Turning Knowledge Into Value

Engineering Services Report

Logan Reserve Fuel Station

Prepared for Logan Reserve Central Pty Ltd

7 April 2022

Calibre Professional Services Pty Ltd
55 070 683 037

QUALITY ASSURANCE STATEMENT

TASK	NAME	SIGNATURE
Project Manager	Oliver Hartigan	
Prepared by	Oliver Hartigan	
Reviewed by	Les Roche	
Approved for Issue by	Les Roche	

DOCUMENT CONTROL

ISSUE	DATE	ISSUE DETAILS	AUTHOR	CHECKED	APPROVED
09.03.22	A	Issued for Approval	OH	LR	
07.04.22	B	Draft Issue	OH	LR	Les Roche RPEQ 14843

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1. Introduction

Calibre Professional Services Pty Ltd has been commissioned by Logan Reserve Central Pty Ltd to prepare this report in support of a Material Change of Use for a fuel station as part of the Logan Reserve Neighbourhood Centre.

The objective of this report is to demonstrate that the proposed development has been provided with appropriate civil infrastructure, and to demonstrate that the proposed development is compliant with the Logan City Council (LCC) Planning Scheme (2015), Australian Standards, and other relevant guidelines.

This report covers issues related to civil infrastructure, including earthworks, roadworks, stormwater quality and quantity management, sewer reticulation, water reticulation and electrical and communication networks.

The proposed development is located on Lot 2 on SP292432. It is shown in Figure 1 below and is known within this report as 'the Site'. The purpose of this application, is to:

- Materially Change the Use of a portion of Building D to 'sports and recreation'; and
- Materially Change the Use of Building B to a fuel station.

The proposed development is bound by a proposed neighbourhood and childcare centre on the eastern boundary (under assessment by Logan City Council under separate applications respectively), Logan Reserve Road to the west, a council access road to the north (Halcyon Way), and private properties to the south. The site of the proposed development is currently vacant. A site layout plan is included in Appendix A of this report.

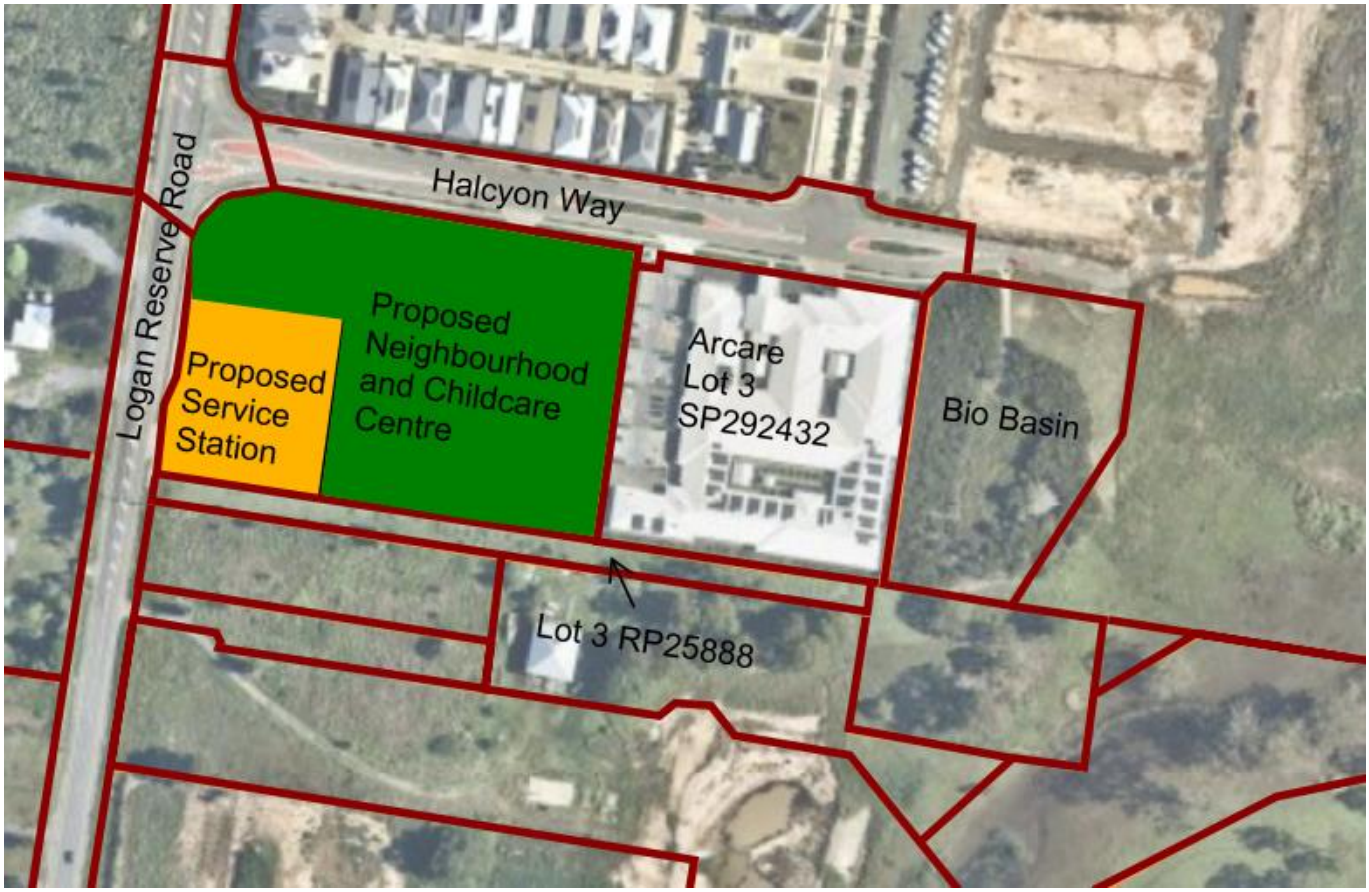


Figure 1. Proposed Site Location

2. Code Compliance

With relation to the proposed development, this report addresses the following Logan City Council Codes:

- Filling and Excavation Code;
- Infrastructure Code; and
- Acid Sulfate Soils Overlay Code.

Code responses have been provided to Saunders Havill Group for a consolidated submission with code responses from other consultants.

3. Earthworks and Retaining Walls

3.1 Existing Earthworks

Pad level earthworks for the proposed development were completed as part of Operational Works Approval OW/368/2017. These earthworks were undertaken to create a site ready for the development of the proposed Neighbourhood and Childcare Centre.

There is an existing concrete sleeper retaining wall along the southern boundary of the Site, also constructed under Operational Works Approval OW/368/2017.

Refer to the as constructed bulk earthworks drawings 15-000483-200(5) and 15-000483-201(7) in Appendix B.

3.2 Proposed Works

A detailed carpark site grading will be undertaken as part of detailed design, which may result in some localised changes to the current topography.

The detailed site grading will take into consideration the approved Stormwater Management Plan for the site, ensuring that the pad globally falls from south to north. Refer to Section 5 for further details.

Any proposed bulk earthworks would be submitted to Logan City Council for operational works approval.

The lowest level proposed is approximately RL 15.31 m AHD. Acid sulfate soils were not encountered during bulk earthworks operations and are not anticipated to be a concern during the proposed development works. No excavation below RL 5.0 m AHD will take place.

3.3 Proposed Erosion and Sediment Control Strategy

The Erosion and Sediment control strategy will identify potential environmental risks associated with the development. Specifically, water quality, erodible soils, and environmental impacts to adjoining land and existing roads will be addressed. These risks will be mitigated by designing in accordance with the Logan City Council and IECA design guidelines and through the implementation of approved site management measures at the time of construction.

Erosion and Sediment control measures will be provided as appropriate during construction activities. These measures can consist of diversion drains, temporary sediment basins, silt fences and check dams. Diversion drains would be designed to separate ‘dirty water’ from ‘clean water’ and appropriately manage the stormwater discharge during construction to minimise sediment laden runoff into the surrounding waterways. Sediment fences would serve to trap sediment in minor storm events while rock check dams would act to reduce the velocity of stormwater runoff therefore reducing the transportation of ‘dirty water’.

It is proposed that, during construction, disturbed areas would be stabilised as soon as practical during civil works to minimise exposure of these areas to ‘dirty water’ runoff. Regular stormwater discharge locations will be incorporated to reduce the volume of concentrated flow, facilitating easier site management during construction. Sediment basins will be constructed at appropriate locations in accordance with best practice standards at the time of the engineering design so that sediment laden water can be captured and treated prior to discharge.

4. Road Network

4.1 Existing Infrastructure

The following infrastructure was constructed under Operational Works Approval OW/368/2017:

- Halcyon Way, and associated infrastructure;
- Footpath along the Logan Reserve Road and Halcyon Way frontages;
- 9.0m wide driveway crossover on Halcyon Way, including associated right turn lane;
- 9.5m wide driveway crossover on Logan Reserve Road; and
- Bicycle lane along Logan Reserve Road frontage.

Refer to as constructed drawings 15-000483-302(6) and 15-000483-304(6) within Appendix B for further details on existing infrastructure.

4.2 Proposed Roadworks

No additional roadworks to Halcyon Way or Logan Reserve Road are proposed under this application.

4.3 Proposed Vehicle Access and Egress

The fuel station is proposed to be accessed from Logan Reserve Road, by modifying the existing driveway crossing 'Entry 3'. Refer to Bitzios Traffic Impact Assessment for further details on the turning paths, dictating the proposed width of crossover.

Refer to the site layout in Appendix A for further details on the proposed access locations.

4.4 Proposed Bicycle Movement

No additional external bicycle movement works are proposed for this development.

4.5 Proposed Pedestrian Movement

Pedestrian access to the Site is proposed to be from the existing footpath. Modification of the footpath will be required on Logan Reserve Road to suit the proposed driveway crossover.

Internal footpaths are proposed to enable appropriate pedestrian movements around the development.

4.6 Proposed Off-Street Car Parking

134 carpark bays including 4 disabled carpark bays are proposed for the overall development. Circulation aisles, parking aisles, and parking bays dimensions are in accordance with Australian Standard 2890.1:2004. The pavement will be a combination of concrete, and asphalt, as required to suit the proposed usage of each section of parking.

4.7 Proposed On-Street Car Parking

No on-street car parking is proposed to be utilised as part of this development.

4.8 Proposed Refuse Collection

It is proposed that refuse will be collected by a private refuse contractor using a vehicle equivalent to a standard council refuse collection vehicle (RCV). Car park and service road geometry is appropriately sized to enable the RCV to navigate the site and access the refuse collection location.

5. Stormwater Quality and Quantity

The proposed development is located on Lots that were created under the Reconfiguration of a Lot for Lot 41 on MAR618.

As part of this development application, a Site Based Stormwater Management Plan (refer to 15-000483-01F for the latest revision reviewed by Logan City Council, Appendix C) and Flood Investigation Report (refer to 15-000483-02E for the latest revision reviewed by Logan City Council, Appendix D) were undertaken by Calibre Professional Services.

Both reports have been reviewed and approved by Logan City Council under Development Permit COM/6/2016/B.

5.1 Flood Investigation

The lot on which the proposed development is proposed to be located on has been considered as a part of the Flood Investigation for the Reconfiguration of Lot 41 on MAR618. The Calibre report reference is 15-000483-02E.

The Flood Investigation defines the existing scenario maximum flood level for the 1% AEP design storm as RL13.36m AHD, and the developed scenario maximum flood level as RL13.38m AHD. The finished surface levels of the proposed development will range from RL14.31m AHD to RL16.50m AHD.

In both the existing scenario and developed scenario flood scenarios, the proposed development is located clear of the defined flood extent and as such the development will not be subjected to flooding from the 1% AEP design storm.

5.2 Stormwater Management

The proposed development was considered as a part of the Site Based Stormwater Management Plan for the Reconfiguration of Lot 41 on MAR618. The Calibre report reference is 15-000483-01F.

With reference to report 15-000483-01F, the proposed development is located within Catchment D. Catchment D discharges to a combined bio-retention / detention basin constructed as part of the Reconfiguration of Lot 41 on MAR618. This combined bio-retention / detention basin has been sized to treat and mitigate peak runoff from Catchment D.

5.2.1 Catchment D Parameters

The stormwater quality and quantity modelling undertaken in preparing report 15-000483-01F adopted an area of 3.81 hectares and fraction impervious of 74% for Catchment D.

With the details of the whole development known as well as the development of Lot 3 SP292432 being completed, the fraction impervious can be re-calculated for these developments.

The typical fraction impervious percentages for each source node have been adopted based on Table 4-2 of the Stormwater Management Plan 15-000483-01F.

Refer to Table 1 for a calculation of the impervious area and Table 2 for a comparison of the impervious area to the previously assumed areas within report 15-000483-01F.

Table 1. Catchment D Impervious Area Calculation

	Total Area (ha)	Impervious Area (ha)	Impervious Percentage
Halcyon Way Road Reserve Fraction Impervious Calculation			
Urban Road Area	0.808	0.485	60%
Bio Retention Basin			
Basin Surrounds	0.533	0	0%
Lot 3 SP292432			
Commercial Roof Area	0.594	0.594	100%
Commercial Ground Area	0.116	0.093	80%
Commercial Road Area	0.285	0.228	80%
Proposed Development, Neighbourhood and Childcare Centre (assessed under separate applications respectively)			
Commercial Roof Area	0.245	0.245	100%
Commercial Ground Area	0.256	0.205	80%
Commercial Road Area	0.790	0.632	80%
Proposed Development, Balance areas (assessed under this application)			
Commercial Roof Area	0.027	0.027	100%
Commercial Ground Area	0.017	0.014	80%
Commercial Road Area	0.139	0.111	80%
Totals			
Urban Road	0.808	0.485	60%
Commercial Roof Area	0.866	0.866	100%
Commercial Ground Area	0.389	0.312	80%
Commercial Road Area	1.214	0.971	80%
Urban Ground	0.533	0.000	0%
Total Area	**3.810**	**2.634**	**69%**

Table 2. Comparison of Impervious Area

	Report 15-000483-01F		
	Assumed Area (ha)	Current Proposed Area (ha)	Impervious Percentage
Urban Road	1.108	0.808	60%
Commercial Roof Area	1.238	0.866	100%
Commercial Ground Area	0.495	0.389	80%
Commercial Road Area	0.743	1.214	80%
Basin Surrounds	0.226	0.533	0%
Total Area	3.810	3.810	

The impervious area of Catchment D has been re-calculated, and has determined:

- The total catchment area has not materially changed; and
- Using consistent impervious percentages for each node, the total impervious area is less than assumed within report 15-000483-01F.

5.2.2 Stormwater Quantity Management

The land use of the proposed development is consistent with parameters adopted for Catchment D in report 15-000483-01F as the fraction impervious of Catchment D is less than 74% following development of proposed Lot 3. As such, the detention basin constructed as part of the Reconfiguration of Lot 41 on MAR618 mitigates peak runoff from the proposed development and no additional works are required.

5.2.3 Stormwater Quality Management

The assumed land uses within Catchment D have been amended, based on the finished development of Lot 3 SP292432 as well as the proposed development of the Neighbourhood and Childcare Centre.

Using the typical fraction impervious percentages for each source node (adopted based on Table 4-2 of the approved Stormwater Management Plan 15-000483-01F), the analysis has determined that the overall impervious area is less than initially assumed. As such, the bio-retention basin constructed as part of the Reconfiguration of Lot 41 on MAR618 sufficiently treats runoff from the proposed development.

Given that the proposed development includes a Fuel Station, a SPEL Puraceptor or approved equivalent device will be required to account for the potential of oil leakages. The location of the Puraceptor is to be confirmed during detailed design.

5.3 Legal Point of Discharge

As part of Operational Works Approval OW/368/2017, four stormwater connections were constructed, being:

- Two 375mm diameter stormwater connections from gully pit G2/1;
- Two 375mm diameter stormwater connections from gully pit G1/3;
- Two 375mm diameter stormwater connections from gully pit G1/4; and
- One 375mm diameter stormwater connection from gully pit G1/5.

These stormwater connections ultimately flow to the existing detention and bio-retention basin, east of the Site.

Refer to as constructed drawing 15-000483-304(6) for the location of these existing stormwater connections. Figure 2 below shows the indicative location of the existing stormwater connections relative to the proposed lot development.

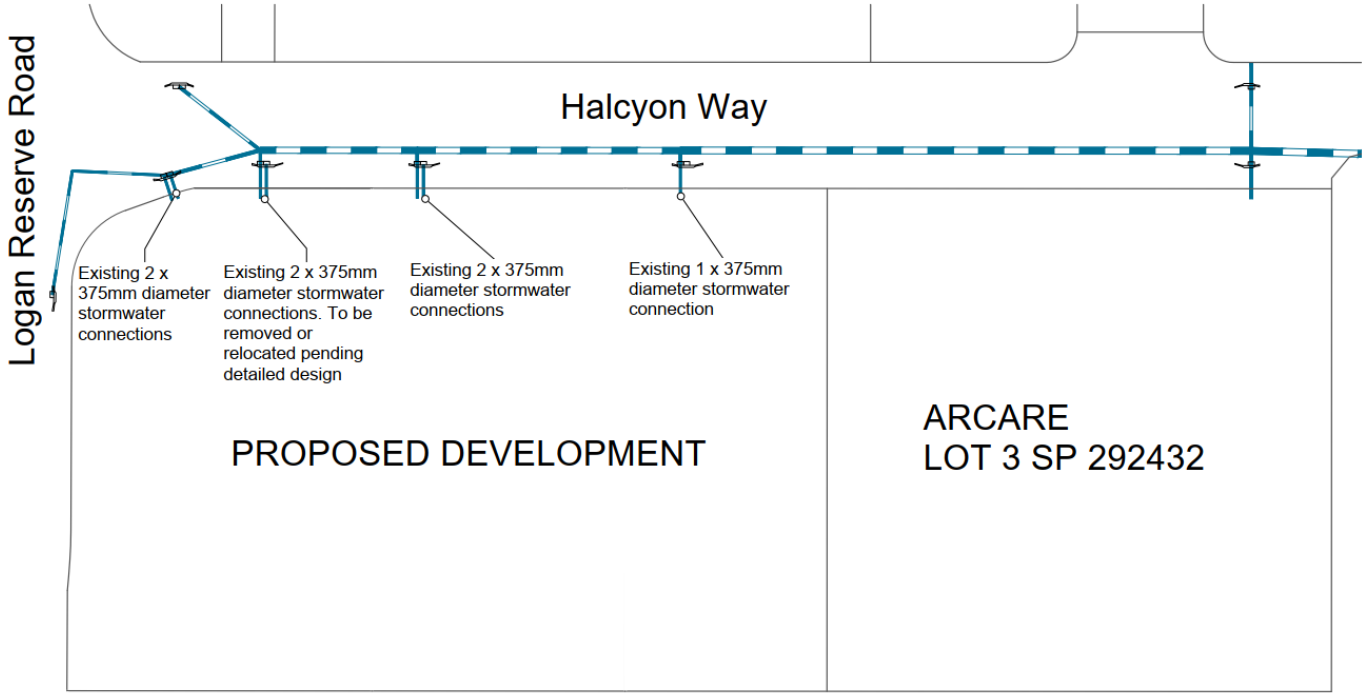


Figure 2. Location of existing stormwater connections

The Site is proposed to connect to the two 375mm diameter stormwater connections to gully pit G2/1.

6. Sewer Reticulation

6.1 Existing Sewer Reticulation

A 225mm diameter U-PVC sewer main exists within with the eastern verge of Logan Reserve Road and southern verge of Halcyon Way, constructed under Operational Works Approval OW/255/2017.

Under this same approval, three 150mm diameter sewer property connections were constructed under Halcyon Way; one connection to service Lot 3 SP292432 and two connections to service the proposed development.

Refer to as constructed drawing 15-000483-503(5) within Appendix B for the location of these connections.

An existing rising main air valve and scrubber also exists on Logan Reserve Road.

6.2 Proposed Sewer Reticulation

The development will require service connections to the existing sewer network. Refer to Figure 3 below for the location of the existing sewer property connections relative to the development. The proposed fuel station can be serviced via the existing connection.

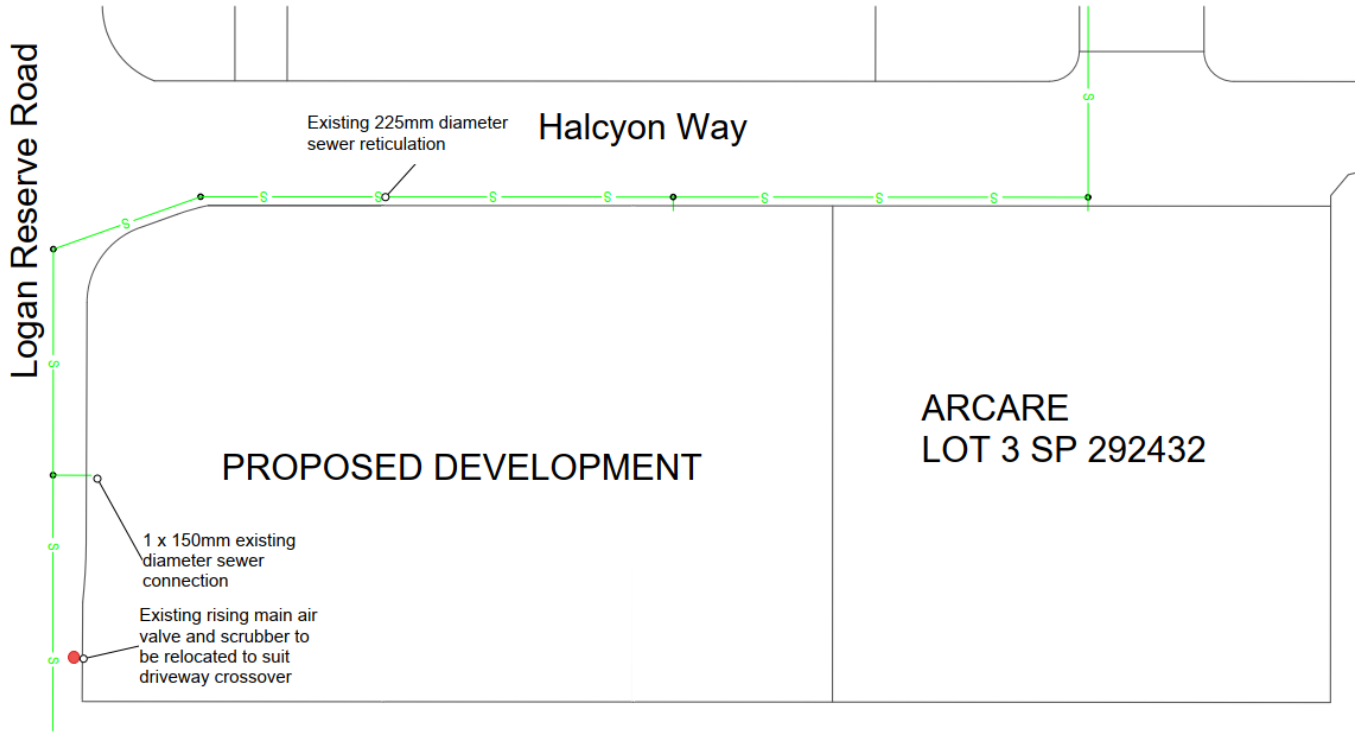


Figure 3. Location of existing and proposed sewer connections

It is proposed to relocate the existing rising main air valve and scrubber, to suit the proposed driveway configuration.

7. Water Reticulation

7.1 Existing Water Reticulation

A DN225 M-PVC water main exists within with the eastern verge of Logan Reserve Road and northern verge of Halcyon Way, constructed under Operational Works Approval OW/255/2017.

Under this same approval, three DN150 water property connections were constructed; one connection to service Lot 3 SP292432 and two connections to service the proposed development.

Refer to as constructed drawing 15-000483-605(5) within Appendix B for the location of these connections.

7.2 Proposed Water Reticulation

Refer to Figure 4 below for the location of the existing water property connections relative to the proposed development. A future water property connection from the existing DN225 water main on Logan Reserve Road will be required to service the proposed fuel station. The location of this connection is to be confirmed during detailed design and submitted to Logan City Council and Logan Water for Operational Works approval.

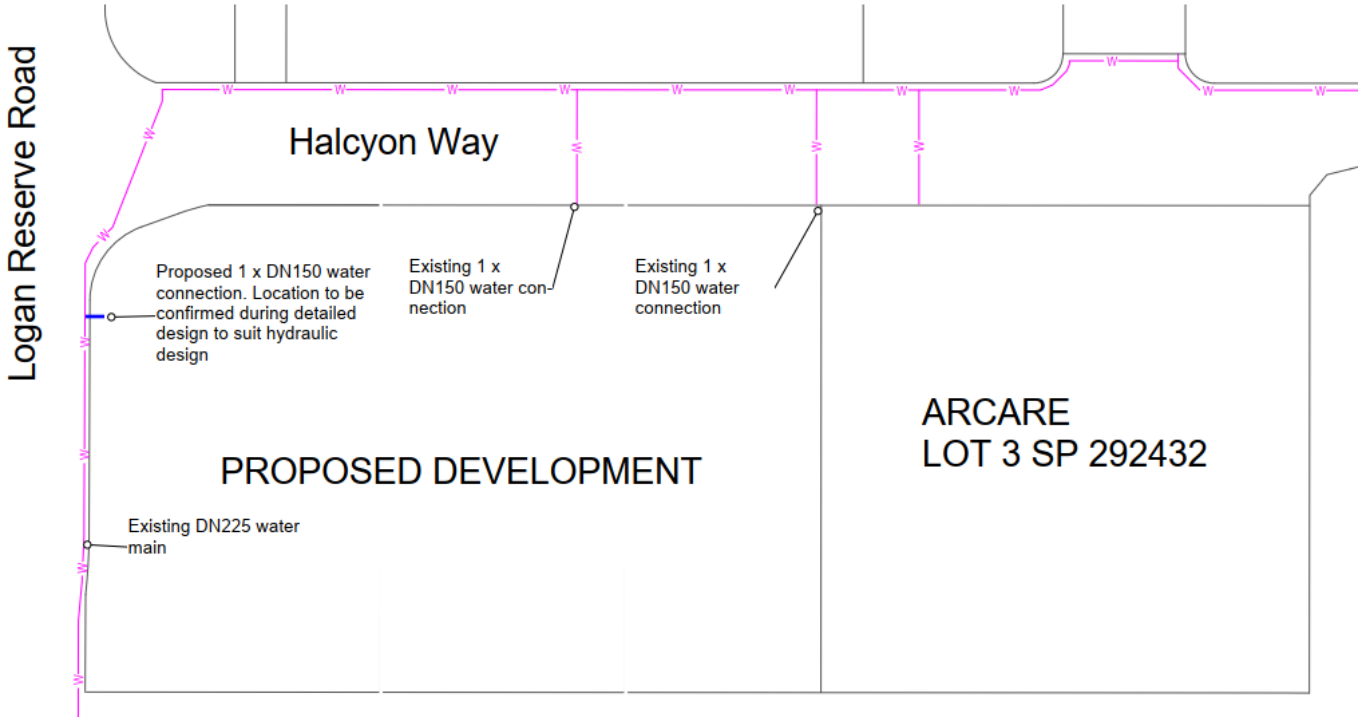


Figure 4. Location of existing and proposed water property connections

8. Electrical, Communications and Gas

8.1 Existing Electrical and Communications

There is an existing underground electrical and communications mains in the western verge of Logan Reserve Road and in the southern verge of Halcyon Way, along the frontage of the proposed development.

8.2 Existing Gas Reticulation

There is an existing 110mm diameter gas main in the eastern verge of Logan Reserve Road and a 63mm diameter gas main in the southern verge of Halcyon Way, along the frontage of the proposed development.

8.3 Proposed Electrical and Communications

Logan Reserve Central Pty Ltd will enter into agreements with local services providers to provide both electrical and communication services to the Site.

8.4 Proposed Gas Reticulation

Logan Reserve Central Pty Ltd will enter into agreements with local services providers to provide gas reticulation connections to the Site, if required.

9. Conclusion

The information presented in this report demonstrates that the proposed development can be constructed in accordance with the Logan City Council Planning Scheme with respect to civil engineering matters.

It has noted:

- Bulk earthworks have been undertaken under a separate Operational Works Approval, with only localised site grading required for the proposed development;
- No proposed external roadworks are anticipated, with additional driveway crossovers required to service all proposed lots;
- The development is consistent with the previous Flood Investigation Report and Stormwater Management Plan; and
- The proposed development may be serviced by the existing wastewater network, with an additional water property connection required.

Appendix A Site Layout Plan

DEVELOPMENT SCHEDULE, STAGE 02
(PARKING SPACE NUMBERS)

USE:	GFA:	CARS RATIO:	CARS REQUIRED:
FAST FOOD	280m²	1/17m²	17
SHOPS (C1-3, D1-2)	870m²	1/17m²	52
SPECIALTY	75m²	1/17m²	5
SERVICE STATION	200m²	*SEE CLAUSE*	11
SPORT & RECREATION	550m²	1/15m²	37
TOTAL	**1975m²**		**122**

CARS PROVIDED: 134

***SERVICE STATION PARKING RATE** - 2 spaces; plus 1 space per 25m² of GFA for a Shop of less than 150m²; plus 1 spaces per 20m² of GFA of Shop area exceeding 150m².

LANDSCAPED AREA - STAGE 02

NAME	AREA	PERCENTAGE
HARD SURFACE - STAGE 02	9842 m²	87%
LANDSCAPED AREA	1435 m²	13%
SITE AREA	11277 m²	

SITE COVER - STAGE 02

NAME	AREA	PERCENTAGE
SITE COVER - STAGE 02	2379 m²	21%
NOT COVERED	8898 m²	79%
SITE AREA	11277 m²	

0 2 4 6 10 20 m

rev	date	details	init.
3	2022-03-30	REVISED DA ISSUE	YH
2	2022-03-28	REVISED SITE PLAN FOR REVIEW	YH
1	2022-03-22	DRAFT DA SET FOR REVIEW	YH

LOGAN RESERVE NEIGHBOURHOOD SHOPPING CENTRE

266 LOGAN RESERVE ROAD, LOGAN RESERVE (TBC)

LOGAN RESERVE CENTRAL PTY LTD ATF - LOGAN RESERVE CENTRAL UNIT TRUST

ABN 76 105 314 654
Trading as ThomsonAdsett.

