Your Ref: RAL/24/0009
Our Ref: F24/20

26 February, 2025

Chief Executive Officer
Mareeba Shire Council
PO Box 154
MAREEBA QLD 4880

Attention: Carl Ewin
Planning Services

Dear Sir,

RE: RESPONSE TO INFORMATION REQUEST
APPLICATION FOR RECONFIGURING A LOT – 1 LOT INTO 14 LOTS AND A BALANCE AREA
LOT 224 ON SP276715, 446 RAY ROAD, MAREEBA.
DEVELOPMENT APPLICATION RAL/24/0009.

I refer to the Mareeba Shire Council's Confirmation Notice and Subsequent Information Request letter dated 12 July, 2024. The following advices are provided for your information in accordance with the Development Assessment Rules, 2017 supported by the *Planning Act, 2016.*

Information Request Item 1

Stormwater Management Plan

Please provide a Stormwater Management Plan (SMP) and Report, prepared by an RPEQ that meets or exceeds the standards of design and construction set out in the Queensland Urban Drainage Manual and the Design Guidelines and Specifications set out in the Planning Scheme Policy 4 - FNQROC Regional Development Manual.

The SMP must specifically investigate the sites existing contribution to the southern Ray Road drainage catchment (including both the developed Estate and the balance land) and demonstrate a non-worsening effect as a consequence of the development on both the balance of the site and surrounding downstream catchments, including the Ray Road catchment.

If detention basins are proposed, a masterplan of the balance area of the Estate must be included to show the location of proposed and future detention basins with respect to future stages of the Estate.

Please see attached the Stormwater Management Plan as provided by ERSCON Consulting Engineers for the proposed development. The attached Stormwater Management Plan has been collated by ERSCON and liaised with Council's Engineering Department.

This completes this Response to the Information Request. Please do not hesitate to contact me, in the first instance, should you require further information in relation to the matter.

Yours faithfully,

MATTHEW ANDREJIC
FRESHWATER PLANNING PTY LTD
Freshwater Planning Pty Ltd
t/e The Freshwater Trust
ACN 603 020 220 | ABN 31 187 983 959
P: 0402729004
E: FreshwaterPlanning@outlook.com
A: 17 Barron View Drive, FRESHWATER QLD 4870

Prepared by:

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CAIRNS QLD 4870

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DOCUMENT ISSUE RECORD

Revision Code	Date Revised	Revision Details	Author	Checked	Approved
A	20/06/24	Stormwater Management Plan	MG	MF	JM
B	17/02/25	Stormwater Management Plan	MG	MF	JM

Table of Contents

1 SUMMARY

1.1 DEVELOPMENT APPLICATION DETAILS

Proposed development:	Land development at Wylandra Estate, Mareeba. Works include earthworks, road works, water connections, and stormwater drainage.
Type of approval sought:	**Operational Works**
Site address:	Off Wylandra Drive, Mareeba
Real property description:	Lot 224 on SP276715
Site area:	74,548 m²
Assessment manager:	Mareeba Shire Council
Owner details:	Conmat Pty Ltd
Applicant details:	Conmat Pty Ltd C/-ERSCON PTY. LTD. PO BOX 7890 CAIRNS QLD 4870

1.2 PLANNING INSTRUMENT DETAILS

Planning scheme:	Mareeba Shire Council Planning Scheme 2016
Zone:	Medium Density Residential
Local plan:	Nil
Level of assessment:	Code Assessment
Applicable codes:	Nil

1.3 REFERRAL AGENCIES

Referral agency and role
Nil

2 SITE DETAILS

2.1 SITE DESCRIPTION

The site is located off Wylandra Drive, Mareeba. This application seeks operational works approval to complete construction of a 14-lot land development as approved for re-configuration by Council.

Table 1: Site description

Site characteristic	Description
Existing land use	The existing land was used for farming.
Existing structures	There is an existing intersection with a temporary drainage outlet that flows into the lots. Existing drainage overland drains are also present to the East of the lots.
Frontage and access	Access will be provided via the new road off Wylandra Drive.
Topography and views	The elevation change is 7m from RL 461.5m to 454.5m and slopes from the South-East towards the North-West at a grade of 1-2%.
Existing vegetation	The existing land is predominantly overgrown grassed areas with scattered trees.
Existing waterways	Drainage pathways are located along the eastern lot boundary and discharge into pathways near the north boundary. These then flow from east to west towards Chinaman Creek and Ray Road.

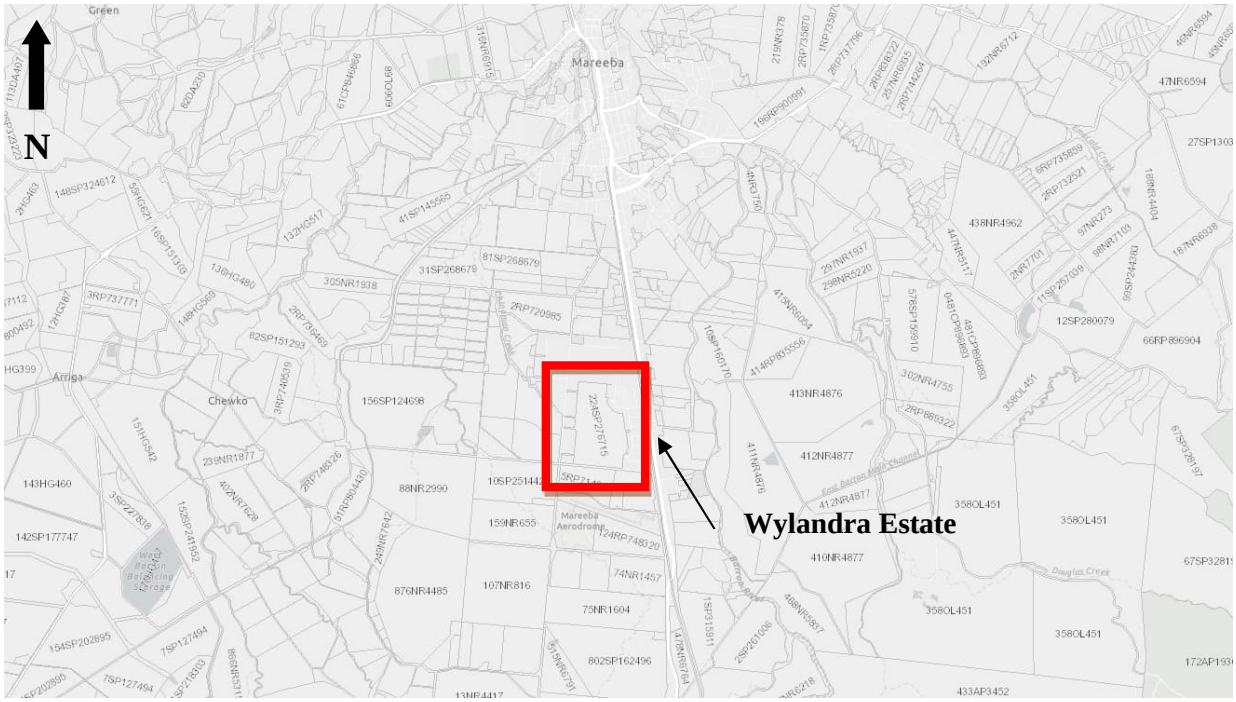


Figure 1: Aerial View of Site Identification
Source: DA Mapping System

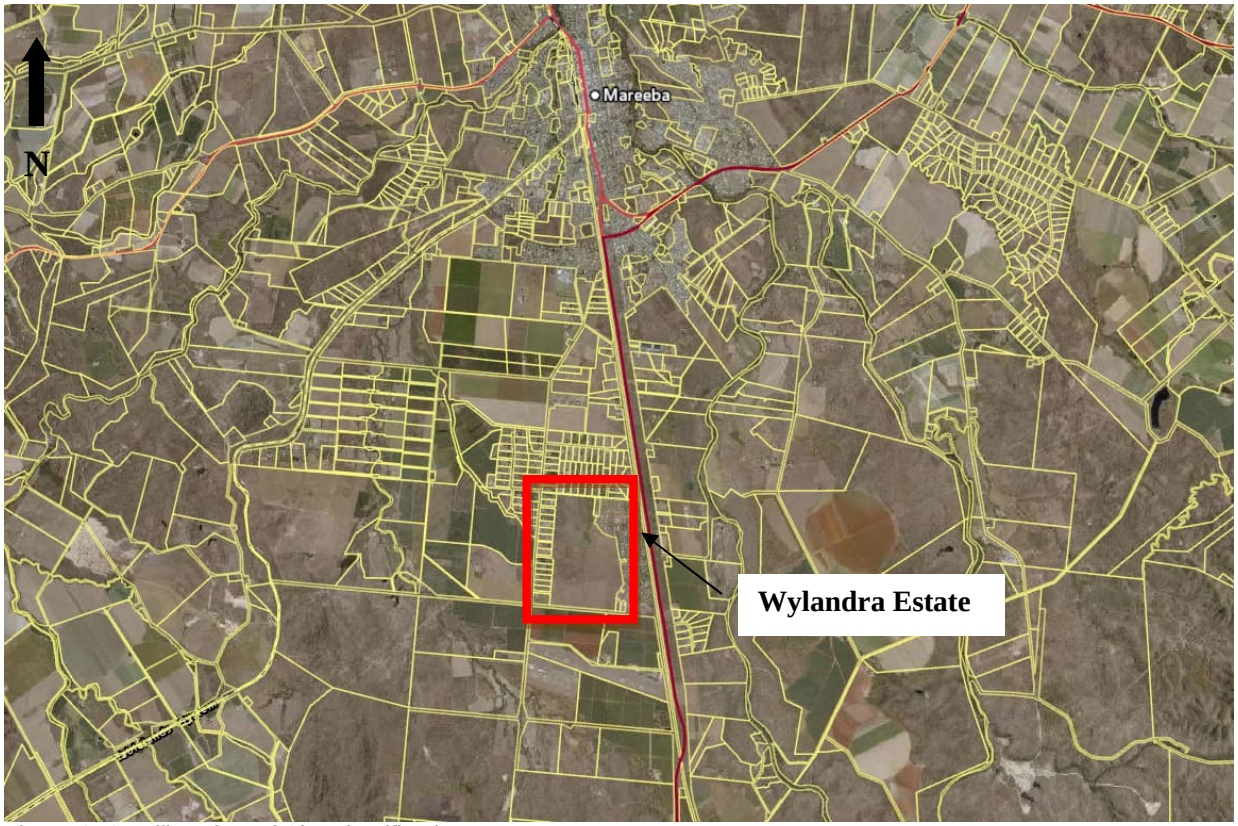


Figure 2: Satellite View of Site Identification
Source: QLD Globe

2.2 SURROUNDING LAND USES

Table 2: Surrounding land uses

	Surrounding land uses
North	Existing residential area
South	Airport and Existing residential area
East	Existing residential area and farmland
West	Existing residential area

3 STORMWATER MANAGEMENT PLAN

3.1 DESIGN METHOD

The stormwater design has been carried out using the Rational Method, in accordance with the Queensland Urban Drainage Manual (QUDM).

In accordance with the QUDM recommendations, the major system design has been calculated based on a 100-year recurrence interval (1 in 100 ARI / 1% AEP), using overland flow and the minor system design has been calculated based on a 18-year recurrence interval (1 in 18 year / 5% AEP), using an underground network system.

Runoff has been calculated using IFD Chart 15 of the FNQROC Development Manual. Runoff Coefficients have been determined in accordance with QUDM.

Since our initial submission of the Stormwater Plan as part of the Operational Works package in June 2024, we have been requested by Council to do further investigations into downstream capacities. We have supplied different options for containing and directing overland flow towards either Coolamon Close or Chinaman Creek Drainage Easements.

On Council's recommendation we were asked to provide a "no worsening" effect on the downstream properties of our development. We have provided a temporary Detention Basin downstream of the Stage 1 works. Specifications and calculations for this basin have been provided in Chapter 4 – Detention Basin.

3.2 CATCHMENT AREAS

Three external catchments have been channelled into the minor network system and the open drain systems on either side of the lots. (see Figure 1 and refer Appendix A – Catchment Plan).

- Catchment 1 is the capture of surface water from the existing lots to the East of the subdivision and upstream to the Kennedy Highway.
- Catchment 2 is the capture of surface water from the existing lots to the East of the subdivision.
- Catchment 3 is the capture of surface water from the proposed lots within Stage 1 and both the existing and proposed future lots to the south of the stage.

Modelling and observations indicated that the external roadworks are captured via the kerb and channel network and drained away from the site.

Figure 1 - Catchment Areas for Wylandra Estate

3.3 HYDROLOGICAL DESIGN PHILOSOPHY

The major drainage system consists of trapezoidal drains which are connected under roadways by culverts. The minor drainage system consists of an underground stormwater network which eventually outflows into the trapezoidal drains.

The overland flow has been modelled for a 300mm freeboard expected within the drain. It has been successfully designed to out flow towards the open drains within the balance of the lot and towards the Chinaman Creek easement and eventually to Ray Road. The contributions for inter lot drainage and the road network, will be diverted towards the minor underground system and outflow into the open drained trapezoidal network.

Coefficients of Discharge have been determined in accordance with Section 4.5 of QUDM assuming an Urban Residential – Low Density (Including roads) Development Category. Rainfall intensities have been obtained from BOM IFD rainfall charts and IFD Chart 18 from FNQROC Section D4 Appendix A.

Times of Concentration have been determined in accordance with Section 4.6 of QUDM. Specifically, the recommended Overland Sheet Flow Times detailed in Table 4.6.4.

The Hydrological Analysis undertaken including the catchment area and flow widths for the rock lined and swale drain layout are shown in the calculation tables contained in Appendix D.

3.3.1 Overland Flow Contributions

The overland flow paths of a Q100 event from the catchment areas 1, 2 & 3, show the water level in the drain below the freeboard level of 300mm below the lip level. (refer **Appendix B** – Q100 Design Sketches).

3.3.2 Hydrological Analysis

Stream velocities and volumes were calculated for the 3 contributing catchments for AEP values of 83%, 39%, 18%, 10%, 5%, 2% and 1%. Accumulated values were then determined when flow paths converged as they descended through the catchment.

The greatest contributing catchment was 1. Flow volumes were determined as 3.02m³/s and a velocity of 1.769m/s for the 5% AEP and 4.30m³/s and 1.944m/s for the 1% AEP. (Refer Appendix D - Hydrological Analysis).

Catchment flow volumes were determined as 1.4m³/s and a velocity of 1.359m/s for the 5% AEP and 2.00m³/s and 1.503m/s for the 1% AEP.

Catchment 3 flow volumes were determined as 3.03m³/s and a velocity of 1.689m/s for the 5% AEP and 4.31m³/s and 1.844m/s for the 1% AEP. (Refer Appendix D - Hydrological Analysis).

3.4 MAJOR DRAINAGE

The site uses a combination of different sized open table drains to channel the overland flow to the legal point of discharge located at the boundary. Flow depths and velocities were determined using ERSCON's Super Drain spreadsheet. These values are calculated by inputting the drain profile, flow volume (m³/s) and relative slope along the travelled path.

Drain 1 to the East of the lots is designed with a 2m wide base and a 1 in 4 batter to the design surface. The longitudinal fall of the drain is 1.25% north of the catchment interface. Drain 2 to the West of the lots is designed with a 1m wide base and a 1 in 4 batter to the design surface. The longitudinal fall of the drain is 1.4% north of the catchment interface. Drain 3 flows into Drain 2 and has a 1m base. The longitudinal fall of the drain is 0.6% north of the catchment interface. Table 9.5.2 of QUDM nominates a maximum velocity of 2.8m/s for a grassed channel with 100% cover of a couch grass (buffalo grass). **Both table drain shapes and grass lining are suitable to handle a 1% AEP flow.**

A hydraulic analysis has been calculated and located in Appendix E.

3.5 MINOR DRAINAGE

The minor drainage system involves overland flow and underground stormwater system. The minor drainage system has a capacity of Q5.

3.5.1 Stormwater Network

In accordance with the requirements of QUDM, the minor drainage system has been designed for a recurrence interval of 20 years (5% AEP). The runoff will be carried by the minor drainage system in the minor network system and discharged into the table drains.

Depth by velocity calculations for half the road flow have been undertaken and all drains produce satisfactory results regarding pedestrian safety.

4 DETENTION BASIN

4.1 INTRODUCTION

Council have requested supporting information to show that there is a “no worsening” effect to downstream properties located along Ray Road, Mareeba from the proposed Stage 1 works at Wylandra Estate.

Stage 1 stormwater flows drain to Coolamon Close easement. Given this, the stormwater flows were determined at the Coolamon Close easement which is located on the western boundary of Wylandra Estate.

The full length of the drainage path for the pre-developed (open grass land) was compared against the post developed Stage 1 area. Flows were also compared for the lesser catchment which flow to the Detention Basin.

The resultant difference between the two scenarios for the pre-developed site and post development was the extra volume of water that would be received at the bottom of the catchment at Coolamon Close or at the Detention Basin.

