINAL
CIVIL



ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the
current conditions of approval associated with

Development Permit No.: D/84-2014

Dated: 15 September 2015



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DOCUMENT CONTROL

R12394

Issue	Date	Issue Details	Author	Checked	Approved
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APPENDIX B	INTERSECTION ANALYSIS TRAFFIC VOLUMES
APPENDIX C	SIDRA OUTPUT
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1 INTRODUCTION

This report has been prepared for Glenmore Holdings (Aust.) Pty Ltd in response to the Rockhampton Regional Council (RRC) Information Request dated 22 May 2014. The notice has been issued in relation to Riverside Estate Stages 9-16 Material Change of Use (MCU) and Reconfiguring of Lot (ROL) application D/84-2014. This Traffic Impact Assessment (TIA) aims to assess specific conditions 9.2 of the Information Request, providing an intersection analysis of the Belmont Road / Birkbeck Drive / Alexandra Street Intersection.

2 BACKGROUND

The proposed development, Riverside Estate – Stages 9-16, is located upon Belmont Road, Parkhurst (shown below).

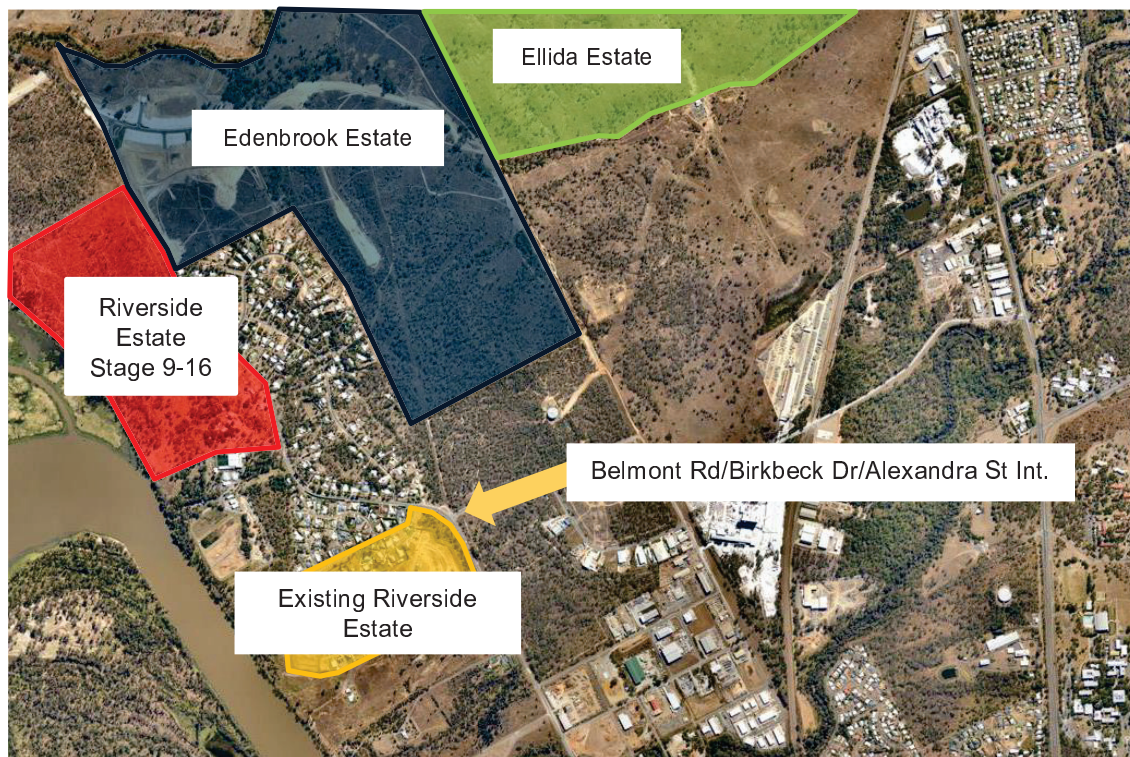


Figure 2-1: Locality Plan

The proposal includes the creation of 201 residential allotments plus Public Use Land (PUL), as shown on Capricorn Survey Group Drawing 5892-01-CPT (G), attached in Appendix A. In addition to the future Riverside Estate Stages 9-16, two additional nearby subdivisions (Edenbrook Estate and Ellida Estate) are likely to contribute a portion of their traffic towards the subject intersection.

3 TRAFFIC GENERATION & ASSUMPTIONS

3.1 EXISTING TRAFFIC GENERATION

Existing traffic generation for the Belmont Road/ Birkbeck Road/ Alexandra Street Intersection was established through an onsite traffic count completed by Calibre Consulting on the afternoon and morning of 2nd and 3rd December (respectively).

Utilising the aforementioned traffic count data, the following existing peak hours were established:

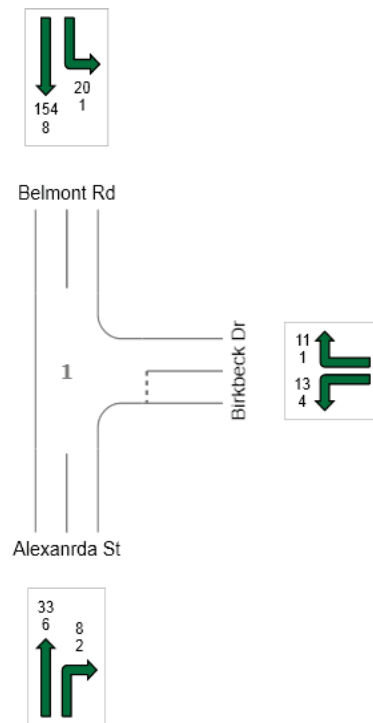


Figure 3-1: AM Peak Hour Traffic Volumes.

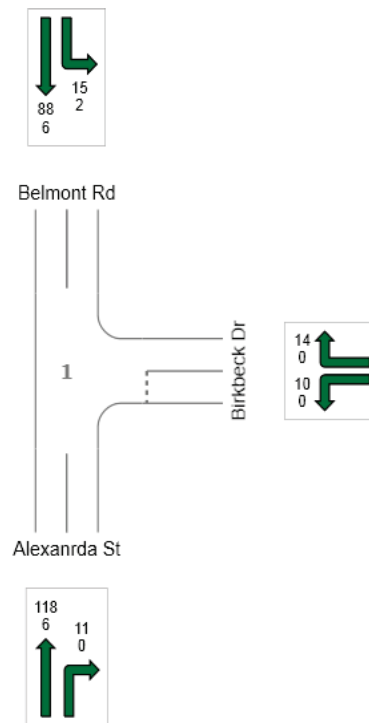


Figure 3-2: PM Peak Hour Traffic Volumes.

As per the Item 9.2 of the Rockhampton Regional Council Information Request, the additional volumes generated by the development of Edenbrook and Ellida Estates are to be considered within this analysis. Due to the unavailability of the traffic analysis associated with these two developments an overly conservative growth factor of 5% per year (compounding) has been assumed. This equates to approximately 9% per year lineal growth.

3.2 DEVELOPMENT TRAFFIC GENERATION

Traffic generation from the proposed developments (Riverside Estate Stages 9-16) have been calculated through the adoption of the following yields, in accordance with the RTA Guide to Traffic Generating Developments. Assumptions include:

Low Density Residential

- Single dwelling per allotment
- 0.85 vehicle movements per dwelling during peak hour
- Daily traffic generation of 10 movements per dwelling
- 2% Heavy Vehicles (HV)

From the above assumptions, a maximum of 171 peak hour movements have been created. Of the peak hour movements created, the following assumptions have been assumed in establishing intersection splits:

- 94% of generated traffic will utilise Alexandra Street to reach their peak hour destination with 6% travelling along Birkbeck Drive.
- 70% of generated traffic movements will exit the proposed estate during the AM peak hour with 30% returning. This assumption will be mirrored during the PM peak hour.

Utilising the above assumptions, the peak hour movements in **Table 3-1** were established.

Time	Belmont Road				Birkbeck Drive		Alexandra Street	
	Left		Thru		Right		Thru	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
AM Peak	7.03	0.14	110.17	2.25	3.01	0.06	47.22	0.96
PM Peak	3.01	0.06	47.22	0.96	7.03	0.14	110.17	2.25

Table 3-1: Generated Traffic Splits

4 ANALYSIS

The following intersections have been analysed to assess the impacts upon the existing road infrastructure network by the introduction of traffic generated through the proposed development. The impact upon all intersections have been analysed using SIDRA Traffic Engineering Software Version 6.0.

4.1 EXISTING INTERSECTION – BELMONT RD / BIRKBECK DR / ALEXANDRA STREET INTERSECTION

The existing intersection in question, located in Parkhurst, will provide for the majority of all generated traffic. The layout is made up of the major legs heading approximately North/South with a secondary leg from the East, controlled by give way.

The speed environment of the intersection 60km/h on all legs with 3.5m wide lanes (one each way) on the major legs and approximately 6.0m (average) lanes on the secondary leg (Birkbeck Drive).

The intersection layout adopted for the SIDRA intersection analysis is presented below.

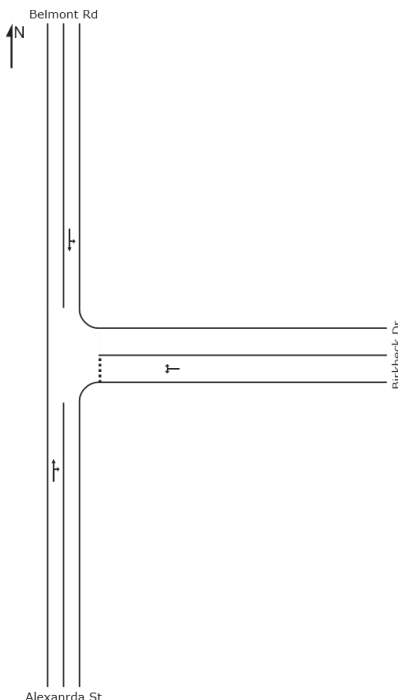


Figure 4-1: Adopted Intersection Layout

4.2 Sidra Input & Development Assumptions

In order to appropriately assess the impact of the proposed development upon the existing road network, the following assumptions have been made:

- The first stage will not be delivered until 2017 with the last stage being delivered in 2025 (approximately 25 lots per year).
- A final year analysis has been completed for the year 2035 (final year plus 10 years).
- A compound growth rate of 5% (compounding) has been assumed and applied against the existing traffic, to account for nearby development.

From the above assumptions, the following scenarios were analysed:

- 1) AM Peak – 2017 (3 Years Background Growth, No Development Generated Traffic)
- 2) AM Peak – 2015 (11 Years Background Growth Plus Development Generated Traffic)
- 3) AM Peak – 2035 (21 Years Background Growth Plus Development Generated Traffic)
- 4) PM Peak – 2017 (3 Years Background Growth, No Development Generated Traffic)
- 5) PM Peak – 2025 (11 Years Background Growth Plus Development Generated Traffic)
- 6) PM Peak – 2035 (21 Years Background Growth Plus Development Generated Traffic)

Traffic volumes utilised in the above scenarios are attached in Appendix B.

5 RESULTS

Standard SIDRA Intersection Analysis is commonly utilised to evaluate an intersections degree of saturation, Level of Service (LOS), queues and average delays. Under a standard sign controlled intersection, the desired ultimate practical degree of saturation is 0.75 with a minimum LOS of D.

A SIDRA 6.0 intersection analysis has been conducted upon the Belmont Road/ Birkbeck Drive/ Alexandra Street intersection. Analysis results have been tabulated below with complete lane summaries attached in Appendix C.

Scenario	DOS	LOS	Average Queue (m)
AM Peak 2017 (Background)	0.118	B	1.6
AM Peak 2025 (Background + Generated)	0.239	B	4.8
AM Peak 2035 (Background + Generated)	0.348	B	9.0
PM Peak 2017 (Background)	0.088	A	3.5
PM Peak 2025 (Background + Generated)	0.192	B	9.5
PM Peak 2035 (Background + Generated)	0.278	B	16.6

Table 5-1: SIDRA Intersection Analysis Output Summary

As shown above, the subject intersection is expected to accept the proposed development generated traffic without any significant impacts to the existing intersection's performance.