TA # 17.0162.17

Telephone +61 7 3840 9999
bne@thomsonadsett.com
128 Robertson Street
Fortitude Valley
Qld 4006 Australia
thomsonadsett.com

thomson adsett

DEVELOPMENT APPLICATION

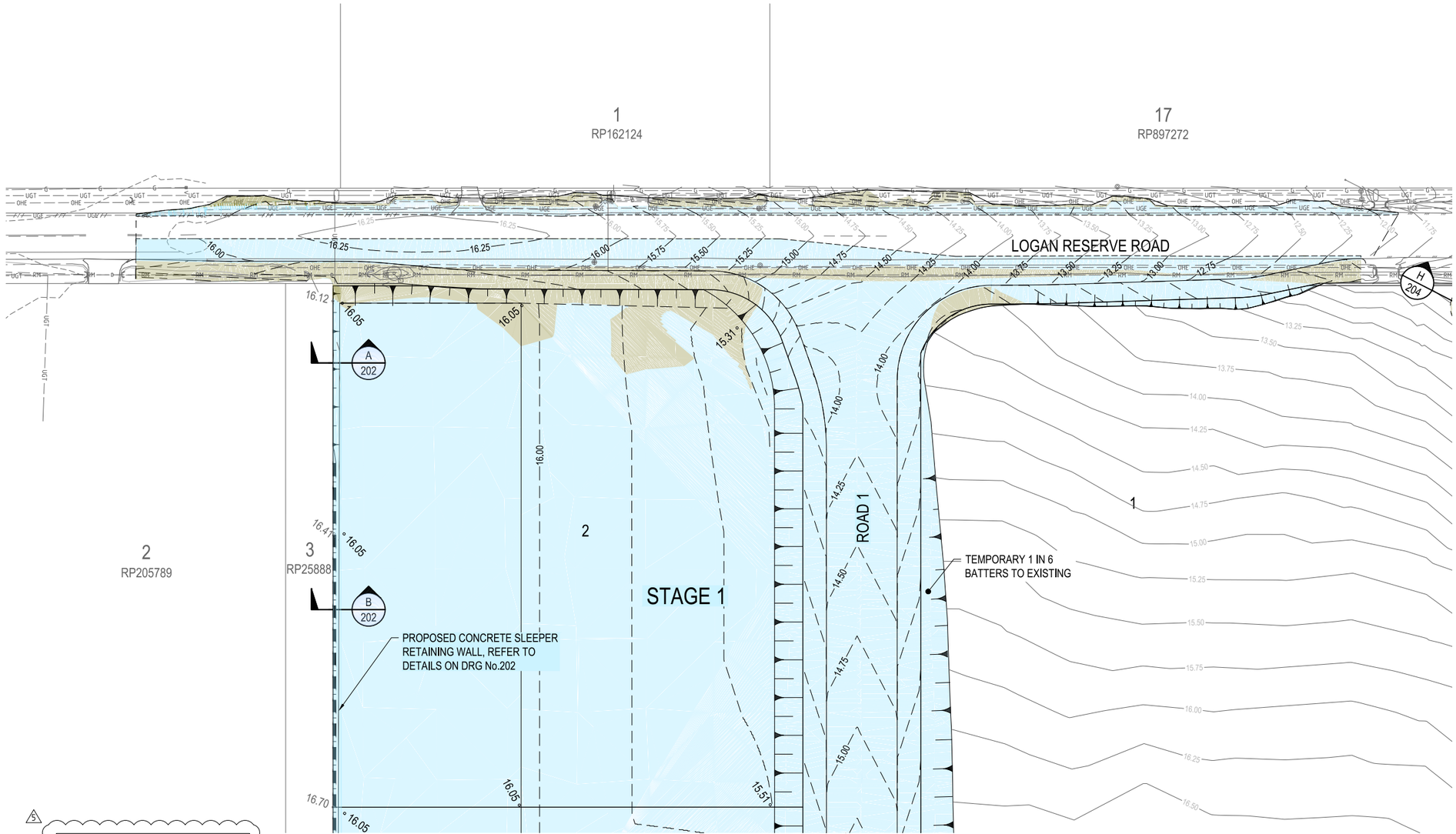
STAGE 02 - SITE PLAN

As indicated @ A1 | 2022-03-30

A-DA-2.11 | **rev. 3**

Appendix B Calibre Plans

NOTE:
REFER DRG. 002 FOR LEGEND AND NOTES



FOR CONTINUATION REFER DRG No. 201

CAUTION !!
UNDERGROUND TELECOMMS CABLES
UNDERGROUND TELECOMMUNICATION CABLES EXIST IN THIS VICINITY. CONTACT SUPPLIER FOR CABLE LOCATIONS. EXTREME CARE MUST BE TAKEN WHILST EXCAVATING.

CAUTION !!
OVERHEAD ELECTRICAL CABLES
OVERHEAD ELECTRICITY CABLES EXIST IN THIS VICINITY. CONTACT ENERGEX WHERE CABLE CLEARANCE IS COMPROMISED BY MACHINERY.

CAUTION !!
UNDERGROUND GAS MAIN
UNDERGROUND GAS MAIN EXIST IN THIS VICINITY. CONTACT SUPPLIER FOR MAIN LOCATIONS. EXTREME CARE MUST BE TAKEN WHILST EXCAVATING

CAUTION !!
UNDERGROUND SEWERAGE RISING MAIN
UNDERGROUND SEWERAGE RISING MAIN EXIST IN THIS VICINITY. CONTACT LOGAN WATER FOR RISING MAIN LOCATIONS. EXTREME CARE MUST BE TAKEN WHILST EXCAVATING

CAUTION !!
UNDERGROUND ELECTRICAL CABLES
UNDERGROUND ELECTRICITY CABLES EXIST IN THIS VICINITY. CONTACT ENERGEX FOR CABLE LOCATIONS. EXTREME CARE MUST BE TAKEN WHILST EXCAVATING

5

AS CONSTRUCTED DETAILS
I, LESLIE ROCHE HEREBY CERTIFY THAT THE AS CONSTRUCTED INFORMATION SHOWN ON THIS PLAN IS A TRUE AND CORRECT RECORD OF THE SIZES, TYPES, MATERIALS, CLASSES ETC., AND IT CORRESPONDS WITH THE RELEVANT APPROVED ENGINEERING DRAWINGS.
SIGNED ..... RPEQ 14843
DATED 29-08-2018

The original issue or last amendment of this drawing contained the original signature. 5

OW/368/2017

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	BATTER REVISED TO 1 IN 6 AND EXTENT OF WORKS CHANGED	LS	LS
5	23.08.18	ISSUED FOR AS CONSTRUCTED	DMP	CS

DRAWN: DMP
DESIGN: CS

STATUS: ISSUED FOR CONSTRUCTION
APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE: 1:500 / 1:1000 — 10 5 0 10 20 — A1 / A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

calibre

calibregroup.com

PROJECT: HALCYON LOGAN RESERVE STAGE 1

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

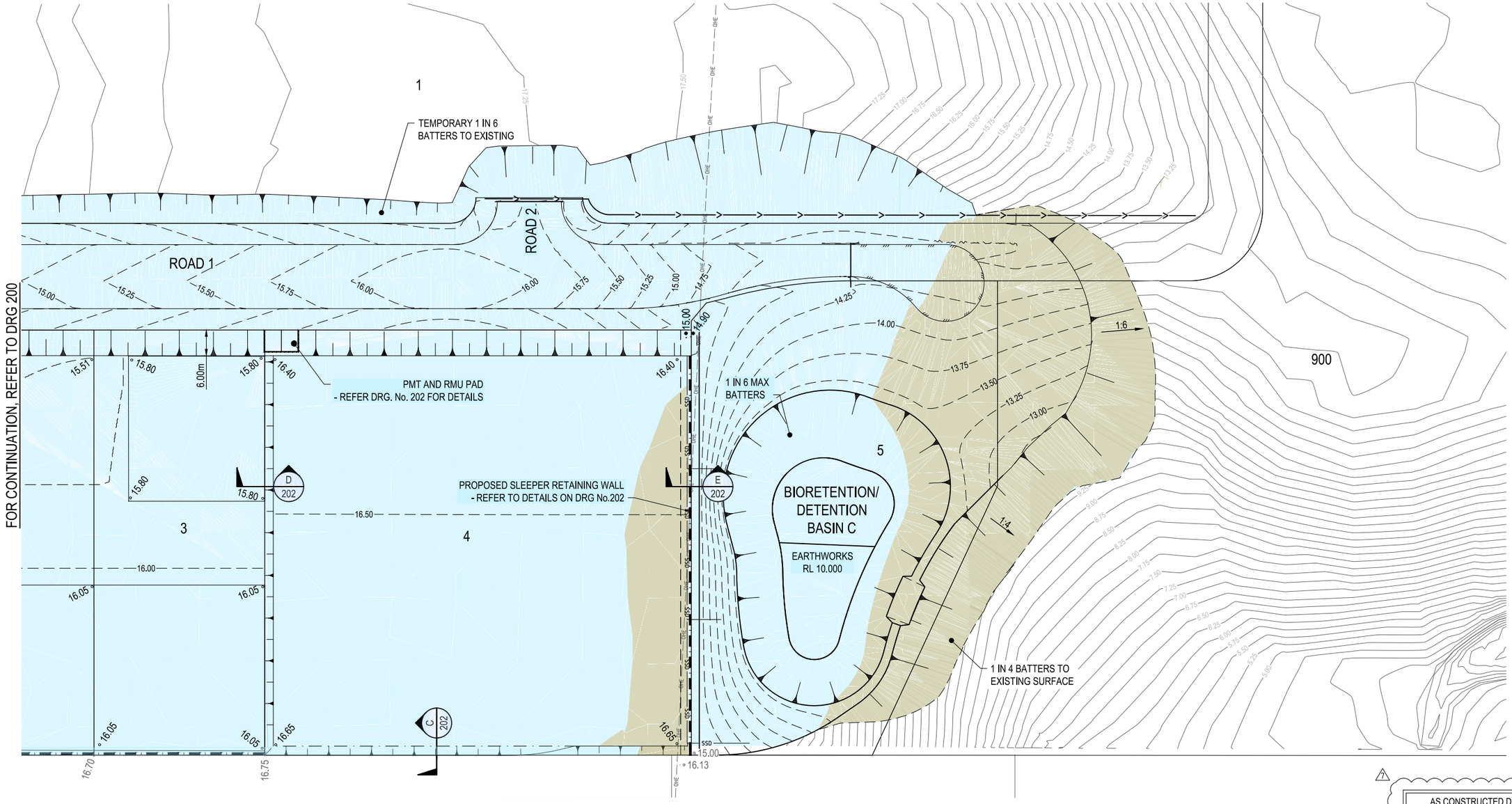
DRAWING TITLE: BULK EARTHWORKS LAYOUT PLAN SHEET 1 OF 3

PROJECT No.	DRAWING No.	REVISION
15-000483	200	5

APPROXIMATE EARTHWORKS VOLUMES (STAGE 1)
CUT: 35,000m³
FILL: 8,800m³
STOCKPILE: 26,200m³

CAUTION !! UNDERGROUND TELECOMMS CABLES	CAUTION !! UNDERGROUND GAS MAIN	CAUTION !! UNDERGROUND ELECTRICAL CABLES	CAUTION !! OVERHEAD ELECTRICAL CABLES	CAUTION !! UNDERGROUND SEWERAGE RISING MAIN
UNDERGROUND TELECOMMUNICATION CABLES EXIST IN THIS VICINITY. CONTACT SUPPLIER FOR CABLE LOCATIONS. EXTREME CARE MUST BE TAKEN WHILST EXCAVATING.	UNDERGROUND GAS MAIN EXIST IN THIS VICINITY. CONTACT SUPPLIER FOR MAIN LOCATIONS. EXTREME CARE MUST BE TAKEN WHILST EXCAVATING	UNDERGROUND ELECTRICITY CABLES EXIST IN THIS VICINITY. CONTACT ENERGEX FOR CABLE LOCATIONS. EXTREME CARE MUST BE TAKEN WHILST EXCAVATING	OVERHEAD ELECTRICITY CABLES EXIST IN THIS VICINITY. CONTACT ENERGEX WHERE CABLE CLEARANCE IS COMPROMISED BY MACHINERY.	UNDERGROUND SEWERAGE RISING MAIN EXIST IN THIS VICINITY. CONTACT LOGAN WATER FOR RISING MAIN LOCATIONS. EXTREME CARE MUST BE TAKEN WHILST EXCAVATING

NOTE:
REFER DRG. 002 FOR LEGEND AND NOTES



AS CONSTRUCTED DETAILS
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SIGNED ..... RPEQ 14843
DATED 29-08-2018

The original issue or last amendment of this drawing contained the original signature.

OW/368/2017

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	BATTER REVISED TO 1 IN 6	LS	LS
5	12.12.17	EARTHWORKS EXTENTS AND PMT SITE AMENDED	LS	LS
6	06.06.18	PMT SITE LOCATION REVISED	LS	LS
7	23.08.18	ISSUED FOR AS CONSTRUCTED	DMP	CS

DRAWN: DMP
DESIGN: CS

STATUS: ISSUED FOR CONSTRUCTION
APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE: 1:500 / 1:1000 — 10 5 0 10 20 — A1 / A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

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PROJECT: HALCYON LOGAN RESERVE STAGE 1

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: BULK EARTHWORKS LAYOUT PLAN SHEET 2 OF 3

PROJECT No.	DRAWING No.	REVISION
15-000483	201	7

NOTE:
REFER DRG. 002 FOR LEGEND AND NOTES

CAUTION !! OVERHEAD ELECTRICAL CABLES	CAUTION !! UNDERGROUND ELECTRICAL CABLES	CAUTION !! UNDERGROUND SEWERAGE RISING MAIN	CAUTION !! UNDERGROUND TELECOMMS CABLES	CAUTION !! UNDERGROUND GAS MAIN
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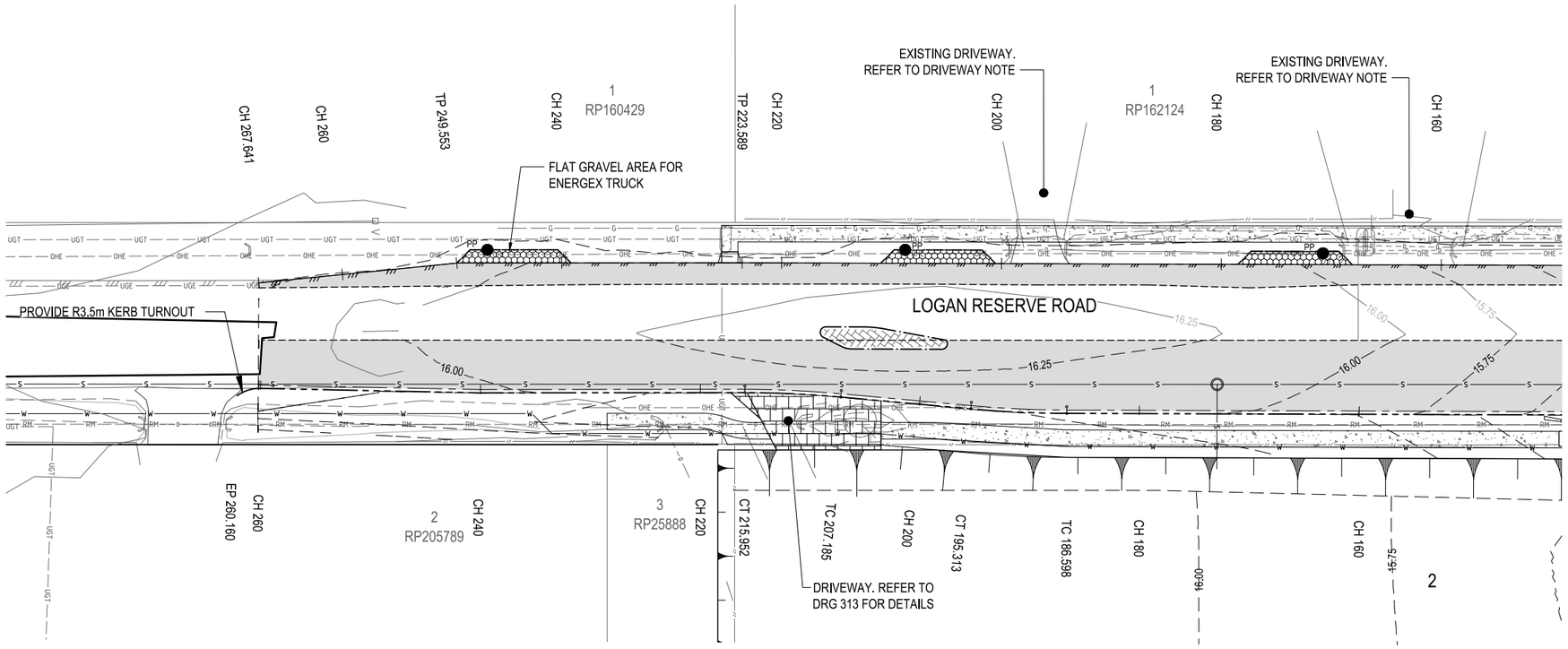
DRIVEWAY NOTE:
EXISTING DRIVEWAY TO BE RECONSTRUCTED TO EXISTING STANDARD UPON COMPLETION OF ROAD WIDENING WORKS. ACCESS TO PROPERTY TO BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION.

NOTE:
ACCESS AND SERVICES TO EXISTING PROPERTIES TO REMAIN AT ALL TIMES.



FOR CONTINUATION REFER DRG 303

6
AS CONSTRUCTED DETAILS
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SIGNED..... RPEQ 14843
DATED 29-08-2018

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OW/368/2017

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	NOTE ADDED AND EXTENTS OF WORKS CHANGED	LS	LS
5	16.05.18	DRIVEWAY CROSS OVER AMENDED AND MEDIAN ISLAND ADDED	LS	LS
6	23.08.18	ISSUED FOR AS CONSTRUCTED	DMP	CS

DRAWN: DMP
DESIGN: CS

STATUS: ISSUED FOR CONSTRUCTION

APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE: 1:250 / 1:500 — 5 0 5 10 — A1 / A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

PROJECT: HALCYON LOGAN RESERVE STAGE 1

DISCLAIMER
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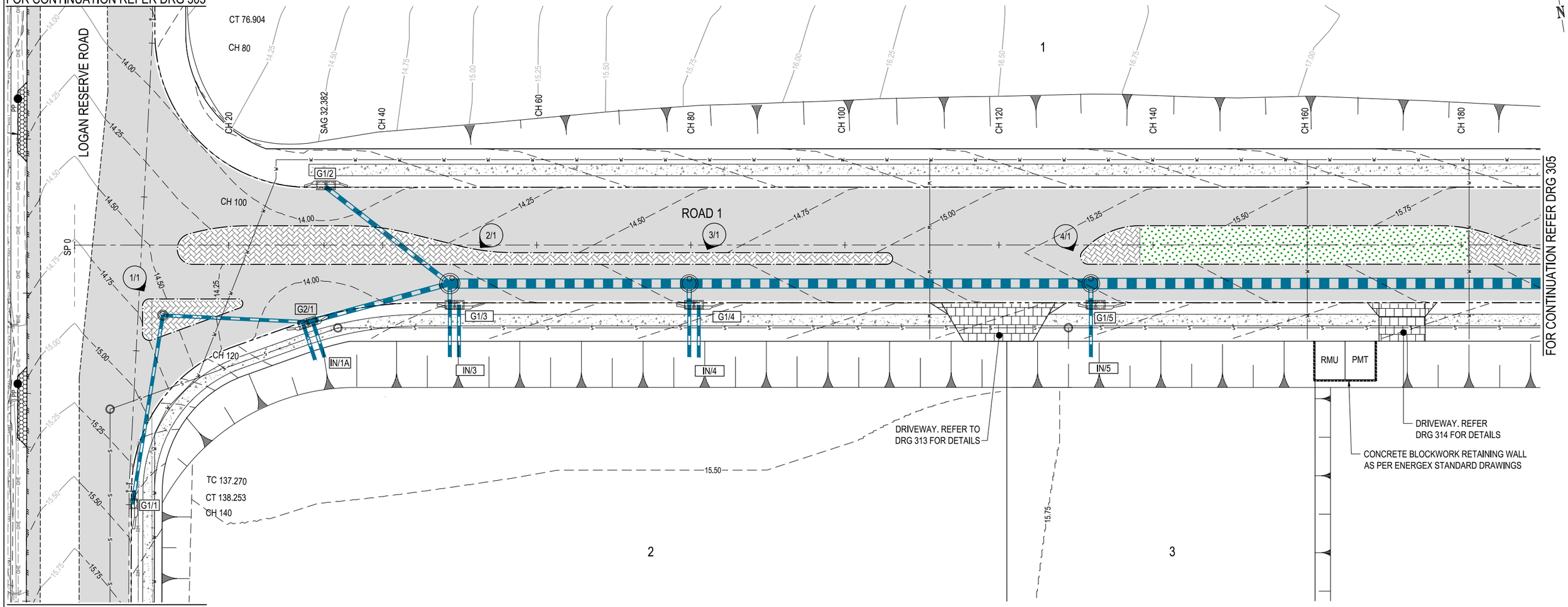
DRAWING TITLE: ROADWORKS AND DRAINAGE LAYOUT PLAN SHEET 1 OF 4

PROJECT No.	DRAWING No.	REVISION
15-000483	302	6

NOTE:
REFER DRG. 002 FOR LEGEND AND NOTES

FOR CONTINUATION REFER DRG 303



FOR CONTINUATION REFER DRG 305

FOR CONTINUATION REFER DRG 302

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2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	STORMWATER DRAINAGE LAYOUT AMENDED, FOOTPATH ADDED AND SWALE REMOVED	LS	LS
5	16.05.18	PMT SITE AND DRIVEWAY LOCATION AMENDED	LS	LS
6	23.08.18	ISSUED FOR AS CONSTRUCTED	DMP	CS

DRAWN: DMP
DESIGN: CS

STATUS: ISSUED FOR CONSTRUCTION

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SCALE: 1:250 / 1:500 — 5 0 5 10 — A1 / A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

PROJECT: HALCYON LOGAN RESERVE STAGE 1

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DRAWING TITLE: ROADWORKS AND DRAINAGE LAYOUT PLAN SHEET 3 OF 4

PROJECT No.	DRAWING No.	REVISION
15-000483	304	6

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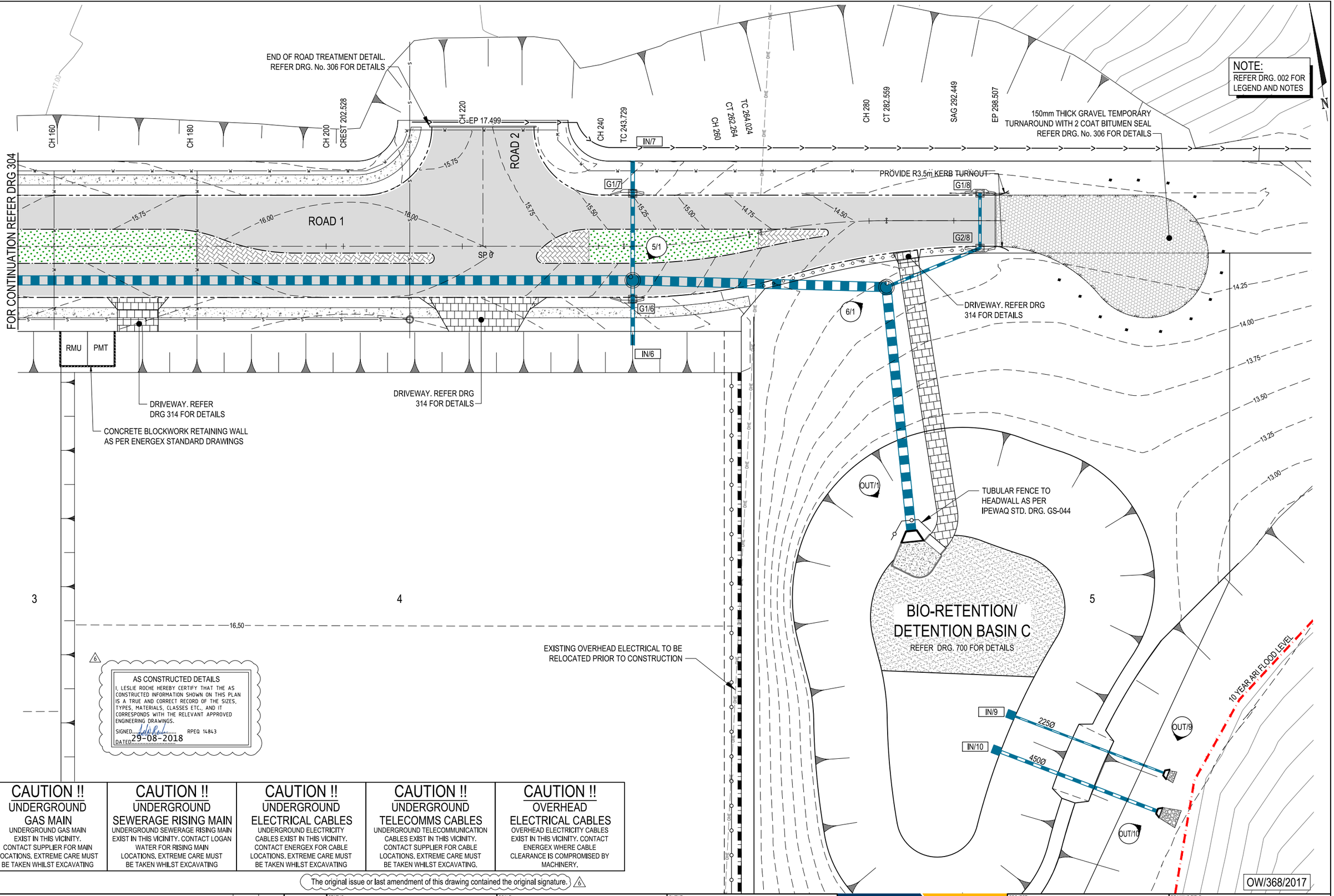
SIGNED ..... RPEQ 14843
DATED 29-08-2018

NOTE:
ACCESS AND SERVICES TO EXISTING PROPERTIES TO REMAIN AT ALL TIMES.

DRIVEWAY NOTE:
EXISTING DRIVEWAY TO BE RECONSTRUCTED TO EXISTING STANDARD UPON COMPLETION OF ROAD WIDENING WORKS. ACCESS TO PROPERTY TO BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION.



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DATED 29-08-2018

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2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	STORMWATER DRAINAGE LAYOUT AMENDED, FOOTPATH ADDED AND SWALE REMOVED	LS	LS
5	16.05.18	PMT SITE AND DRIVEWAY LOCATION AMENDED	LS	LS
6	23.08.18	ISSUED FOR AS CONSTRUCTED	DMP	CS

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DESIGN: CS

STATUS: ISSUED FOR CONSTRUCTION

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CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

PROJECT: HALCYON LOGAN RESERVE STAGE 1

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DRAWING TITLE: ROADWORKS AND DRAINAGE LAYOUT PLAN SHEET 4 OF 4

PROJECT No.	DRAWING No.	REVISION
15-000483	305	6

NOTE:
1. REFER DWG No. 500 FOR SEWERAGE RETICULATION NOTES
2. REFER DWG 500 FOR SEWERAGE RETICULATION LEGEND

N

EXISTING SEWER RISING MAIN
FUTURE STORMWATER DRAINAGE PIPE
WATER MAIN
3/1 E: 1562.455 N: 35261.827
ROAD 1
FUTURE STORMWATER DRAINAGE PIPE
END CAP
E/1 E: 1744.713 N: 35274.714
ROAD 2
0.00
1.75
2250 uPVC
FUTURE STORMWATER DRAINAGE PIPE
3/1
SL.15.092
225Ø uPVC
SL.15.375
SL.15.781
225Ø uPVC
SL.16.220
2/1 E: 1656.175 N: 35247.247
1/1 E: 1744.713 N: 35274.714
15.00
2250 uPVC
SL.14.847
4/1 E: 1531.618 N: 35255.944
FUTURE STORMWATER DRAINAGE PIPE
FUTURE STORMWATER DRAINAGE PIPE
FUTURE STORMWATER DRAINAGE PIPE
1m, PROVIDE 150Ø uPVC PROPERTY CONNECTION
~~IL. 13.910~~ AT 1:60
IL. 14.083
IN HIGHLIGHTED AREA CUT SURFACE TO ULTIMATE SURFACE LEVEL (AS INDICATED BY SPOT LEVELS) TO REDUCE DEPTH OF TRENCHING
1m, PROVIDE 150Ø uPVC PROPERTY CONNECTION
~~IL. 14.100~~ AT 1:100
IL. 14.255
15.50
16.00
2250 uPVC
PROVIDE 1m, 150Ø uPVC, STUB FOR FUTURE CONNECTION
~~IL. 13.104~~ AT 1:180
IL. 13.400
FUTURE STAGE 1
1
RP162124
LOGAN RESERVE ROAD
5/1 E: 1524.634 N: 35211.163
ADOPTED CONTROL LINE 15.95
ADOPTED CONTROL LINE 16.05
x 16.65 ADOPTED CONTROL LINE
EXISTING RM AIR VALVE AND SCRUBBER SIZE AND LOCATION TO BE CONFIRMED ON SITE
3
RP25888
1
RP25888
EXISTING HV ELECTRICAL POLE
16.00
1
RP160429
5.50
0.00
2250 uPVC
2
RP205789
6/1 E: 1506.138 N: 35092.592
PROVIDE 1m, 225Ø uPVC, STUB FOR FUTURE CONNECTION
~~IL. 11.045~~ AT 1:180
IL. 11.614
5.0m LENGTH OF EXISTING BOX CULVERTS TO BE REMOVED FOR INSTALLATION OF SEWER AND WATER MAINS. NEW HEADWALL AND 2 x 1200 x 300 RCBC TO BE INSTALLED TO EXISTING LEVELS UPON COMPLETION OR THIS SECTION MAY BE DIRECTIONAL BORED FINAL METHOD OF CONSTRUCTION TO BE DETERMINED BY CONTRACTOR IN CONSULTATION WITH THE SUPERINTENDENT.

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SIGNED..... RPEQ 14843
DATED.....