This difference determines the base load required for the Detention Basin

4.2 SITE DESCRIPTION

The site is located off Wylandra Drive, Mareeba. Four (4) assessments of two (2) flow paths and catchments have been prepared to determine the differing flows which occur for the pre-developed site and post – Stage 1 developed site. See Appendix A – Catchment Plans.

Givens: 1 hour Intensity for a 10 year storm = 60.4mm/h

Table 1: Site description

Catchment	Site characteristic	Description
Coolamon Close Easement	Pre Development	Area = 189.96Ha Length of Flow Path = 3.384km Time of Concentration = 119 min Fraction Impervious fi = 0.00 C_{10} = 0.62 Frequency Factor 1% AEP = 1.20 Coefficient of Discharge = 0.744
	Post Stage 1 Construction	Area = 189.95Ha; Length of Flow Path = 3.397km Time of Concentration = 120 min Fraction Impervious fi = 0.10 C_{10} = 0.633 Frequency Factor 1% AEP = 1.20 Coefficient of Discharge = 0.760
Detention Basin	Pre Development	Area = 40.86Ha; Length of Flow Path = 2.234km Time of Concentration = 89 min Fraction Impervious fi = 0.00 C_{10} = 0.62 Frequency Factor 1% AEP = 1.20 Coefficient of Discharge = 0.744
	Post Stage 1 Construction	Area = 40.86Ha; Length of Flow Path = 2.247km Time of Concentration = 89 min Fraction Impervious fi = 0.10 C_{10} = 0.64 Frequency Factor 1% AEP = 1.20 Coefficient of Discharge = 0.768

4.3 OVERLAND FLOW INCREASES

DESIGN METHOD

Flow comparisons for a 1% AEP were prepared for the catchment which contributes to the Coolamon Close Easement and similarly for the catchment which contribute to the Detention Basin. The flow volume increase which occurred due to the post developed construction were calculated by subtracting the pre-development flows from the post developed flows.

The extra flow increase is attributable to the impervious area created by proposed roof, sheds and driveway areas. The percentage of overland flow which would allow for the impervious area compared to the pervious area was determined to be 16.5% for flows to Coolamon Close Easement and 24.9% for the flows into the Detention Basin.

These ratios were applied to the C values of 0.62 determined for the pervious open grassland and 0.7 for the low soil permeability.

The resultant volume difference between the non-developed and post Stage 1 developed land was multiplied by 60 to get it to a volume / minute and multiplied again by the Time of concentration to produce the extra volume produced in a 1% AEP due to the Stage 1 development.

This calculated extra volume would need to be captured by the Detention Basin and slowly released by the 450 diameter RCP back into the full overland flow.

The stormwater design has been carried out using the Rational Method, in accordance with the Queensland Urban Drainage Manual (QUDM).

In accordance with the QUDM recommendations, the major system design has been calculated based on a 100-year recurrence interval (1 in 100 ARI / 1% AEP), using overland flow. Runoff Coefficients have been determined in accordance with QUDM.

Runoff has been calculated using BOM IFD Charts from the following site:

http://www.bom.gov.au/water/designRainfalls/ifd-arr87/index.shtml

4.4 CALCULATIONS

Catchment	Site characteristic		Discharge Volume m^3/sec	Difference m^3/sec	Time of Concentration (Tc) min.	Extra volume due to Stage 1 m^3/(Tc)
				$C_2-C_1=A$ Or $D_2-D_1=A$	B	= A x 60 x B
Coolamon Close Easement	Pre Development	**C_1**	**20.81**			
Coolamon Close Easement	Post Stage 1 Construction	**C_2**	**21.09**	**0.28**	**119**	**1999**
Detention Basin	Pre Development	**D_1**	**5.47**			
Detention Basin	Post Stage 1 Construction	**D_2**	**5.65**	**0.18**	**89**	**961**

Table 2 – Extra Volume Produced Due to Post Development of Stage 1 (see Appendix C – Hydrological Analysis)

4.5 DISCHARGE RATE FROM THE DETENTION BASIN

Pipe Size	Inlet Headwater Height (HW)	HW/D	Discharge (Q) From chart 9A-2 TMR RDM	Full flush time of detention basin
m	m		m^3/s	Min.
0.450	0.687	1.520	0.28	**119**

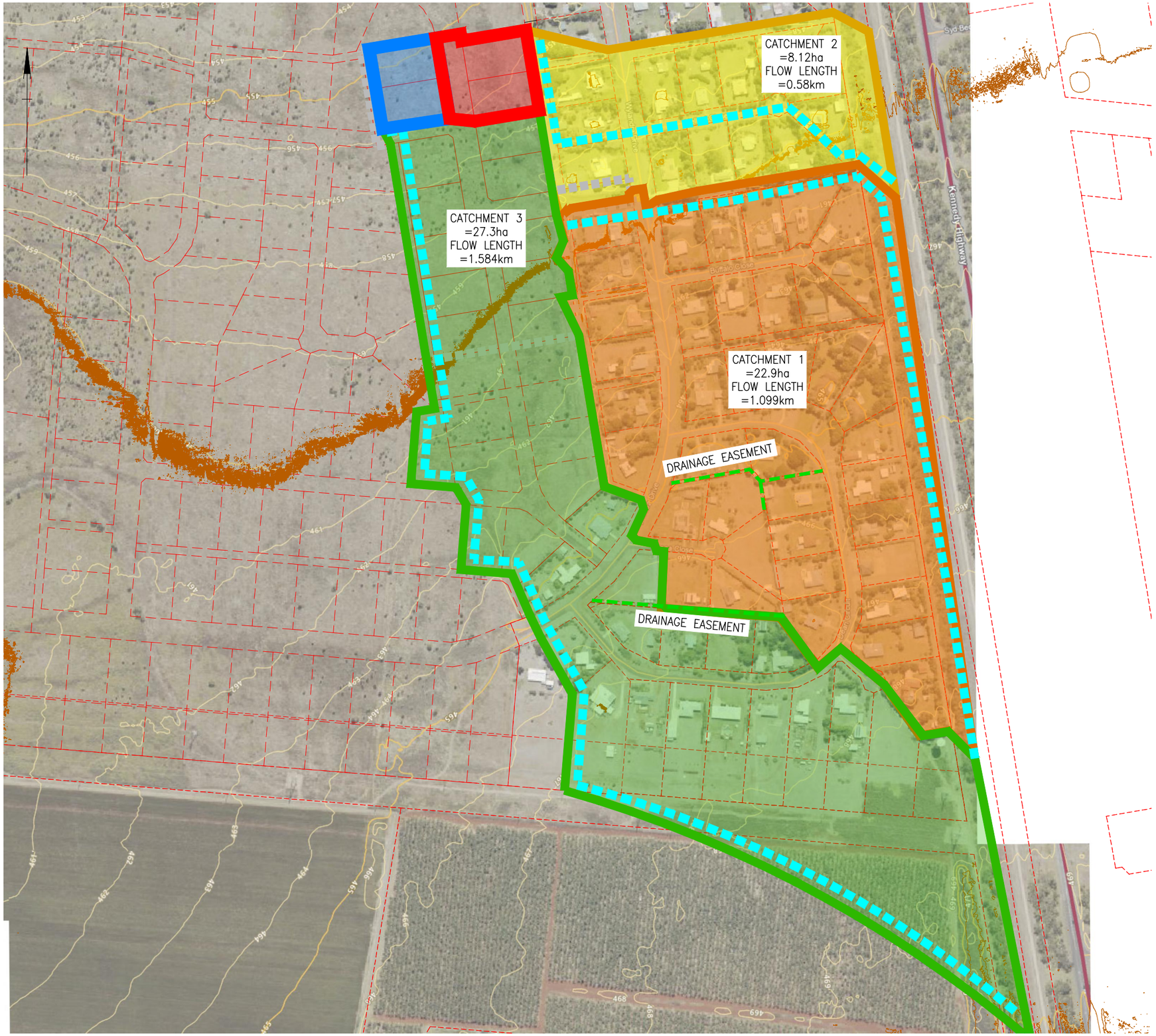
4.6 SUMMARY

The results show that the extra volume of 2,000m^3 of overland flow generated by the introduction of Stage 1 will comfortably be contained within the detention basin which has a capacity of approximately 3,500m^3.

The 450Ø RCP at the detention basin will slowly release the volume of water at a rate of 0.28m^3/sec. This rate will allow for the full flush of the detention basin to be approximately 119 min (2 hours) from full capacity at 2,000m^3 for a 1% AEP. The detention basin size could be considered for reduction, however the extra capacity gives greater immunity and also allows for blockages of the pipe or extra capacity for more intense rain events that may occur on site.

APPENDIX A

Catchment Plans



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- PROPERTY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- FUTURE PROPERTY BOUNDARY
- 10.0 — EXISTING MAJOR CONTOURS (10.0m INTERVAL)

FOR INFORMATION ONLY

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1	18/03/24	INITIAL ISSUE			
NO.	DATE	DESCRIPTION	DESIGN	APPROVED	

ERSCON CONSULTING ENGINEERS

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ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE

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WYLANDRA ESTATE STAGE 1

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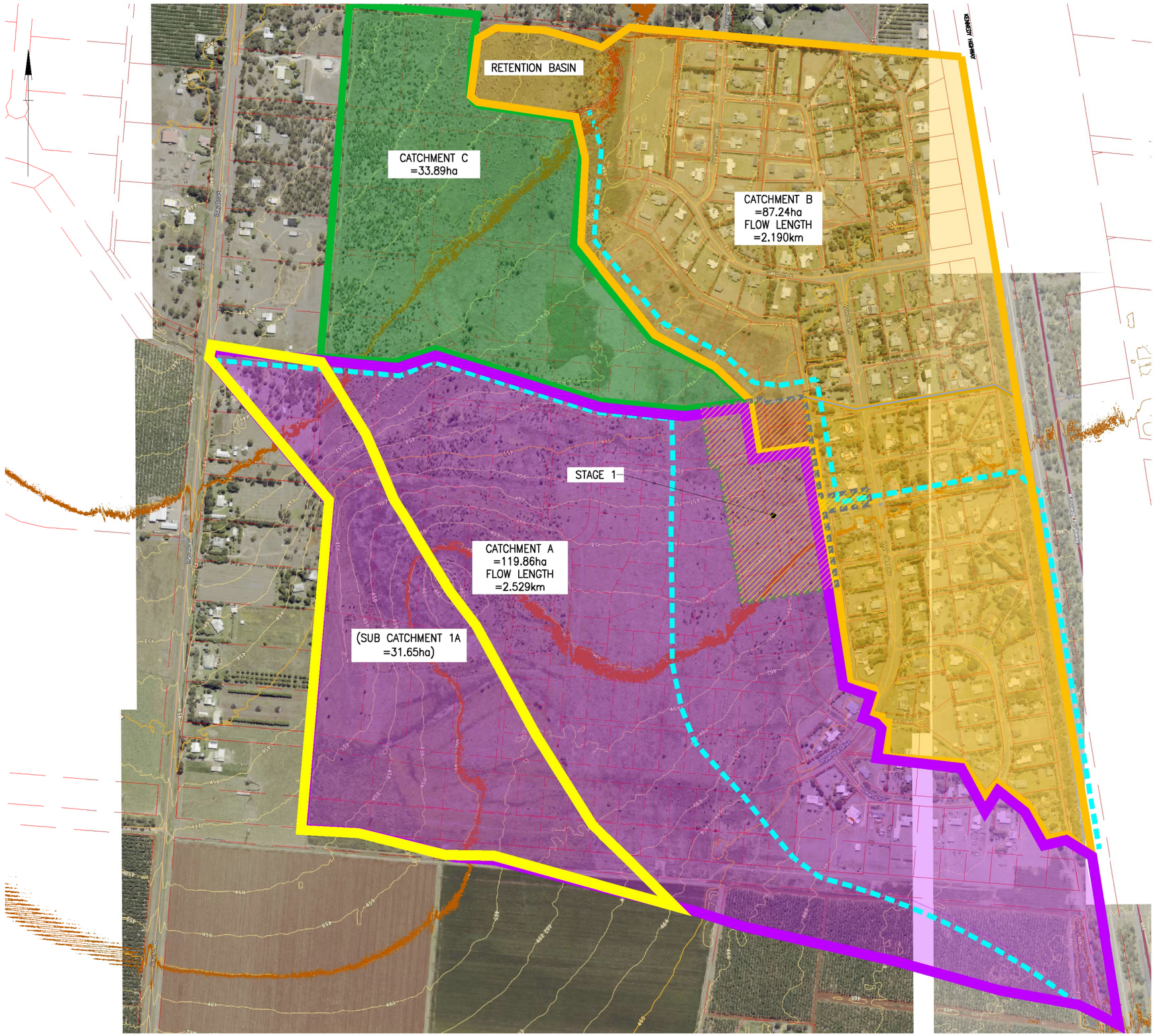

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- STAGE BOUNDARY
- PROPERTY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- FUTURE PROPERTY BOUNDARY
- 10.0 EXISTING MAJOR CONTOURS (1.0m INTERVAL)

NOTES

CONTOURS TAKEN FROM QGLOBE – LIDAR 1m

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REVISIONS				
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ERSCON CONSULTING ENGINEERS

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CIVIL SIGNOFF APPROVAL			

DATE: RPEQ:

PROJECT REF: CONMAT PTY LTD
WYLANDRA ESTATE STAGE 1

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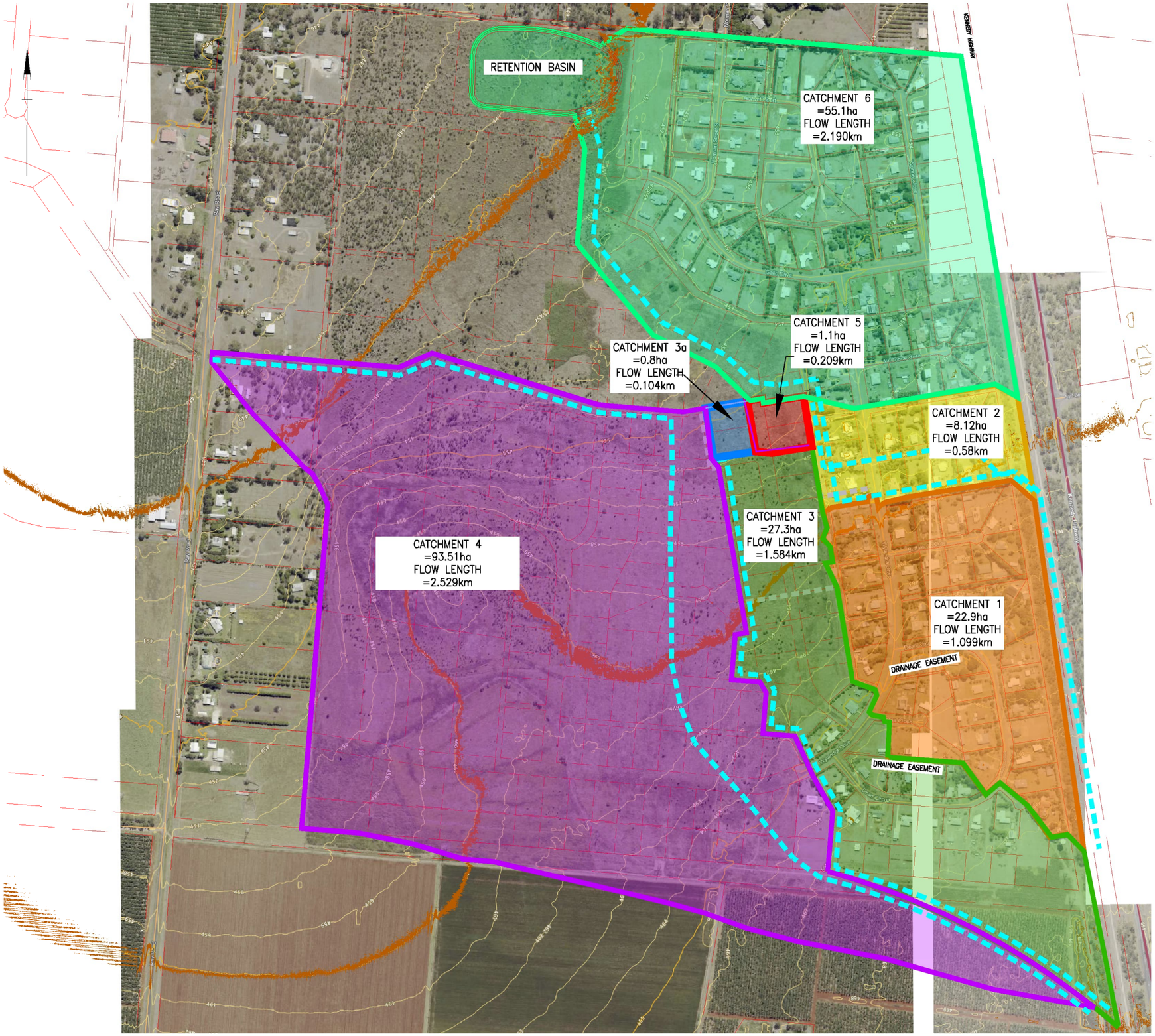