6 TURN WARRANT ANALYSIS

A turn warrant analysis has been completed for the above mentioned peak hours. A summary of the required treatments are summarised below:

Scenario	Required Treatment	Peak Hour Required
2014 BASELINE	BAR, BAL	Both, Both
2017 (BACKGROUND GROWTH)	BAR, BAL	Both, Both
2025 (BACKGROUND GROWTH)	CHR(S), AUL(S)	Both, AM
2025 (BACKGROUND + GROWTH)	CHR(S), AUL(S)	Both, AM
2035 (BACKGROUND GROWTH)	CHR, AUL(S)	PM, Both
2035 (BACKGROUND + GENERATED)	CHR, AUL	Both, AM

Table 6-1: Turn Warrant Summary

From the above, it can be determined that:

- The existing turn treatments are unsatisfactory at 2014 traffic levels with no basic turn treatments being installed.
- Turn treatments will be required to be upgraded to include CHR(S) and AUL(S) auxiliary lanes for both 2025 scenarios. Therefore, the addition of development generated traffic has not triggered an upgrade under this scenario.
- Under the 2035 scenarios, a difference within the required turn treatments for pre and post development is identified. However, it is noted that the existing background traffic with 21 years growth is exceptionally close to requiring an AUL treatment. Back calculation has indicated that the addition of a single left turning movement during the base count would equate to an AUL treatment being required in the 2035 scenario. Given the influence of the other nearby estates (Edenbrook and Ellida Estates), it is reasonable to accept that the proposed development (Riverside Estate Stage 9-16) will not solely, if at all, trigger a requirement to upgrade the left turn treatment to Birkbeck Drive in the future.

7 DISCUSSION

7.1 TRUNK INFRASTRUCTURE

As per Rockhampton Regional Council Transport Network Infrastructure Map 86-3, dated December 2012, the proposed development is located outside of the Priority Infrastructure Area (PIA). It has been identified by RRC that Alexandra Street will be upgraded to varying degrees, including 'upgrade Alexandra Street between Wade Street and Birkbeck Drive to two lane Urban Sub Arterial' by 2031.

7.2 TRAFFIC GROWTH

As previously discussed, no traffic impact assessments were available for use to assess the impact of their development upon the Belmont Road / Birkbeck Drive / Alexandra Street Intersection. Therefore, to account for unforeseen growth an annual growth rate of 5% (Compounding) was adopted. This equates to a lineal growth rate of approximately 9% between 2017 and 2035, which is considered overly conservative. Utilising the above rates, an increase in vehicle movements between the count year and final year of 466 movements was identified (excluding the proposed development generated traffic). At 0.85 peak hour trip per lot this equates to 548 Lots.

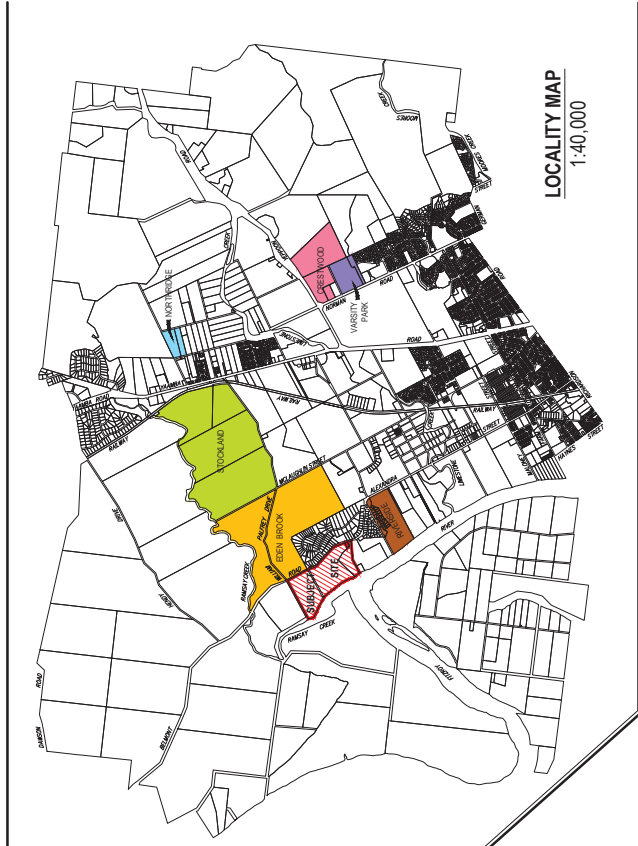
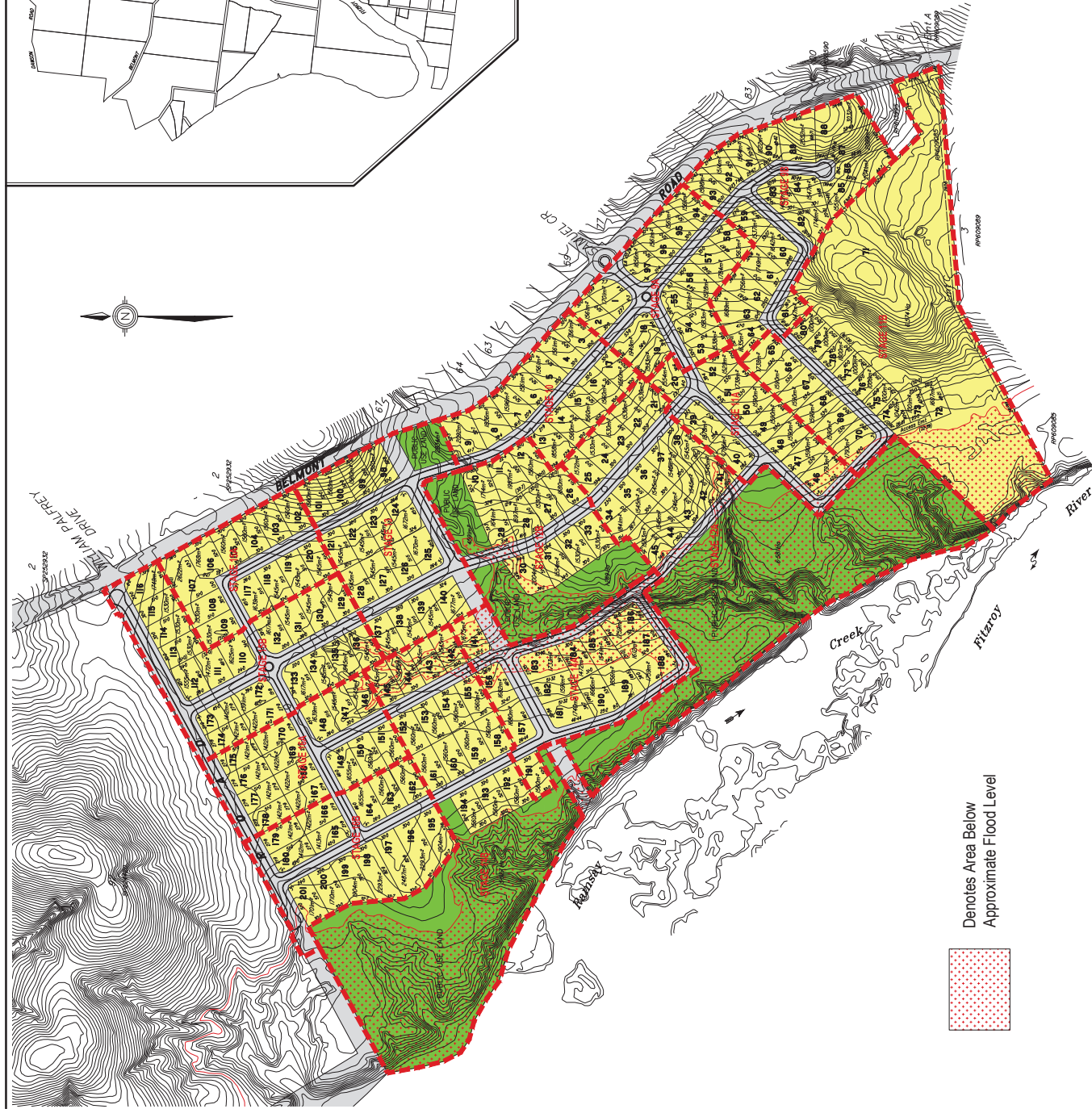
8 CONCLUSION

In conclusion, the intersection of Belmont Road, Birkbeck Drive and Alexandra Street has been analysed using SIDRA intersection analysis software. Incorporating an overly conservative growth factor it has been shown that the intersection can efficiently function beyond the year 2035 with the addition of the proposed development.

A turn warrant analysis has been undertaken and whilst the addition of development generated traffic has meant the upgrade from an AUL(S) to a AUL in the 2035 scenario, it would be unreasonable to attribute the entirety of this trigger towards the proposed development, if at all.

APPENDICES

APPENDIX A CAPRICORN SURVEY GROUP CONCEPT PLAN



client

M. Birkbeck

project Belmont Road
Parkhurst
Riverside Estate
Stages 9-16

plan of

Concept Plan
(201 Lots + Public Use Land)

tpd

Lot 102 on RP860099,
Lot 129 on PL4021 & Lot 2 on RP609995
Parish of Murchison
County of Livingstone

tpa

Rockhampton Regional Council

item	date	description	author
A	15-05-2013	Initial design	RMF
B	15-05-2013	Image underlying added	RMF
C	15-05-2013	Layout amended, underlying removed	RMF
D	15-05-2013	Width of layout amended	RMF
E	15-05-2013	Layout amended, underlying removed	RMF
F	15-05-2013	Layout amended, underlying removed	RMF
G	15-05-2013	Layout amended, underlying removed	RMF

created

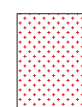
CSG
capitulum survey group
capitulum survey group (cap) city 104
250 mmy street, 104 mmy 104
capitulum survey group (cap) city 104
250 mmy street, 104 mmy 104
capitulum survey group (cap) city 104
250 mmy street, 104 mmy 104

scale 1:2500 @ A1 datum
sheet no. RRC 0.5m Contours
1 of 1 cad file
plan no. 5892-01-CPT-G
revision 5892-01-CPT G

IMPORTANT NOTE

This plan was prepared exclusively for M. Birkbeck for discussion purposes only and should not be used for any other purpose.
The areas shown herein are subject to field survey and are not to be used for any other purpose without the authority which may have requirements under any relevant legislation.
In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.
This note is an integral part of the plan.