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CAUTION !! UNDERGROUND SEWERAGE RISING MAIN
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FOR CONTINUATION REFER TO DWG 502

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REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	06.07.17	FOR OPERATIONAL WORKS APPROVAL	NA	LS
2	03.08.17	REVISED AS PER COUNCIL RFI	LS	LS
3	06.11.17	FOR GENERALLY IN ACCORDANCE APPROVAL	LS	LS
4	27.02.18	INVERT LEVELS AMENDED.	CHC	TR
5	14.08.18	ISSUE FOR AS CONSTRUCTED	DMP	CS

DRAWN
DESIGN

STATUS: AS CONSTRUCTED

APPROVED: LESLIE ROCHE RPEQ 14843
LESLIE ROCHE
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE: 1:500 / 1:1000 — 10 5 0 10 20 — A1 / A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

calibre

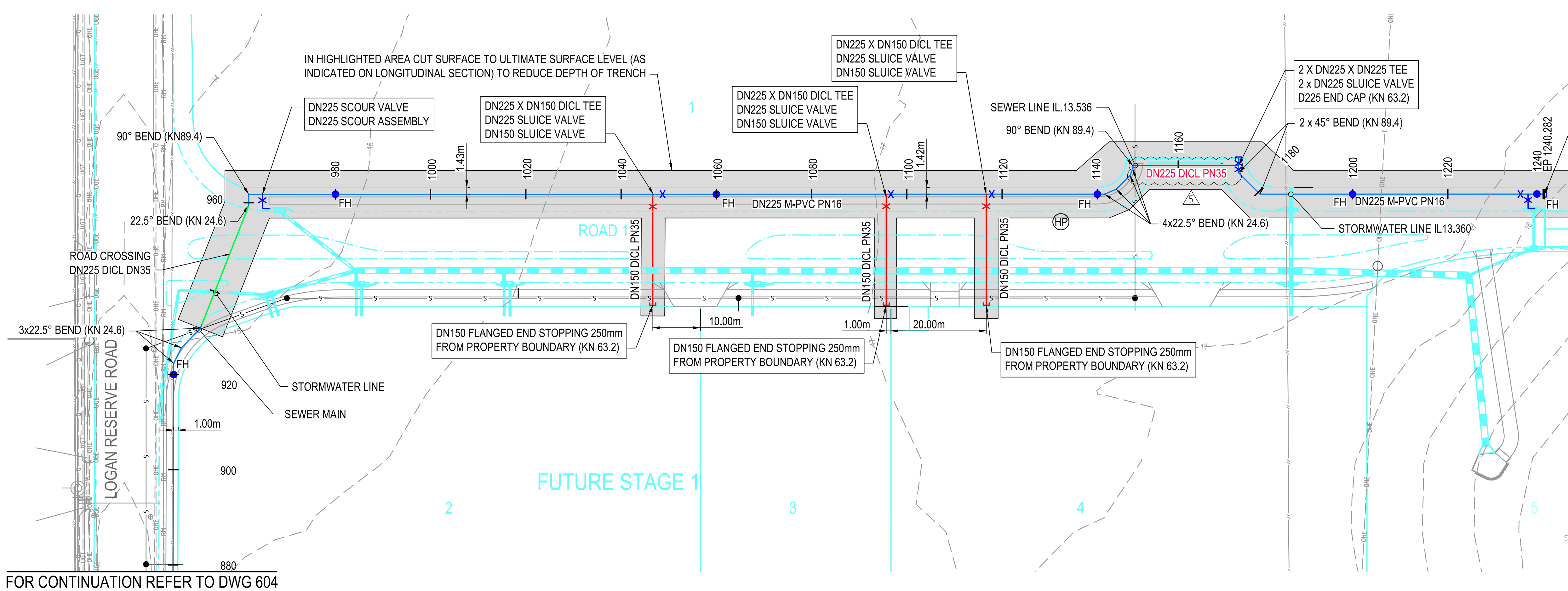
PROJECT: HALCYON LOGAN RESERVE EARLY WORKS - WATER & SEWER

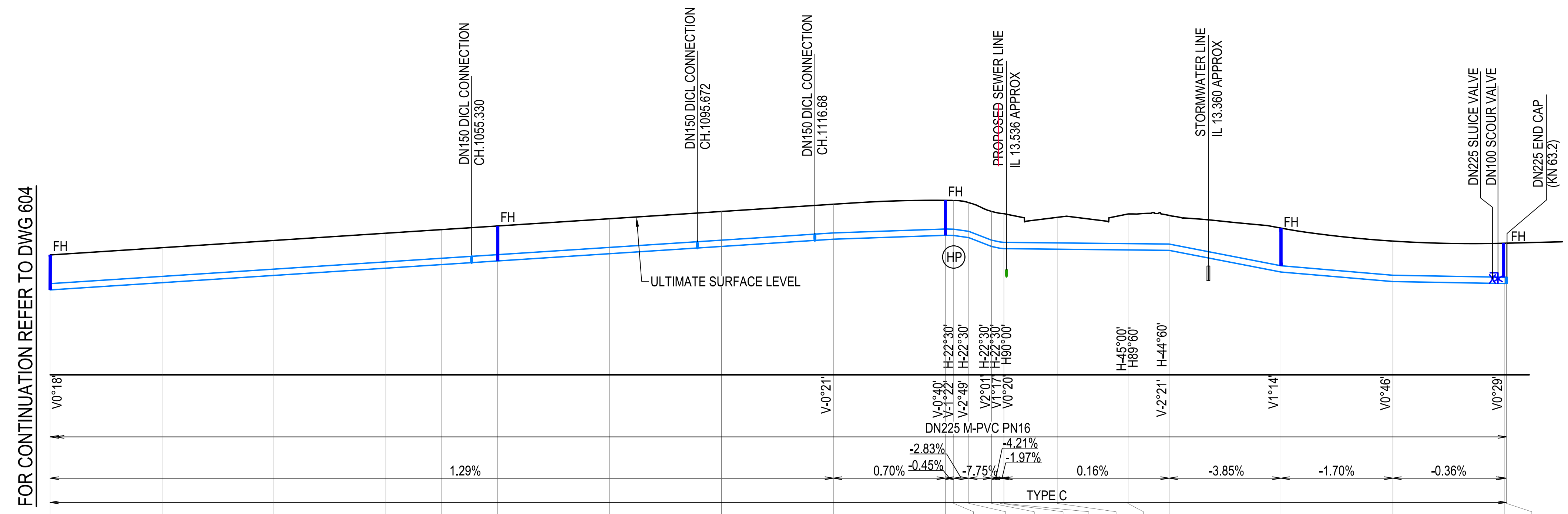
DISCLAIMER: ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: SEWERAGE RETICTULATION LAYOUT PLAN SHEET 2 OF 2

PROJECT No.	DRAWING No.	REVISION
15-000483	503	5

NOTE:
1. REFER DWG No. 600 FOR WATER RETICULATION NOTES
2. REFER DWG 600 FOR WATER RETICULATION LEGEND





DATUM RL 10.000

HORIZONTAL/VERTICAL GEOMETRY

PIPE TYPE: DN225 M-PVC PN16

PIPELINE GRADE: 1.29% | 0.70% | -2.83% | -0.45% | -7.75% | -4.21% | -1.97% | 0.16% | -3.85% | -1.70% | -0.36%

TYPE C

CHAINAGE	DEPTH TO INVERT	PIPE INVERT LEVEL	ULTIMATE SURFACE LEVEL
980	1.250	13.035	14.285
1000	1.250	13.294	14.544
1020	1.250	13.553	14.803
1040	1.250	13.812	15.062
1050	1.250	13.941	15.191
1060	1.250	14.071	15.321
1080	1.250	14.329	15.579
1100	1.250	14.588	15.838
1120	1.250	14.847	16.097
1140	1.250	14.987	16.237
1141.496	1.250	14.980	16.230
1144.192	1.250	14.904	16.154
1148.275	1.250	14.587	15.837
1149.795	1.250	14.523	15.773
1150.473	1.250	14.510	15.760
1160	1.139	14.490	15.629
1172.686	1.286	14.464	15.750
1180	1.250	14.449	15.699
1200	1.570	13.674	15.244
1220	1.446	13.333	14.780
1240	1.442	13.262	14.704
1240.282	1.442	13.264	14.706

CAUTION !!
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SIGNED.............................. RPEQ 14843

DATED..............................

OW/255/2017

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REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	06.07.17	FOR OPERATIONAL WORKS APPROVAL	NA	LS
2	03.08.17	REVISED AS PER COUNCIL RFI	LS	LS
3	06.11.17	FOR GENERALLY IN ACCORDANCE APPROVAL	LS	LS
4	16.05.18	PROPERTY CONNECTION LOCATION AND PIPE MATERIAL TYPE AMENDED	LS	LS
5	14.08.18	ISSUE FOR AS CONSTRUCTED	DMP	CS

DRAWN

DESIGN

STATUS: AS CONSTRUCTED

APPROVED: LESLIE ROCHE RPEQ 14843

*LESLIE ROCHE 5

FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE: 1:500 / 1:1000 — 10 5 0 10 20 — A1 / A3 — HORIZONTAL

1:100 / 1:200 — 2 1 0 2 4 — A1 / A3 — VERTICAL

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

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PROJECT: HALCYON LOGAN RESERVE EARLY WORKS - WATER & SEWER

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DRAWING TITLE: WATER RETICULATION PLAN AND LONGITUDINAL SECTION SHEET 4 OF 4

PROJECT No. 15-000483 | DRAWING No. 605 | REVISION 5

Appendix C Site Based Stormwater Management Plan

Reference 15-000483-01F

PREPARED FOR HALCYON DEVELOPMENTS PTY LTD
DECEMBER 2018
15-000483-01F
ORIGINAL
WATER & ENVIRONMENT

252 Logan Reserve Road, Logan Reserve

Site Based Stormwater Management Plan (Quality & Quantity)

COMMERCIAL IN CONFIDENCE

Calibre Consulting
Ground Floor, 545 Queen Street
BRISBANE QLD 4000

Ph: (07) 3895 3444

DOCUMENT CONTROL
15-000483-01F

Issue	Date	Issue Details	Author	Checked	Approved
A	10/12/2015	For DA Submission	KO	CS	MS (RPEQ 9485)
B	17/05/2016	Information Request Response	CS	MS (RPEQ 9485)	MS (RPEQ 9485)
C	03/11/2017	Operational Works Submission Update	BP	MS	AV (RPEQ 19033)
D	11/09/2018	Layout Update	MP	MS	AV (RPEQ 19033)
E	15/10/2018	Layout Update	MP	AV	AV (RPEQ 19033)
F	04/12/2018	Layout Update	MP	AV	AV (RPEQ 19033)

EXECUTIVE SUMMARY

This report demonstrates that the proposed development at 216-232, 234-252, 254-264 and 266-294 Logan Reserve Road, Logan Reserve will not result in any actionable nuisance to downstream properties due to peak flow discharge and satisfies the required water quality objectives.

Issue A of this report was originally submitted for the DA (COM/6/2016). Issue B of the report was prepared in response to Logan City Council's Information Request dated 19 February 2016. Issue C of the report was prepared to accompany the operational works submission for Stage 1 of the development. Issue D of this report was prepared in response to Logan City Council's *Information Request* (dated 31 July 2018) and to support the updated Site layout incorporating the development of the "Future Development Area" and minor layout changes. The stormwater items of the information request have been address in **Section 3.3**. This report issue (Issue F) has been updated to support the updated Site layout incorporating the Caravan Storage Area. The Caravan Storage Area was previously included in the Issue D report, therefore the only change to this Issue F report is the updated layout shown in **Appendix A**.

A peak flow investigation has been conducted using the Watershed Bound Network Model (WBNM) for the site under existing and developed scenarios. Results of the hydrological modelling indicate that peak flow mitigation can be achieved for the development footprint via providing three detention basins presented below:

- Basin A (private ownership): 4,790m³
- Basin B (private ownership): 1,600m³
- Basin C (will become LCC asset): 4,870m³

All detention basins will be designed to be aesthetically pleasing, safe and will be integrated with surrounding landscapes.

Basin B and C comply with the 1.2m depth requirement during the 20 year ARI, however Basin A has a 1.25m depth during the 20 year ARI. A risk assessment has been undertaken in accordance with *Safety in Design.* Risk mitigation measures such as signage, landscaping to discourage people from entering the basin and emergency egress points will be provided.

No peak flow mitigation measures are proposed within the area of compensatory earthworks in the floodplain on site.

For the entire site peak flow mitigation is achieved at Outlet points 1, 3, 4, 5 and 6. There is an increase in peak flow at Outlet 2 to Logan River (1.51m³/s increase in 100 year ARI). This is due to the compensatory earthworks in the floodplain. This local peak flow increase of 1.51m³/s is less than 0.06% of the regional peak flow (2,590m³/s in 100 year ARI). The local and regional peak flows also do not coincide. Therefore it will not create any actionable nuisance at Logan River and no further peak flow mitigation is proposed at this location.

The proposed stormwater quality management strategy incorporates three combined Bioretention and Detention Basins A, B and C with 1,000m², 450m², and 450m² filter areas respectively. Four Stormwater360 EnviroPod litter baskets (or approved equivalent) are also proposed for the caravan storage area. No stormfilter cartridges are proposed. The strategy satisfies Water Quality Objectives in accordance with the *State Planning Policy* (2014) for the overall development footprint.

Compliance with the waterway stability management requirement is achieved for the development area as the detention basins mitigate 1 year ARI peak flows in comparison to those under the existing scenario.

It is recommended that this stormwater management plan be approved and the management strategies presented within this report be incorporated into future detailed design. Detailed design may result in changes to the concept, however the design objectives presented within this report are to remain unchanged.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

Calibre Consulting (QLD) Pty Ltd has been commissioned by Halcyon Developments Pty Ltd to prepare a *Site Based Stormwater Management Plan (Quality & Quantity)* for the proposed development located at 216-232, 234-252, 254-264 and 266-294 Logan Reserve Road, Logan Reserve.

The development proposal involves the construction of over 300 residential lots and three (3) alternative use allotments in addition to associated roads and open space areas. Refer to **Appendix A** for an extract of the conceptual site layout drawings provided by RPS, which will from herein be referred to as the "site."

Investigations undertaken in this report demonstrate that the development will meet relevant Council and State Government requirements with regards to stormwater quantity and quality management. As part of the stormwater quality management strategies, recommendations for Stormwater Quality Improvement Devices (SQIDs) has been provided.

This report update (Issue E) has been prepared to accompany the updated Site layout. The updated layout documents location of the proposed caravan storage area were not shown on the previous layout (Saunders Havill Group drawing No. **7801 P 09 CD D**). The caravan storage area was included in the stormwater management strategy documented in the Issue D and Issue E report, therefore the only updates to the Issue F report is the Layout documented in **Appendix A** and all analysis, strategies and documentation remain consistent with the Issue D report.

1.1 REPORT OBJECTIVES & SCOPE

The design objectives for this report are:

- Ensure the development complies with the *State Planning Policy* (2014) with regards to Water Quality Objectives (WQOs) and the waterway stability management requirement; and
- Ensure the development complies with Logan City Council (LCC) standards with respect to peak flow mitigation.

The scope of investigations undertaken for this report are as follows:

- Conceptual design of Stormwater Quality Improvement Devices (SQIDs) and Model for Urban Stormwater Improvement Conceptualisation (MUSIC) analysis to demonstrate compliance with the WQOs required under the *State Planning Policy* (2014);
- Identification of lawful points of discharge for the development; and
- Hydrological investigations in accordance with the *Queensland Urban Drainage Manual* (*QUDM,* 2013) and LCC guidelines to demonstrate that the development area will not cause 'adverse impacts' to adjoining private properties with respect to peak flows for standard recurrence intervals up to and including the 100 year Average Recurrence Interval (ARI) storm event. In effect this will also ensure that the development achieves waterway stability management requirement under the *State Planning Policy* (2014).

Based on the outcomes of the above investigations, this report provides recommendations, including concept drawings for stormwater management. These recommendations should be incorporated into future detailed design and subsequent construction documentation.

For Stage 1 detailed design drawings, refer to **Appendix H**.

1.2 PREVIOUS VERSIONS

The initial Site Based Stormwater Management Plan (Issue A) was prepared for DA assessment in January 2015. Issue B of this report, prepared in May 2016, incorporated updates addressing LCC's Information Request dated 19 February 2016. Issue C of this report prepared in November 2017, incorporated the updates to the civil works for the Stage 1 development layout and adjacent area.

Since the submission of the Issue C report, LCC has provided an Information Request (Application No. OW/238/2018 dated 31 July 2018) for the Site. This report (Issue D) has been prepared in response to LCC's *Information Request* and to incorporate updates to the layout and earthworks in support of the development of the "Future Development Area".

The following changes were made to the stormwater analysis:

- Updated hydrological modelling to replicate minor developed catchment changes as a result of the updated layout and the redesign of Basin B; and
- Updated MUSIC modelling based on the additional residential areas incorporated into the layout and minor developed catchment changes.

No other changes were made to the stormwater (quality and quantity) analysis originally presented in report issue A, B & C. Furthermore, the abovementioned analysis updates do not include changes the management strategies proposed. Changes to the configuration of proposed measures are within the development footprint and do not affect regional flooding (presented in Report No. 15-000483-02C).

Changes made to the Issue D report from previous issues have been highlighted with *Italicised* text. The only changes made to the Issue F report from the Issue D report is the Site layout presented in **Appendix A**.

1.3 INFORMATION REQUEST ITEMS

The *Information Request* items addressed in this report, Calibre's response and relevant report sections are outlined below.

2.1 Provide amended plans showing the basin names in accordance with the approved Stormwater Management Plan (Rev C) prepared by Calibre Consulting dated 17/11/2017

Response: All plans have been updated to ensure naming consistency across all documentation and modelling. Refer to **Appendix F** for the amended concept drawings.

2.2 Provide amended cross section drawings for Basin A and Basin B which show the 50 year ARI flood level and demonstrate that the weir will be located above this level for both basins

Response: Basin cross sections drawings for Basin A and Basin B presenting the 50 year ARI flood level has been provided in **Appendix F**. As demonstrated in Drawing No's. **15-000483.03-110** and **15-000483.03-112** in **Appendix F** and **Section 3.3.1.6**, the emergency overflow weirs are not overtopped during a 50 year ARI storm event in either of the proposed basins.

2.3 The proposed levels/features within the stormwater basins appear to differ from the previously approved stormwater management plans (COM/6/2016 and OW/368/2017). Provide an updated stormwater management plan to demonstrate that the change to the basin invert levels, embankment levels, weir levels and lengths and outlet pipe level and size (for Basin A) achieves an equivalent outcome.

Response: The proposed levels and features within the stormwater basins have been updated in accordance with the latest earthworks strategy. All modelling and plans have been updated to represent the updated basin configuration as demonstrated in **Section 3.3.1** and **Appendix F**.

2 SITE CHARACTERISTICS

2.1 LOCATION & SITE DETAILS

The site is located within the LCC local government area as shown on **Figure 2-1**. The real property descriptions of the site are Lot 3 on RP210941, Lot 2 on RP25887, Lot 1 on RP25886, Lot 3 on RP25887 and Lot 41 on MAR618. The site has a total footprint area of 48.97ha.

Figure 2-1: Proposed Logan Reserve Development Site (Source: Nearmap)

As can be seen from **Figure 2-1**, the site is bound by Logan River to the east, Logan Reserve Road to the west, and private properties to the north and south. The site under existing conditions (i.e. pre-development) is significantly pervious with rural residential dwellings located near Logan Reserve Road.

2.2 TOPOGRAPHY AND DRAINAGE

The existing site slopes in multiple directions with the main ridge line running south to north approximately through the middle of the site. Refer to **Appendix B** for the existing site survey. The site is located within the Logan River flood plain and affected by flooding. A flood investigation has been undertaken by Calibre Consulting for the proposed development. Refer to "Flood Investigation Report" dated April 2018 by Calibre Consulting (Report No. **15-000483-02C**).

There is no existing municipal stormwater drainage infrastructure on site, except for the 9No. x 2,700mm diameter culverts under Logan Reserve Road at the northwest corner, and 2No. x 1100mm x 750mm RCBC at 254-264 Logan Reserve Road. There is existing municipal stormwater drainage along Logan Reserve Road to the west. Furthermore, the site contains two existing irrigation dams as illustrated on Drawing No. **15-000483-SK100** in **Appendix F**.

3 PEAK FLOW INVESTIGATION

A Watershed Bounded Network Model (WBNM) has been utilised in the hydrological analysis to determine peak flows originating from the site. The following scenarios were investigated:

- **Calibration Scenario:** Calibration of the WBNM hydrology to the Rational Method calculation. The infiltration loss and lag parameters determined in this model were used as a basis for the subsequent WBNM. The modelling for this scenario is discussed in **Section 3.1.**
- **Existing Scenario:** Representation of the hydrology for the site under existing (pre-development) conditions. This is presented in **Section 3.2**.
- **Developed Scenario:** Representation of the development area peak flows and conceptual sizing of the detention basins. The development of neighbouring sites were not considered. This is presented in **Section 3.3**.

The hydrological modelling presented in this section includes catchment information, land use assumptions used in calculations for the existing and developed scenarios.

Hydraulic modelling presented in Calibre Consulting's *Flood Investigation* Report No. **15-000483-02B** demonstrates no actionable nuisance to downstream dwellings as a result of the site development.

3.1 CALIBRATION SCENARIO

3.1.1 RATIONAL METHOD CALCULATION

The Rational Method calculation was undertaken to calibrate the WBNM peak flows discharging from Catchment B & C of the site to "Outlet C" as shown in **Figure 3-1**.

3.1.1.1 CATCHMENT DATA

Catchment's B & C consist of 19.67ha of catchment area contributing flows to Outlet C. Catchment boundaries were defined based on contours generated from supplied survey. No detention storage was considered in the Calibration Scenario. Refer to **Figure 3-1** for existing catchment delineation.

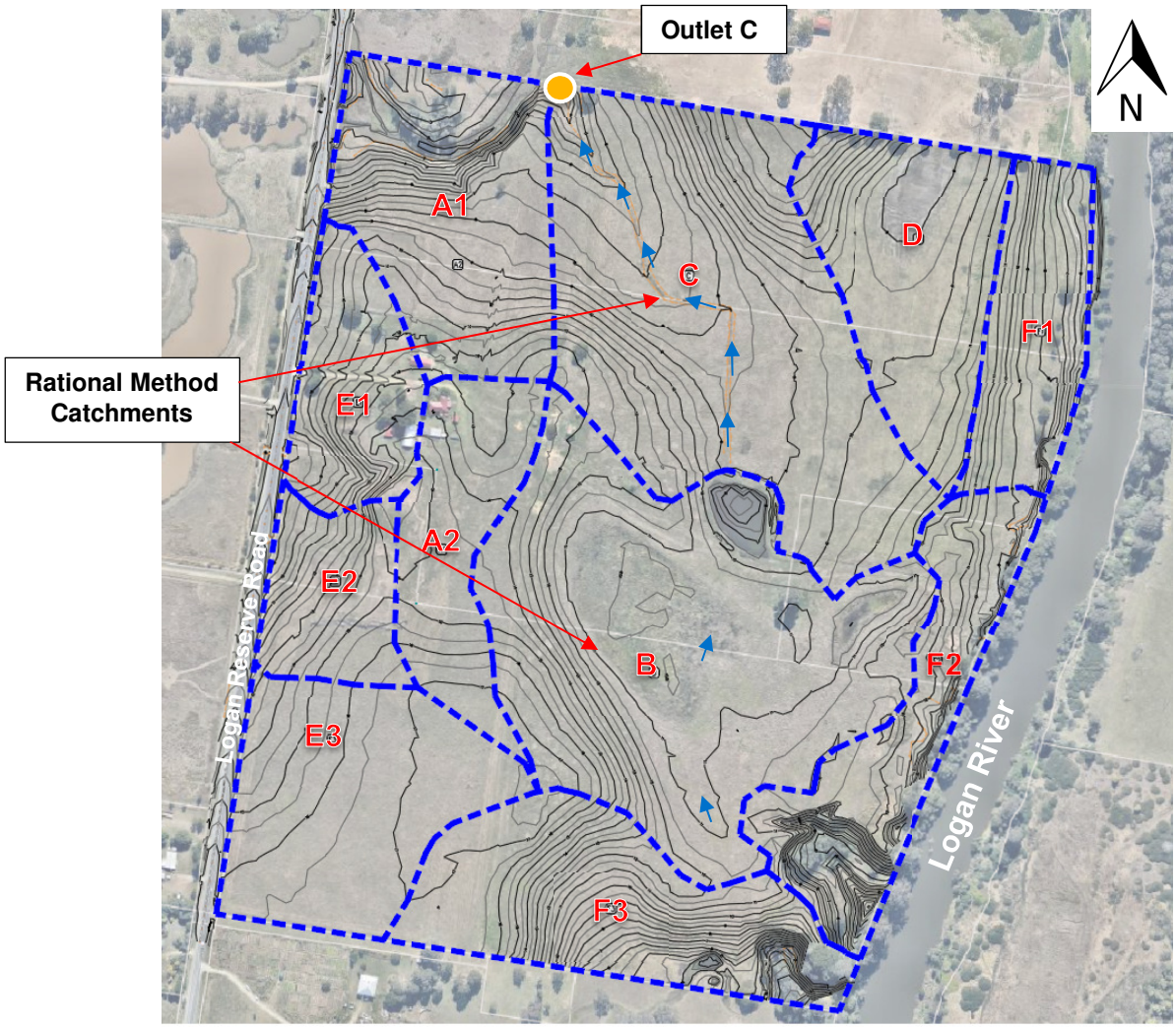

Figure 3-1: Existing Site Catchments

3.1.1.2 TIME OF CONCENTRATION

The time of concentration (t_c) is an input parameter used to derive relevant rainfall intensity for the Rational Method calculation. The following method was used to calculate the t_c for the Calibration Scenario:

- **Overland Sheet Flow & Channel Flow**: Sheet flow travel time was derived using the Friend's Equation in accordance with *Section 4.6.6* of the *QUDM* (2013) for 200m of the upper catchment. Concentrated channel flow in accordance with *Section 4.6.10* of the *QUDM* (2013) was then used to estimate the travel time through the remainder of the catchment based on an assumed velocity of 1.5m/s. Using this method, a t_c of 40 minutes was calculated.

Based on the above method, a t_c of 40 minutes was adopted for the Calibration Scenario. Detailed calculations are presented within **Appendix C**.

3.1.1.3 RAINFALL DATA

Rainfall intensities of the Logan area were adopted from the Bureau of Meteorology's Intensity-Frequency-Duration tool.

3.1.1.4 COEFFICIENT OF RUNOFF

A Coefficient of Runoff (C_{10}) value 0.68 was applied for the Calibration Scenario in accordance with interpolation of *Table 4.5.3* & *4.5.4* of the *Queensland Urban Drainage Manual (QUDM)* (2013).

3.1.1.5 PEAK DISCHARGES

The Rational Method calculation peak flows for Calibration Scenario at Outlet C are presented in **Table 3-1** below.

Table 3-1: Rational Method Calibration Peak Flows at Outlet C

ARI	Rational Method Calibration Peak Flows at Outlet C* (m^3/s)
1	1.36
2	1.85
5	2.63
10	3.10
20	3.72
50	4.79
100	5.53

*Refer to **Figure 3-1** for locality of "Outlet C"

3.1.2 CALIBRATION SCENARIO WBNM

The WBNM was used to determine peak flows for 1 to 100 year ARI storm events for standard durations 15 to 180 minutes. The subsequent sections discuss the model configuration for the WBNM.

3.1.2.1 CATCHMENT DATA

The catchment to Outlet C was divided into two sub-catchments as outlined in **Table 3-2**. No detention storage was considered in Calibration Scenario.

Table 3-2: WBNM Catchments Calibration Scenario

Sub-Catchment	D/S Sub-Catchment	Area (ha)	Fraction Impervious (%)
B	C	9.48	0.13
C	Outlet C	10.19	0.00
Total to Outlet C		**19.67**	**0.06**

3.1.2.2 RAINFALL DATA

Design storm rainfall hydrographs for the Logan region were generated within the WBNM using the log normal intensities and geographical factors presented in **Table 3-3,** which were adopted from the Bureau of Meteorology's Intensity-Frequency-Duration tool.

Table 3-3: WBNM Rainfall Data

Log Normal Intensities	1 hour	12 hour	72 hour
2 year ARI	47.0mm/hr	8.5mm/hr	2.8mm/hr
50 year ARI	86.5mm/hr	17.0mm/hr	5.5mm/hr
Geographical Factors	G	F2	F50
	0.10	4.38	17.20

3.1.2.3 INFILTRATION LOSSES

In calibration of the WBNM to Rational Method calculations, a range of Initial and Continuing Loss values were initially trialled. Optimisation led to the following loss values being adopted for all recurrence intervals modelled.

Table 3-4: WBNM Loss Parameters Calibration Scenario

Pervious Initial Loss (mm)	Pervious Continuing Loss (mm/hr)	Impervious Initial Loss (mm)
15	2.5	2

3.1.2.4 STREAM LAG FACTOR

A flow paths type R value of 1 was used for all sub-catchments.

3.1.2.5 LAG PARAMETER (C VALUE)

A C value of 1.4 was adopted to achieve the best correlation of flows. This lies within the recommended range outlined in *WBNM User Guide* (2007).

3.1.2.6 PEAK FLOWS

The WBNM was calibrated to the lowest percentage variance to the Rational Method. The results from the WBNM and the Rational Method calculation are presented in **Table 3-5** below. The peak flows were compared at Outlet C as illustrated on **Figure 3-1**.

Table 3-5: WBNM Calibration Peak Flows at Outlet C

ARI	QRM Peak Flow at Outlet C* (m^3/s)	WBNM Peak Flow at Outlet C* (m^3/s)	Variance (%)
1	1.44	1.18	-13%
2	1.95	1.80	-3%
5	2.71	2.64	1%
10	3.18	3.16	2%
20	3.81	3.88	4%
50	4.86	4.70	-2%
100	5.62	5.45	-2%

*Refer to **Figure 4-1** for locality of "Outlet C"

As can be seen from the above results, the difference between the Rational Method and the WBNM peak flow at Outlet C is less than 4% for all ARI except for the 1 year ARI. Therefore the WBNM was considered to be well calibrated to the Rational Method calculation. The WBNM parameters outlined above have been adopted for the subsequent hydrological modelling.

3.2 EXISTING SCENARIO

3.2.1 EXISTING SCENARIO WBNM

The WBNM was used to determine peak flows for 1 to 100 year ARI storm events for the standard storm durations 15 to 180 minutes. These durations were confirmed to produce peak flows in the Existing Scenario.

The WBNM for the existing scenario includes detention storage within two existing irrigation dams that are evident within the aerial imagery and contour information.

3.2.1.1 CATCHMENT DATA

The sub-catchment data used in the WBNM for the Existing Scenario is outlined in **Table 3-6** below.

Table 3-6: WBNM Catchments Existing Scenario

Sub-Catchment	Area (ha)	Fraction Impervious (%)
A1	4.68	0.94
A2	2.69	0.29
B	10.19	0.13
C	9.48	0.00
D	3.91	0.00
E1	4.13	1.12
E2	4.48	0.00
F3	5.40	0.00

*Refer to Drawing No. **15-000483-SK100** in **Appendix F** for outlet locations

3.2.1.2 INFILTRATION LOSSES, LAG PARAMETER (C VALUE) & STREAM LAG FACTOR

Infiltration losses, flowpath value, and lag parameter (C Value) were adopted as per the Calibration Scenario.