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- FUTURE PROPERTY BOUNDARY
- 10.0 EXISTING MAJOR CONTOURS (1.0m INTERVAL)

NOTES

CONTOURS TAKEN FROM QGLOBE – LIDAR 1m

FOR INFORMATION ONLY

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WYLANDRA ESTATE STAGE 1

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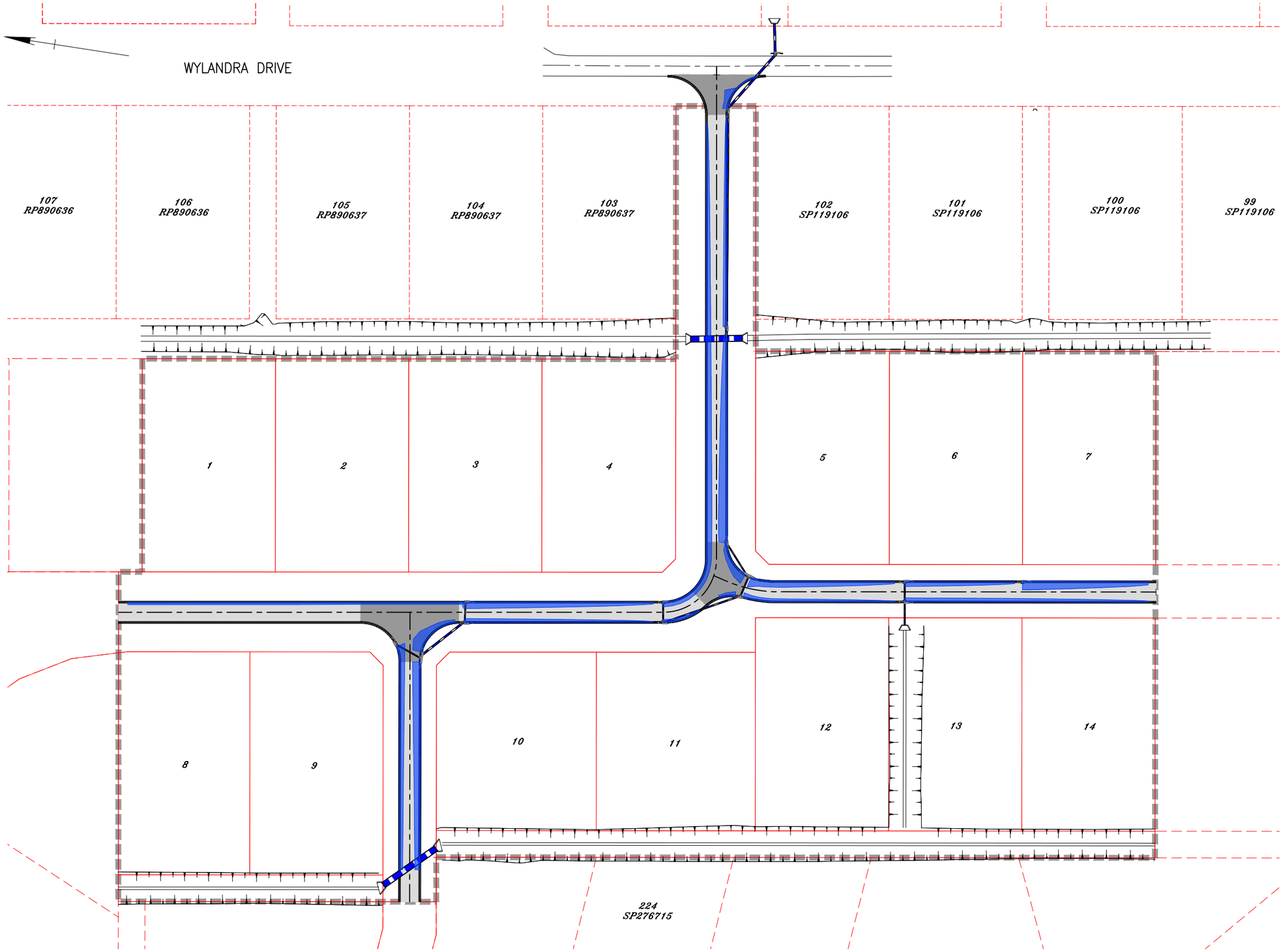
APPENDIX B

Q100 & Q5 Design Sketches



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WYLANDRA ESTATE STAGE 1

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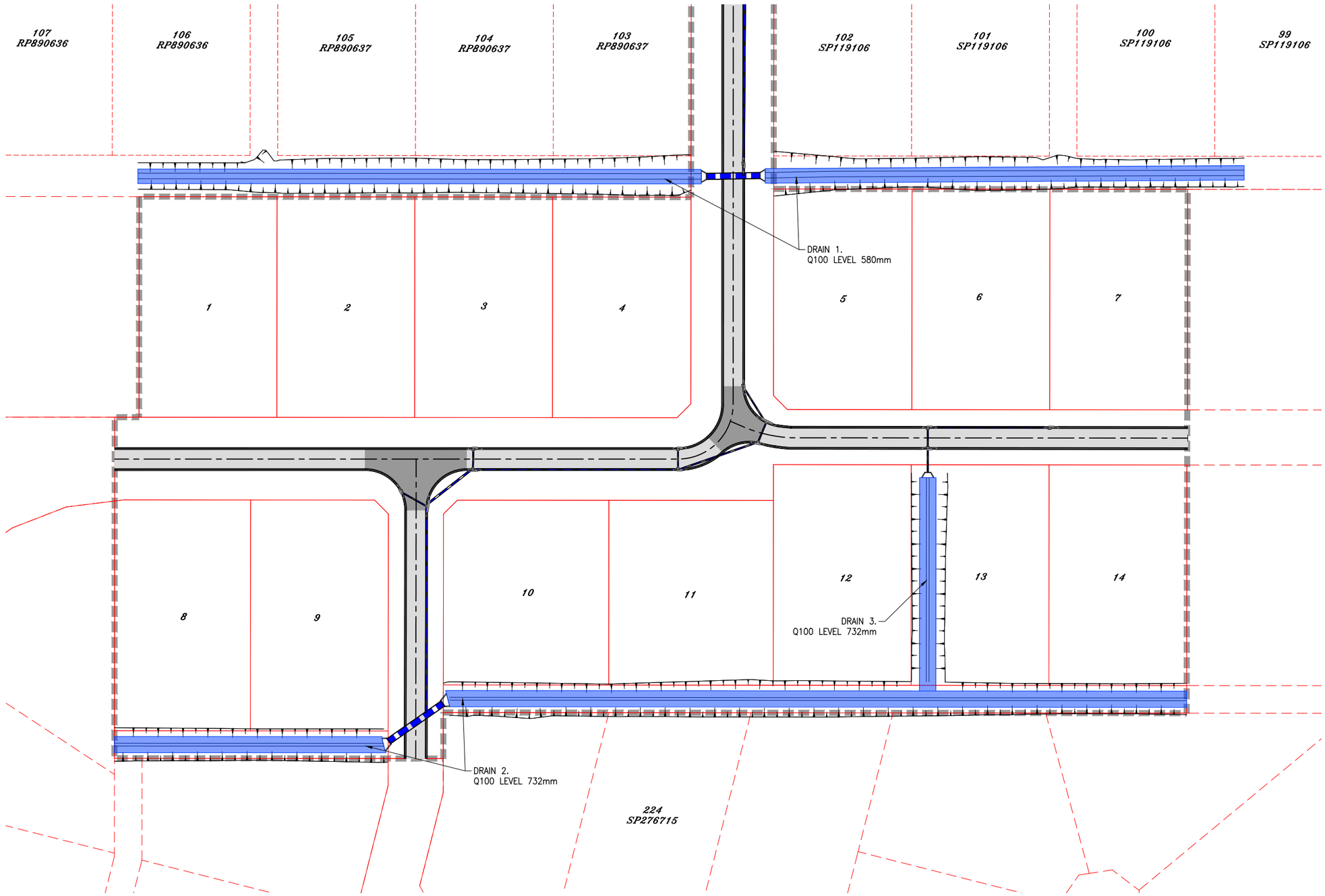

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- Q100 LEVEL

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WYLANDRA ESTATE STAGE 1

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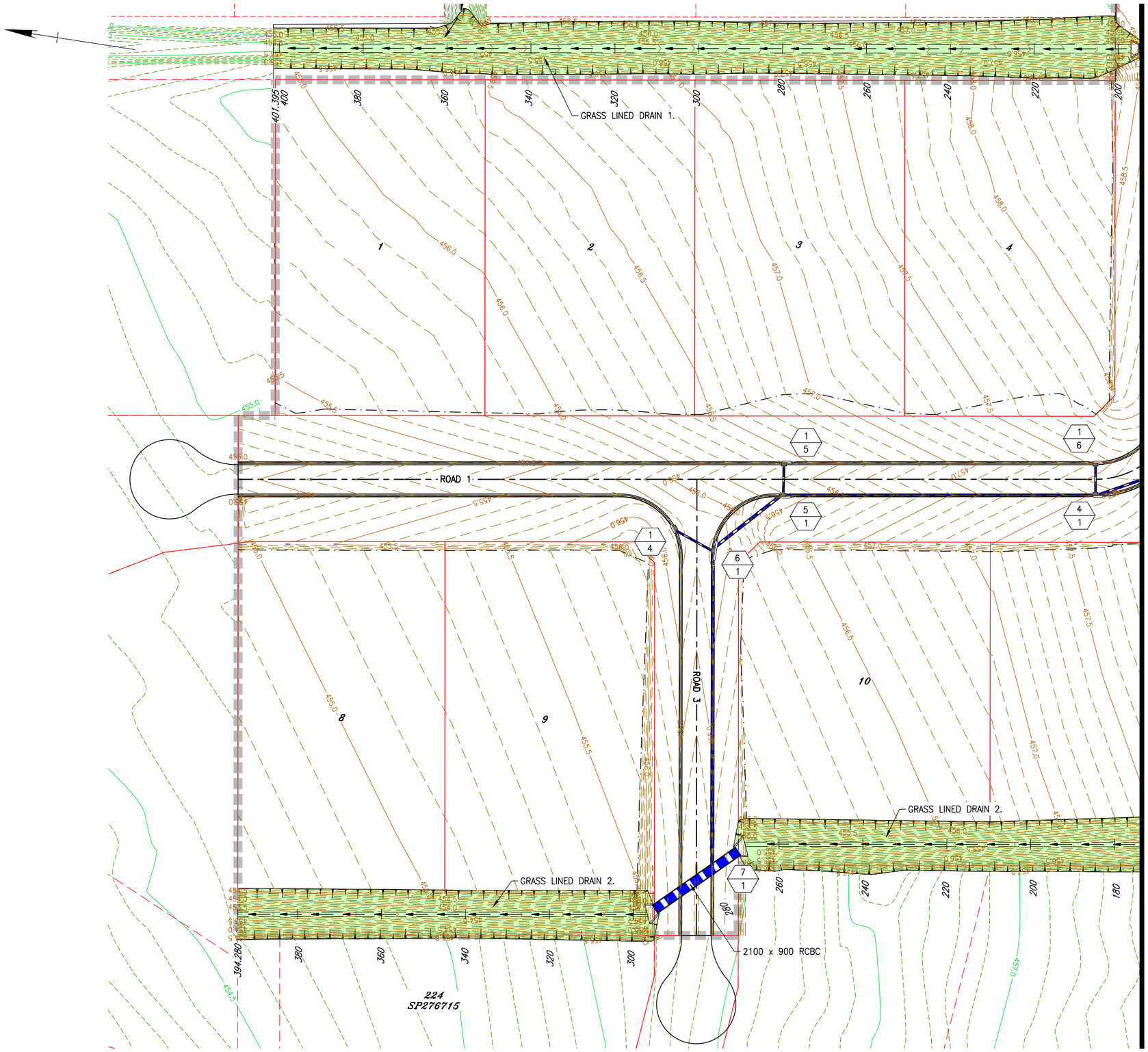

STORMWATER STRUCTURE SETOUT

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1/6	332550.533	8113582.330
4/1	332543.136	8113581.091
5/1	332530.851	8113654.487
6/1	332515.070	8113668.858
7/1	332441.001	8113656.665

LEGEND

- STAGE BOUNDARY
- PROPOSED PROPERTY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- FUTURE PROPERTY BOUNDARY
- 1.0 PROPOSED MAJOR CONTOURS (0.5m INTERVAL)
- PROPOSED MINOR CONTOURS (0.1m INTERVAL)
- 1.0 EXISTING MAJOR CONTOURS (1.0m INTERVAL)
- EXISTING MINOR CONTOURS (0.1m INTERVAL)
- PROPOSED BATTER
- TOP OF BATTER
- TOE OF BATTER
- PROPOSED ROAD CENTRELINE
- STORMWATER PIPE
- NEW GULLY PIT
- NEW HEADWALL WITH GRATED INLET
- 3/1 STRUCTURE NAME

APPROVED FOR CONSTRUCTION

REVISIONS				
NO.	DATE	DESCRIPTION	DESIGN	APPROVED
A	17/06/24	INITIAL ISSUE		

ERSCON CONSULTING ENGINEERS

CLIENT: CONMAT CONSTRUCTION MATERIALS

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ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE

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CIVIL SIGNOFF APPROVAL

DATE: 17/06/24 RPEQ: 05085

PROJECT REF: CONMAT PTY LTD
WYLANDRA ESTATE STAGE 1

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GRASS LINED DRAIN 1.

GRASS LINED DRAIN 1.

ROAD 1

ROAD 2

GRASS LINED DRAIN 3.

GRASS LINED DRAIN 2.

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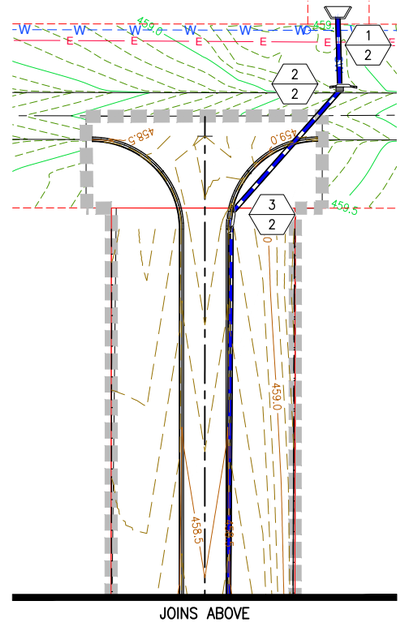

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1/6	332550.533	8113582.330
2/1	332565.227	8113552.304
2/2	332760.478	8113574.858
2/3	332573.063	8113494.203
3/1	332557.405	8113554.111
3/2	332737.087	8113588.825
3/3	332565.664	8113492.971
4/1	332543.138	8113581.092
4/2	332656.461	8113575.954
4/3	332557.113	8113491.549
5/2	332652.227	8113575.246

LEGEND

- STAGE BOUNDARY
- PROPOSED PROPERTY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- FUTURE PROPERTY BOUNDARY
- 1.0 PROPOSED MAJOR CONTOURS (0.5m INTERVAL)
- PROPOSED MINOR CONTOURS (0.1m INTERVAL)
- 1.0 EXISTING MAJOR CONTOURS (1.0m INTERVAL)
- EXISTING MINOR CONTOURS (0.1m INTERVAL)
- PROPOSED BATTER
- TOP OF BATTER
- TOE OF BATTER
- PROPOSED ROAD CENTRELINE
- STORMWATER PIPE
- NEW GULLY PIT
- NEW HEADWALL WITH GRATED INLET
- 3/1 STRUCTURE NAME

APPROVED FOR CONSTRUCTION

REVISIONS				
NO.	DATE	DESCRIPTION	DESIGN	APPROVED
A	17/06/24	INITIAL ISSUE		

ERSCON CONSULTING ENGINEERS

CLIENT: CONMAT CONSTRUCTION MATERIALS

SCALE: 1:1000 (0, 10, 20, 30 A3)

ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE

DRAWN	MG	DESIGNED	MG
DRAWN APPROVED	MF	DESIGN APPROVED	MF

CIVIL SIGNOFF APPROVAL

DATE: 17/06/24 RPEQ: 05085

PROJECT REF: CONMAT PTY LTD
WYLANDRA ESTATE STAGE 1

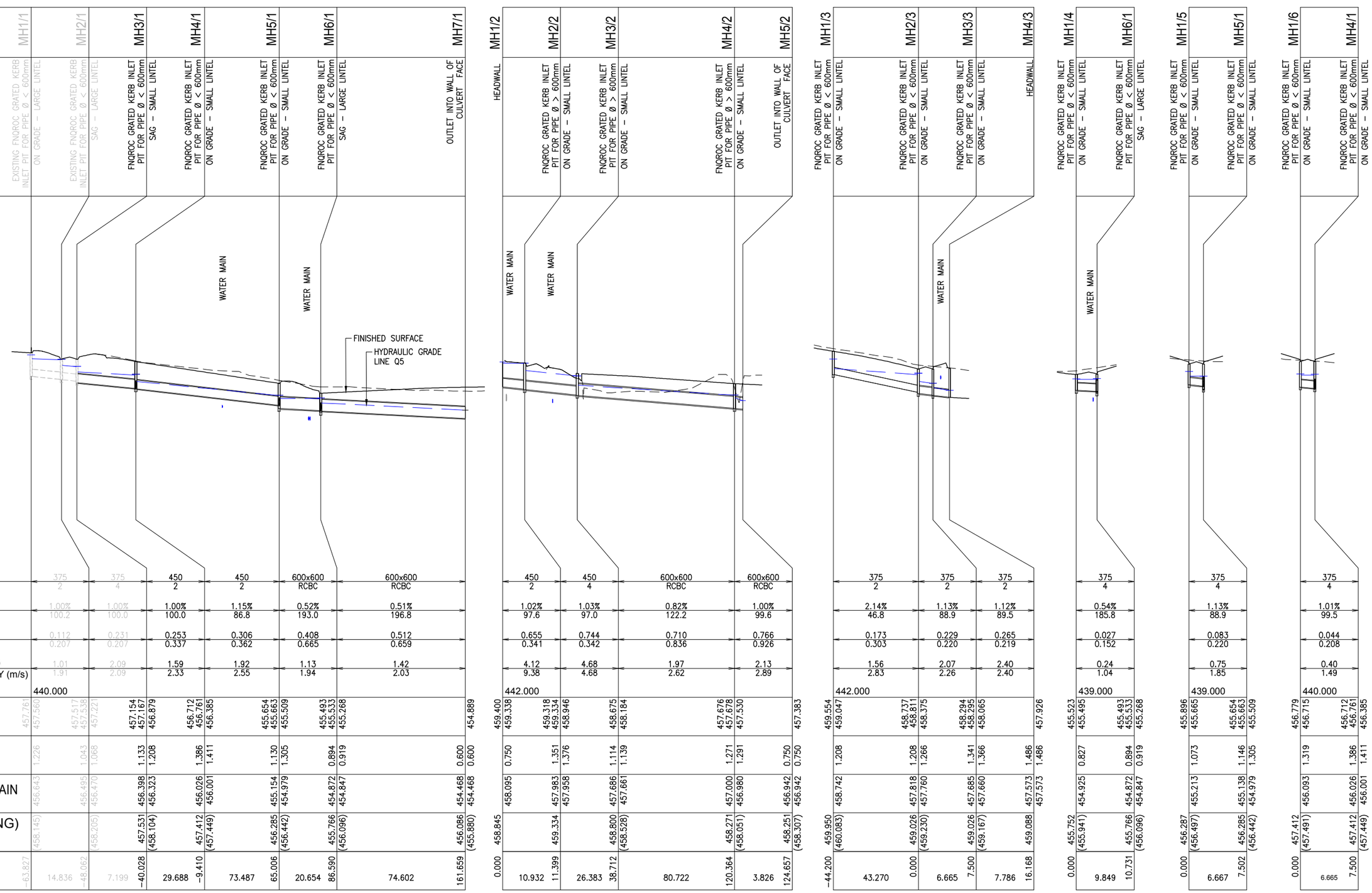
DRAWING REF: STORMWATER Q5 MINOR AND DRAINAGE PLAN (SHEET 2 OF 2)

DRAWING NO: 160-010-C115

SIZE: A3

REVISION: A

PLOT DATE:20/06/2024 10:22:28 AM
FILE LOCATION:D:\ERSCON Dropbox\Erscon\160 Conmat\010 Wylandra Stage 1\5 Drawings\160-010-C115 SW PLAN (2 OF 2).dwg



STRUCTURE NAME	MH1/1		MH2/1		MH3/1		MH4/1		MH5/1		MH6/1		MH7/1
STRUCTURE DESCRIPTION	EXISTING FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – LARGE LINTEL		EXISTING FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm SAG – LARGE LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm SAG – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm SAG – LARGE LINTEL		OUTLET INTO WALL OF CULVERT FACE
PIPE SIZE (mm)		375		375		450		450		600x600 RCBC		600x600 RCBC	
PIPE CLASS		2		4		2		2					
PIPE GRADE (%)		1.00%		1.00%		1.00%		1.15%		0.52%		0.51%	
PIPE SLOPE (1 in X)		100.2		100.0		100.0		86.8		193.0		196.8	
PIPE FLOW (cumecs)		0.112		0.231		0.253		0.306		0.408		0.512	
CAPACITY FLOW (cumecs)		0.207		0.207		0.337		0.362		0.665		0.659	
FULL PIPE VELOCITY (m/s)		1.01		2.09		1.59		1.92		1.13		1.42	
NORMAL DEPTH VELOCITY (m/s)		1.91		2.09		2.33		2.55		1.94		2.03	
DATUM RL	440.000												
HGL ELEVATION	457.761	457.560	457.517	457.538	457.221	457.154	457.167	456.879	456.712	456.761	456.385	455.654	455.663	455.509	455.493	455.533	455.268		454.889
DEPTH TO INVERT	1.226		1.043		1.068	1.133		1.208	1.386		1.411	1.130		1.305	0.894		0.919	0.600	0.600
INVERT LEVEL OF DRAIN	456.643		456.495		456.470	456.398		456.323	456.026		456.001	455.154		454.979	454.872		454.847	454.468	454.468
DESIGN (& EXISTING) SURFACE LEVEL	(458.145)		(458.205)			457.531	(458.104)		457.412	(457.449)		456.285	(456.442)		455.766	(456.096)		456.086	(455.880)
CHAINAGE	63.827	14.836	–48.062	7.199		–40.028		29.688	–9.410		73.487	65.006		20.654	86.590		74.602	161.659	

LINE 1

STRUCTURE NAME	MH1/2		MH2/2		MH3/2		MH4/2		MH5/2
STRUCTURE DESCRIPTION	HEADWALL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø > 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø > 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø > 600mm ON GRADE – SMALL LINTEL		OUTLET INTO WALL OF CULVERT FACE
PIPE SIZE (mm)		450		450		600x600 RCBC		600x600 RCBC	
PIPE CLASS		2		4					
PIPE GRADE (%)		1.02%		1.03%		0.82%		1.00%	
PIPE SLOPE (1 in X)		97.6		97.0		122.2		99.6	
PIPE FLOW (cumecs)		0.655		0.744		0.710		0.766	
CAPACITY FLOW (cumecs)		0.341		0.342		0.836		0.926	
FULL PIPE VELOCITY (m/s)		4.12		4.68		1.97		2.13	
NORMAL DEPTH VELOCITY (m/s)		9.38		4.68		2.62		2.89	
DATUM RL	442.000								
HGL ELEVATION	459.400	459.338	459.318	459.334	458.946	458.675	458.184	457.676	457.678	457.530	457.383
DEPTH TO INVERT	0.750		1.351	1.376		1.114	1.139		1.271	1.291	0.750	0.750
INVERT LEVEL OF DRAIN	458.095		457.983	457.958		457.686	457.661		457.000	456.980	456.942	456.942
DESIGN (& EXISTING) SURFACE LEVEL	458.845		459.334		458.800	(458.528)		458.271	(458.051)		458.251	(458.307)
CHAINAGE	0.000	10.932	11.399		26.383	38.712		80.722		120.364	3.826	124.657	

LINE 2

STRUCTURE NAME	MH1/3		MH2/3		MH3/3		MH4/3
STRUCTURE DESCRIPTION	FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL		HEADWALL
PIPE SIZE (mm)		375		375		375	
PIPE CLASS		2		2		2	
PIPE GRADE (%)		2.14%		1.13%		1.12%	
PIPE SLOPE (1 in X)		46.8		88.9		89.5	
PIPE FLOW (cumecs)		0.173		0.229		0.265	
CAPACITY FLOW (cumecs)		0.303		0.220		0.219	
FULL PIPE VELOCITY (m/s)		1.56		2.07		2.40	
NORMAL DEPTH VELOCITY (m/s)		2.83		2.26		2.40	
DATUM RL	442.000						
HGL ELEVATION	459.554	459.047	458.737	458.511	458.375	458.294	458.295	458.065	457.926
DEPTH TO INVERT	1.208		1.208	1.266		1.341	1.366		1.486	1.486
INVERT LEVEL OF DRAIN	458.742		457.818	457.760		457.685	457.660		457.573	457.573
DESIGN (& EXISTING) SURFACE LEVEL	459.950	(460.083)	459.026	(459.230)	457.760	459.026	(459.167)	459.088	457.573
CHAINAGE	–44.200		43.270	0.000		6.665	7.500	7.786	16.168	

LINE 3

STRUCTURE NAME	MH1/4		MH6/1
STRUCTURE DESCRIPTION	FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm SAG – LARGE LINTEL
PIPE SIZE (mm)		375	
PIPE CLASS		4	
PIPE GRADE (%)		0.54%	
PIPE SLOPE (1 in X)		185.8	
PIPE FLOW (cumecs)		0.027	
CAPACITY FLOW (cumecs)		0.152	
FULL PIPE VELOCITY (m/s)		0.24	
NORMAL DEPTH VELOCITY (m/s)		1.04	
DATUM RL	439.000		
HGL ELEVATION	455.523	455.495	455.493	455.533	455.268
DEPTH TO INVERT	0.827		0.894	0.919
INVERT LEVEL OF DRAIN	454.925		454.872	454.847
DESIGN (& EXISTING) SURFACE LEVEL	455.752	(455.941)	455.766	(456.096)
CHAINAGE	0.000	9.849	10.731	

LINE 4

STRUCTURE NAME	MH1/5		MH5/1
STRUCTURE DESCRIPTION	FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL
PIPE SIZE (mm)		375	
PIPE CLASS		4	
PIPE GRADE (%)		1.13%	
PIPE SLOPE (1 in X)		88.9	
PIPE FLOW (cumecs)		0.083	
CAPACITY FLOW (cumecs)		0.220	
FULL PIPE VELOCITY (m/s)		0.75	
NORMAL DEPTH VELOCITY (m/s)		1.85	
DATUM RL	439.000		
HGL ELEVATION	455.896	455.665	455.654	455.663	455.509
DEPTH TO INVERT	1.073		1.146	1.305
INVERT LEVEL OF DRAIN	455.213		455.138	454.979
DESIGN (& EXISTING) SURFACE LEVEL	456.287	(456.497)	456.285	(456.442)
CHAINAGE	0.000	6.667	7.502	

LINE 5

STRUCTURE NAME	MH1/6		MH4/1
STRUCTURE DESCRIPTION	FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL		FNQROC GRATED KERB INLET PIT FOR PIPE Ø < 600mm ON GRADE – SMALL LINTEL
PIPE SIZE (mm)		375	
PIPE CLASS		4	
PIPE GRADE (%)		1.01%	
PIPE SLOPE (1 in X)		99.5	
PIPE FLOW (cumecs)		0.044	
CAPACITY FLOW (cumecs)		0.208	
FULL PIPE VELOCITY (m/s)		0.40	
NORMAL DEPTH VELOCITY (m/s)		1.49	
DATUM RL	440.000		
HGL ELEVATION	456.779	456.715	456.712	456.761	456.385
DEPTH TO INVERT	1.319		1.386	1.411
INVERT LEVEL OF DRAIN	456.093		456.026	456.001
DESIGN (& EXISTING) SURFACE LEVEL	457.412	(457.491)	457.412	(457.449)
CHAINAGE	0.000	6.665	7.500	

LINE 6

APPROVED FOR CONSTRUCTION

PLOT DATE:25/06/2024 7:50:15 PM
FILE LOCATION:X:\160 Conmat\010 Wylandra Stage 1\5 Drawings\160-010-C117 MINOR SW LONG SECTION.dwg

REVISIONS

NO.	DATE	DESCRIPTION	DESIGN	APPROVED
A	17/06/24	INITIAL ISSUE		

ERSCON CONSULTING ENGINEERS

CLIENT: CONMAT CONSTRUCTION MATERIALS

SCALE
1:2000 HORIZONTAL 0 10 20 30 40 50 60 A3
1:200 VERTICAL 0 2 4 6 A3
ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE

DRAWN	MG	DESIGNED	MG
DRAWN APPROVED	MF	DESIGN APPROVED	MF

CIVIL SIGNOFF APPROVAL
DATE: 17/06/24 RPEQ: 05085

PROJECT REF: CONMAT PTY LTD
WYLANDRA ESTATE STAGE 1
DRAWING REF: STORMWATER Q5 MINOR LONGITUDINAL SECTION
DRAWING NO: 160-010-C117
SIZE: A3
REVISION: A