Denotes Area Below
Approximate Flood Level



APPENDIX B INTERSECTION ANALYSIS TRAFFIC VOLUMES

Traffic Analysis



Time	Belmont Road			Birkbeck Drive			Alexandra Street		
	Left		Thru	Left		Thru	Thru		Right
	Light	Heavy	Light	Light	Heavy	Light	Light	Heavy	Light
AM Peak									
2014 Baseline	20	1	154	13	8	33	1	6	8
2017 (Background Growth)	23.2	1.2	178.3	15.0	9.3	38.2	1.2	6.9	9.3
2025 (Background Growth)	34.2	1.7	263.4	22.2	13.7	56.4	1.7	10.3	13.7
Ultimate Development Generated Traffic	7.0	0.1	110.2	0.0	2.2	47.2	0.1	1.0	0.0
2025 (Background + Generated)	41.2	1.9	373.6	22.2	15.9	103.7	1.8	11.2	13.7
2035 (Background Growth)	55.7	2.8	429.0	36.2	22.3	91.9	2.8	16.7	22.3
2035 (Background + Generated)	62.8	2.9	539.2	36.2	24.5	139.2	2.8	17.7	22.3

Time	Belmont Road			Birkbeck Drive			Alexandra Street		
	Left		Thru	Left		Thru	Thru		Right
	Light	Heavy	Light	Light	Heavy	Light	Light	Heavy	Light
PM Peak									
2014 Baseline	15	2	88	10	6	118	0	6	11
2017 (Background Growth)	17.4	2.3	101.9	11.6	6.9	136.6	0.0	6.9	12.7
2025 (Background Growth)	25.7	3.4	150.5	17.1	10.3	201.8	0.0	10.3	18.8
Ultimate Development Generated Traffic	3.0	0.1	47.2	0.0	1.0	110.2	0.1	2.2	0.0
2025 (Background + Generated)	28.7	3.5	197.7	17.1	11.2	312.0	0.1	12.5	18.8
2035 (Background Growth)	41.8	5.6	245.2	27.9	16.7	328.7	0.0	16.7	30.6
2035 (Background + Generated)	44.8	5.6	292.4	27.9	17.7	438.9	0.1	19.0	30.6

APPENDIX C SIDRA OUTPUT

LANE SUMMARY

▽ Site: AM Peak - 2017 Background

New Site

Giveway / Yield (Two-Way)

Lane Use and Performance													
	Demand Flows		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block %
	Total veh/h	HV %						Veh	Dist m				
South: Alexanrda St													
Lane 1	60	16.2	1642	0.036	100	2.8	LOS A	0.2	1.6	Full	500	0.0	0.0
Approach	60	16.2		0.036		2.8	NA	0.2	1.6				
East: Birkbeck Dr													
Lane 1	35	17.3	1084	0.033	100	10.1	LOS B	0.1	0.9	Full	500	0.0	0.0
Approach	35	17.3		0.033		10.1	LOS B	0.1	0.9				
North: Belmont Rd													
Lane 1	223	5.0	1897	0.118	100	1.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	223	5.0		0.118		1.1	NA	0.0	0.0				
Intersection	318	8.4		0.118		2.4	NA	0.2	1.6				

Level of Service (LOS) Method: Delay (HCM 2000).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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SIDRA INTERSECTION 6.0.13.4101

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INTERSECTION 6

LANE SUMMARY

 **Site: AM Peak - 2025 Background + Generation**

New Site

Giveway / Yield (Two-Way)

Lane Use and Performance													
	Demand Flows		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block %
	Total veh/h	HV %						Veh	Dist m				
South: Alexanrda St													
Lane 1	139	11.1	1639	0.085	100	3.5	LOS A	0.6	4.8	Full	500	0.0	0.0
Approach	139	11.1		0.085		3.5	NA	0.6	4.8				
East: Birkbeck Dr													
Lane 1	55	16.3	798	0.069	100	11.6	LOS B	0.2	1.9	Full	500	0.0	0.0
Approach	55	16.3		0.069		11.6	LOS B	0.2	1.9				
North: Belmont Rd													
Lane 1	455	4.1	1909	0.239	100	0.9	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	455	4.1		0.239		0.9	NA	0.0	0.0				
Intersection	650	6.6		0.239		2.4	NA	0.6	4.8				

Level of Service (LOS) Method: Delay (HCM 2000).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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INTERSECTION 6**

LANE SUMMARY

 **Site: AM Peak - 2035 Background + Generation**

New Site

Giveway / Yield (Two-Way)

Lane Use and Performance													
	Demand Flows		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block %
	Total veh/h	HV %						Veh	Dist m				
South: Alexanrda St													
Lane 1	195	12.6	1463	0.133	100	6.0	LOS A	1.2	9.0	Full	500	0.0	0.0
Approach	195	12.6		0.133		6.0	NA	1.2	9.0				
East: Birkbeck Dr													
Lane 1	117	12.5	637	0.183	100	13.5	LOS B	0.7	5.1	Full	500	0.0	0.0
Approach	117	12.5		0.183		13.5	LOS B	0.7	5.1				
North: Belmont Rd													
Lane 1	663	4.4	1906	0.348	100	1.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	663	4.4		0.348		1.0	NA	0.0	0.0				
Intersection	974	7.0		0.348		3.5	NA	1.2	9.0				

Level of Service (LOS) Method: Delay (HCM 2000).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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INTERSECTION 6**

LANE SUMMARY

▽ Site: PM Peak - 2017 Background

New Site

Giveway / Yield (Two-Way)

Lane Use and Performance													
	Demand Flows		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block %
	Total veh/h	HV %						Veh	Dist m				
South: Alexanrda St													
Lane 1	164	4.4	1877	0.088	100	1.2	LOS A	0.5	3.5	Full	500	0.0	0.0
Approach	164	4.4		0.088		1.2	NA	0.5	3.5				
East: Birkbeck Dr													
Lane 1	29	0.0	1149	0.025	100	9.0	LOS A	0.1	0.6	Full	500	0.0	0.0
Approach	29	0.0		0.025		9.0	LOS A	0.1	0.6				
North: Belmont Rd													
Lane 1	135	7.2	1866	0.072	100	1.4	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	135	7.2		0.072		1.4	NA	0.0	0.0				
Intersection	329	5.2		0.088		2.0	NA	0.5	3.5				

Level of Service (LOS) Method: Delay (HCM 2000).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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LANE SUMMARY

 **Site: PM Peak - 2025 Background + Generation**

New Site

Giveway / Yield (Two-Way)

Lane Use and Performance													
	Demand Flows		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block %
	Total veh/h	HV %						Veh	Queue Dist m				
South: Alexanrda St													
Lane 1	361	3.6	1883	0.192	100	1.6	LOS A	1.3	9.5	Full	500	0.0	0.0
Approach	361	3.6		0.192		1.6	NA	1.3	9.5				
East: Birkbeck Dr													
Lane 1	51	0.2	850	0.060	100	11.3	LOS B	0.2	1.4	Full	500	0.0	0.0
Approach	51	0.2		0.060		11.3	LOS B	0.2	1.4				
North: Belmont Rd													
Lane 1	254	6.1	1881	0.135	100	1.2	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	254	6.1		0.135		1.2	NA	0.0	0.0				
Intersection	666	4.3		0.192		2.2	NA	1.3	9.5				

Level of Service (LOS) Method: Delay (HCM 2000).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Processed: Tuesday, 9 December 2014 4:59:25 PM

SIDRA INTERSECTION 6.0.13.4101

Project: H:\R12\3\9\R12394\Admin\Traffic Reports\IRR Info Request Report\R12394 - IRR.sip6
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**SIDRA
INTERSECTION 6**

LANE SUMMARY

 **Site: PM Peak - 2035 Background + Generation**

New Site

Giveway / Yield (Two-Way)

Lane Use and Performance													
	Demand Flows		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue	Dist	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block %
	Total veh/h	HV %						Veh	m				
South: Alexanrda St													
Lane 1	514	3.9	1851	0.278	100	2.6	LOS A	2.3	16.6	Full	500	0.0	0.0
Approach	514	3.9		0.278		2.6	NA	2.3	16.6				
East: Birkbeck Dr													
Lane 1	78	0.1	640	0.122	100	13.1	LOS B	0.4	2.8	Full	500	0.0	0.0
Approach	78	0.1		0.122		13.1	LOS B	0.4	2.8				
North: Belmont Rd													
Lane 1	379	6.5	1876	0.202	100	1.3	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	379	6.5		0.202		1.3	NA	0.0	0.0				
Intersection	972	4.6		0.278		2.9	NA	2.3	16.6				

Level of Service (LOS) Method: Delay (HCM 2000).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Processed: Tuesday, 9 December 2014 4:59:26 PM

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INTERSECTION 6**

APPENDIX D TURN WARRANT TRAFFIC VOLUMES

Traffic Analysis



Turn Warrant Check	Q _{M(R)}	Q _R	Required Treatment	Q _{M(L)}	Q _L	Required Treatment
AM Peak						
2014 Baseline	222	10	BAR	162	21	BAL
2017 (Background Growth)	257	12	BAR	188	24	BAL
2025 (Background Growth)	380	17	CHR(S)	277	36	AUL(S)
2025 (Background + Generated)	547	17	CHR(S)	389	43	AUL(S)
2035 (Background Growth)	618	28	CHR(S)	451	59	AUL(S)
2035 (Background + Generated)	786	28	CHR	564	66	AUL
PM Peak						
2014 Baseline	235	11	BAR	94	17	BAL
2017 (Background Growth)	272	13	BAR	109	20	BAL
2025 (Background Growth)	402	19	CHR(S)	161	29	BAL
2025 (Background + Generated)	566	19	CHR(S)	209	32	BAL
2035 (Background Growth)	655	31	CHR	262	47	AUL(S)
2035 (Background + Generated)	818	31	CHR	310	50	AUL(S)

Sewer and Water Network Analysis

Client: Glenmore Holdings (Aust) Pty Ltd

Address: C/- Contour Consulting
349 Hobler Avenue
FRENCHVILLE QLD 4701

Site Address: Riverside Waters
Lot 102 on RP860099
Lot 129 on PL4021
Lot 92 on SP224420
Belmont Rd, PARKHURST, 4702

ROCKHAMPTON REGIONAL COUNCIL

AMENDED PLANS APPROVED

24 October 2019

DATE

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/84-2014

Dated: 15 September 2015

Sewer Network Analysis

Description of Analysis:

A sewer network analysis for the proposed site was originally carried out in 2015 as future stages to the Riverside Estate development. Since this time the proposed development has been renamed Riverside Waters and the total number of allotments has increased from 201 to 222.

Preliminary approval has previously been granted for the residential development of lot 102 on RP860099 and Lot 129 on PL4021. The following report has been prepared to meet the further information request for a sewer network analysis to be provided in order to demonstrate that the proposed development will not have any adverse impacts on the existing reticulated sewer network.

It is understood that a further application for the preliminary approval of residential development of Lot 92 on SP224420 is currently being prepared. It has been requested that the additional 127 allotments from this further application be included in the network analysis.

It should be noted that the inclusion of these additional 127 allotments in this network analysis does not imply any approval of the application however if the preliminary approval is granted then the following analysis may be used as supporting information for the proposed sewer strategy.