3.2.1.3 PEAK FLOW RESULTS

The WBNM was re-run for the Existing Scenario incorporating the basins. The peak flows at main discharge points on site are presented in **Table 3-7** below.

Table 3-7: WBNM Existing Peak Flows

ARI	WBNM Existing Peak Flow at Outlets* (m^3/s)					
	OUT1	OUT2	OUT3	OUT4	OUT5	OUT6
	Logan River	Logan River	Logan River	208 Schmidts Road	Logan Reserve Road	Logan Reserve Road
1	0.47	0.29	0.27	0.37	1.40	0.63
2	0.73	0.44	0.40	0.56	2.22	0.98
5	1.04	0.62	0.56	0.79	3.29	1.45
10	1.21	0.74	0.68	0.93	3.93	1.73
20	1.45	0.91	0.83	1.15	4.82	2.11
50	1.72	1.07	0.97	1.36	5.84	2.47
100	2.00	1.24	1.12	1.57	6.76	2.83

*Refer to Drawing No. **15-000483-SK100** in **Appendix F** for outlet locations

3.3 DEVELOPED SCENARIO

This section of the report has been updated for Issue D. The developed unmitigated and mitigated peak outflows at each outlet have been updated based on the Basin B redesign and the minor catchment changes resulting from the updated Site layout. Details of Basin B have been provided to demonstrate the 20 year ARI ponding depth does not exceed 1.2m as required by LCC.

This section has been updated to address Item 2.1, 2.2 & Item 2.3 of Council's IR dated 31 July 2018, specifically the following:

- *All Basin details have been updated in accordance with the updated site layout and earthworks strategies,*
- *Basin level and features have been developed in accordance with the relevant design guidelines,*
- *Plans presented in **Appendix F** and the tables below have been updated to ensure consistency across all documentation, and*
- *Results demonstrate all basins maintain a maximum 20 year ARI ponding depth of 1.2m and all overflow weirs have 50 year ARI immunity.*

The developed unmitigated and mitigated peak outflows at each outlet have been updated based on the Basin B redesign and the minor catchment changes resulting from the updated Site layout.

This section of the report was updated for Issue C. The Developed Unmitigated and Mitigated peak outflows at all outlets have been updated based on the designed civil works associated with the Stage 1 operational works. Information in relation to Outlet 2, 3 and 4 are presented, with details of Basin C indicated, ensuring the 20 year ARI ponding depth is no more than 1.2m. Additional discussion is also provided with respect to mitigating risks associated with the detention basins.

3.3.1 DEVELOPED SCENARIO WBNM

The WBNM was used to determine peak flows for 1 to 100 year ARI storm events for the standard storm durations 15 to 180 minutes. These durations were determined to produce peak flows. The following models were set up for the Developed Scenario analysis.

- **Unmitigated:** To calculate the increases in discharge as a result of the proposed development; and,
- **Mitigated:** To determine required sizing of detention basins to ensure peak flow mitigation of the development discharge.

3.3.1.1 CATCHMENT DATA

Table 3-8 below outlines the sub-catchments for the Developed Scenarios. Drawing No. **15-000483-SK101** in **Appendix F** illustrates the developed sub-catchment boundaries.

Table 3-8: WBNM Catchments Developed Scenario

Sub-Catchment	Area (ha)	Fraction Impervious (%)
A	2.73	60
B	6.67	60
B1	1.84	0
C	5.12	55
D	3.81	74
EX-1	2.45	20
EX-2A	2.58	0
EX-2B	8.19	0
EX-3	3.40	5
EX-4	1.29	0
EX-5	8.32	0
EX-6	3.61	0

*Refer to Drawing No. **15-000483-SK101** in **Appendix F** for catchment delineation.

Table 3-8 *has been amended to reflect the updated developed catchment in accordance with the updated Site layout.*

3.3.1.2 INFILTRATION LOSSES, LAG PARAMETER (C VALUE) & STREAM LAG FACTOR

Infiltration Losses and a Lag Parameter (C Value) of 1.4 were adopted as per the Calibration Scenario. Similarly, a flowpath value of 1 was retained as per the Calibration Scenario for all catchments except for catchment EX-1 which adopted 0.9.

3.3.1.3 UNMITIGATED PEAK FLOW RESULTS

Peak flows for the developed unmitigated scenarios are presented in **Table 3-9** to **Table 3-14** Outlets 1, 5 and 6 represent development area discharge locations. Refer to Drawing No. **15-000483-SK101** in **Appendix F** for outlet locations.

Table 3-9: WBNM Unmitigated Peak Flows at Outlet 1

ARI	Existing Peak Flow at Outlet 1 (m^3/s)	Post-Dev. Unmit. Peak Flow at Outlet 1 (m^3/s)	Variance (%)
1	0.47	0.87	+85%
2	0.73	1.26	+72%
5	1.04	1.75	+68%
10	1.21	2.04	+68%
20	1.45	2.43	+68%
50	1.72	2.81	+63%
100	2.00	3.20	+60%

Table 3-9 *has been updated with the amended unmitigated peak flows from Outlet 1.*

The results in above table demonstrate that peak flow at Outlet 1 will increase. A detention basin will be provided to mitigate these increases. Refer to **Section 3.3.1.4.**

Table 3-10 presents post-development peak flow at Outlet 2.

Table 3-10: WBNM Unmitigated Peak Flows at Outlet 2

ARI	Existing Peak Flow at Outlet 2 (m^3/s)	Post-Dev. Unmit. Peak Flow at Outlet 2 (m^3/s)	Variance (%)
1	0.29	0.64	+120%
2	0.44	1.01	+129%
5	0.62	1.46	+135%
10	0.74	1.72	+133%
20	0.91	2.07	+128%
50	1.07	2.36	+121%
100	1.24	2.75	+122%

***Table 3-10** has been updated with the amended unmitigated peak flows from Outlet 2.*

The results in above table demonstrates that peak flow at Outlet 2 will increase. This is due to the proposed compensatory earthworks in the floodplain. Refer to Drawing No. **15-000483-SK101** in **Appendix F**. The contributing catchment to Outlet 2 does not include any development area.

Outlet 2 discharges directly into Logan River. The increase in peak flow at Outlet 2 due to the compensatory earthworks will not create actionable nuisance because:

- Increase is due to works within floodplain only. There is no increase in impervious area as the contributing catchment to Outlet 2 remains undeveloped;
- Timing of the local catchment peak versus regional peak is significantly different. The 100 year ARI peak flow from the local catchment to Outlet 2 occurs approximately at the 1 hour mark (determined from the WBNM analysis). The TUFLOW flood modelling results show that the regional peak occurs significantly later at 72 hour. Refer to *Flood Investigation Report* (Report No. 15-000483-02C) dated April 2018 for regional flooding;
- A 1.51m^3/s increase at Outlet 2 during the 100 year ARI is approximately 0.06% of the regional 100 year ARI peak flow of 2,589m^3/s;
- A post-development peak flow rate of 2.75m^3/s entering the Logan River at Outlet 2 is negligible compared to regional flow rates of the river. Therefore it will have a negligible effect on river flow regime downstream; and
- The existing floodplain has a higher slope and therefore likely higher velocity compared to the post-compensatory earthworks scenario. Therefore, the post-development scenario will have lower flow velocity and lower scour potential at Outlet 2.

By virtue of the above reasons, no detention basin is proposed at Outlet 2.

Table 3-11 and **Table 3-12** show post-development peak flows at Outlets 3 and 4. The contributing catchments to these two locations are also floodplain areas only. The results demonstrate that peak flows decrease in the post-development scenario. No further peak flow mitigation measures are proposed at Outlet 3 and 4.

Table 3-11: WBNM Unmitigated Peak Flows at Outlet 3

ARI	Existing Peak Flow at Outlet 3 (m^3/s)	Post-Dev. Unmit. Peak Flow at Outlet 3 (m^3/s)	Variance (%)
1	0.27	0.16	-41%
2	0.40	0.23	-43%
5	0.56	0.34	-39%
10	0.68	0.41	-40%
20	0.83	0.49	-40%
50	0.97	0.57	-41%
100	1.12	0.65	-42%

***Table 3-11** has been updated with the amended unmitigated peak flows from Outlet 3*

Table 3-12: WBNM Unmitigated Peak Flows at Outlet 4

ARI	Existing Peak Flow at Outlet 4 (m^3/s)	Post-Dev. Unmit. Peak Flow at Outlet 4 (m^3/s)	Variance (%)
1	0.37	0.35	-7%
2	0.56	0.52	-8%
5	0.79	0.74	-6%
10	0.93	0.89	-4%
20	1.15	1.10	-5%
50	1.36	1.28	-6%
100	1.57	1.48	-6%

***Table 3-12** has been update with the amended unmitigated peak flows from Outlet 4.*

Table 3-13 and **Table 3-14** show post-development unmitigated peak flows at Outlets 5 and 6.

Table 3-13: WBNM Unmitigated Peak Flows at Outlet 5

ARI	Existing Peak Flow at Outlet 5 (m^3/s)	Post-Dev. Unmit. Peak Flow at Outlet 5 (m^3/s)	Variance (%)
1	1.40	1.94	+39%
2	2.22	2.87	+29%
5	3.29	4.07	+24%
10	3.93	4.78	+22%
20	4.82	5.74	+19%
50	5.84	6.76	+16%
100	6.76	7.72	+14%

***Table 3-13** has been updated with the amended unmitigated peak flows from Outlet 5.*

Table 3-14: WBNM Unmitigated Peak Flows at Outlet 6

ARI	Existing Peak Flow at Outlet 6 (m^3/s)	Post-Dev. Unmit. Peak Flow at Outlet 6 (m^3/s)	Variance (%)
1	0.63	0.94	+49%
2	0.98	1.36	+39%
5	1.45	1.90	+31%
10	1.73	2.21	+28%
20	2.11	2.65	+25%
50	2.47	3.05	+23%
100	2.83	3.46	+22%

***Table 3-14** has been updated with the amended unmitigated peak flows from Outlet 6.*

The results demonstrate that if left unmitigated development will cause peak flow increase at Outlet 5 and 6. Detention Basins are proposed to ensure peak flow mitigation at Outlets 5 and 6. Refer to **Section 3.3.1.4.**

3.3.1.4 PROPOSED MITIGATION STRATEGY

The following detention basins (incorporated with stormwater quality treatment) are proposed for peak flow mitigation.

- **Basin A:** a privately-owned combined Bioretention and Detention Basin to mitigate peak flows from the north and eastern part of the development (i.e. Catchment A, B & B1). This basin will be located at the north eastern corner of the development;
- **Basin B:** a privately-owned combined Bioretention and Detention Basin to mitigate peak flows from a majority of the development (i.e. Catchment C). This basin will be located at the north western corner of the site; and
- **Basin C:** a combined Bioretention and Detention Basin to mitigate peak flows from the southern part of the development (i.e. Catchment D). Located at the south-eastern corner of the development site, this basin will become a LCC asset.

The proposed detention basins were conceptually designed generally in accordance with *Section 3.6.6* of LCC's *Logan Planning Scheme SC6.2.5 Planning Scheme Policy 5 – Infrastructure*. Conceptual locations of the basin locations are presented in **Figure 3-2** and also in Drawing No. **15-000483-SK101** in **Appendix F**. The basin shapes shown below are conceptual only. All basins will have overflow weirs at or above the 50 year ARI regional flood level. Refer to **Appendix H** for Stage 1 Operational Works drawings for further details.

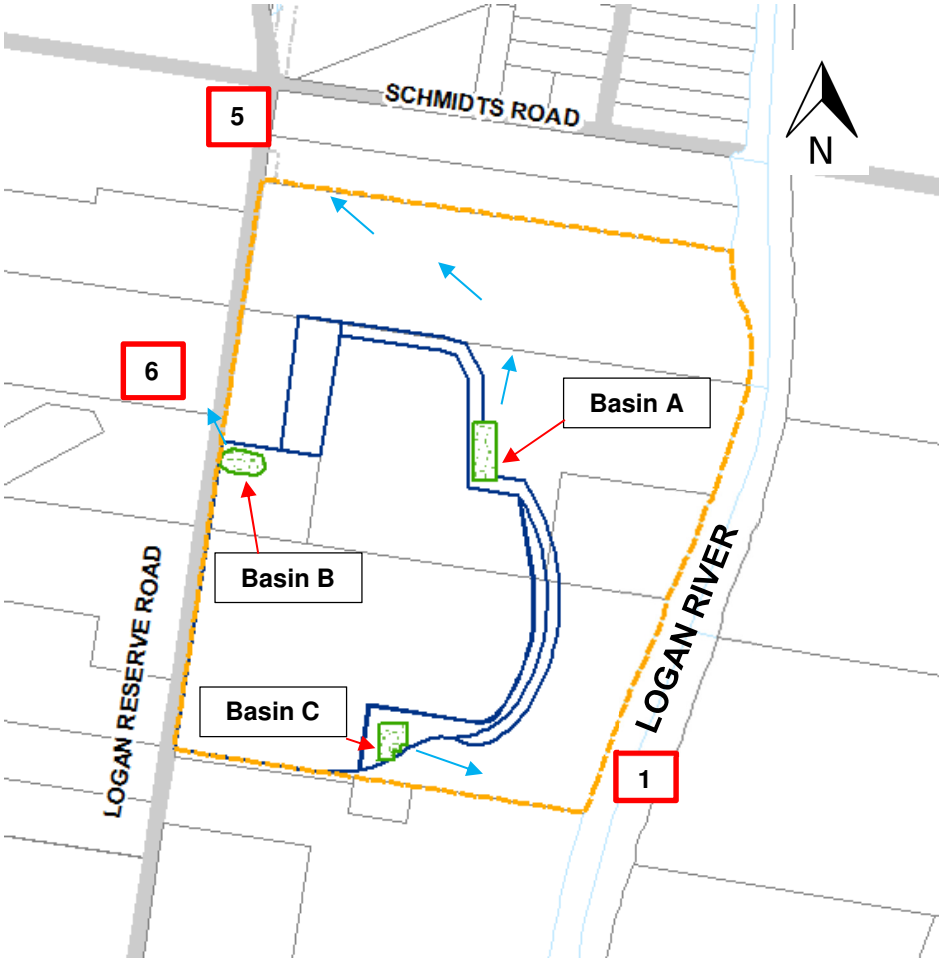

Figure 3-2: Detention Basin Locations

Table 3-15: Detention Basin Concept Details

Basin Details	Basin A	Basin B	Basin C
Volume (m^3)	4,790	1,600	4,870
Embankment Level (m AHD)	13.30	11.00	13.40
Bioretention/Basin Invert (m AHD)	11.20	9.4	10.70
Bioretention Surface Area (m^2)	1,000	450	450
Outlet 1	900 x 900 at RL 11.50 375ø at IL 10.20	900 x 900 at RL 9.70 375ø at IL 8.475	900 x 900 at RL 11.00 225ø pipe at IL 9.775
Outlet 2	1200x1200 at RL 12.02 1200ø at IL 10.125	900 x 900 pit at RL 10.25 900ø at IL 8.40	900 x 900 pit at RL 11.60 450ø at IL 9.700
Overflow Weir	10m weir at RL 12.90	4m weir at RL 10.70	10m weir at RL 12.95

Note: Further basin configuration details are provided in **Appendix C**.
All levels are to AHD.

***Table 3-15** has been amended to reflect the updated Basin B volume and outlet configuration requirements. Refer to Drawing No. **15-000483-SK101** for the relocation of Basin B.*

Conceptual outlet details and the stage-storage discharge relationships are presented in **Appendix C**. Refer to **Appendix H** for Stage 1 Operational Works drawings for further details.

3.3.1.5 MITIGATED PEAK FLOW RESULTS

The WBNM analysis including the proposed detention basins produced the following mitigated peak flows at Outlets 1, 5 and 6. Refer to Drawing No. **15-000483-SK101** in **Appendix F** for Outlet 1, 5 and 6.

Table 3-16: WBNM Mitigated Peak Flows at Outlet 1

ARI	Existing Peak Flow at Outlet 1 (m^3/s)	Post-Dev. Mitigated Peak Flow at Outlet 1 (m^3/s)	Variance (%)
1	0.47	0.44	-6%
2	0.73	0.65	-11%
5	1.04	0.89	-15%
10	1.21	1.12	-8%
20	1.45	1.40	-3%
50	1.72	1.68	-3%
100	2.00	1.88	-6%

***Table 3-16** has been updated with the amended mitigated peak flows from Outlet 1.*

Table 3-17: WBNM Mitigated Peak Flows at Outlet 5

ARI	Existing Peak Flow at Outlet 5 (m^3/s)	Post-Dev. Mitigated Peak Flow at Outlet 5 (m^3/s)	Variance (%)
1	1.40	1.21	-14%
2	2.22	2.10	-5%
5	3.29	3.20	-3%
10	3.93	3.86	-2%
20	4.82	4.79	-1%
50	5.84	5.84	0%
100	6.76	6.73	-1%

***Table 3-17** has been updated with the amended mitigated peak flows from Outlet 5.*

Table 3-18: WBNM Mitigated Peak Flows at Outlet 6

ARI	Existing Peak Flow at Outlet 6 (m^3/s)	Post-Dev. Mitigated Peak Flow at Outlet 6 (m^3/s)	Variance (%)
1	0.63	0.61	-4%
2	0.98	0.89	-9%
5	1.45	1.39	-4%
10	1.73	1.49	-2%
20	2.11	2.08	-2%
50	2.47	2.46	0%
100	2.83	2.81	-1%

***Table 3-18** has been amended to reflect the updated mitigated peak flows discharging from Outlet 6 when incorporating the updated basin configuration. It is to be noted the updated Basin B outlet volume and outlet configuration continue to mitigate peak flows to existing conditions. As such the proposed development complies with the peak flow mitigation requirement of LCC guidelines.*

The results indicate peak flows at Outlet 1, Outlet 5 and Outlet 6 reduce in all recurrence intervals as a result of the proposed detention basins. Therefore, the proposed development complies with the peak flow mitigation requirement of LCC guidelines.

Refer to **Appendix C** for peak outflows from the basins for all durations modelled.

3.3.1.6 DETENTION BASIN WATER SURFACE LEVELS

Maximum water surface levels in the basins for the modelled design events are presented in **Table 3-19**.

Table 3-19: Detention Basin Water Surface Levels

ARI	Basin A		Basin B		Basin C	
	Depth (m)	WSL (mAHD)	Depth (m)	WSL (mAHD)	Depth (m)	WSL (mAHD)
1	0.88	12.08	0.81	10.21	0.76	11.46
2	1.01	12.21	0.98	10.38	0.94	11.64
5	1.12	12.32	1.08	10.48	1.04	11.74
10	1.18	12.38	1.13	10.53	1.09	11.79
20	1.25	12.45	1.19	10.59	1.18	11.88
50	1.32	12.52	1.26	10.66	1.30	12.00
100	1.39	12.59	1.32	10.72	1.42	12.12

***Table 3-19** has been updated to reflect the maximum water surface levels in Basin B for the modelled design events. As demonstrated above, Basin B maintains a 20 year ARI ponding depth of no more than 1.2m as required under the LCC guidelines. Furthermore, the levels presented above demonstrate the major overflow weir for each basin will not be overtopped during a 50 year ARI and hence addressing Item 2.2 of Council's Information Request.*

As can be seen, Basin B and C has 20 year ARI ponding depths no more than 1.2m.

Basin A however, has a 20 year ARI ponding depth of 1.25m, which is 50mm higher than LCC recommended 1.2m depth limit for the 20 year ARI. An additional 50mm of ponding during the 20 year ARI event will not impose any added risk and will not reduce the ability of an individual to evacuate the basin in the unlikely event of flash flooding. A *Safety in Design* risk assessment has been undertaken for the Detention Basin A (refer to **Appendix G)**. To mitigate any possible risk, the following will be provided as a minimum:

- Warning signs;
- Flood depth indicators;
- Access/exit point no steeper than 1 in 6 with signage; and
- Landscaping and signage to discourage people entering the basin.

All Detention Basins will be designed and constructed to be aesthetically pleasing and safe. Landscape design will be undertaken during detailed design phase. The following things have been considered for all three basins:

- Basin batters no steeper than 1 in 4, with 1 in 6 batters where possible;
- Maintenance access will be provided for all three basins, with the access path no steeper than 1 in 6;
- Any retaining walls associated with the basins will be located in the allotments outside of dedicated park areas;
- Retaining walls will incorporate safety fencing;
- Detention basins will be integrated with the surrounding landscape. Landscape design will be undertaken during detailed design phase;
- The overflow weir will be provided at or above the 50 year ARI regional flood level; and
- Minimum freeboard of 300mm in the 100 year ARI storm event in accordance with *Table 3.6.6.3.1 – Freeboard Requirements* of LCC's *Logan Planning Scheme SC6.2.5 Planning Scheme Policy 5 – Infrastructure*.

3.3.2 SUMMARY

Developed Scenario hydrological modelling demonstrates the following:

- Peak flows to Outlets 1, 5 and 6 are reduced due to the proposed mitigation strategy;
- Peak flows at Outlets 3 and 4 are also reduced;
- Peak flows at Outlet 2 have increased, however the peak from the local catchment does not coincide with the peak from the regional catchment;
- All detention basins will be designed and constructed to be aesthetically pleasing and safe;
- Basins B and C comply with the 1.2m depth requirement during the 20 year ARI;
- Basin A exceeds 1.2m by 70mm during the 20 year ARI, however risk mitigation measures will be incorporated into the future detailed design and subsequent construction; and
- All basins will provide 300mm freeboard and integrate with surrounding landscape.

3.4 WATERWAY STABILITY MANAGEMENT

As part of the design objectives of the *State Planning Policy* (2017) for urban stormwater management, developments are required to achieve the waterway stability management criteria. The aim of the waterway stability management is to reduce the impacts of urban development on channel bed and bank erosion by limiting changes in flow rate and duration within receiving waters. The development satisfies the waterway stability management requirement as peak flows are mitigated in comparison to those under Existing Scenario conditions.

4 STORMWATER QUALITY

This section of the report has been amended for Issue B. The stormwater catchment layout has been updated to reflect the latest Site layout incorporating the "Future Development Area" and minor developed catchment changes as a result of the updated layout.

This section of the report has been updated for Issue C. The stormwater quality catchment layout has been updated to be in line with the Stage 1 operational works drawings, provided in **Appendix H**.

In accordance with the *State Planning Policy* (2017) it is a requirement that new developments in Queensland provide stormwater quality treatment to meet relevant Water Quality Objectives (WQOs). Therefore, Stormwater Quality Improvement Devices (SQIDs) are proposed to intercept and capture the pollutants in runoff before leaving the site. This section of the report discusses the following:

- Identification of significant stormwater pollutants associated with the proposed development;
- Identification of the applicable WQOs for the site;
- Recommended measures to mitigate the export of pollutants in runoff from the development site; and
- Conceptual sizing and modelling of the proposed measures to demonstrate the identified WQOs can be achieved.

4.1 POLLUTANTS OF CONCERN

Typical key pollutants expected to be generated during the operational (post-construction) phase of the planned development are listed as follows, with those presented in capitals being the key pollutants to be targeted for treatment:

- LITTER
- SEDIMENT
- Oxygen demanding substances (possibly present)
- NUTRIENTS (N & P)
- Pathogens / Faecal coliforms
- Hydrocarbons
- HEAVY METALS (associated with fine sediments)
- Surfactants
- Organochlorines & organophosphates
- Thermal pollution
- pH altering substances

Only the key pollutants will be further addressed in this report; however, the treatment train developed will adequately mitigate the other pollutant loads. As heavy metals will predominately be associated with fine sediment, controls proposed to reduce total suspended solids will also adequately reduce loads of heavy metals.

4.2 WATER QUALITY OBJECTIVES

The load reduction WQOs presented in **Table 4-1** have been adopted from LCC's *Stormwater Quality and Flow Management Guidelines* (2013) and are also the required WQOs for urban developments within South East Queensland under *Appendix 3* of the *State Planning Policy* (2017).

Table 4-1: Load Reduction Water Quality Objectives for South East Queensland

Pollutant	Total Suspended Solids (kg/yr)	Total Phosphorus (kg/yr)	Total Nitrogen (kg/yr)	Gross Pollutants (kg/yr)
Load Reduction Target	80%	60%	45%	90%

4.3 STORMWATER QUALITY MANAGEMENT STRATEGY

The proposed site measures for treatment of stormwater runoff from the developed areas are three end of line Bioretention devices located at the nominated discharge points, and Stormwater360 EnviroPod litter baskets (or approved equivalent) for the caravan storage area. Refer to Drawing No. **15-000483-SK101** in **Appendix F** for the conceptual plan.

The Bioretention treatment areas will also be integrated into the proposed detention basins mitigating peak flow as discussed in **Section 3.** The Bioretention areas have been conceptually sized using MUSIC modelling software.

These Bioretention Basins will discharge treated runoff generally onto land adjacent to the development areas as shown on Drawing No. **15-000483-SK101** in **Appendix F**.

Bioretention systems utilise sandy loam soil based media to filter runoff. Sediment particle and suspended solids are trapped within vegetation and on the surface of the filter media while micro-organisms and vegetation remove dissolved nutrients (nitrogen and phosphorus) through biological uptake processes. Subsoil drainage provided below the filter media allows for the treated runoff to discharge from Bioretention systems.

Sediment forebays will be provided at Bioretention Basin inlets. The sediment forebays have not been included in MUSIC modelling and will be sized during detailed design in accordance with Healthy Waterway's *Bioretention Technical Design Guidelines* (2014).

Stormwater360 EnviroPod litter baskets (or approved equivalent) will be installed within stormwater pits located in the caravan storage area. They will remove gross pollutants, coarse sediments and associated pollutants (e.g. hydrocarbons, metals etc) before stormwater is discharged from the development. No stormfilter cartridges are proposed.

The subsequent sections from herein discuss the modelling of the abovementioned Bioretention Basins using MUSIC.

4.4 MUSIC MODELLING METHODOLOGY

Water quality modelling of the proposed site has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version 6.1.0, developed by the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC enables the user to conceptualise the transfer of pollutants through a stormwater drainage system and provides an aid in quantifying the effectiveness of the proposed stormwater quality treatment train. MUSIC only provides quantitative modelling for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN) and Gross Pollutants (GP).

4.4.1 METEOROLOGICAL DATA

Six minute pluviographic data was sourced from the Bureau of Meteorology (BOM) for Greenbank Thompson Road Station (No. 40659).

The 10 year period from 1 January 1980 to 31 December 1989 has been adopted for the rainfall duration. The mean annual rainfall for this period is 745mm which corresponds to the mean annual rainfall as specified in the *MUSIC Modelling Guidelines* (2010).

Monthly evapotranspiration data for the 10 year period was sourced from the *MUSIC Modelling Guidelines* (2010) and entered into the MUSIC Model.

4.4.2 SOURCE NODES

Source nodes represent the catchment areas within the development modelled in MUSIC. The model incorporates multiple sub-catchment source nodes representing runoff from road, roof and ground areas as per the split catchment methodology outlined within the *MUSIC Modelling Guidelines* (2010).

Rainfall runoff parameters were assigned as 'urban residential' for development areas as provided by *Table 3.7* of *MUSIC Modelling Guidelines* (2010). Pollutant export parameters for the split catchments road, roof and ground were taken from *Table 3.8* of *MUSIC Modelling Guidelines* (2010).

The source nodes of the proposed Logan Reserve development have been split as detailed in **Table 4-2**. Refer to **Appendix D** for MUSIC model layout.

Table 4-2: MUSIC Source Node Characteristics

Catchment	Source Node Name	Modelled Node Type	Area (ha)	Fraction Impervious (%)
A	Roof (A)	Urban Roof	1.046	100
	Road (A)	Urban Road	0.578	60
	Ground (A)	Urban Ground	1.109	20
B	Roof (B)	Urban Roof	1.735	100
	Road (B)	Urban Road	1.582	60
	Ground (B)	Urban Ground	1.941	20
	Park (B)	Urban Ground	0.046	5
	Leisure Facility (B)	Urban Ground	0.971	70
	Basin Surrounds (A)	Urban Ground	0.397	0
	Carpark (B)	Urban Road	0.608	85
C	Roof (C)	Urban Roof	1.619	100
	Road (C)	Urban Road	0.999	60
	Ground (C)	Urban Ground	1.661	20
	Park (C)	Urban Ground	0.060	0
	Commercial Roof (C)	Commercial Roof	0.155	100
	Commercial Road (C)	Commercial Road	0.062	80
	Commercial Ground (C)	Commercial Ground	0.093	80
	Basin Surrounds (B)	Urban Ground	0.467	0
D	Road (D)	Urban Road	1.108	60
	Commercial Roof (D)	Commercial Roof	1.238	100
	Commercial Ground (D)	Commercial Ground	0.495	80
	Commercial Road (D)	Commercial Ground	0.743	80
	Basin Surrounds (C)	Urban Ground	0.226	0
EX-1	Caravan Storage	Urban Ground	1.609	100

Note: Road areas measured from the layout provided in Appendix A
Residential lot areas measured from the layout provided in Appendix A and split 50-50 between roof and ground
Commercial lot areas in Catchment B & C split 80-20 between roof & ground
Commercial & Aged Care lot areas in Catchment D split 50-20-30 between roof, road & ground

***Table 4-2** has been updated to reflect the amended developed catchments in accordance with the amended Site layout.*

4.4.3 DRAINAGE LINKS

Default drainage link settings have been adopted for the model. As stated in *Section 4.17* of *MUSIC Modelling Guidelines* (2010), MUSIC's default settings apply a conservative approach in assessing treatment performance, assuming all flows and pollutants from the catchment arrive at the treatment node at the same time. Any flow routing has not been incorporated in accordance with *Section 4.17* of *MUSIC Modelling Guidelines* (2010).

4.4.4 TREATMENT NODES

The proposed treatment train for the development comprises of three Bioretention Basins positioned downstream of the identified catchment areas and the four Stormwater360 EnviroPod litter baskets. Refer to **Appendix D** for MUSIC layout.

4.4.4.1 BIORETENTION BASINS

Bioretention treatment nodes were utilised in modelling of the proposed three Bioretention Basins. Default K and C* values were adopted for these treatment nodes. These treatment nodes were set up generally in accordance with the *MUSIC Modelling Guidelines* (2010). Optimised Bioretention Basin sizes and modelled parameters are presented below in **Table 4-3**.

The final footprint area of the basins is subject to detailed design. It is also noted that appropriate pre-treatment (e.g. sediment forebays) will be provided during the detailed design.