Q5 STORMWATER CALCULATIONS

		tc	I	C	A	(CxA)	Q	Qa			Wf	dg	Vg	dg.Vg			Qg	Qb		tc	I	(CxA)	Qrat	Qrc	Qb(net)	Qo	L	S		V	Vt		S/Do	Qg/Qo	Du/Do	V2/2g	Ku	hu	Kw	hw	Sf	hf	dn	Vn							
STRUCTURE NO.	DRAIN SECTION	SUB-CATCHMENT TIME OF CONCENTRATION	RAINFALL INTENSITY	COEFFICIENT OF RUNOFF	SUB-CATCHMENT AREA	TOTAL CONTRIBUTING EQUIVALENT AREA	SUB-CATCHMENT DISCHARGE	FLOW IN K & C (INCLUDING BYPASS)	ROAD GRADE AT INLET	ROAD XFALL AT INLET	FLOW WIDTH	FLOW DEPTH AT INVERT	GUTTER FLOOD VELOCITY	VELOCITY-DEPTH	STRUCTURE TYPE	INLET CAPACITY CURVE	FLOW INTO INLET	BYPASS FLOW	BYPASS STRUCTURE NO.	CRITICAL TIME OF CONCENTRATION	RAINFALL INTENSITY	TOTAL CONTRIBUTING EQUIVALENT AREA	TOTAL PEAK FLOW	HALF ROAD CAPACITY	NET BYPASS FLOW	FLOW IN PIPE	REACH LENGTH	PIPE GRADE	PIPE / BOX DIMENSIONS	FULL-PIPE FLOW VELOCITY	PIPE TRAVEL TIME VELOCITY	12D Ku / kw CHART IDENTIFIERS	SUBMERGENCE RATIO	FLOW RATIO	DIAMETER RATIO	VELOCITY HEAD	U/S PRESSURE HEAD CHANGE COEFFICIENT	CHANGE IN U/S PRESSURE HEAD	W.S.E. COEFFICIENT	CHANGE IN W.S.E.	PIPE FRICTION SLOPE	PIPE FRICTION TOTAL HEAD LOSS	DEPTH	VELOCITY	PIPE U/S INVERT LEVEL	PIPE D/S INVERT LEVEL	PIPE U/S H.G.L.	PIPE D/S H.G.L.	W.S.E.	SURFACE OR K & C INVERT LEVEL	FREEBOARD	STRUCTURE NO.
		min	mm/hr		ha	ha	m3/s	m3/s	%	%	m	m	m/s	m2/s			m3/s	m3/s		min	mm/hr	ha	m3/s	m3/s	m3/s	m3/s	m	%	mm	m/s	m/s					m				m	%	m	m	m/s	m	m	m	m	m	m	m	
MH1-1B	MH1-1B to MH1-1	15	115	0.644	0.563	0.363	0.116	0.116	0.69	3	3.259	0.095	0.745	0.071	AL4D	0.5G,3.3X	0.112	0.004	MH1-1	15	115	0.363	0.116	0.21	0.004	0.112	14.836	1	375	1.01	1.87	G2	2.98	1		0.052	3.84	0.201		0.201	0.29	0.043	0.196	1.91	456.6	456.5	457.6	457.5	457.8	457.9	0.107	MH1-1B
MH1-1	MH1-1 to MH1-2	15	115	0.644	0.563	0.363	0.116	0.12	0.88	2.23		0.045			SAL4D		0.12			15.13	114	0.725	0.231	0.395		0.231	7.199	1	375	2.09	1.88	G2/T6/T9	2.85	0.52	1	0.167	1.78	0.296	1.91	0.318	0.93	0.067	0.375	2.09	456.5	456.4	457.2	457.2	457.5	457.5		MH1-1
MH1-2	MH1-2 to MH1-3	15	115	0.706	0.099	0.07	0.022	0.022	0.77	2.74		0.017			SAL2D		0.022			15.06	115	0.794	0.253	0.302		0.253	29.688	1	450	1.59	2.12	T6/T9	1.88	0.09	0.83	0.129	2.13	0.275	2.23	0.288	0.56	0.167	0.291	2.33	456.3	456	456.9	456.7	457.2	457.5	0.364	MH1-2
MH1-3	MH1-3 to MH1-4	15	115	0.653	0.055	0.036	0.011	0.011	1.28	3.02	1.24	0.04	0.514	0.021	AL2D	1G,3.3X	0.011		MH1-4	15.3	114	0.965	0.306	0.254		0.306	73.487	1.15	450	1.92	2.27	T3/T6	1.83	0.04	1	0.188	1.74	0.327	1.99	0.376	0.99	0.77	0.317	2.55	456	455.2	456.4	455.7	456.8	457.4	0.651	MH1-3
MH1-4	MH1-4 to MH1-5	15	115	0.692	0.111	0.077	0.024	0.024	1.52	3	1.613	0.051	0.66	0.034	AL2D	2G,3.3X	0.024		MH1-5	15.84	113	1.33	0.416	0.279	0.009	0.408	20.654	0.52	600x600	1.13	1.85	T3/T6	1.26	0.06	0.87	0.065	2.22	0.145	2.36	0.155	0.07	0.034	0.35	1.94	455	454.9	455.5	455.5	455.7	456.3	0.621	MH1-4
MH1-5	MH1-5 to MH1-6	15	115	0.662	0.393	0.26	0.083	0.083	0.58	2.52		0.023			SAL4D		0.083			15.78	113	1.663	0.521		0.009	0.512	74.602	0.51	600x600	1.42	1.83	T6/T9	1.44	0.16	1	0.103	2.18	0.225	2.56	0.264	0.51	0.379	0.421	2.03	454.8	454.5	455.3	454.9	455.5	455.8	0.233	MH1-5
MH1-6															HW OUT																																		454.9	456.1		MH1-6
MH2-1	MH2-1 to MH2-2	15	115	0.631	3.255	2.053	0.655	0.655							HW IN		0.655			15	115	2.053	0.655			0.655	10.932	1.02	450	4.12	2.15	utlet Contr	2.9			0.041	1.5	0.062		0.062	0.18	0.02	0.203	9.38	458.1	458	459.3	459.3	459.4	459.4		MH2-1
MH2-2	MH2-2 - MH2-3	15	115	0.692	0.41	0.283	0.09	0.09							AL2D		0.09			15.08	115	2.337	0.744			0.744	26.383	1.03	450	4.68	2.15	T3/T6	3.06	0.12	1	0.236	1.58	0.372	1.65	0.388	1.03	0.271	0.45	4.68	458	457.7	458.9	458.7	459.3	459.3		MH2-2
MH2-3	MH2-3 to MH2-4	5	156	0.794	0.082	0.065	0.028	0.028	1.44	2.43	1.967	0.057	0.566	0.032	AL2D	1G,2.5X		0.057	MH2-4	15.29	114	2.421	0.767	0.215	0.057	0.71	80.722	0.82	600x600	1.97	2.32	T3/T6	1.82		0.66	0.198	2.18	0.432	2.48	0.492	0.63	0.571	0.451	2.62	457.7	457	458.2	457.7	458.7	458.7		MH2-3
MH2-4	MH2-4 to MH2-5	5	156	0.846	0.032	0.027	0.012	0.069	0.49	3	2.978	0.089	0.556	0.049	AL2D	0.5G,3.3X	0.069		MH1-1A	15.87	113	2.448	0.766	0.158		0.766	3.826	1	600x600	2.13	2.57	T1	1.25	0.09	1	0.231	0.63	0.146	0.64	0.148	3.83		0.442	2.89	457	456.9	457.5	457.4	457.7	458.3	0.594	MH2-4
MH2-5															HW OUT auto																																		457.4	458.3		MH2-5
MH3-1A	MH3-1A to MH3-1	15	115	0.643	0.843	0.542	0.173	0.173			3.346	0.099	1.105	0.109	AL2D		0.173			15	115	0.542	0.173	0.291		0.173	43.27	2.14	375	1.56	2.74	G1	2.35	1		0.125	4.06	0.507		0.507	0.72	0.349	0.203	2.83	458.7	457.8	459	458.7	459.6	460	0.396	MH3-1A
MH3-1	MH3-1 to MH3-2	15	115	0.643	0.281	0.181	0.058	0.058	2.6	3	2.02	0.062	1	0.062	AL2D	2G,3.3X	0.058		MH1-1	15.26	114	0.722	0.229	0.366		0.229	6.665	1.13	375	2.07	1.99	T10	2.8	0.25	1	0.219	1.65	0.362	1.99	0.435	1.22	0.081	0.324	2.26	457.8	457.7	458.4	458.3	458.8	459	0.215	MH3-1
MH3-2	MH3-2 to MH3-3	15	115	0.714	0.159	0.113	0.036	0.036	2.6	3	1.689	0.053	0.892	0.047	AL2D	2G,3.3X	0.036		MH1-2	15.32	114	0.836	0.265	0.366		0.265	7.786	1.12	375	2.4	1.98	T1	1.69	0.14	1	0.293	0.78	0.229		0.23	1.78	0.124	0.375	2.4	457.7	457.6	458.1	457.9	458.3	459	0.731	MH3-2
MH3-3															HW OUT																																		457.9	459.1		MH3-3
MH4-1	MH4-1 to MH1-5	5	156	0.792	0.079	0.062	0.027	0.027	0.11	1.65					AL2D		0.027			5	156	0.062	0.027			0.027	9.849	0.54	375	0.24	1.38	G2	1.59	1		0.003	9.2	0.028		0.028	0.02	0.002	0.107	1.04	454.9	454.9	455.5	455.5	455.5	455.8	0.229	MH4-1
MH1-5		15	115	0.662	0.393	0.26	0.083	0.083	0.58	2.52		0.023			SAL4D		0.083														T6/T9	1.44	0.16	1		2.18	0.225	2.56	0.264									455.5	455.8	0.233	MH1-5
MH5-1	MH5-1 to MH1-4	15	115	0.669	0.432	0.289	0.092	0.092	1.52	3	2.679	0.08	0.916	0.074	AL2D	2G,3.3X	0.083	0.009	LOST	15	115	0.289	0.092	0.279	0.009	0.083	6.667	1.13	375	0.75	1.99	G2	1.82	1		0.029	7.97	0.231		0.231	0.16	0.011	0.16	1.85	455.2	455.1	455.7	455.7	455.9	456.3	0.391	MH5-1
MH1-4		15	115	0.692	0.111	0.077	0.024	0.024	1.52	3	1.613	0.051	0.66	0.034	AL2D	2G,3.3X	0.024		MH1-5					0.279								T3/T6	1.26	0.06	0.87		2.22	0.145	2.36	0.155									455.7	456.3	0.621	MH1-4
MH6-1	MH6-1 to MH1-3	5	156	0.786	0.129	0.102	0.044	0.044	1.87	2.9	2.023	0.062	0.763	0.047	AL2D	2G,3.3X	0.044		MH5-1	5	156	0.102	0.044	0.279		0.044	6.665	1.01	375	0.4	1.88	G2	1.83	1		0.008	7.91	0.064		0.064	0.05	0.003	0.117	1.49	456.1	456	456.7	456.7	456.8	457.4	0.633	MH6-1
MH1-3		15	115	0.653	0.055	0.036	0.011	0.011	1.28	3.02	1.24	0.04	0.514	0.021	AL2D	1G,3.3X	0.011		MH1-4					0.254								T3/T6	1.83	0.04	1		1.74	0.327	1.99	0.376									456.8	457.4	0.651	MH1-3

Q100 STORMWATER CALCULATIONS

		tc	I	C	A	(CxA)	Q	Qa			Wf	dg	Vg	dg.Vg			Qg	Qb		tc	I	(CxA)	Qrat	Qrc	Qb(net)	Qo	L	S		V	Vt		S/Do	Qg/Qo	Du/Do	V2/2g	Ku	hu	Kw	hw	Sf	hf	dn	Vn					W.S.E.	SURFACE OR K & C INVERT LEVEL		
STRUCTURE NO.	DRAIN SECTION	SUB-CATCHMENT TIME OF CONCENTRATION	RAINFALL INTENSITY	COEFFICIENT OF RUNOFF	SUB-CATCHMENT AREA	TOTAL CONTRIBUTING EQUIVALENT AREA	SUB-CATCHMENT DISCHARGE	FLOW IN K & C (UNCLUDING BYPASS)	ROAD GRADE AT INLET	ROAD XFALL AT INLET	FLOW WIDTH	FLOW DEPTH AT INVERT	GUTTER FLOOD VELOCITY	VELOCITY-DEPTH	STRUCTURE TYPE	INLET CAPACITY CURVE	FLOW INTO INLET	BYPASS FLOW	BYPASS STRUCTURE NO.	CRITICAL TIME OF CONCENTRATION	RAINFALL INTENSITY	TOTAL CONTRIBUTING EQUIVALENT AREA	TOTAL PEAK FLOW	HALF ROAD CAPACITY	NET BYPASS FLOW	FLOW IN PIPE	REACH LENGTH	PIPE GRADE	PIPE / BOX DIMENSIONS	FULL-PIPE FLOW VELOCITY	PIPE TRAVEL TIME VELOCITY	12D Ku / Kw CHART IDENTIFIERS	SUBMERGENCE RATIO	FLOW RATIO	DIAMETER RATIO	VELOCITY HEAD	U/S PRESSURE HEAD CHANGE COEFFICIENT	CHANGE IN U/S PRESSURE HEAD	W.S.E. COEFFICIENT	CHANGE IN W.S.E.	PIPE FRICTION SLOPE	PIPE FRICTION TOTAL HEAD LOSS	DEPTH	VELOCITY	PIPE U/S INVERT LEVEL	PIPE D/S INVERT LEVEL	PIPE U/S H.G.L.	PIPE D/S H.G.L.	W.S.E.	INVERT LEVEL	FREEBOARD	STRUCTURE NO.
		min	mm/hr		ha	ha	m3/s	m3/s	%	%	m	m	m/s	m2/s			m3/s	m3/s		min	mm/hr	ha	m3/s	m3/s	m3/s	m3/s	m	m	%	mm	m/s	m/s					m		m		m	%	m	m	m/s	m	m	m	m	m	m		m	
MH1-1B	MH1-1B to MH1-1	15	182	0.802	0.563	0.451	0.228	0.228	0.69	3	4.074	0.122	0.894	0.109	AL4D	0.5G,3.3X	0.135	0.093	MH1-1	15	182	0.451	0.228	0.21	0.093	0.135	14.836	1	375	1.22	1.87	G2	3.27	1		0.076	3.51	0.267		0.267	0.42	0.063	0.221	2	456.6	456.5	457.6	457.5	457.9	457.9		MH1-1B
MH1-1	MH1-1 to MH1-2	15	182	0.802	0.563	0.451	0.228	0.528	0.88	2.23		0.255			SAL4D		0.528			15.13	181	0.903	0.455	0.198		0.662	7.199	1	375	5.99	1.88	G2/T6/T9	2.85	0.8	1	0.003	3.14	0.01	3.19	0.011	0.02	0.001	0.375	5.99	456.5	456.4	457.5	457.5	457.5	457.5		MH1-1
MH1-2	MH1-2 to MH1-3	15	182	0.862	0.099	0.086	0.043	0.057	0.77	2.74		0.083			SAL2D		0.057			15.06	182	0.986	0.498	0.151		0.718	29.688	1	450	4.52	2.12	T6/T9	2.68	0.08	0.83	0.038	1.74	0.065	1.85	0.069	0.16	0.049	0.45	4.52	456.3	456	457.5	457.4	457.5	457.5		MH1-2
MH1-3	MH1-3 to MH1-4	15	182	0.81	0.055	0.044	0.022	0.022	1.28	3.02	1.616	0.051	0.606	0.031	AL2D	1G,3.3X		0.352	MH1-4	15.3	181	1.195	0.6	0.254	0.213	0.388	73.487	1.15	450	2.44	2.27	T1/T3	3.14		1	0.303	0.98	0.295	1.19	0.359	1.32	0.97	0.412	2.54	456	455.2	457.1	456.1	457.4	457.4		MH1-3
MH1-4	MH1-4 to MH1-5	15	182	0.848	0.111	0.094	0.048	0.399	1.52	3	4.074	0.133	1.393	0.185	AL2D	2G,3.3X	0.165	0.234	MH1-5	15.84	179	1.646	0.817	0.279	0.188	0.629	20.654	0.52	600x600	1.75	1.85	T3/T6	1.87	0.26	0.87	0.156	1.93	0.301	2.07	0.322	0.46	0.096	0.491	2.13	455	454.9	455.8	455.7	456.1	456.3	0.18	MH1-4
MH1-5	MH1-5 to MH1-6	15	182	0.819	0.393	0.322	0.163	0.397	0.58	2.52		0.255			SAL4D		0.397			15.78	179	2.055	1.021			1.068	74.602	0.51	600x600	2.97	1.83	T6/T9	1.67	0.37	1	0.163	2.06	0.335	2.46	0.401	0.38	0.351	0.6	2.97	454.8	454.5	455.4	455.1	455.8	455.8	0.014	MH1-5
MH1-6															HW OUT																																		455.1	456.1		MH1-6
MH2-1	MH2-1 to MH2-2	15	182	0.789	3.255	2.567	1.298	1.298							HW IN		1.298			15	182	2.567	1.298			1.298	10.932	1.02	450	8.16	2.15	utlet Contr	2.9			0.041	1.5	0.062		0.062	0.18	0.02	0.203	18.6	458.1	458	459.3	459.3	459.4	459.4		MH2-1
MH2-2	MH2-2 - MH2-3	15	182	0.848	0.41	0.347	0.176	0.176							AL2D		0.176			15.08	182	2.915	1.471			1.471	26.383	1.03	450	9.25	2.15	T3/T6	3.06	0.12	1	0.236	1.58	0.372	1.65	0.388	1.03	0.271	0.45	9.25	458	457.7	458.9	458.7	459.3	459.3		MH2-2
MH2-3	MH2-3 to MH2-4	5	246	0.948	0.082	0.078	0.053	0.053	1.44	2.43	2.516	0.071	0.662	0.047	AL2D	1G,2.5X		1.061	MH2-4	15.29	181	3.016	1.515	0.215	1.061	0.455	80.722	0.82	600x600	1.26	2.32	T3/T6	1.69		0.66	0.081	2.26	0.184	2.58	0.209	0.24	0.195	0.32	2.37	457.7	457	458.5	458.3	458.7	458.7		MH2-3
MH2-4	MH2-4 to MH2-5	5	246	1	0.032	0.032	0.022	1.083	0.49	3	4.074	0.242	1.476	0.358	AL2D	0.5G,3.3X	1.083		MH1-1A	15.87	179	3.049	1.512	0.158		1.512	3.826	1	600x600	4.2	2.57	G1/T1	2.2	0.7	1	0.261	2.75	0.718		0.718	0.3	0.037	0.6	4.2	457	456.9	457.6	457.5	458.3	458.3		MH2-4
MH2-5															HW OUT auto																																		457.5	458.3		MH2-5
MH3-1A	MH3-1A to MH3-1	15	182	0.8	0.843	0.674	0.341	0.341			4.074	0.125	1.341	0.167	AL2D		0.341			15	182	0.674	0.341	0.291		0.341	43.27	2.14	375	3.09	2.74	G1	3.22	1		0.171	3	0.512		0.512	0.95	0.412	0.375	3.09	458.7	457.8	459.4	459	460	460		MH3-1A
MH3-1	MH3-1 to MH3-2	15	182	0.8	0.281	0.225	0.114	0.114	2.6	3	2.618	0.079	1.183	0.093	AL2D	2G,3.3X		0.207	MH1-1	15.26	181	0.899	0.452	0.366	0.207	0.245	6.665	1.13	375	2.22	1.99	T10	3.37		1	0.252	1.65	0.414	1.98	0.499	1.4	0.093	0.375	2.22	457.8	457.7	458.5	458.4	459	459	0.002	MH3-1
MH3-2	MH3-2 to MH3-3	15	182	0.87	0.159	0.138	0.07	0.07	2.6	3	2.176	0.066	1.049	0.07	AL2D	2G,3.3X	0.056	0.014	MH1-2	15.32	181	1.037	0.521	0.366	0.221	0.3	7.786	1.12	375	2.72	1.98	T1	2.06	0.19	1	0.377	0.86	0.325		0.326	2.21	0.163	0.375	2.72	457.7	457.6	458.1	457.9	458.4	459	0.594	MH3-2
MH3-3															HW OUT																																		457.9	459.1		MH3-3
MH4-1	MH4-1 to MH1-5	5	246	0.947	0.079	0.075	0.051	0.051	0.11	1.65					AL2D		0.051			5	246	0.075	0.051			0.051	9.849	0.54	375	0.46	1.38	G2	2.2	1		0.01	6.14	0.06		0.06	0.05	0.005	0.15	1.24	454.9	454.9	455.7	455.7	455.8	455.8		MH4-1
MH1-5		15	182	0.819	0.393	0.322	0.163	0.397	0.58	2.52		0.255			SAL4D		0.397															T6/T9	1.67	0.37	1		2.06	0.335	2.46	0.401									455.8	455.8	0.014	MH1-5
MH5-1	MH5-1 to MH1-4	15	182	0.826	0.432	0.357	0.18	0.262	1.52	3	3.977	0.116	1.188	0.138	AL2D	2G,3.3X	0.088	0.174	LOST	15	182	0.357	0.18	0.279	0.093	0.088	6.667	1.13	375	0.79	1.99	G2	2.73	1		0.032	4.4	0.142		0.142	0.18	0.012	0.165	1.88	455.2	455.1	456.1	456.1	456.2	456.3	0.05	MH5-1
MH1-4		15	182	0.848	0.111	0.094	0.048	0.399	1.52	3	4.074	0.133	1.393	0.185	AL2D	2G,3.3X	0.165	0.234	MH1-5					0.279									T3/T6	1.87	0.26	0.87		1.93	0.301	2.07	0.322									456.1	456.3	0.18	MH1-4
MH6-1	MH6-1 to MH1-3	5	246	0.941	0.129	0.122	0.083	0.083	1.87	2.9	2.578	0.078	0.893	0.069	AL2D	2G,3.3X	0.002	0.081	MH5-1	5	246	0.122	0.083	0.279	0.081	0.002	6.665	1.01	375	0.02	1.88	G2	3.52	1			3.24					0.025	0.59	456.1	456	457.4	457.4	457.4	457.4		MH6-1
MH1-3		15	182	0.81	0.055	0.044	0.022	0.022	1.28	3.02	1.616	0.051	0.606	0.031	AL2D	1G,3.3X		0.352	MH1-4					0.254								T1/T3	3.14		1		0.98	0.295	1.19	0.359									457.4	457.4		MH1-3