The following drawings were provided by Contour Consulting

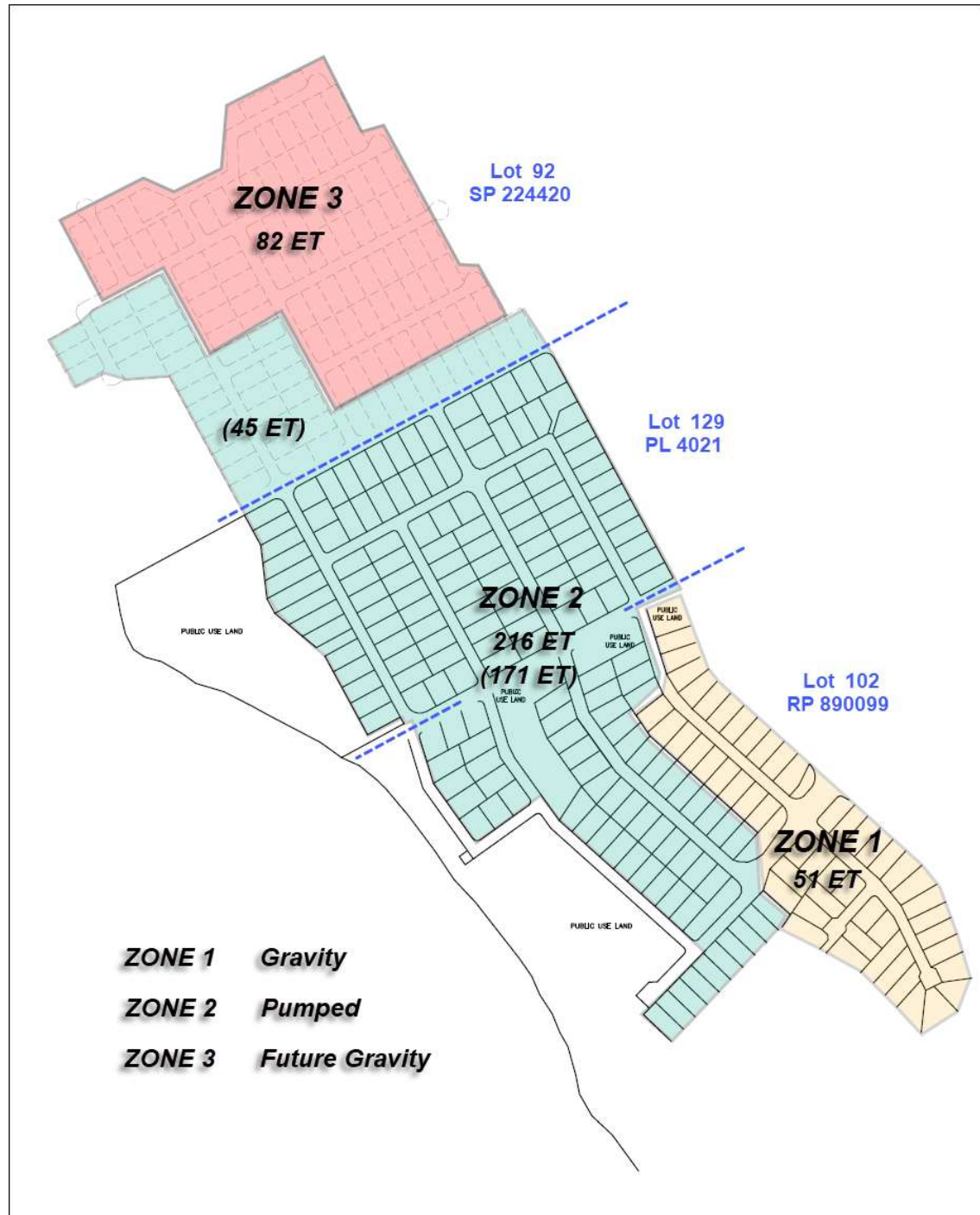
Refer Attachment A

Staging Plan

Allotment layout with finished contours

Network Analysis

From the information provided by Contour Consulting the proposed development has been separated in three catchment zones as shown below.

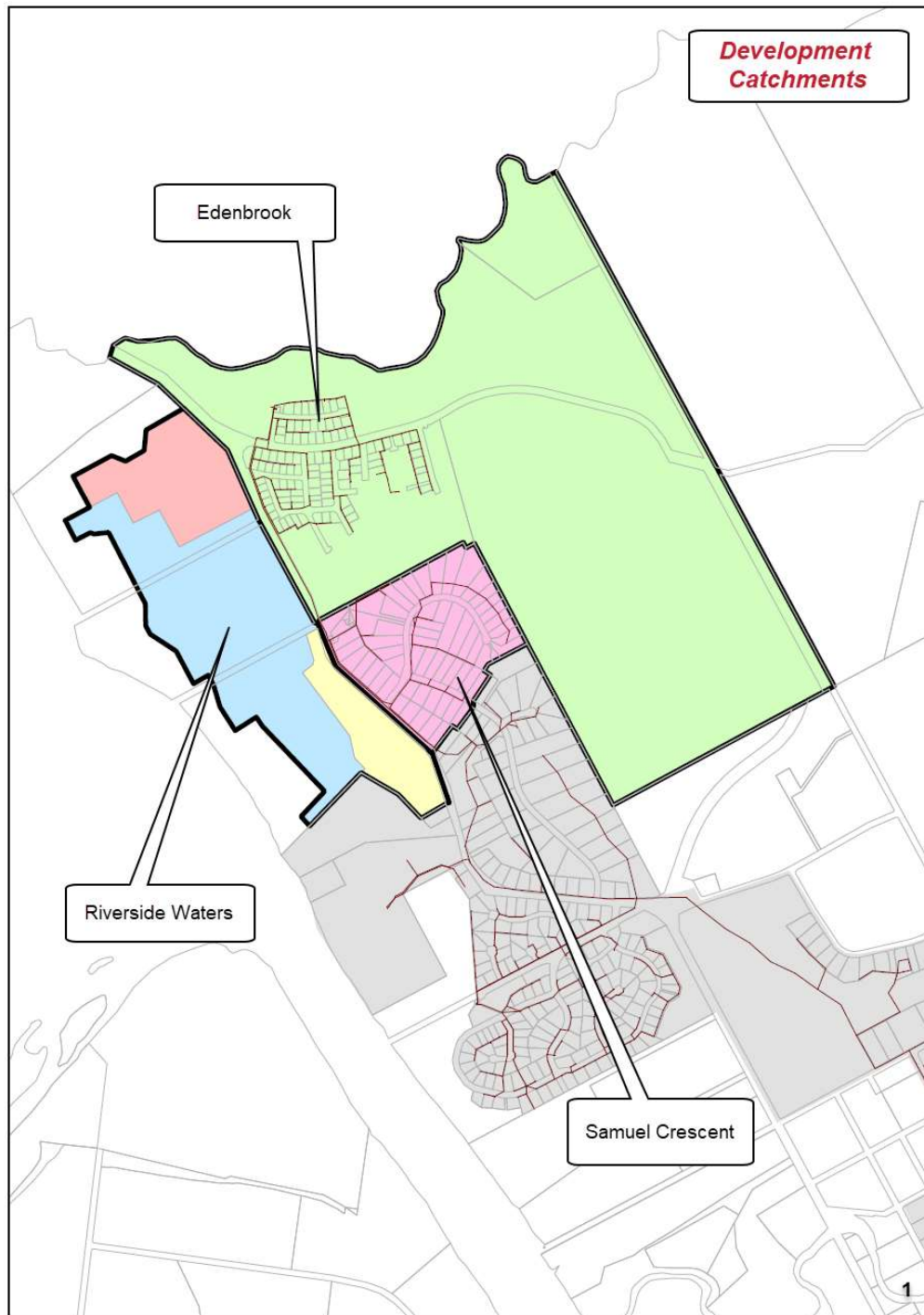


Proposed Catchment Zones

It is noted how Zone 2 extends across both Lot 129 on PL4021 and Lot 92 on SP224420.

Development Catchments

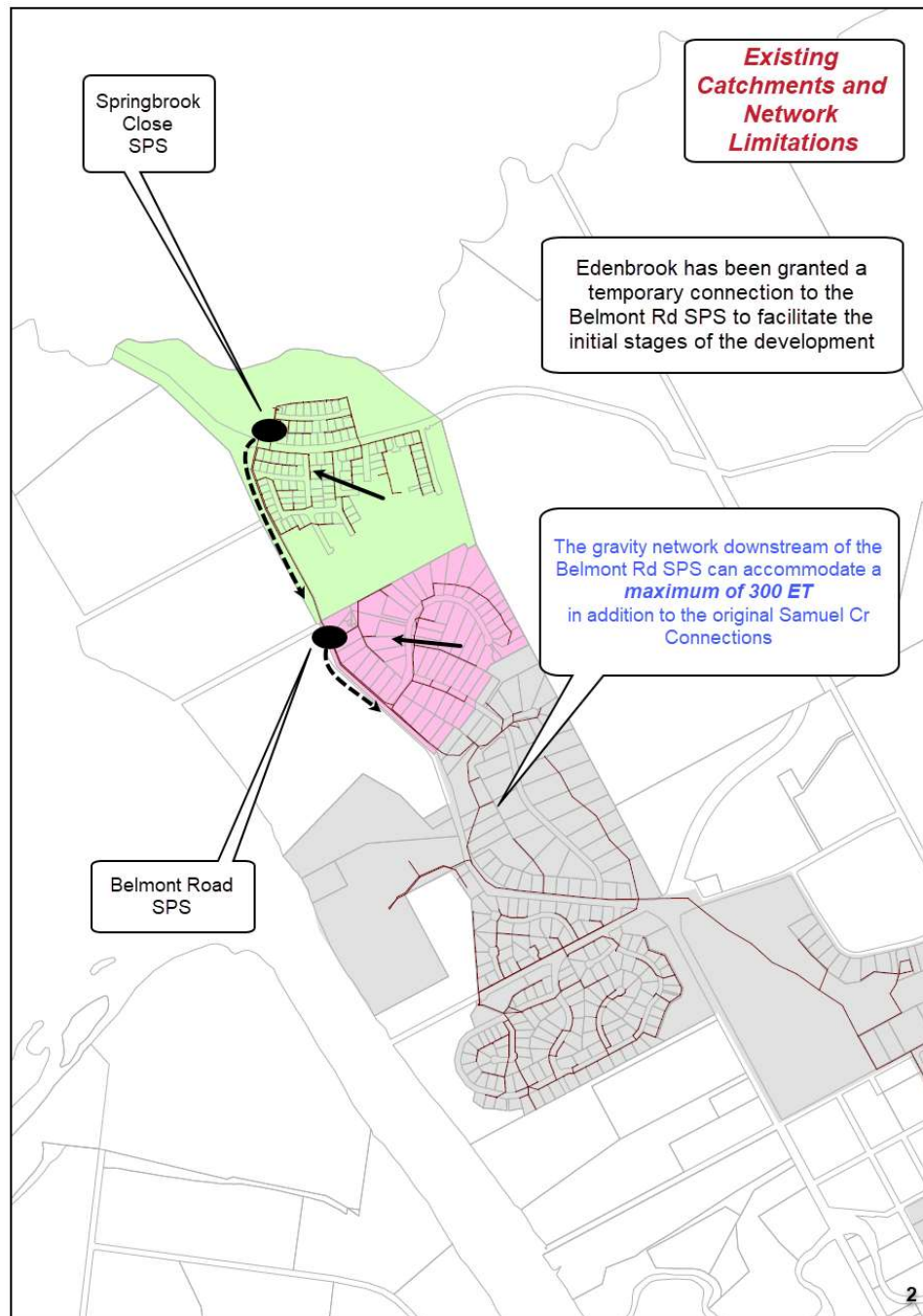
The following sketch shows where the Riverside Waters development lies in respect to the surrounding developments Edenbrook and Samuel Crescent.