Table 4-3: Bioretention Parameters

Parameters	Basin A	Basin B	Basin C
Filter and Surface Area (m^2)	1,000	450	450
Extended Detention Depth (mm)	300	300	300
Filter Depth (mm)	400	400	400
Filter Type	Sandy Loam	Sandy Loam	Sandy Loam
Saturated Hydraulic Conductivity (mm/hr)	200	200	200
Filter Median Particle Diameter (mm)	0.45	0.45	0.45
TN Content of Filter Media (mg/kg)	400	400	400
Orthophosphate Content of Filter Media (mg/kg)	30	30	30

The overflow weir of each Bioretention Basin has been conservatively modelled as 10% of the basin filter area.

4.4.4.2 STORMWATER360 ENVIROPODS

Stormwater360 EnviroPods were modelled in MUSIC using a GPT Treatment Node. The treatment node was configured in accordance with Stormwater360 MUSIC modelling documentation with no TP or TN removal. **Table 4-4** outlines the number of EnviroPods adopted and calculated high flow bypass required. Refer to **Appendix D** for MUSIC model layout.

Table 4-4: Stormwater360 EnviroPod Configuration

Sub-Catchment	No. of EnviroPods	High Flow Bypass (m^3/s)
Caravan Storage Area	4	0.08

4.5 MUSIC MODELLING RESULTS

Table 4-5 below provides the results from MUSIC modelling for the overall development.

Table 4-5: MUSIC Modelling Results

Description	Pollutant Load (kg/year)			
	TSS	TP	TN	GP
WQO (% Reduction)	**80%**	**60%**	**45%**	**90%**
Source Loads – without SQIDs (kg/yr)	17,900	36.4	215	2,540
Residual Loads – with SQIDs (kg/yr)	3,030	10.9	103	16.5
% Reduction Achieved	83	70	52	99
WQO Achieved?	**YES**	**YES**	**YES**	**YES**

***Table 4-5** has been updated to reflect the updated MUSIC modelling results.*

The above results indicate that the concept stormwater quality strategy is effective in treating pollutant loads generated from the proposed development and achieves the WQOs required under the *State Planning Policy* (2017) for the overall development area.

5 CONSTRUCTION, OPERATIONAL MANAGEMENT & MAINTENANCE OF SQIDS

The following sections discuss the inspection and maintenance details of the SQIDs proposed. **Appendix E** outlines the frequency and procedures for the maintenance inspections of Bioretention Basins and Stormwater360 EnviroPods. General requirements, health and safety and yearly reviews for the SQIDs are outlined in **Section 5.4**.

No monitoring of water quality is proposed. The level of operational management and the maintenance proposed is considered best practice and if followed will ensure SQIDs will operate to their design intent.

5.1 BIORETENTION BASINS

Outlined below are the proposed procedures and methodology for the construction and operational management of the Bioretention & Detention Basins. Details provided in this section will be incorporated into the detailed design.

5.1.1 CONSTRUCTION & ESTABLISHMENT PHASES

Construction of the development and the building works has the potential to mobilise large quantities of sediment in runoff. For Bioretention Basins to perform as designed the filter media and basin vegetation needs to be protected during construction. A staged construction and establishment method for construction is proposed generally in accordance with *Option 1* of the *Staged Construction and Establishment Methodology* as outlined in *Table 3.6* and *Section 3.8.1* of the Water by Design *Construction and Establishment Guidelines* (2010). A summary of this methodology is presented below.

1. Civil Works (Functional Installation) – Initially the Bioretention & Detention Basins will be used as a Sediment Basins. Once the majority of the civil construction works are complete, earthworks and shaping to create the layout and functional elements of the Bioretention Basins will be undertaken. The installation of functional elements (e.g. inlets, outlets structures, subsoil drainage, transition layers and filter media) shall be undertaken as per the methodology detailed in *Section 3.9.1* in the *Water by Design Construction and Establishment Guidelines* (2010). Prior to the commencement of the Building Phase, sediment fences will be erected around the perimeter of the basins to avoid the entry of sediment. Laying a temporary filter cloth (or 25mm thick layer of course sand and 25mm of topsoil) over the basins shall protect the filter media during both the Civil Works and the Building Phase.
2. Building Phase (Building Construction) – During this phase the Bioretention Basins' extended detention depths shall continue operate as Temporary Sediment Basins. Sediment fences shall remain around the perimeter of the basin (both around the filter media and the top of batter) to restrict sediment inflow. Clear indications of the restriction of traffic to the Bioretention systems shall also be displayed.
3. Landscape Establishment (Operational Establishment) – when the Building Phase is 80% complete, the temporary protective measures and accumulated sediments will be removed. The basins shall be planted with vegetation and landscaping as proposed. Sufficient watering and removal of weeds following planting shall be undertaken in accordance with *Section 3.9.3* of the Water by Design *Construction and Establishment Guidelines* (2010).

5.1.2 OPERATIONAL PHASE

During Operational Phase, regular inspections of the Bioretention Basins is required to ensure vegetation establishes and the properties of the filter media remain effective.

5.1.2.1 INSPECTION REQUIREMENTS

Checklists have been developed for the Bioretention Basins. The condition and maintenance carried out will be recorded on the checklist at the time the inspection and/or maintenance is undertaken. A copy of the checklist is presented in **Appendix E.**

Maintenance personnel should also be encouraged to report and document changes in vegetation type within the Bioretention Basins. Photographic documentation and mapping of vegetation types are to be recorded annually to determine changes in vegetation over time. Photographs of each device are to be taken at the same location annually.

Through these procedures a reliable maintenance database can be developed and used to determine if the maintenance undertaken is ensuring the SQID is functioning as intended.

Except for periods of extended wet weather, mosquitoes are unlikely to be an issue - as surface water within the Bioretention Basins is not expected to remain for more than two days.

5.1.2.2 WEED REMOVAL

Maintenance personnel will need to identify species of both terrestrial and semi-aquatic weeds common to the area. As the Bioretention Basins are "dry" SQIDs, aquatic weed infestation is unlikely. When weeds have been identified they are to be removed by hand immediately or eradication methods scheduled before the infestation becomes larger and more difficult to control. It should be noted that herbicides should not be used in the removal of invasive weeds as this has negative impacts on downstream water quality.

5.1.2.3 REPLANTING

Replanting of vegetation is to be carried out to replace dead or damaged vegetation, vegetation that has been removed by scour or erosion, or vegetation that is being re-planted following tilling or the replacement of filter media. Removed vegetation should be replaced by plants of similar size and species, or as indicated on the appropriate Landscaping Plans.

5.1.2.4 FILTER INSPECTION AND REPLACEMENT

Fine sediment and silt may accumulate within the filter media of the Bioretention Basins over time. Removal of sediment and silt trapped within the filter media is expected to be the most costly maintenance requirement for Bioretention Basins.

It is recommended that a visual inspection of the infiltration properties be undertaken at least three times per year with more frequent inspections no greater than three months apart between October and May. This is to determine whether built-up fine sediment and silt has reached a point where the filter media has become clogged.

The infiltration properties of the filter media within the Bioretention Basins needs to be checked after a period of significant rainfall event, which is defined as a 24 hour period with rainfall greater than 100mm, or a shorter period with an average rainfall intensity greater than 50mm/hr. This is an ideal period to assess the infiltration properties as water should not pond for an extended period. Therefore inspections should occur 24 to 72 hours after an appropriate rainfall event.

In the event that isolated boggy patches occur within the Bioretention Basin then the subsoil drainage pipes could be blocked. If this is not the case and no other blockages have been observed then surface of the media is to be tilled (raked and aerated) to a depth of 100 to 150mm. This will require temporarily removing and storing the surface vegetation prior to tilling the surface. Should the infiltration properties be improved then the removed vegetation and coarse aggregate layer can be replanted. Should tilling prove unsuccessful or if an infiltration check indicates filter media to be clogged, then the top portion of the filter media is to be replaced as follows:

1. Removal of surface vegetation and coarse aggregate layer and store for re-establishment;
2. Remove the top 150mm of filter media and dispose of in an approved manner;
3. Till the remaining filter media to a further depth of 300mm;
4. Place a new layer of appropriate filter media as per the specification (refer to **Appendix E**), free from organic matter, clay and silt; and
5. Replant the removed vegetation.

If blockages occur frequently, a filter media with a higher saturated hydraulic conductivity should be considered. Reassessing the species and planting density of vegetation is also an option. Unless changes to the filter media specification are made through a review of the SQID performance, the filter media to be used for the Bioretention Basin is to be a Sandy Loam as per the FAWB *Guidelines for Filter Media in Biofiltration Systems* (*Version 3.01,* 2009) presented in **Appendix E.**

5.1.2.5 SUBSOIL DRAINAGE INSPECTION & CLEANOUT

The build-up of fine sediment and silt within the subsoil drainage pipes is unlikely as it will be trapped by the filter media. However the subsoil drainage is to be checked annually for blockages that may be caused by foreign matter entering through cleanout inspection openings or by small fauna. This can be done by either:

- Observing the condition of the subsoil drain through the cleanout and inspection openings located towards the downstream end of a subsoil drainage pipe.
- Observing the amount of sediment and silt flushed into the downstream field inlet when water is pumped into the upstream end of the subsoil drainage line (through a cleanout and inspection opening).

If a considerable amount of sediment and silt is observed or carried into the downstream inlet, then each subsoil drainage line must be flushed out with high pressure water.

Water is to be pumped into each subsoil drainage pipe through the upstream cleanout inspection opening until all sediment has been ejected from the pipe. To collect the water and ejected sediment within the downstream pit a temporary barrier is to be placed over the downstream pipe opening (such as sand bags) and a pump used to draw the water, sediment and silt out of the pit and irrigated onto areas of open space away from each basin. This will ensure the sediment and silt does not enter the downstream waterway.

If frequent issues occur with the subsoil drainage system, CCTV checking could be undertaken to identify any damage subsoil drainage.

5.1.2.6 MONITORING

Visual monitoring of Bioretention devices is proposed as part of the inspection and maintenance requirements for the devices. Visual inspections will occur at least three times per year with more frequent inspections to occur no more than three months apart between October and May. Inspection should be made not less than 24 hours and not more than 72 hours after the cessation of rainfall if the total rainfall on any day exceeds 100mm.

5.2 STORMWATER360 ENVIROPOD

5.2.1 OPERATIONAL PHASE

EnviroPod devices (or approved equivalent) must be inspected and maintained regularly to ensure they are working properly through the estimated design life. The EnviroPod filters require servicing every 1 to 6 months depending on site characteristics.

During each inspection, details of the mass, volume and type of material observed should be recorded to provide ongoing data for future management plan revisions and the optimisation of the maintenance frequency. It is essential that maintenance (including inspections, recording and reporting) be carried out in a systematic manner and is undertaken by qualified and experienced personnel. Stormwater360 can provide required maintenance services at a cost to the property/asset owner.

To ensure that the unit performs optimally, the material collected by the filter bag should be emptied when the level of material is approximately half to two thirds of the total bag depth or when there is evidence of material overflow. Maintenance frequency should be adjusted to accommodate variable rainfall patterns. Refer to *StormFilter/EnviroPod SFEP Treatment Train Operations and Maintenance* (2013) provided in **Appendix E**.

5.3 GENERAL REQUIREMENTS

5.3.1 YEARLY REVIEW OF MAINTENANCE MANAGEMENT PLAN

Each year a review is to be carried out to determine if the programmed inspection and maintenance (including checklists) is ensuring SQIDs are functioning as intended. The review should include an assessment of the maintenance database to determine whether the programmed inspections and maintenance is effective. Information on the database should be assessed to determine whether any noticeable changes are evident in vegetation, presence of fauna and operational efficiency of any structures or features of the device. This will further provide indicators as to whether sufficient information is being recorded for management purposes.

5.3.2 MAINTENANCE PERSONNEL SAFETY (OH&S)

The *Workplace Safety Regulation* 2011 requires that all reasonably practicable steps be taken to protect an employee's health in a workplace. Organisations involved in the inspection and maintenance of the SQIDs should therefore:

- Have a documented occupational health and safety policy in place;
- Ensure all staff and maintenance personnel are aware of and abide by the policy; and
- The policy provides a mechanism for review and improvement.

As part of the policy personnel involved in the maintenance of the SQIDs are to have sufficient resources (such as personnel protective equipment, training etc.) to carry out the task in a safe manner.

5.3.3 GENERAL PUBLIC SAFETY

The safety of the general public in the area of the SQID being maintained also needs to be ensured. Notices to inform the staff and public accessing the site regarding the SQID maintenance needs to be circulated prior to the scheduled date. Temporary signage and safety barriers need to be erected around maintenance work areas prior to the works commencing and are not to be removed until all works have finished.

6 CONCLUSION

Calibre Consulting (Qld Pty Ltd has prepared this *Site Based Stormwater Management Plan (Quality & Quantity)* for the proposed residential development located in Logan Reserve. This issue (Issue E) of the report was prepared to support the updated Site layout. The outcomes of the investigation undertaken are as follows:

- Stormwater quantity investigations using WBNM (1 to 100 year ARI, 15 to 180 min durations) have demonstrated that the development peak flows will be mitigated via three detention basins. They are:
    - Basin A (privately owned): 4,790m³;
    - Basin B (privately owned): 1,600m³; and
    - Basin C (will become LCC asset): 4,800m³;
- All detention basins will be designed to be aesthetically pleasing and safe. Basin B and C has 20 year ARI ponding depths not exceeding 1.2m. Basin A has a 20 year ARI ponding depth of 1.27m. A *Safety in Design* risk assessment has been undertake and the following mitigation measures are proposed as a minimum:
    - Warning signs;
    - Flood depth indicators;
    - *Appropriate* landscaping;
    - Emergency egress.

    *All documentation referring to the proposed Basin's has been updated to ensure consistency between all plans and tables. Refer to **Appendix F** and **Section 3.3.1** for further details.*
- Peak flow mitigation is achieved for Outlets 1, 3, 4, 5 and 6. The peak flow at Outlet 2 increases as a result of the compensatory earthworks in the floodplain. However, as this discharge point is in Logan River, and the local catchment peak flow does not coincide with the regional catchment peak flow, there will be no actionable nuisance at Outlet 2.

    *The updated stormwater quantity analysis has determined all Basin overflow weirs have 50 year ARI immunity as demonstrated in Drawing No. **15-000483.03-110** and **15-000483.03-112** in **Appendix F**. Furthermore all peak flow from the site discharge locations are reduced to existing conditions to demonstrate adverse impacts as a result of the development.*
- Compliance with the waterway stability management requirement will be achieved via the detention basins;
- Three end of line Bioretention Basins (incorporated within detention basins), and four Stormwater360 EnviroPods (or approved equivalent) are proposed for stormwater quality management; and
- The EnviroPods have been modelled in MUSIC with no TP and TN removal. MUSIC modelling confirms that the proposed stormwater quality management strategy will achieve the required WQOs.

The above outcomes achieve the LCC *Planning Scheme* requirements for peak flow mitigation and stormwater quality management. The above outcome also address *items 4.1, 4.2, 6.1* and *6.2* of the *Information Request.*

7 RECOMMENDATIONS

It is recommended that the stormwater quality and quantity management strategies proposed in this report are approved by LCC on the basis that acceptable outcomes will be provided.

Future design and construction of the development will incorporate the stormwater strategies presented in this report. The detailed of Stage 1 has incorporated the conceptual designs presented in previous issues of this report and the design objectives have been maintained. Refer to **Appendix H** for Operational Works submission drawings for Stage 1 of the proposed development.

8 REFERENCES

- Department of Energy and Water Supply (2014), *Queensland Urban Drainage Manual;*
- Department of State Development, Infrastructure and Planning (2017), *State Planning Policy 2017;*
- Healthy Waterways (2010), *MUSIC Modelling Guidelines 2010;*
- Healthy Waterways (2010), *Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands, Version 1.1;*
- Logan City Council (2013), *Stormwater Quality and Flow Management Guidelines.*

9 DISCLAIMER

This report has been prepared on behalf of and for the exclusive use of Halcyon Developments Pty Ltd and is subject to and issued in accordance with the agreement between Calibre Consulting (QLD) Pty Ltd.

Our investigation and analysis has been specifically catered for the particular requirements of Halcyon Developments Pty Ltd and may not be applicable beyond this scope. For this reason, any other third parties are not authorised to utilise this report without further input and advice from Calibre Consulting (QLD) Pty Ltd.

Calibre Consulting (QLD) Pty Ltd accepts no liability or responsibility whatsoever for the report in respect of any use of or reliance upon this report by any third party.

The investigation and analysis has relied on information provided by others. We accept no responsibility for accuracy of material supplied by others. The accuracy of the investigation, analysis and report is dependent upon the accuracy of this information.

APPENDICES

Appendix A – Site Layout
Appendix B – Existing Site Survey
Appendix C – MUSIC Modelling Results
Appendix D – Rational Method Calculation
Appendix E – SQID Maintenance
Appendix F – Calibre Consulting Concept Drawings
Appendix G – Safety in Design for Basin A
Appendix H – Stage 1 Operational Works Drawings

APPENDIX A SITE LAYOUT

PROPOSAL PLAN

NOT TO BE USED FOR ENGINEERING DESIGN OR CONSTRUCTION

NOTES

This plan was prepared as a conceptual layout only. The information on this plan is not suitable for any other purpose.

Property dimensions, areas, numbers of lots and contours and other physical features shown have been compiled from existing information and may not have been verified by field survey. These may need verification if the development application is approved and development proceeds, and may change when a full survey is undertaken or in order to comply with development approval conditions.

No reliance should be placed on the information on this plan for detailed subdivision design or for any financial dealings involving the land.

Pavements and centrelines shown are indicative only and are subject to Engineering Design.

Saunders Havill Group therefore disclaims any liability for any loss or damage whatsoever or howsoever incurred, arising from any party using or relying upon this plan for any purpose other than as a document prepared for the sole purpose of accompanying a development application and which may be subject to alteration beyond the control of the Saunders Havill Group. Unless a development approval states otherwise, this is not an approved plan.

LEGEND

- Site Boundary
- Residential Allotments - 8.847 ha
- Sales Office - 1905 m²
- Leisure Facilities - 1.0 ha
- Caravan Storage - 1.609 ha
- Neighbourhood Centre & Child Care Centre - 1.480 ha
- Accommodation Activity - 9914m²
- Community Facility - 642m²
- Logan River Corridor & Metropolitan Recreation Park - 18.401 ha
- Private Open Space - 12.063 ha
- Detention Basin - 7850 m²
- Public Detention Basin - 6771 m²
- Pedestrian Link
- Extent of Level Caravan Storage Pad - RL 11.50
- Q50 Floodline
- Q100 Floodline

RP DESCRIPTION: Lots 2 & 3 on RP25887, 1 on RP25886, 3 on RP210941 & 41 on MAR618

SCALE @A1 1:2000 @A3 1:4000 - LENGTHS ARE IN METRES

20 0 20 40 60 80 100 120 140 160 180 200 220

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HALCYON MANAGEMENT PTY LTD, ATF HALCYON MANAGEMENT UNIT TRUST

216-294 LOGAN RESERVE ROAD, LOGAN RESERVE • 28/11/2018 • 7801 P 10 PP C

NOTES

This plan was prepared as a provisional layout to accompany a development application. The information on this plan is not suitable for any other purpose.

Property dimensions, areas, numbers of lots and contours and other physical features shown have been compiled from existing information and may not have been verified by field survey. These may need verification if the development application is approved and development proceeds, and may change when a full survey is undertaken or in order to comply with development approval conditions.
No reliance should be placed on the information on this plan for detailed subdivision design or for any financial dealings involving the land.

The Saunders Havill Group therefore disclaims any liability for any loss or damage whatsoever or howsoever incurred, arising from any party using or relying upon this plan for any purpose other than as a document prepared for the sole purpose of accompanying a development application and which may be subject to alteration beyond the control of the Saunders Havill Group. Unless a development approval states otherwise, this is not an approved plan.

* This note is an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and not suitable for use.

N

18 RP110452
A RP178268
27 RP110452
26 RP110452
19 RP110452
20 RP110452
21 RP110452
22 RP110452
23 RP110452
25 RP110452
24 RP110452
RP110452
8 RP110452
7 RP110452
6 RP110452
5 RP110452
4 RP110452
3 RP110452
2 RP110452
1 RP110452
AP1684
1 SP154735
A SP168641
2 RP210941
493·2
150·37
RP2
2 RP136814
0.5m WIDE ROAD RESUMPTION ALONG LOGAN RESERVE ROAD
356·0
1 RP150260
4 RP224555
3 RP25887
134·1
120·7
134·1
LOGAN RESERVE ROAD
0.5m WIDE ROAD RESUMPTION ALONG LOGAN RESERVE ROAD
92·717
17 RP897272
1 RP162124
0.5m WIDE ROAD RESUMPTION ALONG LOGAN RESERVE ROAD
1 RP160429
2 RP165534
1 RP205789
2 RP205789
RP25888
STAGE 2
STAGE 1
1
26·39 ha
901
7·07 ha
900
10·0 ha
(Excluding Detention Basin and New Road)
33·3
29·7
269·7
262·7
228·4
NEW ROAD
179·7
25·0
134·5
NEW ROAD
2
1·08 ha
85·3
80·0
111·0
3
3984 m²
40·0
40·0
4
9951m²
99·95
99·95
99·5
5
6771 m²
61·5
44·4
69·5
42·3
(10·6)
DETENTION BASIN
312·1
Logan River
2 WD6013
319 MAR6115

STATISTICS - STAGE 1

No. of Proposed Lots.....	4
Length of New Road.....	260 m
Area of New Road.....	7015m²
Area of Road Dedication.....	151m²
Total Area of Subdivision....	3.878 ha

STATISTICS - STAGE 2

No. of Proposed Lots.....	3
Length of New Road.....	380 m
Area of New Road.....	7190m²
Area of Road Dedication.....	178m²
Area of Park (Lot 900).....	10.0 ha
Total Area of Subdivision....	44.79 ha

STATISTICS

No. of Proposed Lots.....	6
Length of New Road.....	640 m
Area of New Road.....	1.421ha
Area of Road Dedication.....	329m²
Area of Park (lot 900).....	9.391 ha
Total Area of Subdivision....	48.67 ha

Scale 1:4000 – Lengths are in Metres.

50 0 50 100 150 200 250 300

Revision	No.	by	Date	Description
	C	TBG	21.04.16	Bdys & Rd amended. 901 Added
	D	AJB	05.05.16	Lot 5 removed
	E	AJB	09.11.16	Road Dedication/Lot 900 amended
	F	AJB	14.11.16	Lot 5 & Staging added
	G	AJB	06.12.16	Road Dedication Areas added
	H	AJB	10.02.17	Lots 900 & 901 revised

Level Datum: AHD der.

Origin of Levels:
RL of Origin:

Contour Interval:

Lot Description

Lot 41 on MAR618, Lot 1 on RP25885, Lot 2 on RP25887 and Lot 3 on RP210941

Locality of Logan Reserve

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surveying town planning urban design environmental management landscape architecture
web www.saundershavill.com
phone (07) 3251 9444 fax (07) 3251 9455
address 9 Thompson St Bowen Hills Q 4006

Design
Date
Drawn AJB
Date 18/12/15
Checked

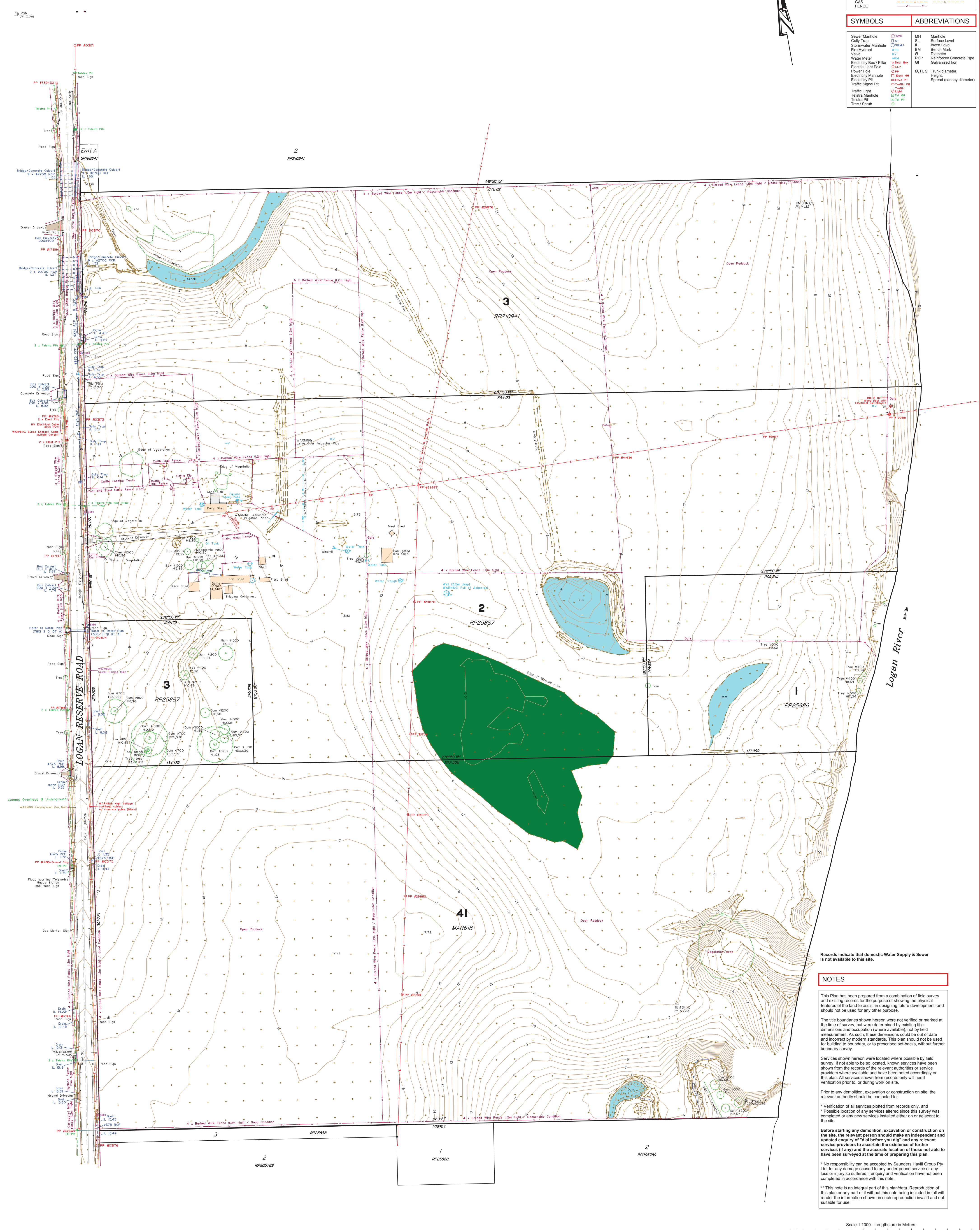
Plan of
PROPOSAL PLAN
Project LOGAN RESERVE ROAD, LOGAN RESERVE
Client L H PROPERTY PARTNERS PTY LTD

town planning

Scale @A3 1: 4000

Dwg No. 7801 P 04 PP H

APPENDIX B EXISTING SITE SURVEY



LEGEND

	by Survey	by Records
O/H ELECTRICITY	E	E
U/G ELECTRICITY	E	E
O/H TELSTRA	T	T
U/G TELSTRA	T	T
U/G DRAINAGE	D	D
SEWERAGE	S	S
WATER	W	W
GAS	G	G
FENCE	//	

SYMBOLS

Sewer Manhole	SMH
Gully Trap	GT
Stormwater Manhole	SWMH
Fire Hydrant	FH
Valve	V
Water Meter	WM
Electricity Box / Pillar	Elect Box
Electric Light Pole	ELP
Power Pole	PP
Electricity Manhole	Elect MH
Electricity Pit	Elect Pit
Traffic Signal Pit	Traffic Pit
Traffic Light	Traffic Light
Telstra Manhole	Tel MH
Telstra Pit	Tel Pit
Tree / Shrub	

ABBREVIATIONS

MH	Manhole
SL	Surface Level
IL	Invert Level
BM	Bench Mark
Ø	Diameter
RCP	Reinforced Concrete Pipe
GI	Galvanised Iron
Ø, H, S	Trunk diameter, Height, Spread (canopy diameter)

NOTES

This Plan has been prepared from a combination of field survey and existing records for the purpose of showing the physical features of the land to assist in designing future development, and should not be used for any other purpose.

The title boundaries shown hereon were not verified or marked at the time of survey, but were determined by existing title dimensions and occupation (where available), not by field measurement. As such, these dimensions could be out of date and incorrect by modern standards. This plan should not be used for building to boundary, or to prescribed set-backs, without further boundary survey.

Services shown hereon were located where possible by field survey. If not able to be so located, known services have been shown from the records of the relevant authorities or service providers where available and have been noted accordingly on this plan. All services shown from records only will need verification prior to, or during work on site.

Prior to any demolition, excavation or construction on site, the relevant authority should be contacted for:

* Verification of all services plotted from records only, and
* Possible location of any services altered since this survey was completed or any new services installed either on or adjacent to the site.

Before starting any demolition, excavation or construction on the site, the relevant person should make an independent and updated enquiry of "dial before you dig" and any relevant service providers to ascertain the existence of further services (if any) and the accurate location of those not able to have been surveyed at the time of preparing this plan.

* No responsibility can be accepted by Saunders Havill Group Pty Ltd, for any damage caused to any underground service or any loss or injury so suffered if enquiry and verification have not been completed in accordance with this note.