APPENDIX C

Hydrological Analysis

JOB NO: 160-010
JOB: Wylandra Stage 1 Drainage
TITLE : Catchment 1
DATE: 1/05/2024

Time of concentration Calculation
(Using Bransby-Williams' Equation)

Proportionality Factor P= 58 (for Ha)

Length of Flow Path L= 1.099 km
Top of Catchment (RL) RL = 467 m
Area of Catchment A = 22.90 Ha

Catchment Profile 459 [to utilise graph area better]

Chainage	RL	RL	Area under Graph (m²)
0	459	0	-----
500	462	3	750
1000	467	8	2750
1000	467	8	0
1000	467	8	0
1000	467	8	0
1000	467	8	0
1000	467	8	0
1000	467	8	0
1099	468.5	9.5	866

Average Slope Calculation	
Outlet Chainage	0
Catchment length	1099
Outlet RL	0
Top RL (Av Slope)	7.9

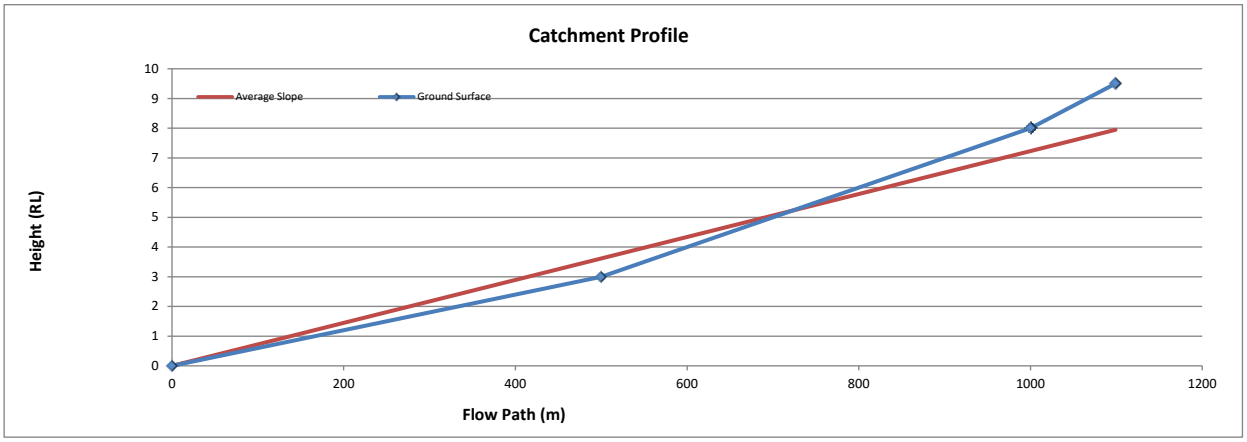
$$Tc = \frac{P \times L}{(A \wedge 0.1) \times (S \wedge 0.2)}$$

Tc = 49.7 min

Adopted Tc 50.0 min

Total area under graph **4366** m^2
Area below outlet level 0 m^2
Area above outlet 4366 m^2

Height for average slope 7.95 m
Average Slope S = 0.7 %



Flow Calculation for Upstream Catchment

Catchment 1

Fraction Impervious = f_i = 0.1 Table Below (QUDM Table 4.5.3)
1 hour @ 10 year ARI = $^{1}I_{10}$ = 60.4 mm/hr (IFD CHARTS)
C_{10} = 0.59 (QUDM Table 4.5.3)

AEP		63%	39%	18%	10%	5%	2%	1%		
Design ARI		**1**	**2**	**5**	**10**	**20**	**50**	**100**		
Frequency Factor	F_Y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_Y	0.472	0.5015	0.5605	0.59	0.6195	0.6785	0.708		(QUDM Equation 4.3)
Time of Concentration	T_C	50	50	50	50	50	50	50	min	
Rainfall Intensity	$^{97min}I_{10}$	39	44	59	68	77	88	96	mm/hr	(IFD CHARTS)
Area	A	22.9	22.9	22.9	22.9	22.9	22.9	22.90	Ha	
Path A Flow		**1.17**	**1.40**	**2.09**	**2.55**	**3.02**	**3.78**	**4.30**	**m^3/s**	
Velocity		**1.357**	**1.429**	**1.599**	**1.689**	**1.769**	**1.879**	**1.944**	**m/s**	Taken from ERSCON Super Drain Table
Height		**0.318**	**0.347**	**0.419**	**0.460**	**0.497**	**0.551**	**0.585**	**m**	

JOB NO: 160-010
JOB: Wylandra Stage 1 Drainage
TITLE : Catchment 2
DATE: 1/05/2024

Time of concentration Calculation
(Using Bransby-Williams' Equation)

Proportionality Factor P= 58 (for Ha)

Length of Flow Path L= 0.580 km
Top of Catchment (RL) RL = 460 m
Area of Catchment A = 8.12 Ha

Catchment Profile **455.7** [to utilise graph area better]

Chainage	RL	RL	Area under Graph (m²)
0	455.7	0	-----
300	456.2	0.5	75
300	456.2	0.5	0
300	456.2	0.5	0
300	456.2	0.5	0
300	456.2	0.5	0
300	456.2	0.5	0
300	456.2	0.5	0
300	456.2	0.5	0
580	460	4	630

Average Slope Calculation	
Outlet Chainage	0
Catchment length	580
Outlet RL	0
Top RL (Av Slope)	2.4

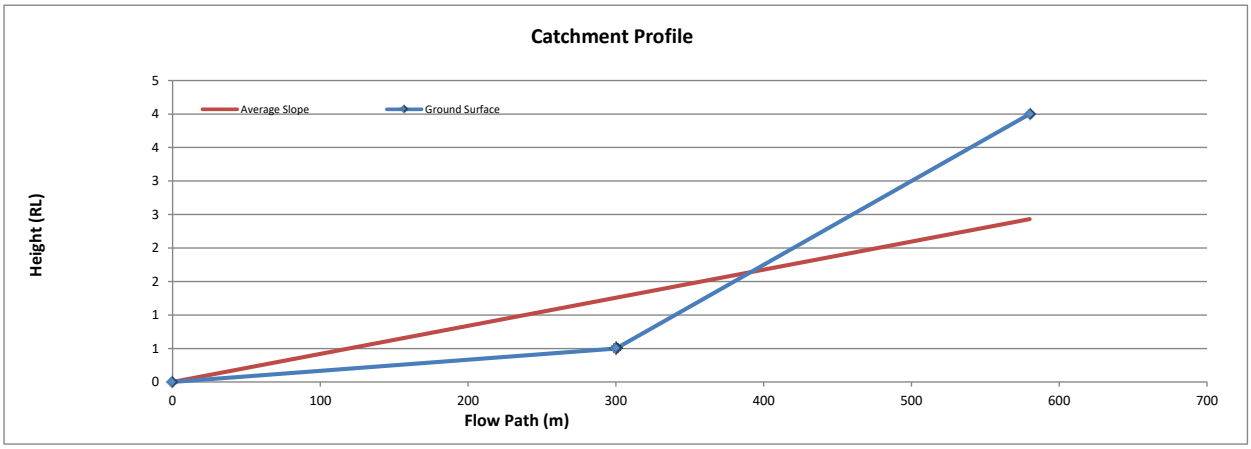
$$Tc = \frac{P \times L}{(A \wedge 0.1) \times (S \wedge 0.2)}$$

Tc = 32.5 min

Adopted Tc **32.0** **min**

Total area under graph **705** m^2
Area below outlet level 0 m^2
Area above outlet 705 m^2

Height for average slope 2.43 m
Average Slope **S =** **0.4** **%**



Flow Calculation for Upstream Catchment

Catchment 2

Fraction Impervious = f_i = 0.1 Table Drain (QUDM Table 4.5.3)
1 hour @ 10 year ARI = $^{1}I_{10}$ = 60.4 mm/hr (IFD CHARTS)
C_{10} = 0.59 (QUDM Table 4.5.3)

AEP		63%	39%	18%	10%	5%	2%	1%		
Design ARI		**1**	**2**	**5**	**10**	**20**	**50**	**100**		
Frequency Factor	F_Y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_Y	0.472	0.5015	0.5605	0.59	0.6195	0.6785	0.708		(QUDM Equation 4.3)
Time of Concentration	T_C	32.0	32	32	32	32	32	32.0	min	
Rainfall Intensity	$^{10min}I_{10}$	51	57	77	89	100	115	125	mm/hr	(IFD CHARTS)
Area	A	8.12	8.12	8.12	8.12	8.12	8.12	8.12	Ha	
Path B Flow		**0.54**	**0.65**	**0.97**	**1.18**	**1.40**	**1.76**	**2.00**	**m^3/s**	
Velocity		**1.026**	**1.082**	**1.222**	**1.293**	**1.359**	**1.450**	**1.503**	**m/s**	Taken from ERSCON Super Drain Table
Height		**0.206**	**0.224**	**0.271**	**0.297**	**0.322**	**0.359**	**0.381**	**m**	

JOB NO: 160-010
JOB: Wylandra Stage 1 Drainage
TITLE : Catchment 3
DATE: 1/05/2024

Time of concentration Calculation
(Using Bransby-Williams' Equation)

Proportionality Factor P= 58 (for Ha)

Length of Flow Path L= 1.584 km
Top of Catchment (RL) RL = 469 m
Area of Catchment A = 27.30 Ha

Catchment Profile **454.8** [to utilise graph area better]

Chainage	RL	RL	Area under Graph (m²)
0	454.8	0	-----
250	457.8	3	375
500	460.8	6	1125
750	462.9	8.1	1763
1000	466.7	11.9	2500
1500	468	13.2	6275
1500	468	13.2	0
1500	468	13.2	0
1500	468	13.2	0
1584	469.0	14.2	1151

Average Slope Calculation	
Outlet Chainage	0
Catchment length	1584
Outlet RL	0
Top RL (Av Slope)	16.7

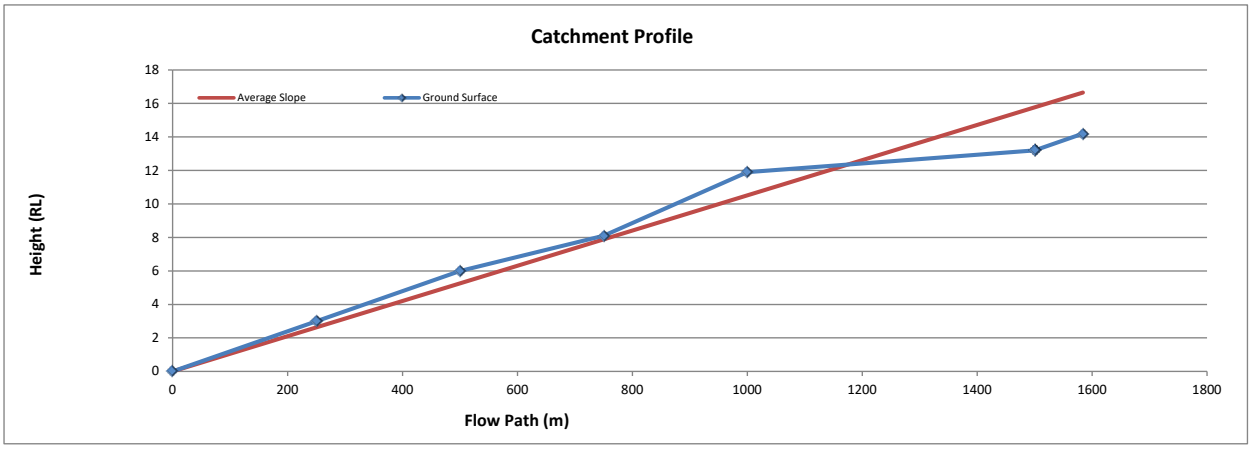
$$Tc = \frac{P \times L}{(A \wedge 0.1) \times (S \wedge 0.2)}$$

Tc = 65.3 min

Adopted Tc **65.0** **min**

Total area under graph **13188** m^2
Area below outlet level 0 m^2
Area above outlet 13188 m^2

Height for average slope 16.65 m
Average Slope **S =** **1.1** **%**



Flow Calculation for Upstream Catchment

Catchment 3

Fraction Impervious = f_i = 0.1 Table Drain (QUDM Table 4.5.3)
1 hour @ 10 year ARI = $^{1}I_{10}$ = 60.4 mm/hr (IFD CHARTS)
C_{10} = 0.59 (QUDM Table 4.5.3)

AEP		63%	39%	18%	10%	5%	2%	1%		
Design ARI		**1**	**2**	**5**	**10**	**20**	**50**	**100**		
Frequency Factor	F_Y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_Y	0.472	0.5015	0.5605	0.59	0.6195	0.6785	0.708		(QUDM Equation 4.3)
Time of Concentration	T_C	65	65	65	65	65	65	65	min	
Rainfall Intensity	$^{9min}I_{10}$	33	37	49	57	65	74	80	mm/hr	(IFD CHARTS)
Area	A	27.3	27.3	27.3	27.3	27.3	27.3	27.30	Ha	
Path C Flow		**1.18**	**1.41**	**2.10**	**2.56**	**3.03**	**3.79**	**4.31**	**m^3/s**	
Velocity		**1.332**	**1.393**	**1.541**	**1.619**	**1.689**	**1.786**	**1.844**	**m/s**	Taken from ERSCON Super Drain Table
Height		**0.423**	**0.457**	**0.542**	**0.589**	**0.632**	**0.694**	**0.732**	**m**	

JOB NO: 160-010
JOB: Wylandra Stage 1 Drainage
TITLE : Catchment A (4 + 3 + 3A)
DATE: 31/07/2024

Time of concentration Calculation
(Using Bransby-Williams' Equation)

Proportionality Factor P= 58 (for Ha)

Length of Flow Path L= 2.529 km
Top of Catchment (RL) RL = 471 m
Area of Catchment A = 121.61 Ha 121.61

Catchment Profile 447 [to utilise graph area better]

Chainage	RL	RL	Area under Graph (m²)
0	447.4	0.4	-----
266	450	3	452
444	451.5	4.5	668
726	454	7	1620
924	454.4	7.4	1427
1163	458	11	2199
1391	460	13	2736
1644	463	16	3669
1926	467	20	5076
2529	471.0	24	13266

Average Slope Calculation	
Outlet Chainage	0
Catchment length	2529
Outlet RL	0
Top RL (Av Slope)	24.2

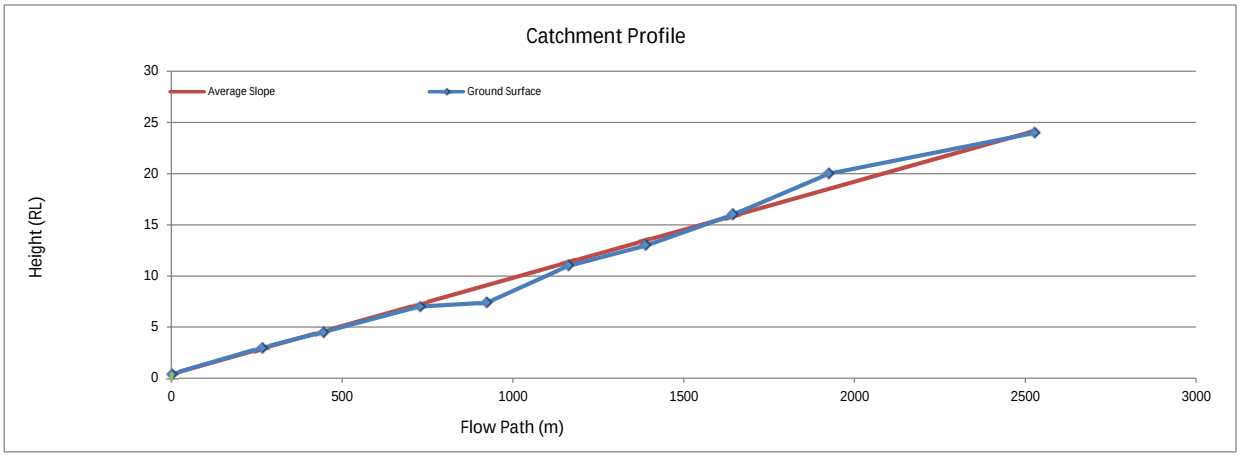
$$Tc = \frac{P \times L}{(A \wedge 0.1) \times (S \wedge 0.2)}$$