Surrounding Developments

Belmont Road Sewage Pump Station

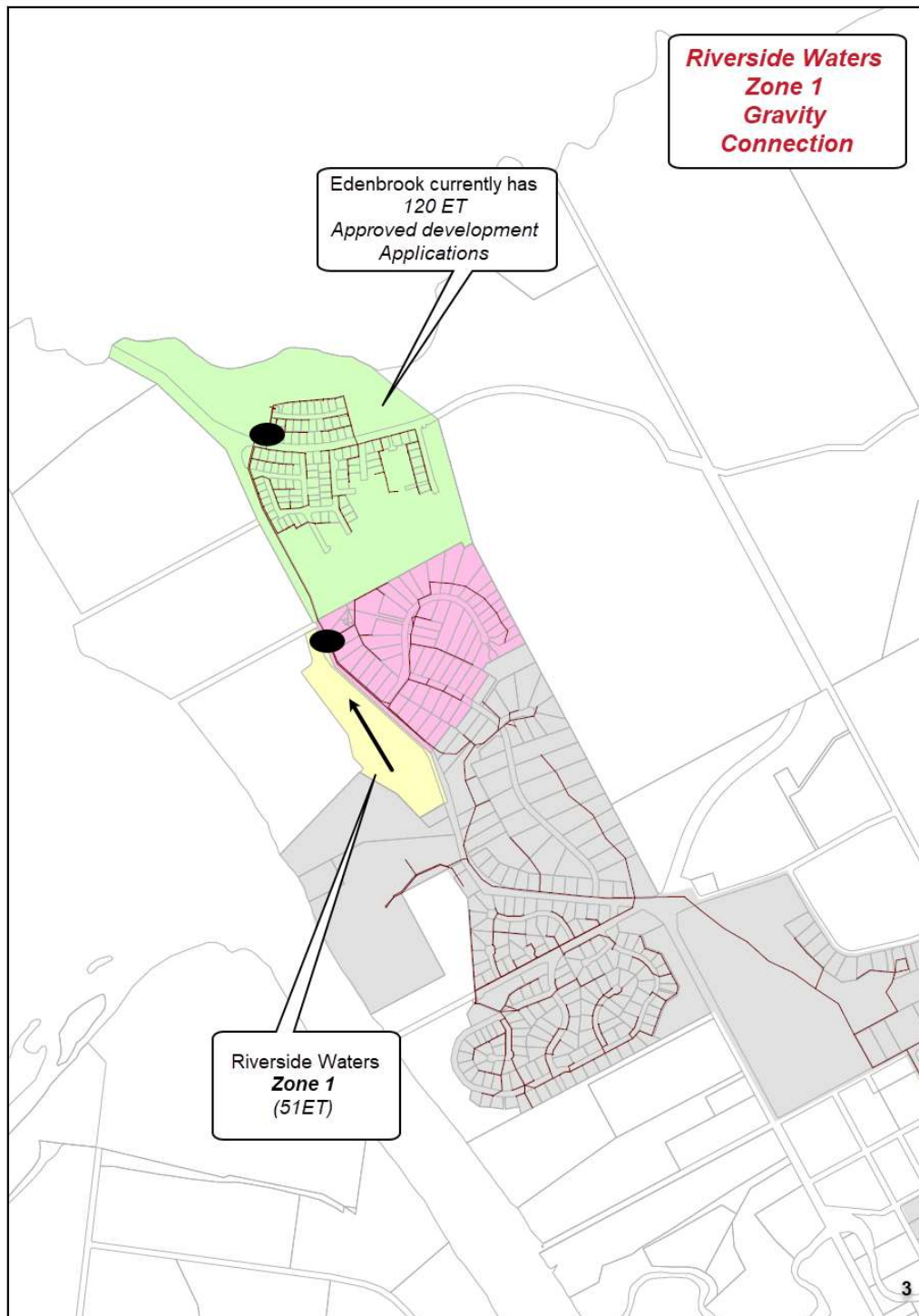
The Belmont Road sewage pump station was constructed in 1984 to service the Samuel Crescent catchment. The following sketch shows how the Edenbrook development was granted a temporary connection in 2014 to facilitate the initial stages of development via the Springbrook Close pump station.



Existing Belmont Road Sewer Pump Station Catchment

Riverside Waters Zone 1

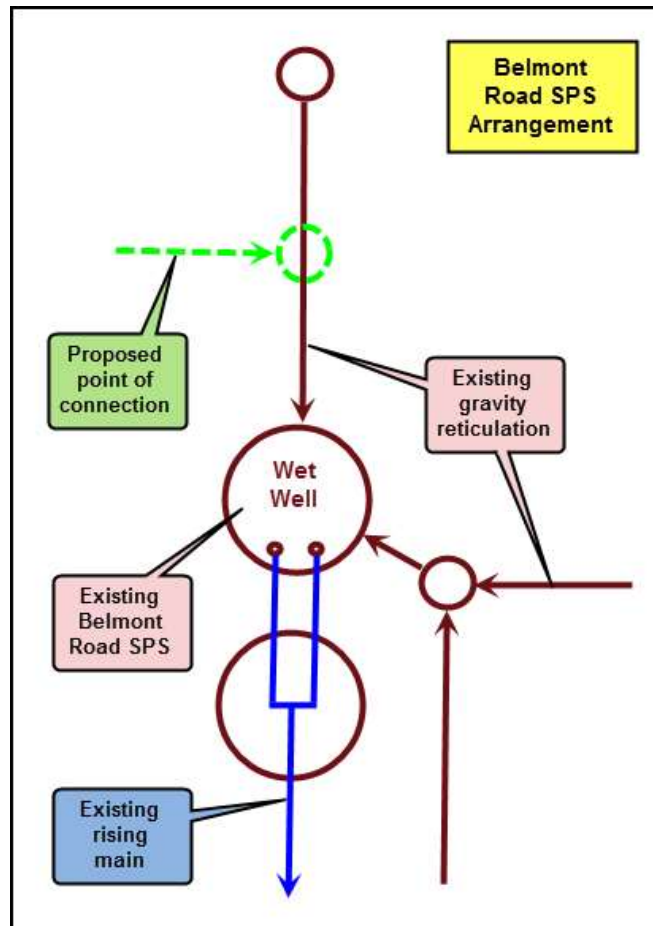
The following sketch shows where Zone 1 is to feed via gravity to the Belmont Road sewer pump station.



Riverside Water Zone 1 Gravity Connection

Point of Connection

The proposed point of connection to the existing sewer network is recommended to be via a new access chamber constructed over the existing sewer located north of the Belmont Road SPS.



Riverside Waters Connection to Existing Network

Catchment Limitations

The catchment capacity limitations are associated with the gravity sewer network located downstream from where the Belmont Road sewer pump station discharges. Recent network analysis confirms the gravity network has the capacity to accommodate an additional 300ET on top of the existing Samuel Crescent load.

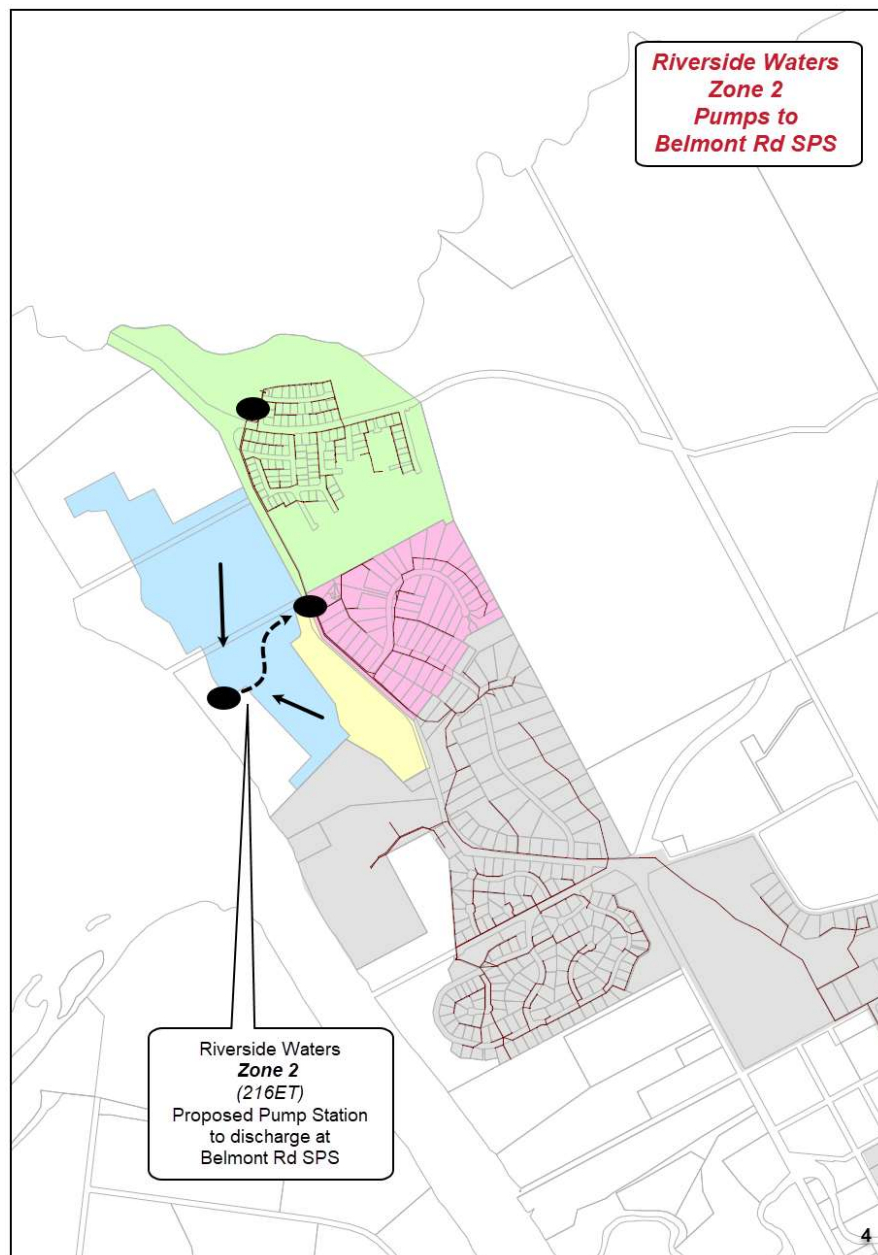
The Edenbrook development was originally granted temporary approval to discharge an additional 151ET into the Belmont Road sewer pump station until an alternative strategy would need to be implemented. Operational Works approvals for Edenbrook currently stand at approximately 120ET.

The available 180ET (300 available -120 Edenbrook) may be utilised by Edenbrook or Riverside Waters on a first come first serve basis of approved applications. Once triggered by either development, the Springbrook diversion scheme will need to be implemented (see below).

Riverside Waters Zone 2

It is assumed that the Riverside Waters Zone 2 may commence while Edenbrook is still connected to the Belmont Road sewer pump station.

The following sketch shows where Zone 2 feeds via gravity to the Proposed Riverside Waters sewer pump station.

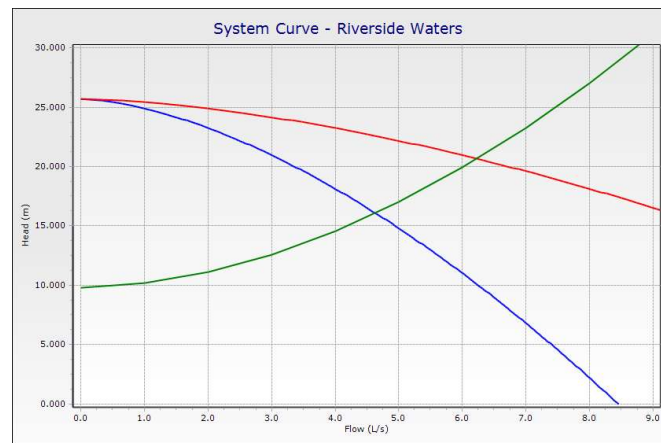


Riverside Water Zone 2 Pumped Connection

Preliminary Pump station Sizing

The ultimate allotment yield for Zone 2 is 216ET

- The adopted sewer loading per EP is 200L/day
- The adopted EP per ET is 2.5
- ADWF = $200 / 3600 / 24$
= **0.0023 L/EP/s**
= $0.0023 \times 2.5 \times 216$
= **1.3 L/s**
- PWWF = 5 x ADWF
= 5×1.3
= **6.5 L/s**
- Length of Rising Main = 450m
- Diameter = 80mm
- Static Head = 10m