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Scale 1:1000 - Lengths are in Metres.

saunders havill group

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■ surveying ■ town planning ■ urban design ■ environmental management ■ landscape architecture

Issues

No.	by	Date	Description
A	CW	29/07/15	ORIGINAL ISSUE

Surveyed: DN
Date: 23/07/2015
Drawn: CW
Date: 29/07/2015
Checked: KD

Plan of
DETAIL PLAN

Project 210-294 LOGAN RESERVE ROAD, LOGAN RESERVE
Client HALCYON MANAGEMENT PTY LTD, ATF HALCYON MANAGEMENT UNIT TRUST

Level Datum: AHD der.
Origin of Levels: OPM130385
RL of Origin: 15.546
Contour Interval: 0.5m

Lot Description
Lots 2 & 3 on RP25887,
1 on RP25886, 3 on RP210941 &
41 on MAR618

Locality of Logan Reserve
Parish of Mackenzie
County of Stanley

surveying

Scale @A0 1: 1000
@A2 1: 2000

Dwg No. 7801 S 02 DT A

APPENDIX C PEAK FLOW CALCULATIONS

Appendix C1 – Rational Method Calculations

Catchment B & C

File: H:\15\000483\Stormwater\WBNM\[Rational Method Calculations.xlsx]Catchment B&C
Date: 28/10/2015
Job: 15-000483
By: KO/CS
Locality: LCC
IFD Ref: IFD_LCC
IFD Source: Logan City Council Development Manual (2001)

Catchment Area

Catchment Area (ha)	19.67

Time of Concentration

Reference	Equation Type / Method	Length (m)	Av. Slope (%)	Velocity (m/s)	Roughness (Mannings/ Hortons)	Sub Total (mins)
4.06.6 QUDM	*Overland Sheet Flow - Friends*	200	0.7		0.05	33.5
4.6.3 a(iv) QUDM	*Assumed Channel Velocity*	600		1.5		6.7
					Adopted tc	40

C10 Value

Reference	Fraction Impervious	$1I_{10}$ (mm/hr)	C10
QUDM	6%	67	0.68

Flow Calculations

ARI	Cy	$^{tc}I_y$	A (ha)	Q (m^3/s)	WBNM Peak Flow (m^3/s)	Variance (%)
1	0.54	46	19.67	1.35	1.176	-13%
2	0.57	59	19.67	1.85	1.803	-2%
5	0.64	75	19.67	2.62	2.644	1%
10	0.68	84	19.67	3.09	3.163	2%
20	0.71	96	19.67	3.71	3.875	5%
50	0.78	113	19.67	4.78	4.696	-2%
100	0.81	125	19.67	5.52	5.448	-1%

Appendix C2 – Detention Basin Stage Storage Discharge Relationships

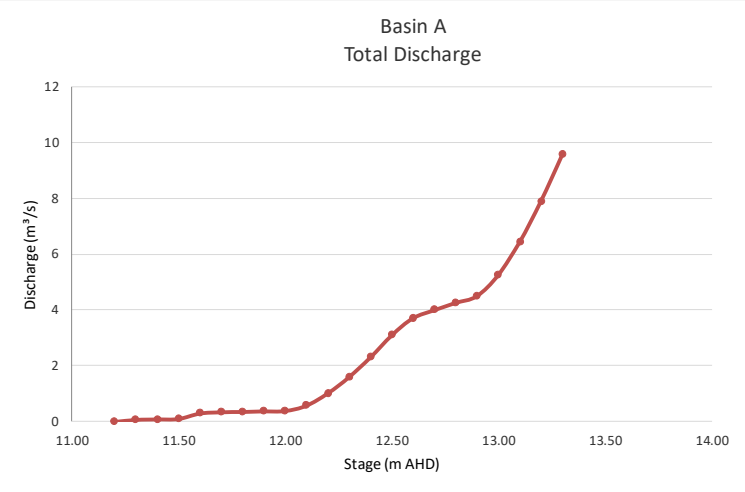
CONCEPT DETENTION BASIN DESIGN CALCULATIONS

File: H:\15\000483\Stormwater\WBNM\[Detention Basin Design SSD.xlsx]BASIN A
Date: 23/03/2016
User: CS
Note: Storage and outlet calcs for Detention Basin A

STAGE - STORAGE RELATIONSHIP FOR WBNM

Stage volumes taken from 12D model

RL (m AHD)	Accum. Vol. (m^3)
11.20	0
11.30	149
11.40	305
11.50	468
11.60	639
11.70	817
11.80	1003
11.90	1197
12.00	1399
12.10	1609
12.20	1827
12.30	2054
12.40	2288
12.50	2531
12.60	2783
12.70	3043
12.80	3312
12.90	3590
13.00	3876
13.10	4172
13.20	4476
13.30	4790



OUTLET CALCULATIONS

Type	Bio	Pit 1 Weir Flow	Pit 1 Pit 1 Orifice Flow	Pipe 1	Pit 2 Weir Flow	Pit 2 Pit 2 Orifice	Pipe 2	Weir
Length (m)		0.9	0.9	10	1.2	1.2	20	
Width (m)		0.9	0.9		1.2	1.2		
No. of		1	1	1	1	1	1	
Dia (m)				0.375			1.2	
Area (m^2)	1000		0.81	0.11		1.44	1.13	
Invert Level (R.L)	11.20	11.50	11.50	10.20	12.02	12.02	10.125	12.90
Inflow Level (R.L)	11.20	11.50	11.50	11.50	12.02	12.02	12.02	
D/S HGL (R.L)				10.20			10.20	
f (Fig 1.6)				0.029			0.020	
Pit Loss (K)				1.5			1.5	
Hyd Cond. (k) (m/hr)	0.2							
Depth Media d (m)	0.4							
Perimeter (m)		3.6			4.8			10
% Opening Clear *		75%			75%			

STAGE - DISCHARGE RELATIONSHIP FOR WBNM

RL (m AHD)	Accum. Vol. (m^3)	Bio (m^3/s)	Pit 1 Weir Flow (m^3/s)	Pit 1 Orifice Flow (m^3/s)	Pipe 1 (m^3/s)	Pit 2 Weir Flow (m^3/s)	Pit 2 Orifice Flow (m^3/s)	Pipe 2 (m^3/s)	Weir (m^3/s)	Total Discharge (m^3/s)
11.20	0	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
11.30	149	0.069	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.069
11.40	305	0.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083
11.50	468	0.097	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.097
11.60	639	0.111	0.189	0.760	0.328	0.000	0.000	0.000	0.000	0.300
11.70	817	0.125	0.535	1.075	0.342	0.000	0.000	0.000	0.000	0.342
11.80	1003	0.139	0.982	1.317	0.357	0.000	0.000	0.000	0.000	0.357
11.90	1197	0.153	1.512	1.520	0.370	0.000	0.000	0.000	0.000	0.370
12.00	1399	0.167	2.113	1.700	0.384	0.000	0.000	0.000	0.000	0.384
12.10	1609	0.181	2.777	1.862	0.397	0.180	1.209	3.584	0.000	0.578
12.20	1827	0.194	3.500	2.011	0.410	0.608	1.813	3.697	0.000	1.019
12.30	2054	0.208	4.276	2.150	0.423	1.181	2.261	3.809	0.000	1.604
12.40	2288	0.222	5.102	2.281	0.436	1.866	2.634	3.918	0.000	2.302
12.50	2531	0.236	5.976	2.404	0.448	2.650	2.961	4.026	0.000	3.098
12.60	2783	0.250	6.894	2.521	0.460	3.520	3.255	4.132	0.000	3.715
12.70	3043	0.264	7.856	2.633	0.472	4.468	3.524	4.236	0.000	3.996
12.80	3312	0.278	8.858	2.741	0.484	5.489	3.774	4.339	0.000	4.258
12.90	3590	0.292	9.899	2.844	0.496	6.578	4.009	4.441	0.000	4.505
13.00	3876	0.306	10.979	2.944	0.507	7.730	4.231	4.541	0.525	5.263
13.10	4172	0.319	12.095	3.041	0.519	8.943	4.441	4.640	1.485	6.445
13.20	4476	0.333	13.246	3.134	0.530	10.213	4.642	4.737	2.728	7.900
13.30	4790	0.347	14.432	3.225	0.541	11.539	4.835	4.834	4.200	9.574

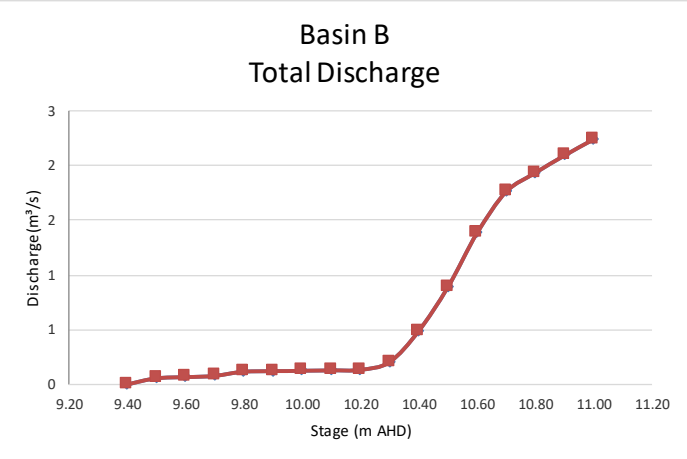
CONCEPT DETENTION BASIN DESIGN CALCULATIONS

File: H:\15\000483\Stormwater\WBNM\[Detention Basin Design SSD_20180814.xlsx]BASIN B_Final
Date: 2018-04-20
User: MP
Note: Storage and outlet calcs for Detention Basin B

STAGE - STORAGE RELATIONSHIP FOR WBNM

Stage volumes taken from 12D model

RL (m AHD)	Accum. Vol. (m^3)
9.40	0
9.50	48
9.60	101
9.70	160
9.80	224
9.90	295
10.00	372
10.10	456
10.20	547
10.30	644
10.40	749
10.50	860
10.60	980
10.70	1107
10.80	1242
10.90	1385
11.00	1535



OUTLET CALCULATIONS

Type	Bio	Pit 1 Weir Flow	Pit 1 Orifice Flow	Pipe 1	Pit 2 Weir Flow	Pit 2 Orifice Flow	Pipe 2	Weir
Length (m)		0.9	0.9	10	0.9	0.9	20	
Width (m)		0.9	0.9		0.9	0.9		
No. of		1	1	1	1	1	1	
Dia (m)				0.375			0.9	
Area (m^2)	450		0.81	0.110		0.81	0.636	
Invert Level (R.L)	9.40	9.70	9.70	8.475	10.25	10.25	8.40	10.70
Inflow Level (R.L)	9.40	9.70	9.70	9.70	10.25	10.25	10.25	
D/S HGL (R.L)				8.475			8.475	
f (Fig 1.6)				0.029			0.022	
Pit Loss (K)				1.5			1.5	
Hyd Cond. (k) (m/hr)	0.2							
Depth Media d (m)	0.4							
Perimeter (m)		3.6			3.6			4
% Opening Clear *		75%			75%			

STAGE - DISCHARGE RELATIONSHIP FOR WBNM

RL (m AHD)	Accum. Vol. (m^3)	Bio (m^3/s)	Pit 1 Weir Flow (m^3/s)	Pit 1 Orifice Flow (m^3/s)	Pipe 1 (m^3/s)	Pit 2 Weir Flow (m^3/s)	Pit 2 Orifice Flow (m^3/s)	Pipe 2 (m^3/s)	Weir (m^3/s)	Total Discharge (m^3/s)
9.40	0	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.50	48	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.031
9.60	101	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.038
9.70	160	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044
9.80	224	0.050	0.189	0.760	0.317	0.000	0.000	0.000	0.000	0.239
9.90	295	0.056	0.535	1.075	0.331	0.000	0.000	0.000	0.000	0.331
10.00	372	0.062	0.982	1.317	0.346	0.000	0.000	0.000	0.000	0.346
10.10	456	0.069	1.512	1.520	0.360	0.000	0.000	0.000	0.000	0.360
10.20	547	0.075	2.113	1.700	0.374	0.000	0.000	0.000	0.000	0.374
10.30	644	0.081	2.777	1.862	0.387	0.067	0.538	2.042	0.000	0.454
10.40	749	0.088	3.500	2.011	0.401	0.347	0.931	2.110	0.000	0.748
10.50	860	0.094	4.276	2.150	0.414	0.747	1.202	2.175	0.000	1.161
10.60	980	0.100	5.102	2.281	0.426	1.237	1.422	2.240	0.000	1.664
10.70	1107	0.106	5.976	2.404	0.439	1.804	1.613	2.304	0.000	2.051
10.80	1242	0.113	6.894	2.521	0.451	2.438	1.783	2.366	0.210	2.444
10.90	1385	0.119	7.856	2.633	0.463	3.132	1.938	2.428	0.594	2.995
11.00	1535	0.125	8.858	2.741	0.475	3.882	2.082	2.489	1.091	3.648

Note:

The following equations have been used to calculate flow capcaties for the outlet types for each stage:

Sand Filter Equation (NSW EPA 1997)	$Q = A \times k(h+d) / d$
Pipe Flow (M.J.Boyd 1972)	$Q = 0.421 \times g^{0.5} \times Dia^{0.87} \times HW^{1.63}$ (where HW/Dia < 1.2)
	$Q = 0.53 \times g^{0.5} \times Dia^{1.87} \times HW^{0.63}$ (where HW/Dia > 1.2)
	where $g = 9.81 m/s^2$
Weir Equation (AR&R Equ. 14.5)	$Qi = 1.66 \times P \times d^{1.5}$
Orifice Equation (AR&R Equ. 14.6)	$Qi = 0.67 \times A \times (2g \times d)^{0.5}$
HGL Calculation (as per Section 5.21 QUDM)	

CONCEPT DETENTION BASIN DESIGN CALCULATIONS

File: H:\15\000483\Stormwater\WBNM\[Detention Basin Design SSD.xlsx]BASIN C Detailed Design
Date: 22/03/2016
User: CS
Note: Storage and outlet calcs for Detention Basin C

STAGE - STORAGE RELATIONSHIP FOR WBNM
Stage volumes taken from 12D model

RL (m AHD)	Accum. Vol. (m³)
10.70	0
10.80	92
10.90	190
11.00	293
11.10	403
11.20	518
11.30	640
11.40	768
11.50	902
11.60	1043
11.70	1191
11.80	1345
11.90	1510
12.00	1676
12.10	1852
12.20	2035
12.30	2227
12.40	2426
12.50	2632
12.60	2847
12.70	3070
12.80	3302
12.90	3541
13.00	3790
13.10	4047
13.20	4313
13.30	4588
13.40	4872

OUTLET CALCULATIONS

Type	Bio	Pit 1			Pit 2			Weir
		Pit Weir Flow	Pit Orifice Flow	Pipe 1	Pit Weir Flow	Pit Orifice Flow	Pipe 2	
Length (m)		0.9	0.9	10	0.9	0.9	20	
Width (m)		0.9	0.9		0.9	0.9		
No. of		1	1	1	1	1	1	
Dia (m)				0.225			0.45	
Area (m²)	850		0.81	0.04		0.81	0.16	
Invert Level (RL)	10.70	11.00	11.00	9.775	11.60	11.60	9.70	12.95
Inflow Level (RL)	10.70	11.00	11.00	11	11.60	11.60	11.60	
D/S HGL (RL)				9.8			9.78	
f (Eq 1.6)				0.035			0.027	
Pit Loss (K)				1.5			1.5	
Hyd Cond. (k) (m/hr)	0.2							
Depth Media d (m)	0.4							
Perimeter (m)		3.6			3.6			10
% Opening Clear ^		75%			75%			

STAGE - DISCHARGE RELATIONSHIP FOR WBNM

RL (m AHD)	Accum. Vol. (m³)	Bio Filtration (m³/s)	Pit Weir Flow (m³/s)	Pit Orifice Flow (m³/s)	Pipe 1 (m³/s)	Pit Weir Flow (m³/s)	Pit Orifice Flow (m³/s)	Pipe 2 (m³/s)	Weir (m³/s)	Total Discharge (m³/s)
10.70	0	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
10.80	92	0.059	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.059
10.90	190	0.071	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.071
11.00	294	0.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083
11.10	403	0.094	0.189	0.760	0.116	0.000	0.000	0.000	0.000	0.116
11.20	518	0.106	0.535	1.075	0.121	0.000	0.000	0.000	0.000	0.121
11.30	640	0.118	0.982	1.317	0.125	0.000	0.000	0.000	0.000	0.125
11.40	768	0.130	1.512	1.520	0.129	0.000	0.000	0.000	0.000	0.129
11.50	902	0.142	2.113	1.700	0.133	0.000	0.000	0.000	0.000	0.133
11.60	1043	0.153	2.777	1.862	0.136	0.000	0.000	0.000	0.000	0.136
11.70	1191	0.165	3.500	2.011	0.140	0.189	0.760	0.577	0.000	0.329
11.80	1346	0.177	4.276	2.150	0.144	0.535	1.075	0.595	0.000	0.678
11.90	1510	0.189	5.102	2.281	0.147	0.982	1.317	0.613	0.000	0.760
12.00	1676	0.201	5.976	2.404	0.151	1.512	1.520	0.630	0.000	0.781
12.10	1852	0.213	6.894	2.521	0.154	2.113	1.700	0.647	0.000	0.801
12.20	2036	0.224	7.856	2.633	0.157	2.777	1.862	0.664	0.000	0.822
12.30	2227	0.236	8.858	2.741	0.161	3.500	2.011	0.679	0.000	0.839
12.40	2426	0.248	9.899	2.844	0.164	4.276	2.150	0.692	0.000	0.856
12.50	2633	0.260	10.979	2.944	0.167	5.102	2.281	0.705	0.000	0.872
12.60	2847	0.272	12.095	3.041	0.170	5.976	2.404	0.718	0.000	0.888
12.70	3071	0.283	13.246	3.134	0.173	6.894	2.521	0.730	0.000	0.903
12.80	3302	0.295	14.432	3.225	0.176	7.856	2.633	0.743	0.000	0.919
12.90	3542	0.307	15.651	3.313	0.179	8.858	2.741	0.755	0.000	0.934
13.00	3790	0.319	16.903	3.400	0.181	9.899	2.844	0.767	0.186	1.134
13.10	4047	0.331	18.186	3.484	0.184	10.979	2.944	0.779	0.964	1.927
13.20	4312	0.342	19.500	3.566	0.187	12.095	3.041	0.790	2.075	3.052
13.30	4586	0.354	20.845	3.646	0.190	13.246	3.134	0.802	3.437	4.429
13.40	4868	0.366	22.219	3.724	0.192	14.432	3.225	0.813	5.011	6.017

Note:
The following equations have been used to calculate flow capcaties for the outlet types for each stage:

Sand Filter Equation (NSW EPA 1997) $Q = A \times k(h+d)/d$

Pipe Flow (M.J.Boyd 1972)
$Q = 0.421 \times g^{0.5} \times Dia^{0.67} \times HW^{1.83}$ (where HW/Dia < 1.2)
$Q = 0.53 \times g^{0.5} \times Dia^{1.87} \times HW^{0.38}$ (where HW/Dia > 1.2)
where $g = 9.81 m/s^2$

Weir Equation (AR&R Equ. 14.5) $Qi = 1.66 \times P \times d^{1.5}$

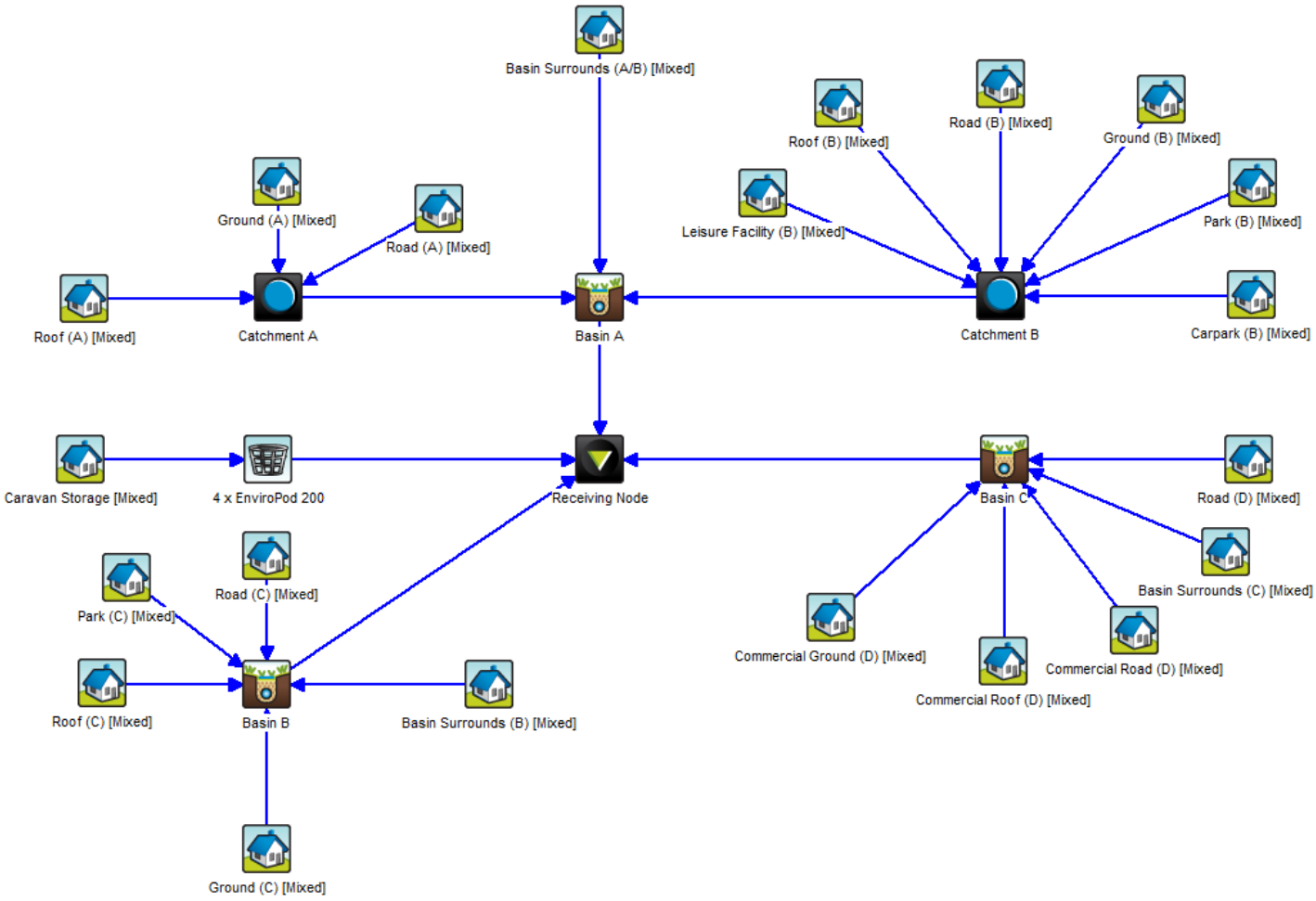
Orifice Equation (AR&R Equ. 14.6) $Qi = 0.67 \times A \times (2g \times d)^{0.5}$

HGL Calculation (as per Section 5.21 QUDM)

Appendix C3 – 100 yr ARI peak basin outflows for all durations modelled

Storm Event	Basin A Outflow (m3/s)	Basin B Outflow (m3/s)	Basin C Outflow (m3/s)
100 Year 15 Mins	2.32	1.59	0.55
100 Year 20 Mins	2.93	1.84	0.72
100 Year 25 Mins	3.07	1.90	0.76
100 Year 30 Mins	2.94	1.82	0.77
100 Year 45 Mins	3.09	1.82	0.79
100 Year 60 Mins	3.63	2.13	0.81
100 Year 90 Mins	3.42	1.92	0.80
100 Year 120 Mins	3.13	1.76	0.79
100 Year 180 Mins	2.84	1.58	0.78

APPENDIX D MUSIC MODELLING



	Sources	Residual Load	% Reduction
Flow (ML/yr)	94.3	92.2	2.3
Total Suspended Solids (kg/yr)	17900	3030	83.1
Total Phosphorus (kg/yr)	36.4	10.9	70.1
Total Nitrogen (kg/yr)	215	103	52
Gross Pollutants (kg/yr)	2540	16.5	99.4

APPENDIX E SQID MAINTENANCE

- Bioretention Inspection and Maintenance Requirements
- Bioretention Inspection Checklist
- FAWB Guidelines for Filter Media in Biofiltration Systems (Version 3.01, 2009)
- Stormwater 360 StormFilter / EnviroPod SFEP Treatment Train Operations and Maintenance

Bioretention Basin Inspection & Maintenance Requirements

Treatment Device / Property	Inspection	Inspection Frequency	Maintenance
Bioretention Basin			
Litter & Weeds	Visually check for litter, weeds and debris within the Bioretention Basin.	Quarterly for first year then every six months after establishment. Also after significant storm events.*	Remove litter, weeds and debris from the basin and dispose of at approved waste disposal facility.
Inlet and Outlet	Visually check for blockages within the upstream and downstream inlet pits. Check for locked weep holes within the upstream pit.		Remove any blockages or debris within inlet pits or blockages to weep holes.
Sedimentation	Visually check surface of Bioretention Basin for accumulation of sediment.		If sediment build-up is observed, remove accumulated sediment where it is smothering vegetation.
Scour, Erosion and Vehicle Damage	Visually check Bioretention Basin surface for scouring and areas of erosion or vehicle damage.		Repair damage to Bioretention Basin surface and filter media if exposed. Undertake replanting if necessary and maintain watering of area until vegetation has established.
Vegetation	Visually check for any planted vegetation that has died.	Quarterly for first year then every six months after establishment.	Remove dead vegetation and replace with stock of equivalent size and species as detailed in plant schedule. Maintain watering until new vegetation has established.
Filter Media	Check surface of Bioretention Basin for any isolated "boggy" areas.	Every six months.	Increase infiltration rate by tilling the surface of the filter media.
	Visually check and determine time of ponding within basin after a storm event.*	During wetter periods.	If duration of ponding exceeds 48 hours, trial tilling of the surface of the filter media. If no improvement occurs then dispose and replace the top 100 to 150mm layer of filter media (below is the detailed procedure): i. Remove vegetation and store for replanting. ii. Remove top 150mm of filter media and dispose of in an approved manner. iii. Till the remaining filter media to a further depth of 300mm. iv. Place a new layer of appropriate filter media; v. Replant removed vegetation
Subsoil Drainage	Check subsoil drainage for blockages. This is subject to earlier stages of inspection. To discover blockage, flush subsoil drain from the upstream inspection opening. If there is no evidence of a blockage, no further action is required.	Subject to earlier stage of inspection.	If blockage is discovered remove by flushing out the subsoil drainage pipe. Below is an outline of the procedure i. Set up a pump and an appropriate collection device (i.e. a sandbag) at the downstream pipe. ii. Draw outflow through pipe, not allowing any sediment/silt to enter the downstream stormwater drainage system. iii. Collect and dispose flushed material appropriately.

* Significant Rain Event defined as a 24 hour period with rainfall greater than 200mm, or shorter period with an average rainfall intensity greater than 20mm/hour.

BIORETENTION BASIN INSPECTION & MAINTENANCE CHECKLIST

SQID:				
Location:				
Date:				
Time:				
Inspector:				
Weather Conditions				
	Condition Acceptable			
Maintenance Item	**Yes**	**No**	**N/A**	**Comments**
1. Basin Surface				
Clear of sediment build-up				
Check for erosion, scour, vehicle & other damage				
Check for dead or damaged vegetation				
2. Filter Media				
Check for erosion, scour, vehicle & other damage				
Check for isolated boggy patches				
3. Subsoil Drainage				
Visually check subsoil drainage through cleanout inspection openings for build-up of sediment				
Check for blockages to subsoil drainage using other methods (eg. CCTV or flush-out)				
Additional Comments				
Actions to be taken				

GUIDELINES FOR FILTER MEDIA IN BIOFILTRATION SYSTEMS (Version 3.01) June 2009

The following guidelines for filter media in biofiltration systems have been prepared on behalf of the Facility for Advancing Water Biofiltration (FAWB) to assist in the development of biofiltration systems, including the planning, design, construction and operation of those systems.

NOTE: This is a revision of the previous FAWB guideline specifications (published in 2006 (Version 1.01), 2008 (Version 2.01)). It attempts to provide a simpler and more robust guideline for both soil-based and engineered filter media. FAWB acknowledges the contribution of EDAW Inc., Melbourne Water Corporation, Dr Nicholas Somes (Ecodynamics), Alan Hoban (South East Queensland Healthy Waterways Partnership), Shaun Leinster (DesignFlow) and STORM Consulting to the preparation of the revised guidelines.

1 GENERAL DESCRIPTION

The biofiltration filter media guidelines require three layers of media: the filter media itself (400-600 mm deep or as specified in the engineering design), a transition layer (100 mm deep), and a drainage layer (50 mm minimum cover over underdrainage pipe). The biofiltration system will operate so that water will infiltrate into the filter media and move vertically down through the profile.

The filter media is required to support a range of vegetation types (from groundcovers to trees) that are adapted to freely draining soils with occasional wetting. The material should be based on **natural or amended natural soils** or it can be **entirely engineered**; in either case, it can be of siliceous or calcareous origin. In general, the media should have an appropriately high permeability under compaction and should be free of rubbish, deleterious material, toxicants, declared plants and local weeds (as listed in local guidelines/Acts), and should not be hydrophobic. The filter media should contain some organic matter for increased water holding capacity but be low in nutrient content. In the case of natural or amended natural soils, the media should be a **loamy sand**.

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Maintaining an adequate infiltration capacity is crucial in ensuring the long-term treatment efficiency of the system. The ability of a biofiltration system to detain and infiltrate incoming stormwater is a function of the filter surface area, extended detention (ponding) depth, and the hydraulic conductivity of the filter media (Figure 1). Most importantly, design of a biofiltration system should optimize the combination of these three design elements.

For a biofiltration system in a temperate climate with an extended detention depth of 100 – 300 mm and whose surface area is approximately 2% of the connected impervious area of the contributing catchment, the prescribed hydraulic conductivity will generally be between 100 – 300 mm/hr in order to meet best practice targets (Figure 2). This configuration supports plant growth without requiring too much land space. In warm, humid (sub- and dry- tropical) regions the hydraulic conductivity may need to be higher in order to achieve the required treatment performance using the same land space (i.e., ensuring that the proportion of water treated through the media meets requirements).

Where one of these design elements falls outside the recommended range, the infiltration capacity can still be maintained by offsetting another of the design elements. For example, a filter media with a lower hydraulic conductivity may be used, but the surface area or the extended detention depth would need to be increased in order to maintain the treatment capacity. Similarly, if the available land were the limiting design element, the system could still treat the same size storm if a filter media with a higher hydraulic conductivity were installed. Where a hydraulic conductivity greater than 300 mm/hr is prescribed, potential issues such as higher watering requirements during the establishment should be considered. Biofiltration systems with a hydraulic conductivity greater than 600 mm/hr are unlikely to support plant growth due to poor water retention, and may also result in leaching of pollutants. However plant survival might be possible if the outlet pipe were raised to create a permanently submerged zone.

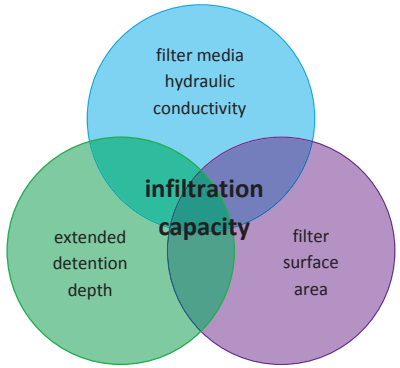

Figure 1. Design elements that influence infiltration capacity.