Tc = 91.9 min

Adopted Tc 91.0 min

Total area under graph **31112** m^2
Area below outlet level 1012 m^2
Area above outlet 30101 m^2

Height for average slope 23.80 m
Average Slope S = 0.9 %



Flow Calculation for Upstream Catchment

Catchment 3

Fraction Impervious = f_i = 0.1 Table Drain (QUDM Table 4.5.3)
1 hour @ 10 year ARI = $^1I_{10}$ = 63.5 mm/hr (IFD CHARTS)
C_{10} = 0.62 (QUDM Table 4.5.3)

AEP		63%	39%	18%	10%	5%	2%	1%		
Design ARI		**1**	**2**	**5**	**10**	**20**	**50**	**100**		
Frequency Factor	F_Y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_Y	0.496	0.527	0.589	0.62	0.651	0.713	0.744		(QUDM Equation 4.3)
Time of Concentration	T_C	91	91	91	91	91	91	91	min	
Rainfall Intensity	$^{91min}I_{10}$	28	32	42	49	55	63	68	mm/hr	(IFD CHARTS)
Area	A	121.61	121.61	121.61	121.61	121.61	121.61	121.61	Ha	
Path D Flow		**4.70**	**5.61**	**8.33**	**10.16**	**12.05**	**15.06**	**17.14**	**m^3/s**	
Velocity		**1.228**	**1.309**	**1.505**	**1.612**	**1.709**	**1.843**	**1.924**	**m/s**	Taken from ERSCON Super Drain Table
Height		**0.351**	**0.386**	**0.477**	**0.531**	**0.582**	**0.656**	**0.703**	**m**	

JOB NO: 160-010
JOB: Wylandra Stage 1 Drainage
TITLE : Catchment B (6 + 1 + 2 + 5)
DATE: 31/07/2024

ERSCON CONSULTING ENGINEERS

Time of concentration Calculation
(Using Bransby-Williams' Equation)

Proportionality Factor P= 58 (for Ha)

Length of Flow Path L= 2.190 km
Top of Catchment (RL) RL = 468.2 m
Area of Catchment A = 87.22 Ha 121.61

Catchment Profile **447** [to utilise graph area better]

Chainage	RL	RL	Area under Graph (m²)
0	447.4	0.4	-----
122	450.5	3.5	238
212	451	4	338
289	452	5	347
483	453	6	1067
609	454	7	819
825	455	8	1620
1070	459	12	2450
1646	464	17	8352
2190	468.2	21.2	10390

Average Slope Calculation	
Outlet Chainage	0
Catchment length	2190
Outlet RL	0
Top RL (Av Slope)	23.0

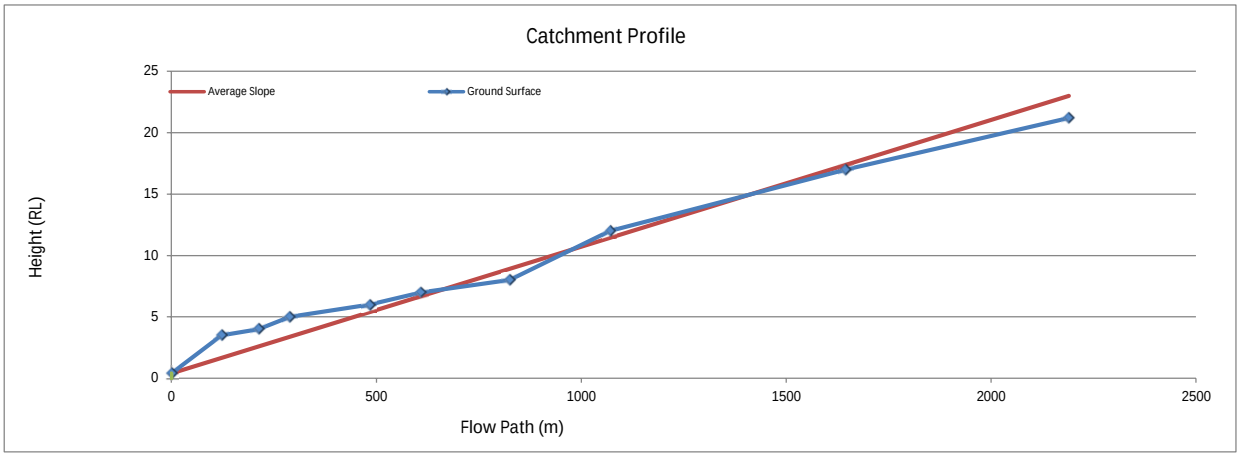
$$Tc = \frac{P \times L}{(A \wedge 0.1) \times (S \wedge 0.2)}$$

Tc = 80.7 min

Adopted Tc **80.0** **min**

Total area under graph **25620** m^2
Area below outlet level 876 m^2
Area above outlet 24744 m^2

Height for average slope 22.60 m
Average Slope **S =** **1.0** **%**



Flow Calculation for Upstream Catchment

Catchment 3

Fraction Impervious = f_i = 0.1 Table Drain (QUDM Table 4.5.3)
1 hour @ 10 year ARI = $^{1}I_{10}$ = 63.5 mm/hr (IFD CHARTS)
C_{10} = 0.62 (QUDM Table 4.5.3)

AEP		63%	39%	18%	10%	5%	2%	1%		
Design ARI		**1**	**2**	**5**	**10**	**20**	**50**	**100**		
Frequency Factor	F_Y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_Y	0.496	0.527	0.589	0.62	0.651	0.713	0.744		(QUDM Equation 4.3)
Time of Concentration	T_C	80	80	80	80	80	80	80	min	
Rainfall Intensity	$^{80min}I_{10}$	31	35	46	54	61	69	75	mm/hr	(IFD CHARTS)
Area	A	87.22	87.22	87.22	87.22	87.22	87.22	87.22	Ha	
Path D Flow		**3.73**	**4.45**	**6.61**	**8.07**	**9.56**	**11.95**	**13.60**	**m^3/s**	
Velocity		**1.288**	**1.369**	**1.674**	**1.674**	**1.769**	**1.902**	**1.924**	**m/s**	Taken from ERSCON Super Drain Table
Height		**0.357**	**0.391**	**0.535**	**0.535**	**0.585**	**0.658**	**0.703**	**m**	

APPENDIX D

Hydraulic Analysis

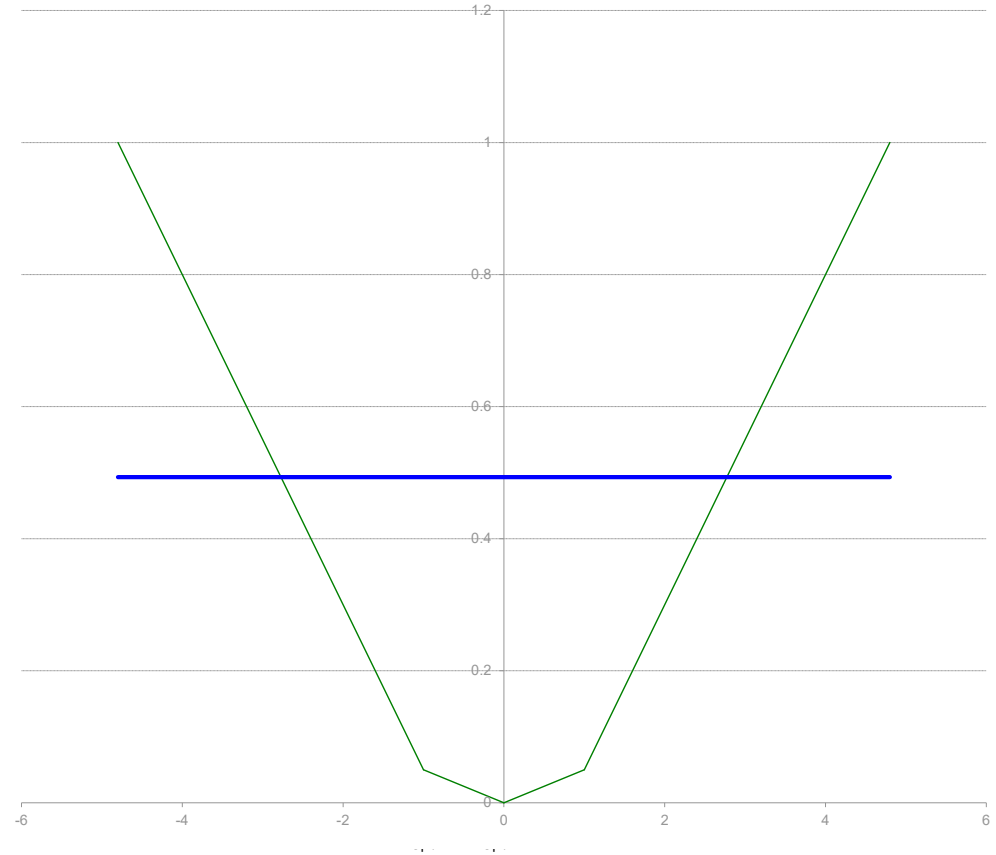
WYLANDRA ESTATE STAGE 1
DRAIN 1
Q5 FLOW

Q =	3.02	Slope	1.6 %	Depth	0.493	n	0.0319	q	3.0199	A	1.722	v	1.7535

Label	Constraints	Horizontal (m)	Vertical (m)	Grade %	Surface	n
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	2	3.8	0.95	25.0%	Poorly Grassed	0.035
	2	1	0.05	5.0%	Poorly Grassed	0.035
Invert Line						
	2	1	0.05	5.0%	Poorly Grassed	0.035
	2	3.8	0.95	25.0%	Poorly Grassed	0.035
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					

Left of Invert

Right of Invert



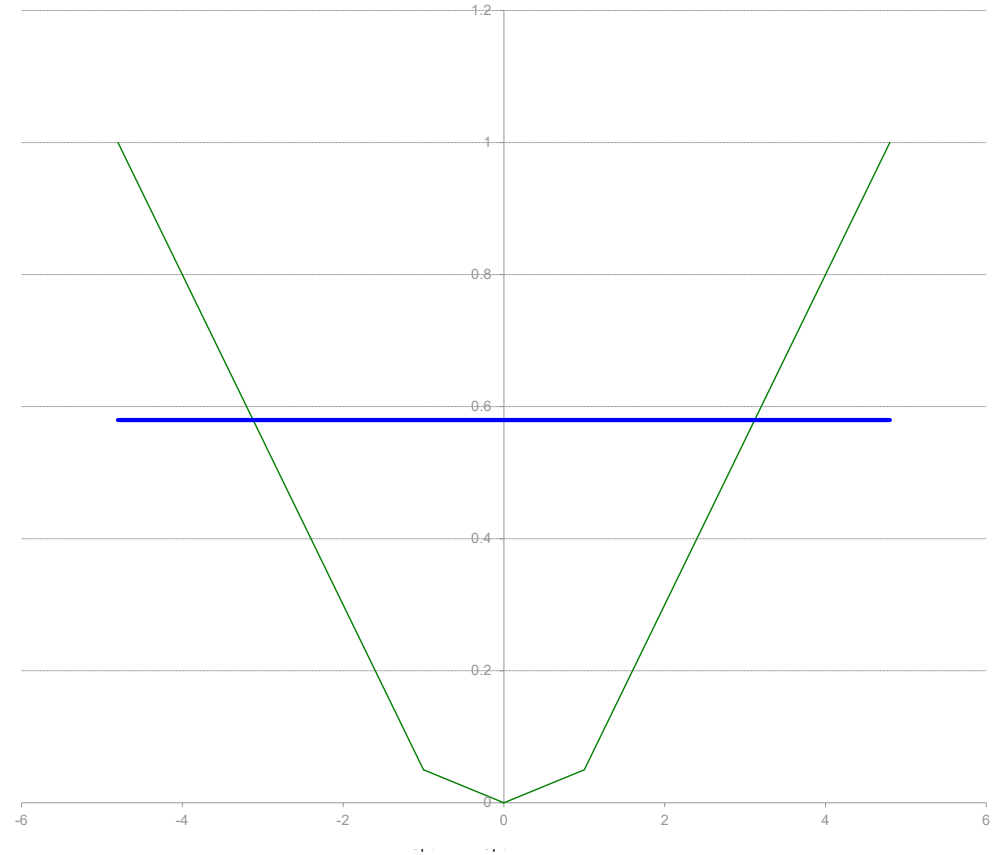
WYLANDRA ESTATE STAGE 1
DRAIN 1
Q100 FLOW

Q =	4.3	Slope	1.6 %	Depth	0.580	n	0.032	q	4.2999	A	2.232	v	1.9269

Label	Constraints	Horizontal (m)	Vertical (m)	Grade %	Surface	n
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	2	3.8	0.95	25.0%	Poorly Grassed	0.035
	2	1	0.05	5.0%	Poorly Grassed	0.035
	Invert Line					
	2	1	0.05	5.0%	Poorly Grassed	0.035
	2	3.8	0.95	25.0%	Poorly Grassed	0.035
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					

Left of Invert

Right of Invert



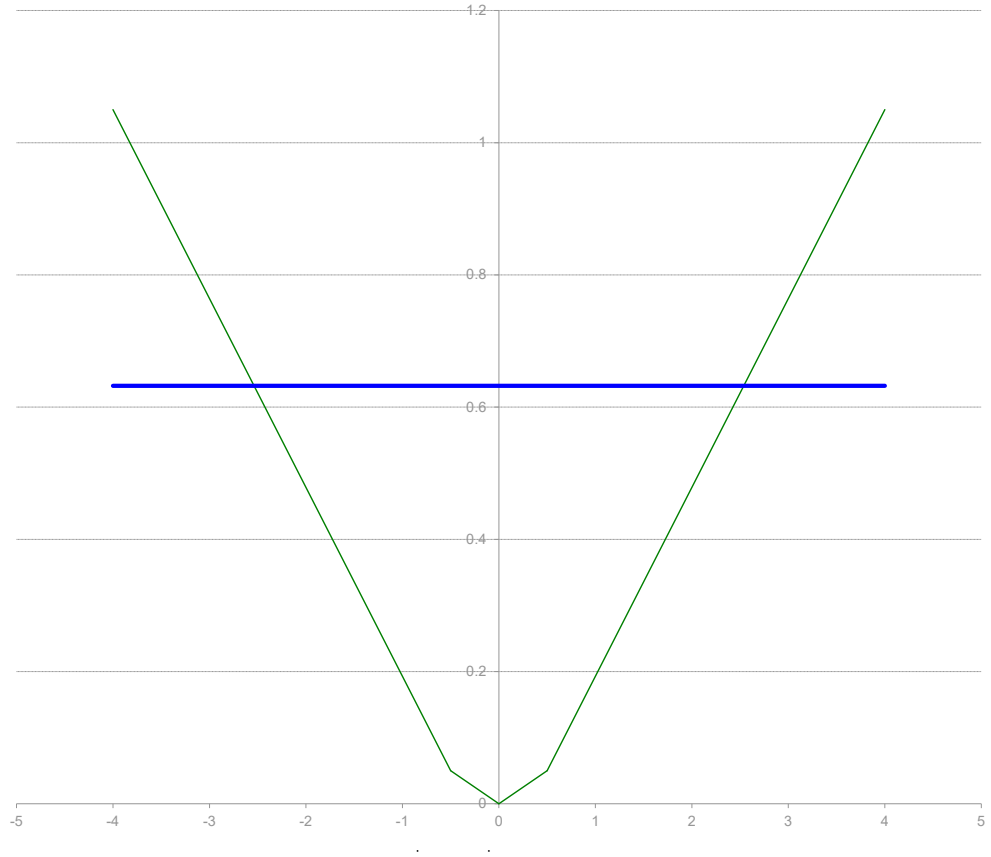
WYLANDRA ESTATE STAGE 1
DRAIN 2 & 3
Q5 FLOW

Q =	3.03	Slope	1.3 %	Depth	0.632	n	0.0324	q	3.03	A	1.794	v	1.6892

Label	Constraints	Horizontal (m)	Vertical (m)	Grade %	Surface	n
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	2	3.5	1	28.6%	Poorly Grassed	0.035
	2	0.5	0.05	10.0%	Poorly Grassed	0.035
		Invert Line				
	2	0.5	0.05	10.0%	Poorly Grassed	0.035
	2	3.5	1	28.6%	Poorly Grassed	0.035
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					