Riverside Waters Zone 2 – Pump Station System Curve

- Modelled Pumps CP 3060 HT 3-252 Rated Power 2.4kW

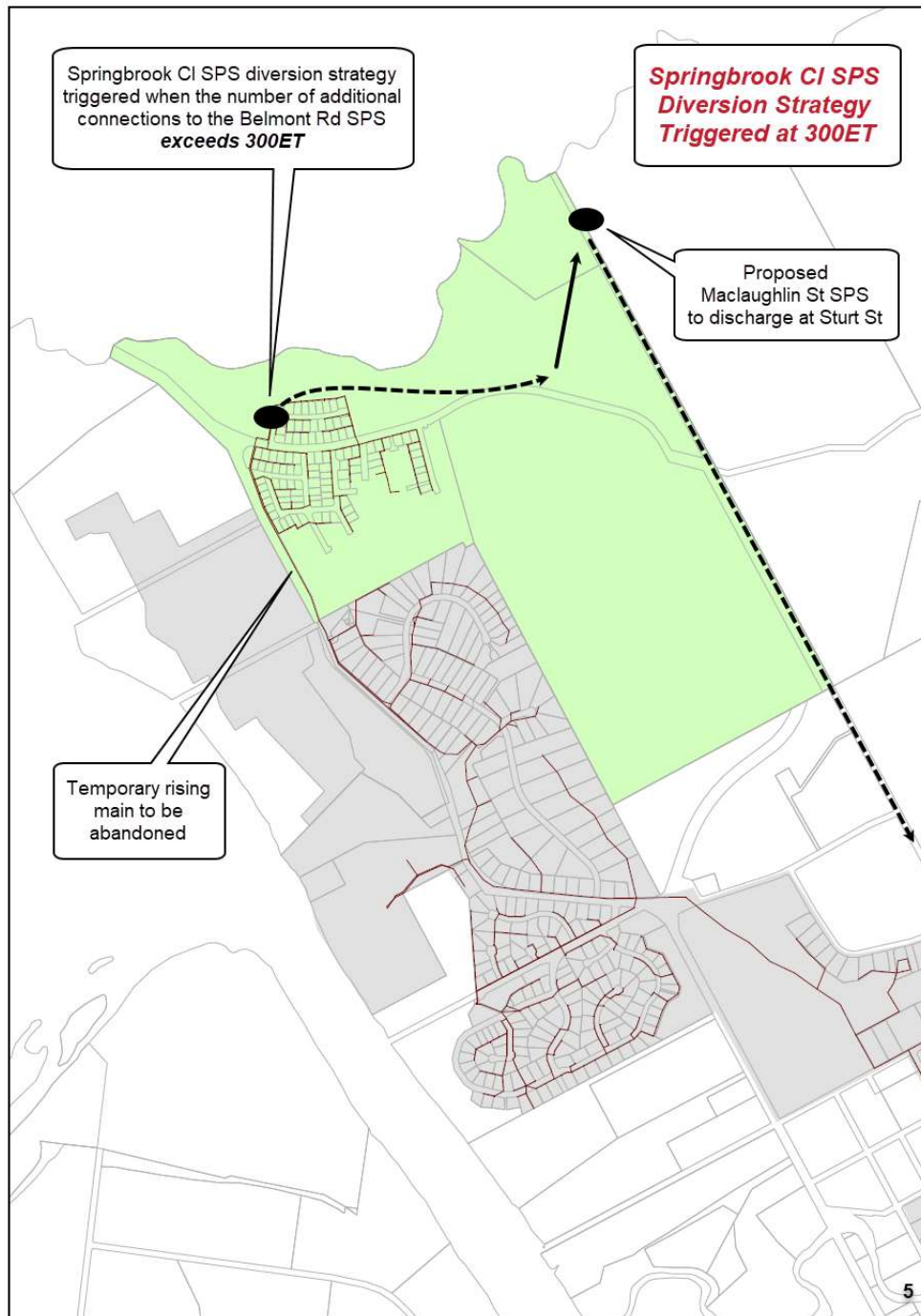
No of Pumps	Flow (L/s)	Head (m)	Efficiency (%)	Velocity (m/s)
1	4.80	16.2	51	0.95
2	6.37	20.9	46	1.27

Refer Attachment B

Pump Operation Curves

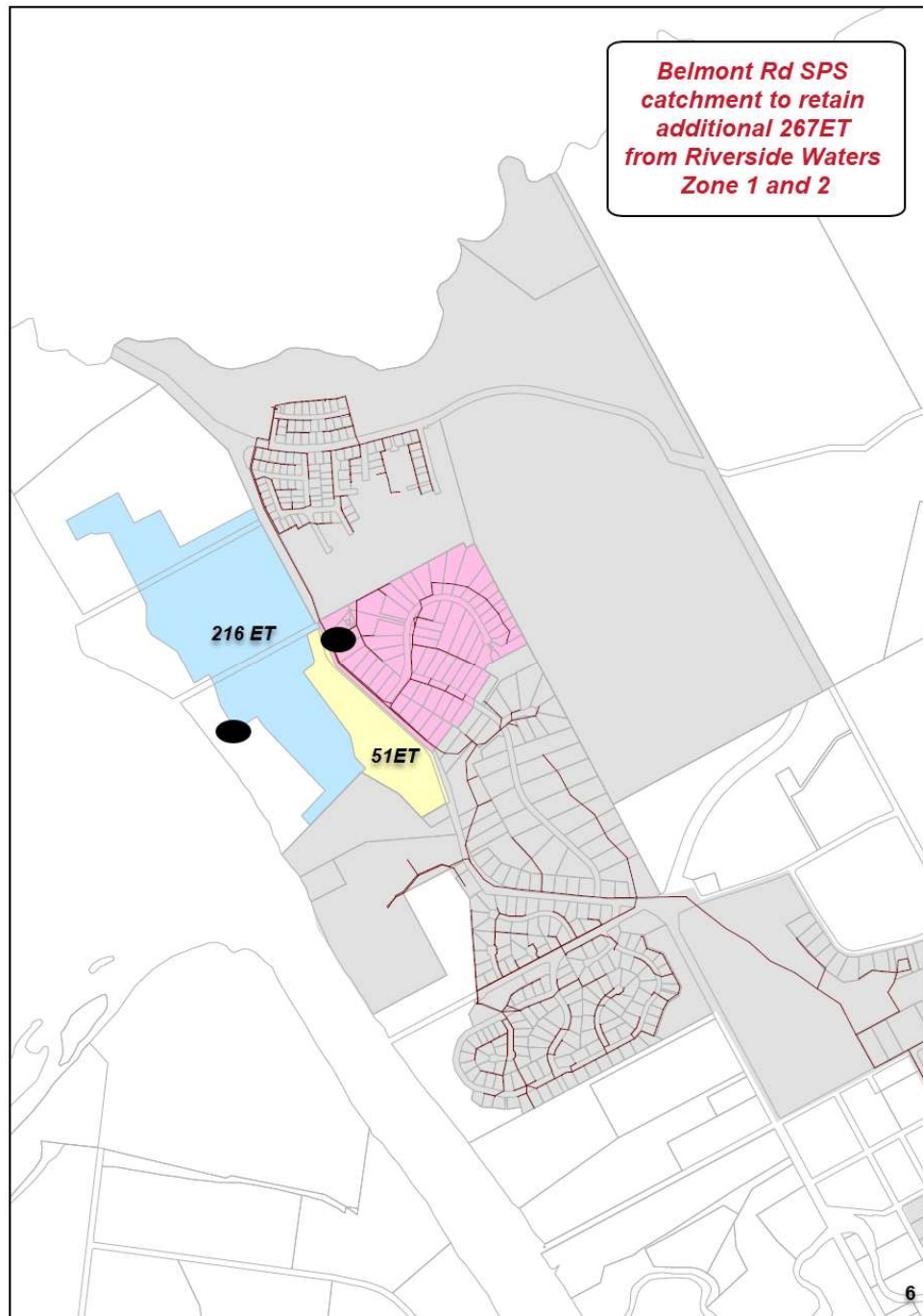
Catchment Limitation of 300 ET Triggered

It is assumed that the partial development of Zone 2 is likely to coincide with the catchment limitation trigger of 300ET being exceeded. This will trigger the implement the Springbrook Close sewer pump station diversion strategy. A high level sketch of the proposed diversion strategy is given below.



Springbrook Close Sewer Pump Station Diversion Strategy

With Edenbrook diverted this effectively enables Riverside Waters to utilise the additional capacity freed up at the Belmont sewer pump station. The total load on the Belmont Road sewer pump station from Riverside Waters is in the order of 267ET as shown below.

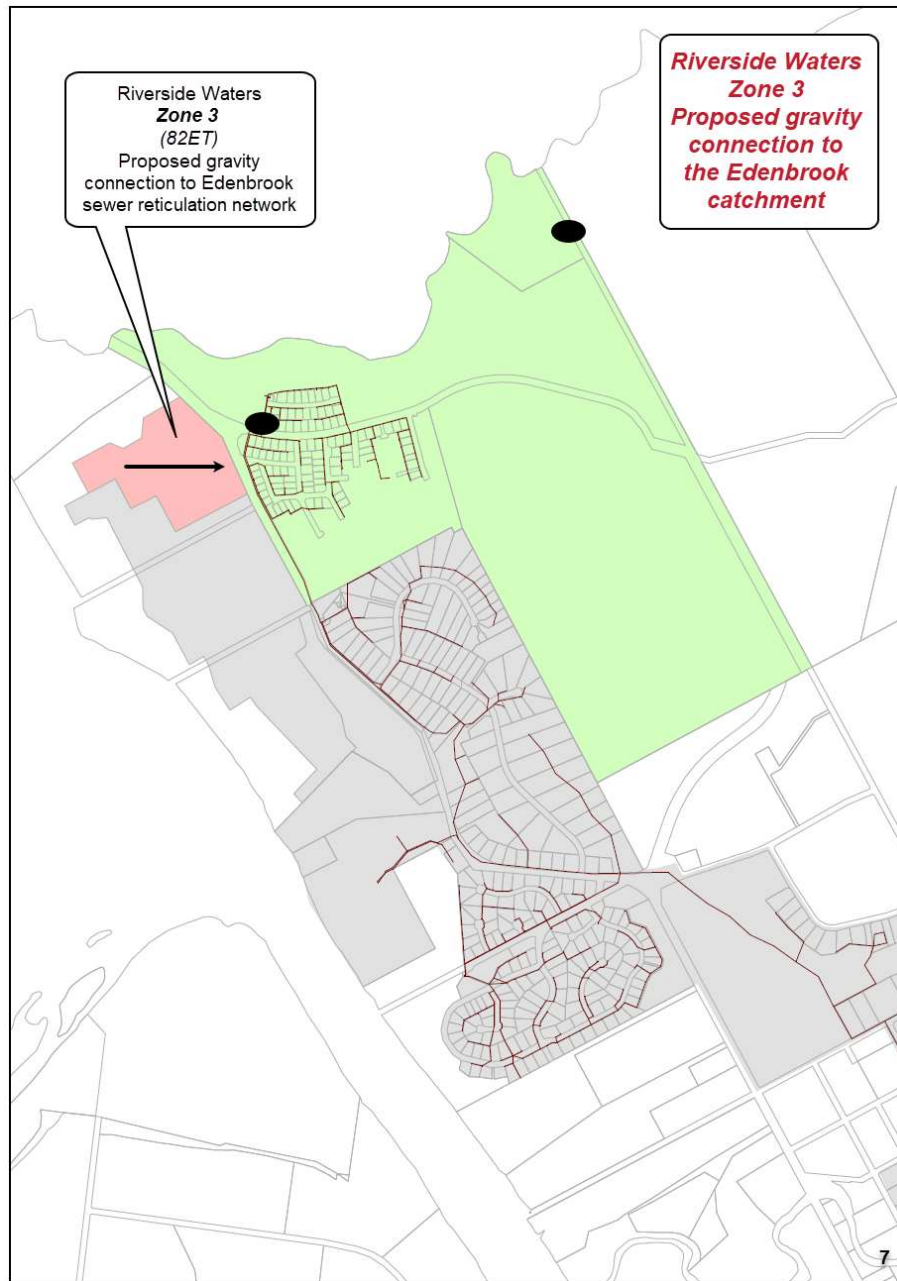


Total load on the Belmont Road sewer pump station from Riverside Waters is in the order of 267ET

It is noted that this is less than maximum allowable additional capacity of 300ET.

Riverside Waters Zone 3

The following sketch shows where Zone 3 is to feed via gravity into the Edenbrook sewer network.