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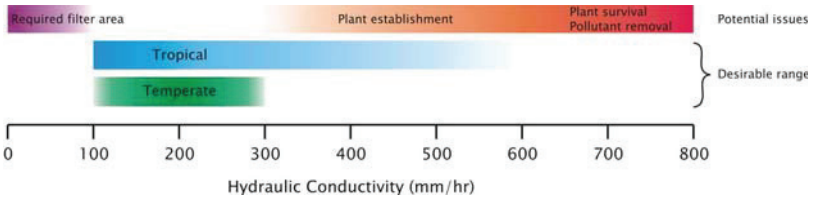

Figure 2. Recommended filter media hydraulic conductivity range and potential issues

The infiltration capacity of the biofiltration system will initially decline during the establishment phase as the filter media settles and compacts, but this will level out and then start to increase as the plant community establishes itself and the rooting depth increases (see Appendix A). In order to ensure that the system functions adequately at its eventual (minimum) hydraulic conductivity, a safety co-efficient of 2 should be used: i.e., **designs should be modelled using half the prescribed hydraulic conductivity**. If a system does not perform adequately with this hydraulic conductivity, then the area and/or ponding depth should be increased. It may also be desirable to report sensitivity to infiltration rate, rather than simply having expected rate. This is important when assessing compliance of constructed systems as systems should ideally meet best practice across a range of infiltration rates.

2 TESTING REQUIREMENTS

2.1 Determination of Hydraulic Conductivity

The hydraulic conductivity of potential filter media should be measured using the ASTM F1815-06 method. This test method uses a compaction method that best represents field conditions and so provides a more realistic assessment of hydraulic conductivity than other test methods.

Note: if a hydraulic conductivity lower than 100 mm/hr is prescribed, the level of compaction associated with this test method may be too severe and so underestimate the actual hydraulic conductivity of the filter media under field conditions. However, FAWB considers this to be an appropriately conservative test, and recommends its use even for low conductivity media.

2.2 Particle Size Distribution

Particle size distribution (PSD) is of secondary importance compared with hydraulic conductivity. A material whose PSD falls within the following recommended range does not preclude the need for hydraulic conductivity testing i.e., it does not guarantee that the material will have a suitable hydraulic conductivity. However, the following composition range (percentage w/w) provides a useful guide for selecting an appropriate material:

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Clay & Silt	<3%	(<0.05 mm)
Very Fine Sand	5-30%	(0.05-0.15 mm)
Fine Sand	10-30%	(0.15-0.25 mm)
Medium to Coarse Sand	40-60%	(0.25-1.0 mm)
Coarse Sand	7-10%	(1.0-2.0 mm)
Fine Gravel	<3%	(2.0-3.4 mm)

Clay and silt are important for water retention and sorption of dissolved pollutants, however they substantially reduce the hydraulic conductivity of the filter media. This size fraction also influences the structural stability of the material (through migration of particles to block small pores and/or slump). It is essential that the total clay and silt mix is **less than 3% (w/w)** to reduce the likelihood of structural collapse of such soils.

The filter media should be well-graded i.e., it should have all particle size ranges present from the 0.075 mm to the 4.75 mm sieve (as defined by AS1289.3.6.1 - 1995). There should be no gap in the particle size grading, and the composition should not be dominated by a small particle size range. This is important for preventing structural collapse due to particle migration.

2.3 Soil-Based Filter Media: Properties

The following specifications are based on results of extensive treatment performance testing conducted by FAWB as well as recommendations made by AS4419 – 2003 (Soils for Landscaping and Garden Use). Filter media must be tested for the following; media that do not meet these specifications should be rejected or amended:

i. Total Nitrogen (TN) Content – <1000 mg/kg.

ii. Orthophosphate (PO_4^{3-}) Content – <80 mg/kg. Soils with total phosphorus concentrations >100 mg/kg should be tested for potential leaching. Where plants with moderate phosphorus sensitivity are to be used, total phosphorus concentrations should be <20 mg/kg.

iii. Organic Matter Content – at least 3% (w/w). An organic content lower than 3% is likely to have too low a water holding capacity to support healthy plant growth. In order to comply with both this and the TN and PO_4^{3-} content requirements, a low nutrient organic matter will be required.

iv. pH – as specified for 'natural soils and soil blends' 5.5 – 7.5 (pH 1:5 in water).

v. Electrical Conductivity (EC) – as specified for 'natural soils and soil blends' <1.2 dS/m.

Optional testing:

vi. Dispersibility – this should be carried out where it is suspected that the soil may be susceptible to structural collapse. If in doubt, then this testing should be undertaken.

Potential filter media should generally be assessed by a horticulturalist to ensure that they are capable of supporting a healthy vegetation community. This assessment should take into

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consideration delivery of nutrients to the system by stormwater. Any component or soil found to contain high levels of salt (as determined by EC measurements), high levels of clay or silt particles (exceeding the particle size limits set above), or any other extremes which may be considered retardant to plant growth should be rejected.

3 ENGINEERED FILTER MEDIA

Where there is not a locally available soil-based material that complies with the properties outlined in Sections 2.1 - 2.3, it is possible to construct an appropriate filter medium. A washed, well-graded sand with an appropriate hydraulic conductivity should be used as the filter medium. Suitable materials include those used for the construction of turf profiles (e.g. golf greens); these materials are processed by washing to remove clay and silt fractions. In large quantities (>20 m^3), they can be obtained directly from sand suppliers, while smaller quantities can be purchased from local garden yards. The **top 100 mm of the filter medium** should then be ameliorated with appropriate organic matter, fertiliser and trace elements (Table 1). This amelioration is required to aid plant establishment and is designed to last four weeks; the rationale being that, beyond this point, the plants receive adequate nutrients via incoming stormwater.

Table 1. Recipe for ameliorating the top 100 mm of sand filter media

Constituent	Quantity (kg/100 m^2 filter area)
Granulated poultry manure fines	50
Superphosphate	2
Magnesium sulphate	3
Potassium sulphate	2
Trace Element Mix	1
Fertilizer NPK (16.4.14)	4
Lime	20

Laboratory testing has shown that biofilters that contain an engineered filter medium will achieve essentially the same hydraulic and treatment performance as those containing a soil-based filter medium (Bratieres *et al.*, 2009). However, it is recommended that a submerged zone be included in biofiltration systems that utilise such a free draining filter medium to provide a water source for vegetation between rainfall events.

4 TRANSITION LAYER

The transition layer prevents filter media from washing into the drainage layer. Transition layer material shall be a clean, well-graded sand material containing <2% fines. To avoid migration of the filter media into the transition layer, the particle size distribution of the sand should be assessed to ensure it meets 'bridging criteria', that is, the smallest 15% of the sand particles bridge with the largest 15% of the filter media particles (Water by Design, 2009; VicRoads, 2004):

D_{15} (transition layer) ≤ 5 x D_{85} (filter media)

where: D_{15} (transition layer) is the 15th percentile particle size in the transition layer material (i.e., 15% of the sand is smaller than D_{15} mm), and
D_{85} (filter media) is the 85th percentile particle size in the filter media.

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A dual-transition layer, where a fine sand overlays a medium-coarse sand, is also possible. While it is acknowledged that this can increase the complexity of the construction process, testing indicates that a dual-transition layer produces consistently lower levels of turbidity and concentrations of suspended solids in treated outflows than a single transition layer. Therefore, it is recommended that this design be specified for stormwater harvesting applications (to enable effective post-treatment disinfection) and where minimising the risk of washout during the establishment period is of particular importance.

The transition layer can be omitted from a biofiltration system provided the filter media and drainage layer meet the following criteria as defined by the Victorian Roads *Drainage of Subsurface Water from Roads - Technical Bulletin No 32* (VicRoads, 2004):

D_{15} (drainage layer) ≤ 5 x D_{85} (filter media)

D_{15} (drainage layer) = 5 to 20 x D_{15} (filter media)

D_{50} (drainage layer < 25 x D_{50} (filter media)

D_{60} (drainage layer) < 20 x D_{10} (drainage layer)

These comparisons are best made by plotting the particle size distributions for the filter media and gravel on the same soil grading graphs and extracting the relevant diameters (Water by Design, 2009).

5 DRAINAGE LAYER

The drainage layer collects treated water at the bottom of the system and converys it to the underdrain pipes. Drainage layer material is to be clean, fine gravel, such as a 2 – 5 mm washed screenings. Bridging criteria should be applied to avoid migration of the transition layer into the drainage layer (Water by Design, 2009; VicRoads, 2004):

D_{15} (drainage layer) ≤ 5 x D_{85} (transition layer)

where: D_{15} (drainage layer) is the 15th percentile particle size in the drainage layer material (i.e., 15% of the gravel is smaller than D_{15} mm), and
D_{85} (transition layer) is the 85th percentile particle size in the transition layer material.

Note: The perforations in the underdrain pipes should be small enough that the drainage layer cannot fall into the pipes. A useful guide is to check to that the D_{85} (drainage layer) is greater than the pipe perforation diameter.

Geotextile fabrics are **not recommended** for use in biofiltration systems due to the risk of clogging. An open-weave shade cloth can be placed between the transition layer and the drainage layer to help reduce the downward migration of smaller particles if required, however this should only be adopted where there is insufficient depth for transition and drainage layers.

6 INSTALLATION

It is recommended that filter media be lightly compacted during installation to prevent migration of fine particles. In small systems, a single pass with a vibrating plate should be used to compact the filter media, while in large systems, a single pass with roller machinery (e.g. a drum lawn roller) should be performed. Under no circumstance should heavy compaction or multiple-passes be made. Filter media should be installed in two lifts unless the depth is less than 500 mm.

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7 FIELD TESTING

It is recommended that field testing of hydraulic conductivity be carried out at least twice: 1. one month following commencement of operation, and 2. in the second year of operation to assess the impact of vegetation on hydraulic conductivity.

The hydraulic conductivity of the filter media should be checked at a minimum of three points within the system. The single ring, constant head infiltration test method (shallow test), as described by Le Coustumer *et al.* (2007), should be used. Given the inherent variability in hydraulic conductivity testing and the heterogeneity of the filter media, the laboratory and field results are considered comparable if they are within 50% of each other. However, even if they differ by more than 50%, the system will still function if both the field and laboratory results are within the relevant recommended range of hydraulic conductivities.

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APPENDIX A

Figure A.1 illustrates the change in hydraulic conductivity during the establishment phase of a Melbourne biofiltration system containing a sandy loam filter media. The hydraulic conductivity initially declines as the filter media is compacted under hydraulic loading, but recovers back to the design value (as indicated by the dashed horizontal line) as plant growth and increased rooting depth counters the effects of compaction and clogging.

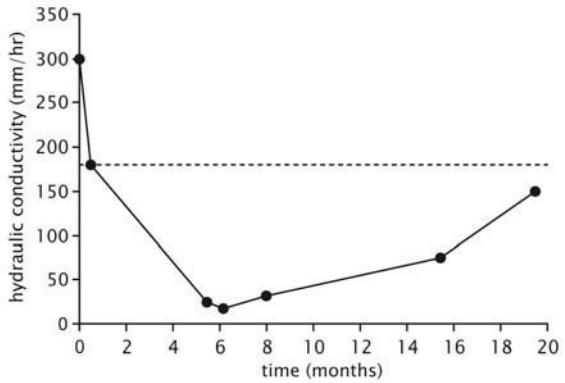

Figure A.1 Evolution of hydraulic conductivity during the first 20 months of a biofiltration system (after Hatt *et al.*, 2009)

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Bioretention Design and Check Summary

User input values

Section 3.7 of Bioretention Technical Design Guidelines (2014)

Job 15-000483
File: W:\Resource Library\Spreadsheets\Water Quality\[Bioretention Design Checklist.xlsx]DESIGN CHECKLIST
Date: 7/11/2017
User: BHP
Job Name: Logan Reserve Road, Logan Reserve - Stage 1 Operational Works Submission

1. TREATMENT		**Detail**	**Unit**	**Recommendation/Notes**
a)	Catchment Area	3.859	ha	
b)	Filter media area (excluding batters)	450	m^2	Single or multiple cells < 800m^2 each
c)	Confirm WQOs achieved?	Yes		Typically via MUSIC modelling.
d)	Confirm hydrologic performance meets relevant frequent flow objectives	Yes		
2. DESIGN INFLOWS		**Detail**	**Unit**	**Recommendation/Notes**
a)	Minor design storm entering system	10% AEP	AEP	
b)	Minor storm peak flow rate	0.957	m^3/s	Based on Rational Method or other hydrological/hydraulic modelling
c)	Major design storm entering system	1% AEP	AEP	Major Peak flows Bypass
d)	Major storm peak flow rate	1.35	m^3/s	Based on Rational Method or other hydrological/hydraulic modelling, N/A if bypassing the bioretention basin.
3. DEPTH PROFILE				
a)	Bioretention drainage profile type		Type	Typically "Type 3", refer to *Table 23* of the *Bioretention Technical Design Guidelines (2014)*
b)	Minimum drainage layer depth	200	mm	See *Section 3.2.2.3* and *3.2.2.4 f* or "Type 1" ≥ 150mm for "Type 2" ≥ 300mm for "Type 3" Not needed for "Type 4"
c)	Maximum drainage layer depth	300	mm	Same as minimum except for "Type 2"
d)	Transition layer depth	100	mm	See *Section 3.2.2.4* for "Type 1" ≥ 100 mm for "Type 2", "Type 3" and "Type 4"
e)	Saturated zone depth for Type 1 bioretention systems	0	mm	See *Section 3.2.2.4*
f)	Filter media layer depth	400	mm	≥ 400 mm (≥700 mm with trees)
g)	Extended detention depth	300	mm	< 300mm
h)	Maximum water level depth above extended detention	**1170**	**mm**	
i)	Freeboard to top of embankment	1230	mm	Multiple, see *Section 3.2.3.6*
j)	Total system profile depth [3(c)+3(d)+3(f)+3(h)+3(i)]	**3500**	**mm**	**= 4(j)** **OK**
k)	Liner type (i) Permeable (ii) Impermeable (iii) None to base	(ii) Impermeable		Subject to drainage profile type and in-situ soils/groundwater (see *Section 3.2.4*)
l)	AASS/PASS assessed and appropriately managed			
m)	Presence of dispersive soils assessed and appropriately managed			
4. DESIGN LEVELS				
a)	Outlet invert level	9.775	m AHD	from design drawings
b)	Overflow pit invert level	9.775	m AHD	from design drawings
c)	Minimum drainage layer level	9.9	m AHD	from design drawings
d)	Filter media surface level	10.7	m AHD	from design drawings
e)	Overflow pit crest level	11	m AHD	from design drawings
f)	Overflow weir level	12.95	m AHD	from design drawings
g)	Maximum design water level	12.17	m AHD	from design drawings
h)	Top of embankment/batter level	13.4	m AHD	from design drawings
i)	Inlet/inflow invert level	11	m AHD	from design drawings
j)	Total level difference [4(h)-4(c)]	**3.5**	**m**	**=3(j)** **OK**
k)	Highest astronomical tide level	NA	m AHD	"Type 1" - impermeable liner extends ≥ 300 mm above HAT "Type 2", "Type 3" & "Type 4" - base of transition layer ≥ 300 mm above HAT
l)	Groundwater level	NA	m AHD	Varies with drainage profile type, see Table 8
5. LAYOUT				
a)	Maximum filter media length	28.6	m	≤ 40 m
b)	Maximum filter media width	23.9	m	≤ 20 m (preferred ≤ 15m)
c)	Maximum batter slope	1 in 4	V:H	
d)	Maximum wall height (where applicable)	No	m	
e)	Provision for services (water, sewer, gas, telecommunications, stormwater)	NA		

f)	Maintenance access provided	Yes		
g)	Flood storage volume above extended detention (where bioretention combined with flood storage)	4579	m^3	
6. INLET DESIGN				
a)	Inlet/inflow type	(i) pipe		
b)	Diversion/surcharge type (where applicable)	NA		
c)	Coarse sediment removal	(i) forebay		Refer to sediment basin design guidelines if "Inlet Pond"
	For Sediment Forebays:			
	Sediment Capture Efficiency (R)	0.8		Typically 80%, i.e 0.8
	Sediment Loading Rate (R_o)	0.6	$m^3/ha/yr$	Refer to guidelines
	Catchment Area (A_c)	3.4081	ha	
	Sediment Forebay Volume (V_s)	**1.635888**	**m^3**	
d)	Sediment Forebay Area	**26**	**m^2**	Propose 26m2 sediment forebay area
e)	Coarse sediment removal depth	0.3	m	Typically 100 - 300mm?
f)	Coarse sediment clean-out frequency (F_c)	1	years	recommends ≤ once per year
	1mm Capture Check			
	Settling Velocity	0.1	m/s	0.1m/s for 1mm particle as per Healthy Waterways
	Treatable Flow Rate (Q_{minor})	0.215	m^3/s	From Cell I17, typically Q_{3month}
	Turbulence Parameter (n)	0.5		
	Calculated Capture Efficiency for 1mm particles	**0.8007**		**OK**
g)	Flow distribution type			Required if filter media area > 400 m^2
h)	Confirm scour protection at inflow locations	Yes		Typically Q_{3month}
	Minimum filter media width	20	m	
i)	Minor storm flow velocity over filter (*Equation 6*)	**0.120**	**m/s**	**<1m/s OK**
j)	Major storm flow velocity over filter (*Equation 6*)	**0.021**	**m/s**	**<1m/s OK**
7. UNDERDRAIN (OUTLET DESIGN)				
a)	Filter media saturated hydraulic conductivity	200	mm/hr	100-300 mm /hr
b)	Maximum filter infiltration capacity (*Equation 7*)	**0.044**	**m^3/s**	
c)	Underdrain Capacity Check (taking into account blockage factors)			
c)	Flow through slotted pipes			
	Blockage Factor (B)	0.50		Typically 0.5
	Discharge Coefficient (C_d)	0.61		Typically 0.61
	Length of Subsoil Drainage Pipe (L)	138	m	Measure from design
	Area of slots along drainge pipe (A_s)	0.004	m^2/m	*Vinidex product information states slot dimension at3 rows of 100mm x 4mm at 300mm centres*
	Min. subsoil drainag depth	0.200	m	
	Filter media depth	0.400	m	
	Max. water above filter media	1.170	m	
	Flow through Slots ($Q_{slotted}$)	**0.992**	**m^3/s**	**Qslotted > Qfilter OK**
	Slotted Pipe Diameter	150	mm	
	Manning's n	0.009		0.009 for uPVC
	Pipe slope	0.005	m/m	Typically 0.5%
	No. of pipe lengths	16	no.	Typically 1.5m apart (i.e. bioretention basin width/1.5)
	Flow through Slotted Pipes	**0.249**	**m^3/s**	**Qpipe > Qfilter OK**
c)	Flow through Collector Pipe			
	Collector Pipe Diameter	375	mm	
	Manning's n	0.013		0.009 for uPVC, 0.013 for concrete
	Pipe slope	0.005	m/m	Typically 0.5%
	Flow through Slotted Pipes	**0.124**	**m^3/s**	**Qpipe > Qfilter OK**
c)	Underdrain capacity (taking into account blockage factors)	**0.124**	**m^3/s**	**Underdrain capacity OK**
8. OVERFLOW (OUTLET DESIGN)				
a)	Overflow type	Pit + Weir		
b)	Overflow Pit Width	86.6	m	Measured to be the perimeter of bioretention filter area. Actual width = perimeter of ponded area at 300mm above filter level

b)	Overflow Pit Length	1	m	
	Available Head	1.95	m	
c)	Overflow weir length	4	m	
	Available Head	-0.78	m	
d)	Overflow pit capacity	**10.163**	**m^3/s**	**OK**
e)	Overflow pit plus overflow weir capacity	**12.168**	**m^3/s**	**OK**
f)	Outlet Pipe Diameter	450 & 225	mm	**Outlet Pipes designed for Stormwater Quantity Mitigation**
f)	Manning's n	0.013		0.009 for uPVC, 0.013 for concrete
f)	Pipe slope	0.005	m/m	Typically 0.5%
f)	Flow through Outlet Pipe (for minor AEP)	**#VALUE!**	**m^3/s**	**#VALUE!**
g)	Appropriate outlet scour protection provided	Yes		
9. VEGETATION DESIGN				
a)	Planting style i) small scale urban ii) med-large scale urban iii) bushland	(ii)		Med-large scale urban
b)	Trees and shrubs to be included (yes/no)	no		Items below Landscape Architect
c)	Species diversity (number of species)	6		Refer Table 19
d)	Species selection	(refer to plan:___)		≥ 50% coverage with plants from Table 20
e)	Planting density	6-Aug	m^2	May vary between plant species, refer to plan if required
f)	Mulch type and depth	75mm		See Section 3.6.7 and Section 4.4.4
	COMMENTS			
	Bioretention basin has dual purpose of mitigating Stormwater quantity as well as quality.			

*Streetscape application only

Operations and maintenance

StormFilter® EnviroPod Treatment Train

Stormwater360
AUSTRALIA

Device details			
Location of Device			
GPS Coord	N:	E:	D P Number:
Relevant Council			
Company			
Contact		Email	Ph
Engineer			
Contact		Email	Ph

SFEP Treatment
1
2

Frequency of Inspection/Maintenance	Inspections (time/year)	Major Maintenance
StormFilter		
EnviroPod		

Maintenance Estimated Annual Cost
StormFilter
EnviroPod
TOTAL

Contents

Maintaining the EnviroPod® Stormwater Gully Pit Insert

Maintenance is as integral to every stormwater management system as it is to any other item of machinery or equipment.

The primary purpose of the EnviroPod® Stormwater Gully Pit insert is to filter out and remove pollutants from entering our waterways. To ensure that the EnviroPod® continues to function effectively, it is important that the pollutants it captures are periodically removed, and the filtration components properly cleaned.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site, as well as the occurrence of events such as chemical spills or excessive sediment loading due to site erosion or extreme storms. Similarly, the system should be inspected after all major storm events.

Treatment Train Specifications

Performance Specification

The stormwater filtration treatment train shall consist of x 200 micron gully pit basket/s and x 460/690mm passive, siphon-actuated, radial flow, self cleaning media filtration cartridge system/s operating at a specific flow rate of not more than 1.5L/s/m^2.

The gully pit basket system shall consist of the following components;

- Removable 200 micron Nylon monofilament Precision woven Filtration Bag
- Fixed Galvanised Mesh Cage (no greater than 80mm x 80mm) around the Filtration Bag
- Recycled modified ABS plastic to seal the unit into the pit
- By-pass mechanism above the Filter with no moving parts
- System rigidly fixed to the walls of the pit.

The media filtration system shall be located within the following structure.

- Manhole
- DownPipe
- Linear
- Vault
- Large Box
- Detention.

Regardless of the system type, the media filtration system shall consist of the following components;

- Inlet energy dissipation
- Cartridge section
- Outlet section to bypass storm flows and convey treated stormwater
- Access Lids in roof slab for access to Cartridges
- Siphon actuated cartridges filled with proprietary ZPG™ filter media
- Specific flow rate of each individual cartridge limited not to exceed 1.5L/s/m^2
- Air Lock Cap complete with one way Air Valve Flap
- Outer Hood complete with Scrubbing Regulators
- Automated high-energy turbulence on the screen face (only) at the end of storm flows to flush pollutants from the cartridge
- Centre Drainage Tube complete with Buoyancy Float
- Individual Cartridge Flow Restrictor Disc
- ¼ Turn Bayonet Fittings
- Under drain manifold to convey treated stormwater to the receiving environment.

Components of any proposes treatment train or technology

The components of any proposed the treatment train or technology, including a gully pit basket upstream of a radial flow cartridge filtration system, must be evaluated for a range of pollutants and these performance expectations must comply with current best practice guidelines, i.e. Water by Design "MUSIC Modeling Guidelines version 1.0 2010" for South East Queensland.

In short, the performance evaluation of any system must show:

1. Any reduction efficiencies are justified by rigorous scientific testing as determined by an independent peer reviewer and the results further peer reviewed and published in a credible scientific journal. Any potential or perceived conflicts of interest should be disclosed within the published article.
2. Published article providing insight into the pollutant composition (e.g. soluble vs particulate for nitrogen) and the mean concentration of inflow and outflow to compare to local and or regional conditions.
3. Performance evaluation undertaken in dry weather conditions or a method to take into account any potential leaching of nutrients that may occur in the system(s).
4. Evaluation is conducted using full-scale systems with details of treatable flow rates sampled and how they correlate to discrete removal efficiencies and comparisons to the designed treatable flow rates of the device. A comparison should also be made to the climatic conditions especially where un-restricted filters are used.

Maintenance Overview

The primary purpose of the Stormwater Treatment Train is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the system to its full efficiency and effectiveness.

* Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance must be performed in accordance with the Treatment Trains Operation and Maintenance Guidelines.

Introduction

This manual has been designed to assist you with cleaning and maintaining the EnviroPod Stormwater Gully Pit Insert, using the methods recommended by the manufacturer.

The cleaning process and methods described cover all aspects of the system, including:

- Removing the grate
- Cleaning the filter bag
- Inspecting the unit
- Rejuvenating the filter bag
- Re-installing the filter bags.

The manual should be used in conjunction with your site's traffic management and safety plans, as well as other appropriate Stormwater360 (IES) documents such as the IES Employee Health and Safety Manual. We also recommend that maintenance and cleaning contractors, or device owners, develop their own site-specific health and safety activity plans to ensure a safe work environment.

* **Please note:** This manual consists primarily of the processes and tasks associated with the hand maintenance and inductor maintenance procedures. It does not include details of the site's traffic management or occupational health and safety requirements. Contractors or IES staff should utilise their own Employee Health and Safety Manual, which details the policies and procedures for safe work.

Why cleaning and maintenance are so vitally important

Adhering to the inspection and maintenance schedule of each stormwater treatment device is essential to ensuring that it works properly throughout its estimated design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It's also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner. To ensure consistency, we recommend that one person be responsible for overseeing the management of the maintenance and cleaning process.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up).

Health and safety

The EnviroPod has been designed to trap and retain pollutants in stormwater runoff, helping to maintain the quality of water entering our aquatic ecosystems. Depending on the nature of your site, pollutants can range from organic material such as leaves and sticks through to debris such as broken glass, syringes or other potentially harmful materials.

Access to gully pits containing EnviroPods may require removing heavy protective grates, while cleaning such pits may entail working in confined spaces. For these reasons, all aspects of maintaining and cleaning your EnviroPod require careful adherence to Occupational Health and Safety (OH&S) guidelines. Doing so will ensure that all maintenance personnel are adequately protected and have been properly trained before taking part in any specialist activities. The same level of care needs to be taken to protect non-work personnel in and around the site, while appropriate traffic control measures must be put in place where collection pits are situated in, or adjacent to, roadways or car parks.

* The procedures indicated in the Operations section of this manual are recommended as the safest and most efficient manner of conducting the maintenance of EnviroPod units (Section 2), however contractors and cleaning staff may vary the procedure in response to the site conditions; varying work practices; or general preferences in the cleaning techniques. Please note that procedures outlined in this manual are not exhaustive, and that any changes made should always comply with general safe work practices.

Cleaning of EnviroPod filters and StormFilters is a specialist activity. The material collected by the devices can be harmful, and needs to be handled correctly. For example, sediments may contain heavy metals and carcinogenic substances as well as harmful objects such as broken glass and syringes. It is essential that Occupational Safety and Health guidelines are followed at all times, and that the following steps are carried out to ensure safe and successful maintenance operations.

In addition to the dangers associated with the cleaning and handling of material in the filter bags, precaution needs to be taken with activities such as removing the grate as well as with managing the traffic, pedestrians and other non-worker personnel at the site. The general workplace hazards associated with working outdoors also need to be taken into account.

2.1 Personnel health and safety

All contractors and staff must comply with all current workplace health and safety legislation and take all practicable steps to:

- Comply with all applicable laws, regulations and standards
- Ensure that all employees, contractors and visitors are informed of and understand their obligations in respect of current workplace health and safety legislation
- Ensure that employees understand and accept their responsibility to practice and promote a safe and healthy work environment.

* Take proper care. Pollutants can range from organic materials such as leaves and sticks through to debris such as broken glass, syringes or other potentially harmful materials.

While cleaning and maintaining filters, all relevant precautions must be taken to prevent contact with sediment and litter. This includes wearing the following personal protective and safety equipment:

- Puncture resistant gloves
- Steel capped safety boots
- Fluorescent safety vest
- Overalls or similar skin protection
- Safety apron (if necessary)*
- Eye protection (if necessary)*.

* Higher personal safety conditions may be required when maintaining units that may contain more hazardous material, for example pits where syringes have been observed or pits located in areas associated with such activities.

2.2 Traffic control

Stormwater collection pits are typically situated either in or on roads and car parks, or adjacent to roads in a footpath or swale. Traffic control requirements across all such locations differ with most of the state and local road authorities requiring the same controls to be implemented whether the work is to be conducted on the road or on the road reserve.

As traffic requirements differ depending on road usage and the specific road configuration, separate traffic control plans should be prepared for each site. Given that maintenance is typically a quick process, the contractor should liaise with the relevant road authority to determine the specific road safety requirements for each location to ensure that on site workers can conduct the cleaning operations safely and efficiently, while complying with all laws and regulations.

State government publications such as the NSW RMS *Traffic Control at Work Sites* safety manual outline the signage requirements, placement of barricades or witches hats and the positioning of traffic control personnel that's required when working on public roads. For increased safety, IES recommends that the maintenance vehicle be used to shield the work area from oncoming traffic.

Photo 1 shows the maintenance vehicle with cones placed around and positioned to shield the work area. **Photo 2** shows the head-on view, note the vehicle is positioned to allow access to the drive, whilst still blocking the pit from on-coming traffic. The vehicle has a flashing light on the roof and the hazard lights switched on.

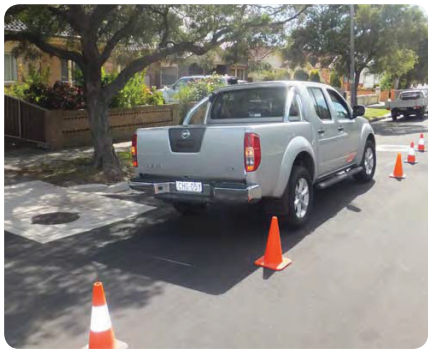


Photo 1 Vehicle positioned near pit, preventing traffic from passing close to the pit.

2.3 Confined spaces

Confined space entry procedures are not included as part of this manual. For IES employees these procedures are included as part of the IES Safety Manual. It is recommended that all contractors evaluate their own needs for confined space entry and compliance with Occupational Health and Safety regulations.