Left of Invert

Right of Invert



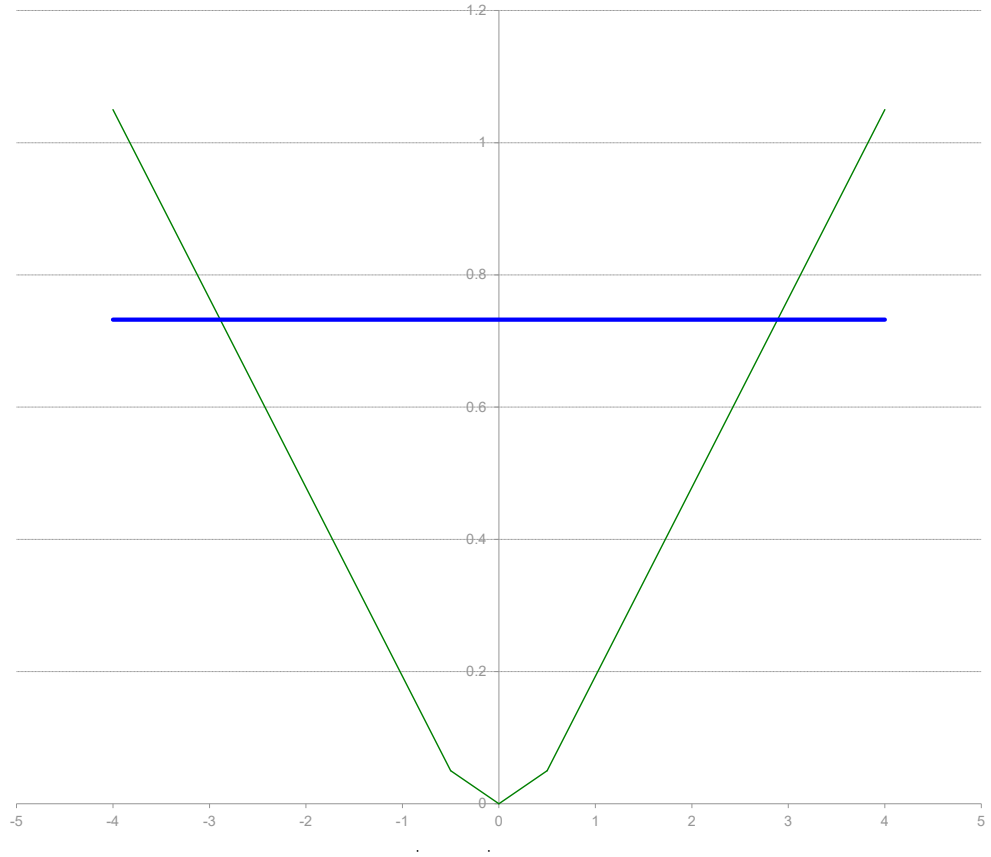
WYLANDRA ESTATE STAGE 1
DRAIN 2 & 3
Q100 FLOW

Q =	4.31	Slope	1.3 %	Depth	0.732	n	0.0327	q	4.3099	A	2.337	v	1.8444

Label	Constraints	Horizontal (m)	Vertical (m)	Grade %	Surface	n
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	2	3.5	1	28.6%	Poorly Grassed	0.035
	2	0.5	0.05	10.0%	Poorly Grassed	0.035
	Invert Line					
	2	0.5	0.05	10.0%	Poorly Grassed	0.035
	2	3.5	1	28.6%	Poorly Grassed	0.035
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					
	1					

Left of Invert

Right of Invert



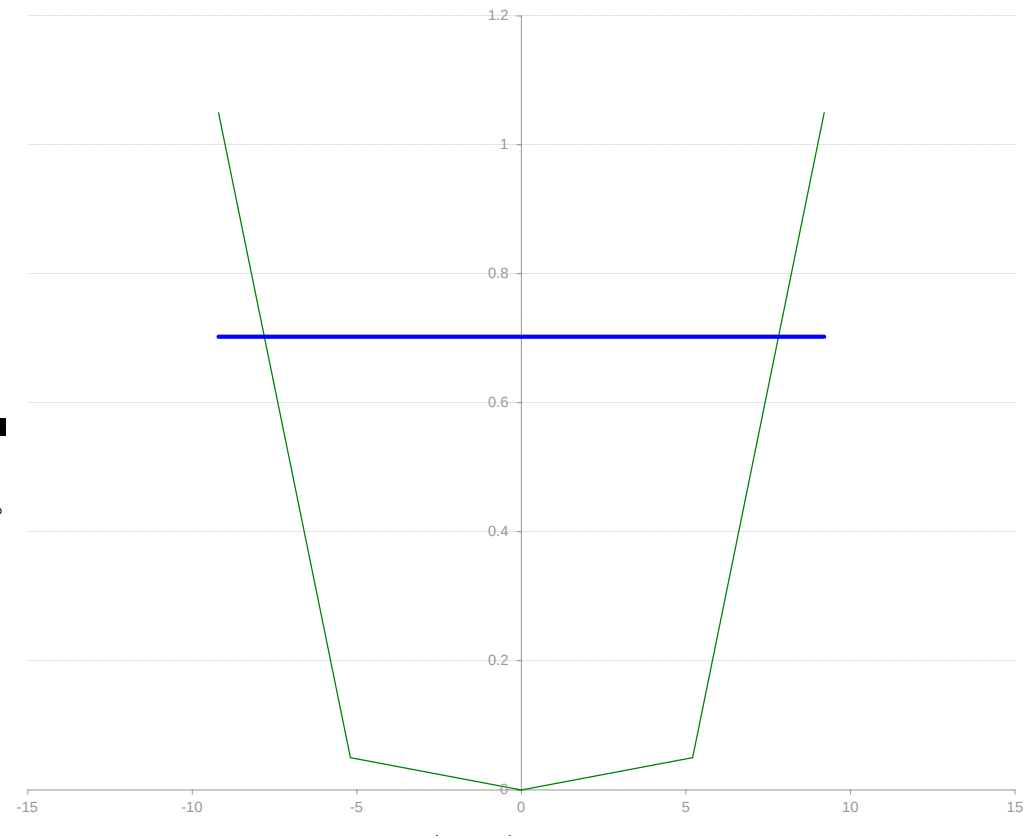
PROJECT
DRAIN
Qxxx FLOW

Q =	16.84	Slope	0.9 %	Depth	0.703	n	0.0331	q	16.84	A	8.75	v	1.9245

Label	Constraints	Horizontal (m)	Vertical (m)	Grade %	Surface	n
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
2		4	1	25.0%	Poorly Grassed	0.035
2		5.2	0.05	1.0%	Poorly Grassed	0.035
	Invert Line					
2		5.2	0.05	1.0%	Poorly Grassed	0.035
2		4	1	25.0%	Poorly Grassed	0.035
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						

Left of Invert

Right of Invert



PROJECT
DRAIN
Qxxx FLOW

Q =	13.6	Slope	1 %	Depth	0.703	n	0.0327	q	13.6	A	6.863	v	1.982

Label	Constraints	Horizontal (m)	Vertical (m)	Grade %	Surface	n
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
1						
2		4	1	25.0%	Poorly Grassed	0.035
2		3.8	0.05	1.3%	Poorly Grassed	0.035
	Invert Line					
2		3.8	0.05	1.3%	Poorly Grassed	0.035
2		4	1	25.0%	Poorly Grassed	0.035
1						
1						
1						
1						
1						
1						
1						
1						
1						
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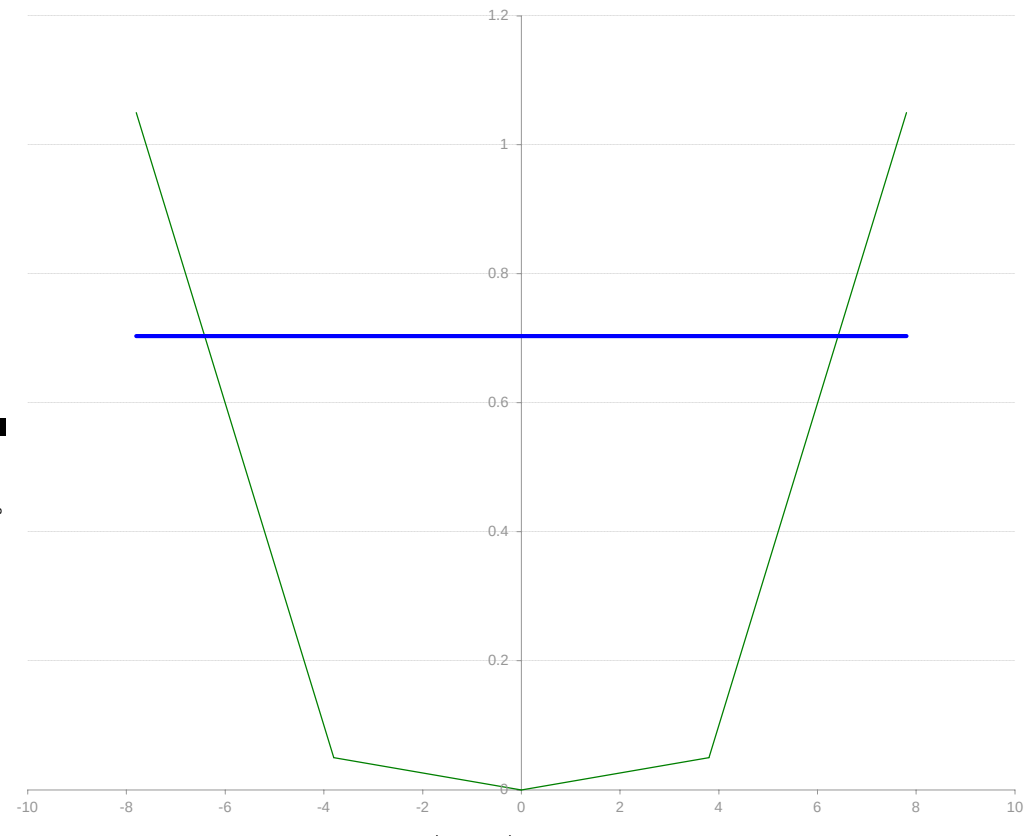
1						
1						
1						

Left of Invert

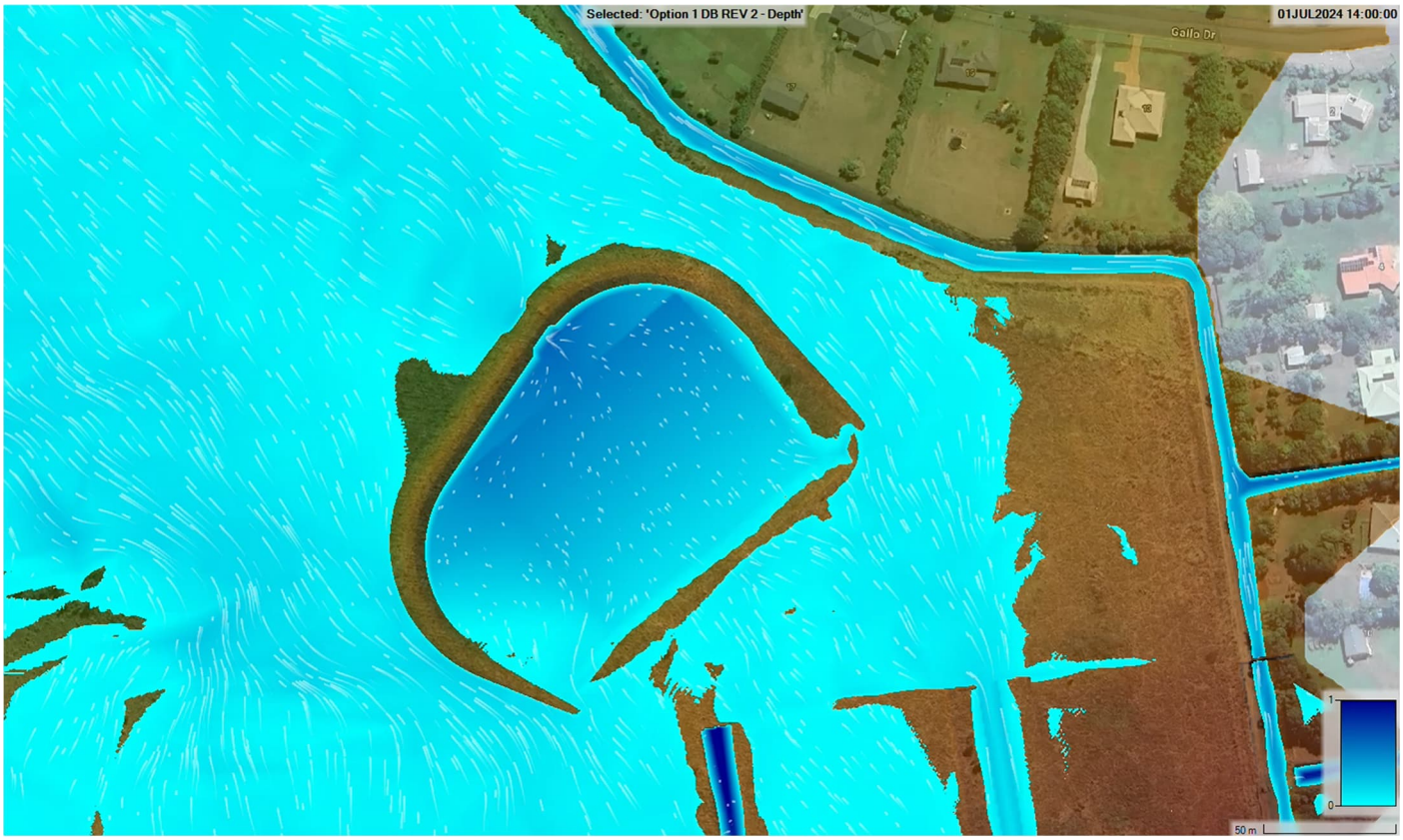
Right of Invert

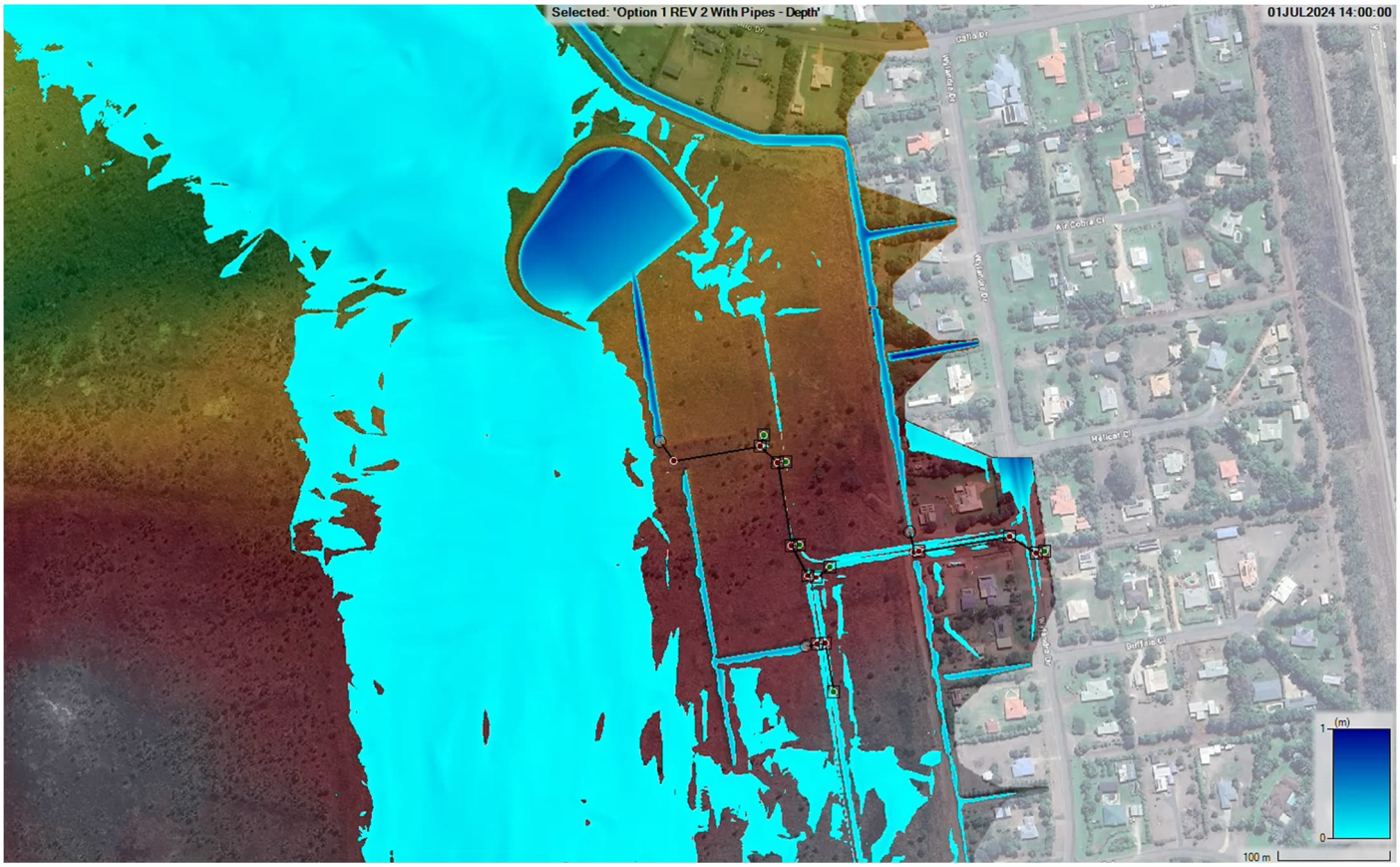


APPENDIX E

HEC RAS Analysis

Detention Basin Max Flows





Coolamon Close and Chinaman Creek Flows