Riverside Zone 3 to Discharge via Gravity into the Edenbrook Network

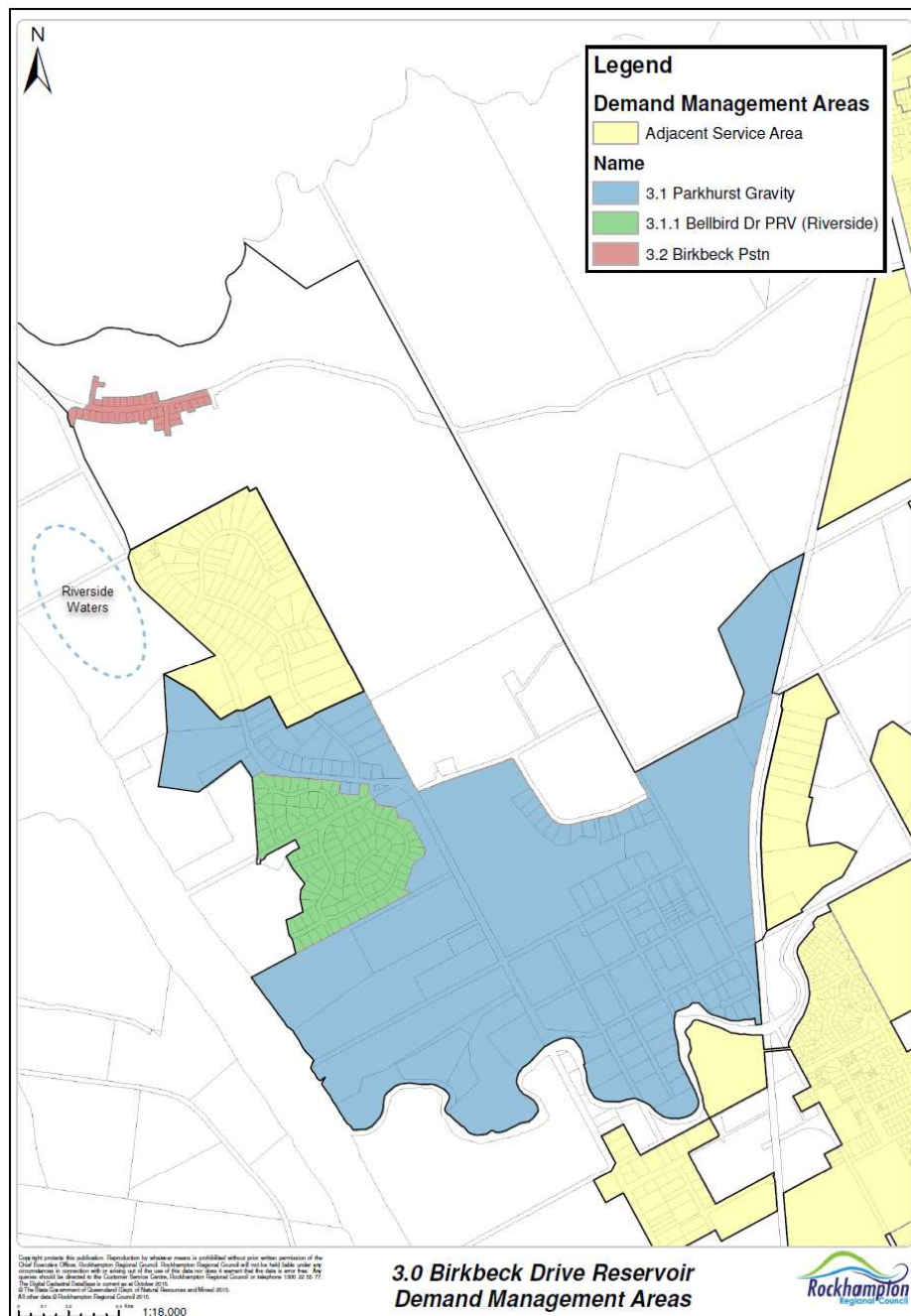
It is noted that as no sewer layout was provided for the proposed allotment layout within Lot 92 on SP224420, the gravity sewer within Zone 3 has been interpreted from the proposed finished contour sketch.

Water Network Analysis

Description of Analysis:

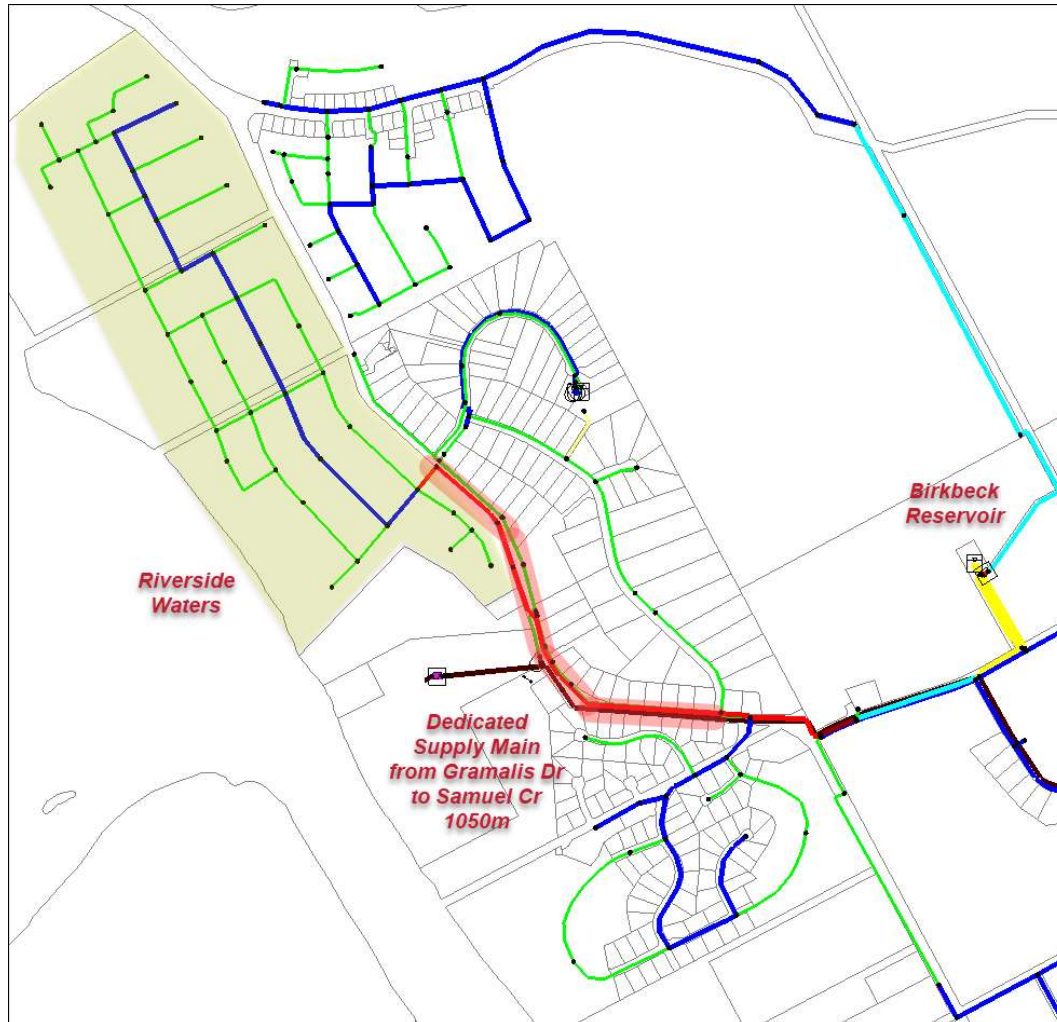
A water network analysis has been carried out for the 347 allotments proposed for the Riverside Waters development.

The following Demand Management Area map shows how the Riverside Waters development lies west of the Birkbeck reservoir Parkhurst Gravity area.



Birkbeck reservoir Parkhurst Gravity Service Area

It is proposed to service the development via a connection to the Parkhurst gravity zone. A dedicated supply main is proposed along Belmont Road between Gremalis Drive and Samuel Crescent as shown below.



Riverside Waters - Dedicated Supply Main

Network Analysis

Two scenarios were investigated for the 1,050m long supply main.

- 150mm Diameter Main
- 200mm Diameter Main

The scenarios were analysed to assess the capacity to provide a minimum service pressure of 220kPa and a fire fighting capacity of 15L/s at a minimum pressure of 120kPa.

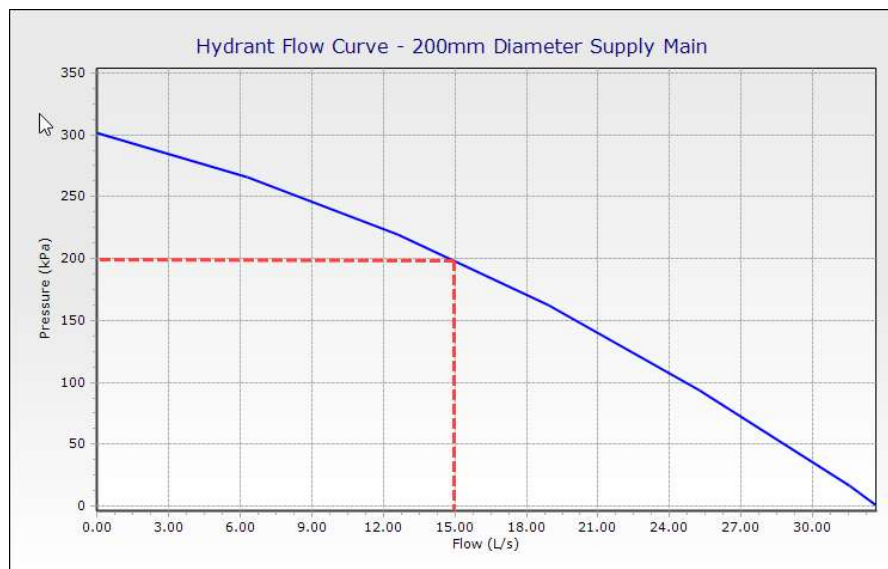
Results

The following table of results were taken from the critical node located at an elevation of 27m. They show that the 150mm diameter main was able to meet the minimum service pressure but could not provide the required fire flow achieving only 9L/s at 120kPa. The 200mm diameter main remains meets all of the required design criteria.

Scenario Diameter (mm)	Residential		Fire Flow
	Residual Pressure (kPa)		Max @ 120kPa (L/s)
	Min	Max	
150	246	334	9
200	301	334	23

200mm Diameter Supply Main Scenario Meets the Design Criteria

The hydrant flow curve at the critical node for the 200mm diameter supply main scenario is given below.



Hydrant Flow curve at Critical Node for 200mm Diameter Supply Main

The pressure results for all modelled nodes are given on the following page including the recommended minimum pipe size diameters for the internal network.



Recommendations

Water:

The initial three stages (51ET) of the Riverside Waters development will require significant external water infrastructure with the construction of 1,050m of 200mm diameter main in Belmont Road from Gremalis Drive to Samuel Crescent. It is noted that the critical 900mm diameter primary supply main from the Glenmore Water Treatment Plant is located along half the length of this route. Extensive liaison with Fitzroy River Water is required to ensure there is no risk to this main during construction.

Sewer:

The initial three stages are able to connect via gravity to the Samuel Crescent sewer network that is serviced by the Belmont Road sewer pump station. It is noted that the Belmont Road sewer pump station has a limited capacity to receive an additional 300ET. The available 300ET may be utilised by Edenbrook or Riverside Waters on a first come first serve basis of approved applications. There is currently approved applications for approximately 120ET.

The future stages of Riverside Waters identified within this report as Zone 2 will require the construction of an internal sewer pump station to permanently discharge into the Belmont Road sewer pump station (via the Zone 1 gravity network).

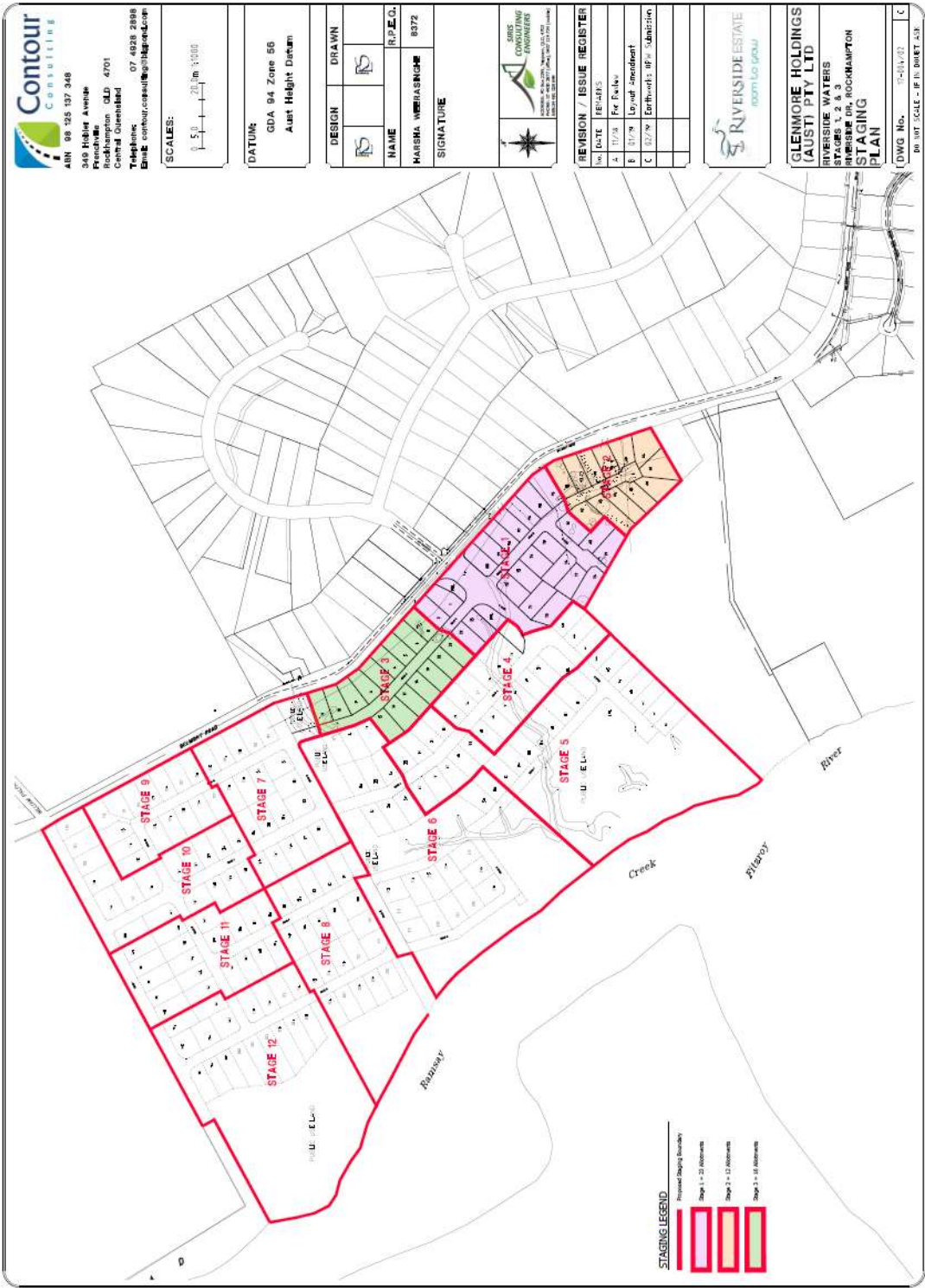
Zone 2 is comprised of 216ET. It should be noted that the full development of Zone 2 will not be able to occur until the “Springbrook Close Sewer Pump Station Diversion Strategy” has been implemented.

The future stage identified within this report as Zone 3 is to connect to the Edenbrook sewer network via gravity. The design of the “Springbrook Close Sewer Pump Station Diversion Strategy” will need to include capacity to accommodate the additional 82ET from Zone 3.

No sewer layout was provided for the proposed allotment layout within Lot 92 on SP224420. The potential for a gravity sewer layout within Zone 3 to discharge into the Edenbrook sewer network has been interpreted from the proposed finished contour sketch provided in Attachment A.

End of Report

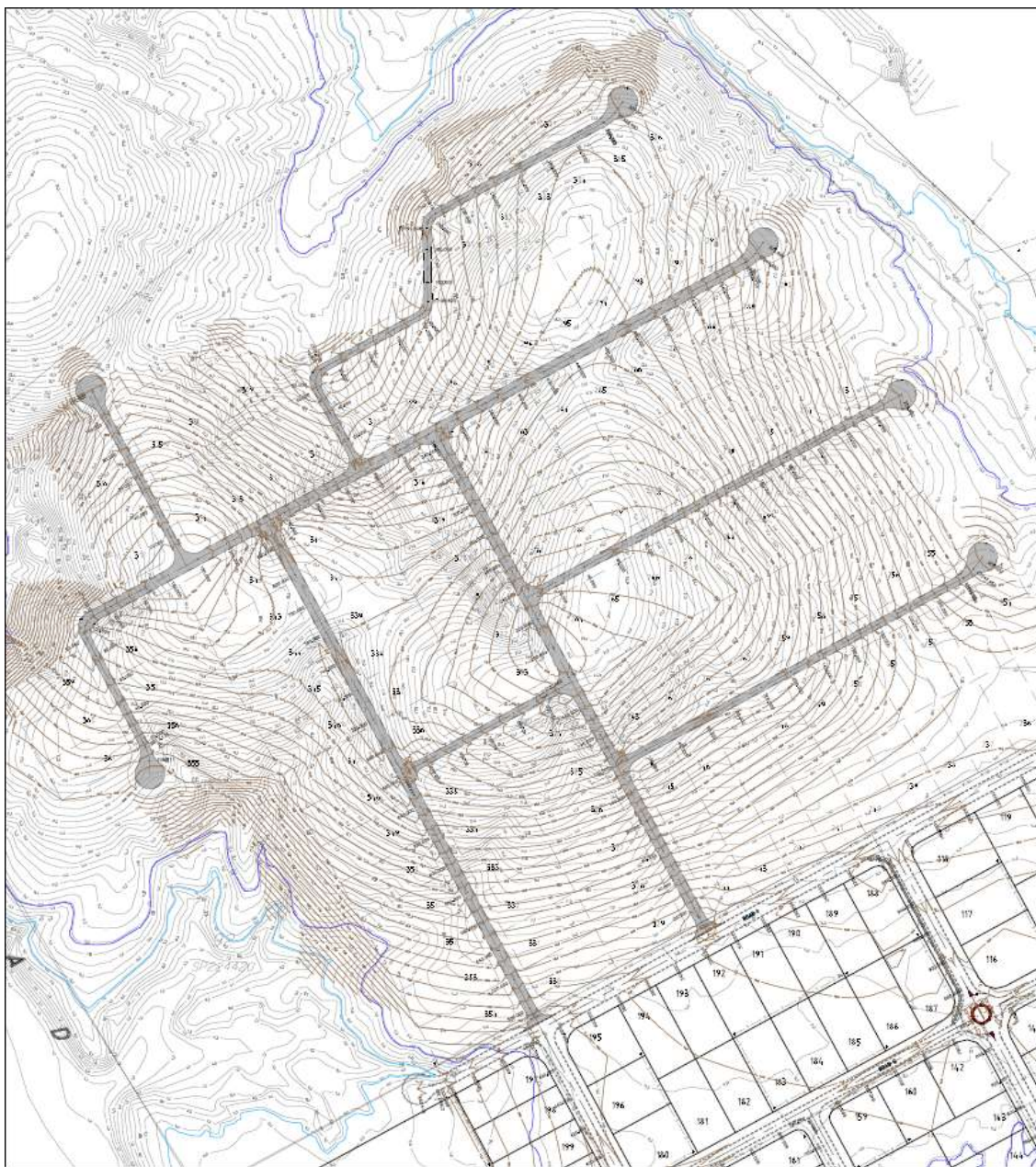
Attachment A



Staging Plan for lot 103 on RP860099 and Lot 129 on PL4021



Overall Layout

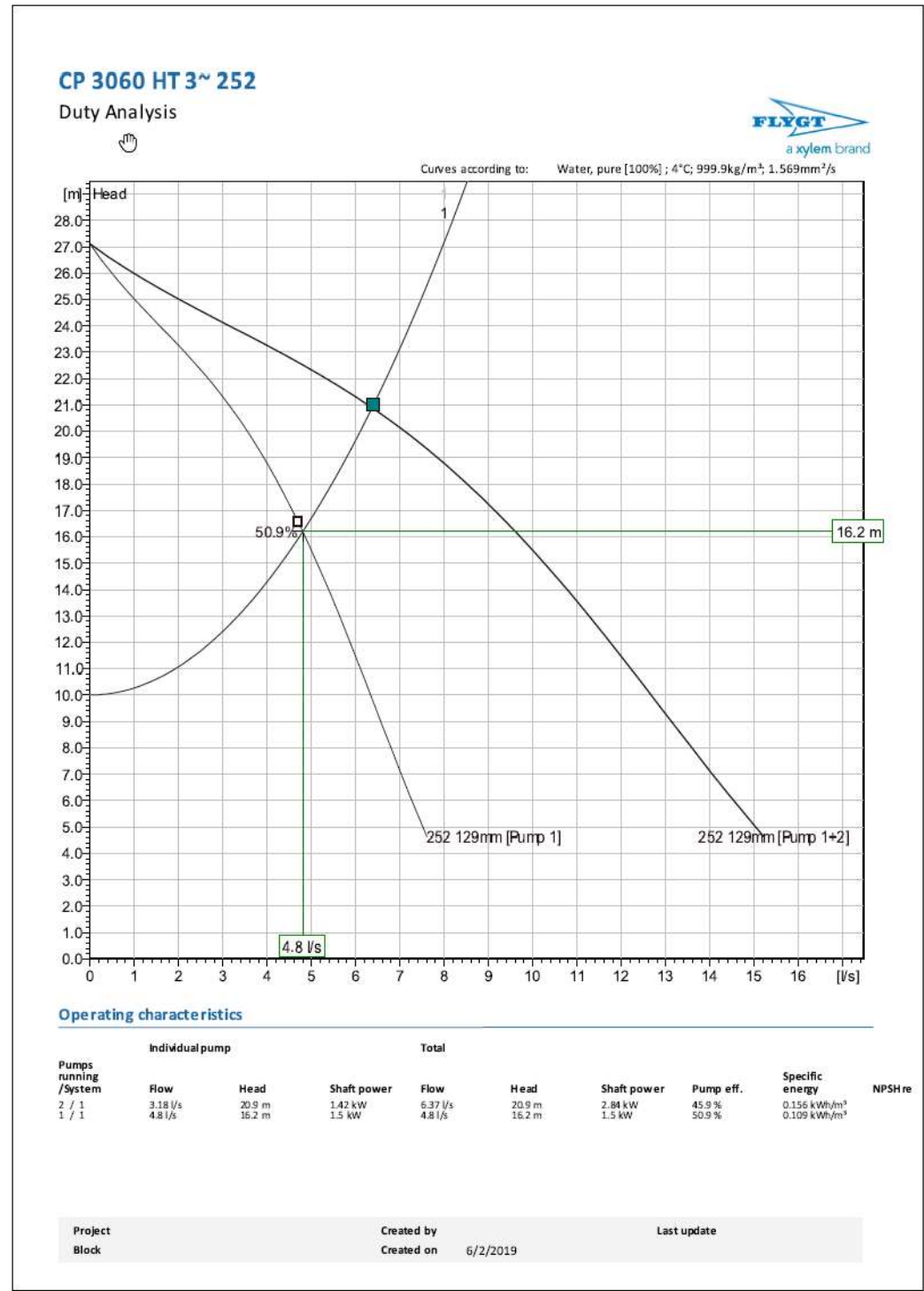


Proposed finished contours and allotment layout for Lot 92 on SP224420

Attachment B

Riverside

Internal Pump Station - Single Pump Operation



Riverside

Internal Pump Station - Dual Pump Operation