When repairs or maintenance activities cannot be conducted from the surface, and there is a need to enter and work in a confined space, only staff with current confined space training are permitted to operate in a confined space. Appropriate measures and controls must be put in place to meet confined space entry requirements. At all times the necessary safety equipment must be worn, and where gas or oxygen hazards occur, only staff trained in its use will use breathing apparatus gear. **Non-trained staff must not go into confined spaces.**

* Confined spaces pose a serious safety hazard for all personnel; however during the normal maintenance procedures there should be no reason to enter a confined space and all maintenance procedures are able to be conducted from the surface.

Photo 2 Head-on view, indicating the placement of the vehicle near the pit.

Operations

EnviroPod units need to be regularly inspected to determine whether they require maintenance or cleaning. This process involves several steps, and may require two or more maintenance personnel working together, as well the use of specialised equipment such as a hydraulic lifting arm or an inductor truck with a vacuum hose.

As gully pit grates are usually quite heavy, it is important that correct lifting procedures are adopted, and that the area surrounding the opened pit is shielded from access to non-work personnel.

If inspection reveals that the filter bag needs to be emptied and rejuvenated, the entire unit should also be examined to ensure that all connections and joints are sound. Any material that has accumulated in the overflow diversion channels or outlet pipes also needs to be removed, with those areas then being flushed. Where required, filter bags may need to be cleaned or repaired, and all waste material must be disposed of according to local guidelines at either an approved disposal site or transfer station.

This section outlines the procedures for cleaning the EnviroPod units. It has been written so that someone who has never previously encountered a stormwater pit or an EnviroPod unit can carry out such maintenance by simply following the outlined steps.

3.1 Maintenance and monitoring of EnviroPod filters

To ensure that each EnviroPod unit achieves optimal performance, the material collected by the filter bag should be emptied when the level of material is no more than approximately **half to two thirds** of the total bag depth or when there is evidence of material overflow. While the bag has a greater storage capacity, it is recommended that it is not left to fill completely prior to emptying, for the following reasons:

- the bags are capable of retaining a heavy mass of material (in excess of 50kg), which will make them more difficult to lift and empty
- material near the top of the bag can be re-suspended during high to extreme rainfall events
- blockage of the overflow sections can occur, when material is allowed to build up above the filter bag.

It is also recommended that additional monitoring is conducted following moderate to extreme rainfall events, especially when preceding months have had little or no rainfall. This increased frequency of monitoring is necessary as there is a greater accumulation of surface contamination during low rainfall periods, which will then enter the unit with the higher volumes of runoff generated during a major rainfall event. It is also important to ensure that the units have not been damaged due to high pipe velocities.

3.2 Stormwater pit cover removal

3.2.1 Hinged pit grates

These are the steps for opening a hinged pit grate:

1. Insert the lifting hooks beneath the grate. (Position indicated in **Photo 3**)
2. Check hinge point is not damaged and debris is not caught in the hinge area.
3. Fully open pit grate, ensuring that the grate will stay in the open position without any external forces applied. Grates that do not remain open without being held should be removed or secured during cleaning or maintenance activities. **Photo 4** indicates the grate being opened and grate resting freely in the open position, respectively.

* **Please note:** Many cast iron hinges are not hinged securely (to enable the removal of the grate). This may result in the pit grate not being able to sit in an open position. Additionally the hinge pins may also be damaged or corroded, which may allow the grate to fall into the pit. Such pit grates can be removed using the method indicated below for non-hinged grates.

Photo 3 Lifting the grate

Photo 4 Fully open grate

Photo 5 Lowering grate

3.2.2 Non-hinged pit grates

To remove a non-hinged pit grate:

1. Place lifting hooks beneath grate, where possible in the four corners of the grate (see **Photo 6**). Concrete lids may have Gatic lifting points, a key arrangement or holes in the lid, which may require special equipment such as Gatic lifters
2. Position each person either side of the grate (see **Photo 7**)
3. Lift the grate, ensuring that good heavy lifting posture is used at all times
4. Place the grate on an angle on the gutter, to allow for the lifting hooks to be removed (see **Photo 8**)
5. For extremely heavy one-piece grates and concrete Gatic covers, insert the lifters in place and slide the lids back. Note some lids may still require two people

Photo 6 Insert hook near edge of grate

Photo 7 Position each lifter either side of the grate

Photo 8 Lift grate and move grate to one side

Photo 9 Lift grate above the support frame

Photo 10 Reinstated non hinged grate

3.3 Cleaning methods

One of the following maintenance methods should be used for servicing EnviroPod Filters:

3.3.1 Cleaning using an inductor truck

Follow these steps to safely and efficiently clean the EnviroPod using an inductor truck:

1. Open gully pit (See Section 3.2)
2. Place the inductor hose over the material collected in the filter bag and switch on the inductor
3. Using the inductor hose, suck out all of the sediment, organic leaf material, litter etc. collected in the filter bag
4. Allow the filter bag to be sucked up into the inductor hose for a few seconds to allow for the filter mesh pores to be cleaned. Care is to be taken that there are no sharp edges on the inductor hose that can damage the filter bag
5. If material has built up around the overflows, use the inductor hose to clear the accumulated material
6. Remove filter bag from the pit
7. Sediment retained in the gully pit grate is to be removed
8. Back-opening channels are to be cleared of any debris to ensure flow is not hindered. This debris can also be collected using the inductor truck
9. All gully pit waste is to be removed from the pit
10. Check the EnviroPod unit (Section 3.4)
11. Check filter bag (Section 3.4)
12. Reinstate filter bag and gully pit lids

Photo 11 Cleaning an EnviroPod using the inductor method

3.3.2 Hand maintenance

To clean the EnviroPod manually by hand, follow these steps:

1. Open gully pit (See Section 1)
2. Place the lifting hooks in the lifting loops of the filter bag (See **Photo 12**)
3. For extremely heavy and overfilled bags either use a hydraulic lifting arm to lift the bag, or remove excess material using a shovel or similar piece of equipment. IES prefers the use of a post hole shovel, due to the reduced strain on the back when digging and the ability of the shovel to grab material vertically
4. Lift the bag vertically off the supporting frame, ensuring that no undue pressure is placed on the filter bag. (See **Photo 13**)
5. Lift the bag clear of the stormwater pit (See **Photo 14**)
6. Position the bag over the truck or other collection vehicle, taking hold of the loops at the base of the bag (See **Photo 15** and **Photo 16**)
7. Lift and empty the filter bag by holding the bottom lifting loops only (See **Photo 17**)
8. Completely empty the filter bag (See **Photo 18**)
9. Brush the filter bag with a stiff brush to remove bound sediment from the filter pores
10. Check the EnviroPod unit (Section 3.4)
11. Check the filter bag (Section 3.5)
12. Reinstate filter bag, ensuring bag is installed the correct way (See **Photo 19** and **Photo 20**)
13. Reinstate gully pit lids (See **Photo 21** and **Photo 22**)

Photo 12 Place the lifting hooks through the bag loops

Photo 13 Lift the bag from the cage and support frame

Photo 14 Lift the bag from the stormwater pit

Photo 15 Lift the bag onto the collection vehicle

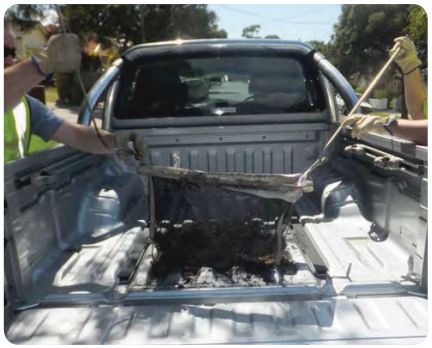


Photo 16 Grab the bottom lifting loops

Photo 17 Lifting the bottom bag loops empty the filter bag

Photo 18 Completely empty the contents of the filter bag

Photo 19 Reinstall filter bag

Photo 20 Ensure that the unit is positioned correctly, with the lifting loops on the inside

Photo 21 Correctly installed filter bag

Photo 22 Installed filter bag and sealed pit

Please note: Under no circumstances are gully pit sediments to be backwashed into the gully pit.

Photo 23 Check seals are pushed against the pit walls

Photo 24 Check joining rivets (two piece unit shown above)

3.4 Unit inspection

After the EnviroPod filter bag has been removed, emptied and cleaned, the following should be checked to ensure that the unit has not been damaged:

- All connections and joints should be checked and broken rivets replaced (See **Photo 23**)
- The plastic pit seals should be inspected for unit movement or damage (See **Photo 24**)
- The cage should be inspected for damage or movement.

The overflow diversion channels, and the area between the EnviroPod cage and pit wall should also be inspected for any accumulated debris. Any observed debris should be removed and disposed of off-site. Accumulated material within the outlet pipe may also need to be flushed.

If spare parts are required, Stormwater360 is able to provide these at a cost to the owner of the EnviroPod unit, although these parts may also be obtained from other suppliers.

Please note: If the units are not cleaned regularly, the mobilisation of material collected in the EnviroPod unit may occur. As such, cleaning of the units in accordance with this management plan is required. As this plan is based on observations and data collected during the monitoring period, ongoing adjustment of the cleaning frequency is generally required to improve the overall efficiency in the removal of collected material and prevent material overflow.

3.5 Filter bag inspection and rejuvenation

After the filter bags have been emptied and cleaned, they should be inspected to evaluate their condition. Given the nature of stormwater, the filter bag may become considerably clogged with fine sediment or damaged by various objects in stormwater as well as fauna. Sharp material such as sticks, combined with high velocity water and a large mass in the filter bag, can cause small tears in the filter material. Animals such as rats have also been known to chew through fine mesh filter bags located in gully pits near takeaway food outlets.

3.5.1 Clogged filters

Clogged filter bags can be cleaned using several different methods. If the techniques described in the general maintenance sections above do not adequately clean the filter bags, the following options should be considered:

- Using a stiff brush and a bucket of soapy water, scrub the filter bag surface.
- Remove filter bags from the pit and wash the bags using a high pressure water spray, taking care not to transfer the contamination elsewhere. Wastewater from the process should be collected and disposed of correctly.
- Remove the filter bags from the pits and the support rings and wash the bags in an industrial washing machine.

This final option typically results in the bags appearing like new, with no visible stain or pore clogging within the filter mesh.

Photo 25 Slightly clogged filter bag, indicated by the brown stain on in the centre of the bag

Photo 26 A clean used filter bag

3.5.2 Damaged filters

Damaged filter bags can often be repaired, provided the damage is small. Small tears in the fabric may occur due to several reasons, however the overall strength and structure of the nylon fabric typically prevents small tears becoming much larger. Although the bag is unlikely to tear further, care must be used when cleaning torn bags so as not to spill the collected material into the pit.

Small tears may be repaired by either sewing the tear back together with additional fabric to increase the strength of the stitching, or by sewing a patch of the filter material onto the filter bag. If large tears are present, the filter bag may need to be replaced as it is no longer able to function as intended.

3.6 Disposal of material

All gully pit wastes are to be taken off site and disposed of at a transfer station or similar approved disposal site. Stormwater sediments can contain lead, copper, zinc, mercury, hydrocarbons and PCBs, which are harmful to both humans and the receiving environment. Appropriate sampling and laboratory analysis may be required to classify the material as suitable for reuse, or disposal under appropriate local guidelines.

Emergency procedures

Spills and blockages can have an immediate impact on the performance of a stormwater management system, and can potentially result in serious damage to built infrastructure as well as the surrounding waterways and wetlands.

In these types of emergencies, it is important to act quickly to remediate the problem by removing affected sediment or clearing the cause of the blockage, so that the system can resume normal and effective functioning as soon as possible.

4.1 Spill procedures

In the event of a spill discharging into any gully pit, all sediment is to be extracted and the filter bags are to be removed and replaced with rejuvenated filter bags. Normal operation procedures apply to additional cleaning as a result of spills.

4.2 Blockages

In the unlikely event of surface flooding around a gully pit fitted with an EnviroPod the following steps should be carried out:

1. Check EnviroPod overflow bypass. The EnviroPod filter has been designed with an overflow mechanism built into the filter box. If surface flooding still exists, check the overflow slots underneath the rubber seal. If debris is lodged in the overflow slots it can be easily cleared by hand or a steel rod.
2. If overflow is clear and surface flooding still exists remove EnviroPod and check outlet pipe for blockages.
3. Removal of the EnviroPod may be difficult if the filter is clogged and the EnviroPod is holding water. If the filter is clogged, brush the sidewalls of the filter with a yard broom or similar. This will dislodge particles trapped at the interface allowing contained water to flow through the filter.
4. If the outlet pipe is blocked, it is likely that a gully sucker truck will be required to unblock it. Debris should be removed from the EnviroPod with the gully sucker truck before removal of the EnviroPod filter. If a gully sucker truck is not available and the EnviroPod needs to be removed by hand, follow the steps below:

a. Remove excess debris by hand or brush the side of the filter.

b. Lift and place filter ring through the filter box and into cage.

c. Remove Filter box.

d. Lift cage containing filter bag and ring out of the pit.

e. Unblock outlet pipe.

The Stormwater Management StormFilter®

For almost two decades the Stormwater Management StormFilter® has helped meet the most stringent stormwater quality requirements.

The system has been continually tested and refined, to ensure it achieves maximum reliability and performance.

As a best management practice (BMP) system, it removes the most challenging target pollutants – including fine solids, soluble heavy metals, oils and total nutrients (including soluble) – by using a variety of media to achieve site-specific pollutant removal objectives.

StormFilter® overview

1.1 Description

StormFilter is a passive, flow-through stormwater filtration system consisting of vaults that house rechargeable cartridges filled with a variety of filter media, and is installed in-line with storm drains. The StormFilter works by passing stormwater through media-filled cartridges, which trap particulates and adsorb materials such as dissolved metals and hydrocarbons. After being filtered through the media, the treated stormwater flows into a collection pipe or discharges into an open channel drainage way. StormFilter is offered in three different configurations: cast-in-place, precast and linear. The precast and linear models utilise pre-manufactured vaults. The cast-in-place units are customised for larger flows and may be either covered or uncovered underground units.

1.2 Operation

1.2.1 Purpose

The StormFilter is a passive stormwater filtration system designed to improve the quality of stormwater runoff from the urban environment before it enters receiving waterways.

Through independent third party studies, it has been demonstrated that the StormFilter is highly effective for treatment of first flush flows, and fast-paced flows, during the latter part of a storm. In general, StormFilter's efficiency is highest when pollutant concentrations are highest. The primary target pollutants for removal are: sediments (TSS), soluble metals, soluble phosphorus, nitrates, and oil and grease.

1.2.2 Sizing

The StormFilter is typically sized to meet design water quality objectives, which are subject to legislation regulated by local government authorities and other relevant environmental bodies. MUSIC modelling software is used to determine pollutant loads from a site, influenced by a number of factors such as site area, imperviousness and land use. Pollutant load reduction capabilities, based on third party testing, allows the number of StormFilter cartridges required to achieve the relevant objectives to be established. Cartridges are designed to treat a peak flow between 0.7 and 1.6 litres/second, depending on the cartridge size used. For example, 10 standard sized cartridges (460mm) are able to treat 11 L/s, as each filter can treat 1.1 L/s.

Because of the highly porous nature of the granular filter media, the flow through a newly installed cartridge is restricted to 1 L/s (average 460mm), using a restrictor disc, to ensure adequate pollutant-media contact time.

Photo 27 Filter cartridge

1.2.3 Basic function

The StormFilter is designed to siphon stormwater runoff through a filter cartridge containing media. The variety of media available can be designed to act as a mechanical filter to remove sediments, as an ion exchanger to remove dissolved heavy metals, and as an absorber to remove oils and greases.

1.2.4 Priming system function

The treated stormwater collects in the centre tube of the cartridge, which is equipped with a self-priming siphon system. (Figure 1 illustrates this system.) The key component of the system is the plastic float, consisting of a ball located at the base leading up to a larger portion, which provides increased buoyancy. Initially the ball rests in a seat, effectively closing off the port to the drainage manifold.

As a result, the filter fills the centre drainage tube until the water level has risen high enough to purge the air from the filter cartridges and displaces the float. At a water depth of 22 inches the float pulls loose and allows the filtered water to drain out through the manifold. This effectively "primes" a siphon within the drainage tube and greatly increases the potential across the filter. The priming system increases StormFilter's ability to be loaded with sediment. A related feature is the cartridge "hood". This hood maintains the siphon effect by preventing air from being drawn into the cartridge until the external water level drops below the bottom of the hood.

Cartridges are connected to the manifold with a plastic connector. These can be either quarter turn connectors or in the older systems, threaded connectors.

StormFilter is also equipped with flow spreaders that trap floating debris and surface films, even during overflow conditions. Depending on individual site characteristics, some systems are equipped with high and/or low flow bypasses. High flow bypasses are installed when the calculated peak storm event generates a flow that overcomes the overflow capacity of the system. This is especially important for precast systems. Low flow bypasses are sometimes installed to bypass continuous inflows caused by ground water seepage, which usually do not require treatment. All StormFilter units are designed with an overflow. The overflow operates when the inflow rate is greater than the infiltration capacity of the filter media.

1.2.5 Maintenance overview

The primary purpose of the StormFilter is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, these pollutants must be removed periodically to restore the StormFilter to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. To assist the owner with maintenance issues, Stormwater360 provides detailed Operation and Maintenance Guidelines with each unit.

Stormwater360 can provide maintenance services completely, or in part. Available services include tracking of installed systems, advising the system's owner of maintenance needs, and notification of the regulatory agency once the system has been maintained.

Maintenance is usually performed in the dryer periods to rejuvenate the filter media and prepare the system for the next rainy period. Maintenance activities can also be required in the event of a chemical spill or excessive sediment loading due to site erosion or extreme storms. It is good practice to inspect the system after severe storm events.

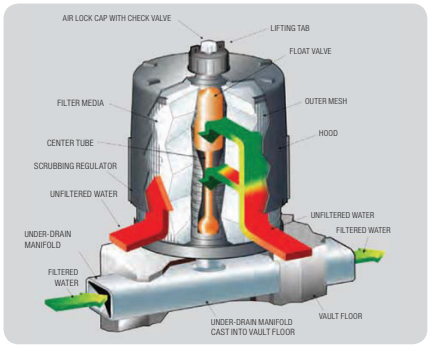


Figure 1 Filter cartridge

StormFilter® maintenance and performance expectations

To ensure the optimal and ongoing performance of the StormFilter, the system requires systematic inspection, cleaning and maintenance. This maintenance regime falls into two categories – ongoing minor inspection and maintenance, and major cleaning and maintenance. The maintenance frequency is largely determined by the conditions of each site, and the amount of sedimentation in the stormwater runoff that flows through the system. Unexpected events such as chemical spills, erosion or extreme storm activity require immediate inspection of the system, together with removal of debris or contaminated sediment, and where appropriate, replacement of the media cartridges.

While some maintenance activities can be completed by hand, others require specialised equipment such as an inductor truck with a vacuum hose. In all cases, it is important that maintenance staff are properly trained in the functioning of the StormFilter system and have a good knowledge of the correct procedures for disposing contaminated sediment as well as the methods for removing and installing StormFilter media cartridges.

At all times, appropriate safety equipment must be used, and Occupational Health And Safety (OH&S) guidelines adhered to.

2.1 Types of maintenance

Presently, procedures have been developed for two levels of maintenance:

- Inspection and/or minor maintenance
- Major maintenance.

Inspection/minor maintenance activities are combined since the minor maintenance does not require special equipment and typically little or no materials are in need of disposal.

Inspection/minor maintenance typically involves opening the flow restricting valves (to pre-set levels) and cleaning up vegetation and debris. Major maintenance typically includes cartridge recharging. Major maintenance may involve disposal of materials that require consideration of regulatory guidelines. Depending on the particular unit configuration and equipment used, major maintenance may require an understanding of OSHA rules. **Table 1** summarises the primary activities associated with StormFilter maintenance.

Table 1: StormFilter

Facility component requiring maintenance	Maintenance activity	When maintenance activity is required	Expected facility performance after maintaining
StormFilter cartridges and containment structure	Litter and debris removal	Floatable objects or other litter is present in the filter. Remove to avoid hindrance of filtration and eliminate unsightly debris and litter.	Permanent removal from storm system.
StormFilter cartridges and containment structure	Cartridge replacement and sediment removal	Media has been contaminated by high levels of pollutants, such as after a spill.	New media is able to effectively treat stormwater.
Drainage system piping	Flushing with water	Drainage system is obstructed by debris or sediment.	Outflow is not restricted.

2.2 Maintenance activities

2.2.1 Maintenance activity timing

Two scheduled inspections/maintenance activities should take place during the year. During the minor maintenance activities (routine inspection, debris removal), the type of major maintenance required is determined and, if required for disposal, samples of the sediments and media are obtained.

The next scheduled date is to perform major maintenance activities (replacement of the filter cartridges and associated sediment removal). In addition to the scheduled activities, it is important to check the condition of the filter after major storms to check for damage caused by high flows and to check for high sediment accumulation, which may be caused by localised erosion in the drainage area. It may be necessary to adjust maintenance activity scheduling depending on the actual operating conditions encountered by the system.

2.2.2 Maintenance activity frequency

The primary factor controlling timing of maintenance for the StormFilter is sedimentation. A properly functioning system will remove solids from water by trapping these particulates within the porous structure of the media. The flow through the system will naturally decrease as more and more solids are trapped. Eventually the flow through a system will be low enough to require replacement of the cartridges. Sediment should be removed from upstream trapping devices on an as-needed basis to prevent material from being re-suspended and discharged to the system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction should be inspected and maintained more often than those in fully established areas. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after large storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual filter.

2.3 Maintenance crew requirements

Table 2 lists the anticipated crew requirements for maintenance operations. Removal of water and sediments during major maintenance activities can be accomplished using either a pump and water truck or a vacuum truck. All applicable occupational health and safety (OH&S) and disposal regulations should be followed. A general description of the maintenance activities follows.

Table 2 Anticipated Crew Requirements

	Inspection/Minor Maintenance	Major Maintenance: Sediment Removal	Major Maintenance: Cartridge Replacement
Labourer	1		1
Skilled Worker	1	1	1
Vacuum/Water Truck Operator		1	0/1
Total	**2***	**2***	**2/3***
Special Requirements	Knowledge of Proper StormFilter Function	Knowledge of Disposal Requirements	Knowledge of Cartridge Removal and Installation Procedures

* May require OH&S trained person if/when vault entry occurs.

2.4 Maintenance methods

2.4.1 Minor maintenance/inspection (twice a year)

Minor maintenance typically will involve the steps below, however if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately.

Steps for Minor Maintenance/Inspection

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open access covers. Also set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the access covers to the vault and allow the system to air out for 5-10 minutes.
5. **Without entering the vault,** inspect the inside of the unit, including components.
6. Take notes about the external and internal condition. This includes inspecting pit penetrations, walls, lids, ladders and grates etc.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault and on top of the internal components. If flow is occurring, note the level of water and estimate the flow rate per drainage pipe. Record all observations.
8. Remove large loose debris and litter using a pole with a grapple or net on the end.
9. Close and fasten the access cover, and remove safety equipment.
10. Finally, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.

* In the case of a spill, workers should abort maintenance activities until the proper guidance has been obtained.

2.4.2 Major maintenance inspection (once a year)

The primary goal of the major maintenance inspection is to assess the condition of the cartridges relative to the level of sediment loading. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present and very little flow will be discharging from the drainage pipes. It is likely that the cartridges need to be replaced. Major maintenance inspection will typically involve the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Steps for Pre-Major Maintenance Inspection

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the access covers to the vault and allow the vault to air out for 5-10 minutes.
5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
6. Take notes about the external and internal condition.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault, and on top of the internal components.
8. Remove large loose debris and litter using a pole with a grapple or net on the end.
9. If the visit is during a storm, make the flow observations discussed above.
10. Close and fasten the access cover, and remove safety equipment.
11. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
12. Review the condition reports from the previous minor and major maintenance visits and schedule for cartridge replacement if needed.

2.4.3 Major maintenance: sediment removal and cartridge replacement (and emergency)

Major maintenance/filter cartridge replacement typically involves the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Depending on the configuration of the particular system, a worker may be required to enter the vault to perform some tasks. If vault entry is required, OH&S rules for general confined space entry must be strictly adhered to. Filter cartridge replacement should occur during dry weather and it may be necessary to plug the filter inlet pipe if base flows exist. Standing water present in the vault should be regarded as polluted and contained during this operation by temporarily capping the manifold connectors.

* **Please note:** Confined space entry may be required on StormFilter systems. In this case, please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and is valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 immediately.

Steps For Cartridge Replacement Maintenance

1. Depending on the particular unit, one or two utility workers and a hauling truck operator will deliver the replacement cartridges to the site. Information concerning how to obtain the replacement cartridges is available from Stormwater360.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the doors to the vault and allow the system to air out for 5-10 minutes.
5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
6. Make notes about the external and internal condition.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault and on top of the internal components.
8. Ensuring safe working procedures are met, off load the replacement cartridges (16-39kgs each) and set aside.
9. Remove the top cap (threaded), upper seal and float from the cartridge. Repeat procedure for every cartridge within StormFilter vault. Place items in a large plastic container to be lifted form the vault.
10. Using a cordless drill and 8mm hex head, remove the three screws located around the top perimeter of the cartridge hood. Place screws in the large plastic container and, once full or completed, remove plastic container from vault.
11. Move the vacuum truck near the StormFilter vault on the down-wind side. Be sure that the truck is not too close to the vault so that fumes will not enter the vault. Make sure that the last 500mm of the nozzle is approximately 100-125mm in outside diameter.
12. Feed vacuum nozzle into cartridge bay and start vacuum truck. Remove cartridge hood and place nozzle directly onto filter media. Completely remove media from each cartridge and repeat process for every cartridge in vault.
13. Once completed disconnect cartridges from vault floor and place hood back on cartridges
14. Using the appropriate lifting cap, attach the cable and remove the cartridge (up to 10kgs. each) from the vault. It is strictly prohibited to have personnel standing under suspended cartridges. Care must also be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless Stormwater360 is performing maintenance activities and damage is not related to discharges to the system.
15. Set the used cartridge aside or load onto the hauling truck.
16. Repeat steps 14 to 15 until all cartridges have been removed.
17. Remove deposited sediment from the floor of the vault. This can be accomplished by using the vacuum truck
18. Once the sediments are removed, it is necessary to assess the condition of the vault, particularly the manifold and the connectors. These are short sections of 2-inch schedule 50 PVC, or threaded schedule 80 PVC that should protrude above the floor of the vault. If required, apply a light coating of FDA approved silicon grease to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe. Replace any damaged connectors.
19. Using the boom, crane, or tripod, lower and install the new cartridges (typically 30kg for standard 460 cartridges). Once again, take care not to damage connectors.
20. Close and fasten the access cover, and remove safety equipment.
21. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.
22. Finally, dispose of the residual materials in accordance with applicable regulations. Make arrangements to return the used cartridges to Stormwater360.

2.4.4 Related maintenance activities (performed on an as-needed basis)

StormFilter units are often just one of many components in a more comprehensive stormwater drainage and treatment system. The entire system may include catch basins, detention vaults, sedimentation vaults and manholes, detention/retention ponds, swales, artificial wetlands, and other miscellaneous components. In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities. In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil and grease loading, and discharges of inappropriate materials.

2.5 Typical equipment required for maintenance activities

Typical equipment required for conducting maintenance is shown in Table 3. Some of the materials listed are suggestions rather than requirements. It should be noted that there is more than one way to accomplish some tasks. Owners with available labour and equipment resources may desire to use alternative methods. However, it is advisable that guidance from Stormwater360 be obtained prior to using alternative techniques.

Table 3 Maintenance Equipment Requirements

Maintenance equipment required		
Minor maintenance	**Pre-major maintenance inspection**	**Major maintenance cartridge replacement**
• Safety equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats • Work clothes: Rubber boots, overalls, and gloves • Door bolt, wrench, proprietary lifters (e.g. Gatic) and miscellaneous Tools • Tape measure • Flashlight • Grapple or net pole • Record keeping forms • Litter/debris container	• Safety equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats • Work clothes: Rubber boots, overalls, and gloves • Door bolt, wrench, proprietary lifters (e.g. Gatic) and miscellaneous Tools • Tape measure • Flashlight • Grapple or net pole • Record keeping forms • Litter/debris container	• Safety equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats • Work clothes: Rubber boots, overalls, and gloves • Door bolt, wrench, Pentasocket and miscellaneous Tools • Tape measure • Flashlight • Grapple or net pole • Record keeping forms • Vacuum truck • Replacement cartridges • Cartridge hauling truck • Crane, tripod and hoist, or other lifting device (150kg minimum capacity) • Shovels • Extra 50mm PVC cartridge connectors • Spare flow restrictor discs • Litter/debris container • Vault inlet pipe plug • Dolly • PVC Pipe cutter • Ladder • Cartridge installation and removal sling

*Confined space equipment may be required for vault entry. This equipment must be used by personnel with the appropriate OH&S training. This equipment typically includes: Atmospheric testing devices, atmospheric purging and ventilating devices, and entry, exit, and rescue assisting devices.

2.6 Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in a manner that will not allow the material to affect surface or ground water. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily travelled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations.

It is not appropriate to discharge these materials back to the stormwater drainage system. Part of arranging for maintenance to occur should include coordination of disposal of solids (landfill coordination) and liquids (municipal vacuum truck decant facility, local wastewater treatment plant, on-site treatment and discharge). Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals. Stormwater360 will determine disposal methods or reuse of the media contained in the cartridges. If the material has been contaminated with any unusual substance, the cost of special handling and disposal will be the responsibility of the owner.

SFEP StormFilter & Enviropod Maintenance Data Sheet

Stormwater360 AUSTRALIA

Date:	Location:	GPS COORD:
System size:	Type: ○ Cast-in-place ○ Precast ○ Linear	
Number of Cartridges:	Type of Cartridge: ◉ 460mm ○ 690mm ○ 310mm	
Filter Media: ○ ZPG ○ Perlite		
Type of EnviroPods:		Number of EnviroPods:
Personnel:		

STORMFILTER SYSTEM OBSERVATIONS

Last service:
Sediment Depth on Vault Floor:
Structural Damage:
Cartridges submerged: ○ Yes ○ No How deep:
Comments:

ENVIROPOD SYSTEM OBSERVATIONS

Last service:
Amount of Sediment in Basket:
Structural Damage:
Comments:

DRAINAGE AREA REPORT

Excessive Oil and Grease Loading	○ Yes	○ No	Source:
Sediment Accumulation on Pavement	○ Yes	○ No	Source:
Erosion of Landscaped Areas	○ Yes	○ No	Source:
Comments:			

STORMFILTER CARTRIDGE MAINTENANCE ACTIVITIES

Remove Litter and Debris	○ Yes	○ No	Details:
Sediment Removed from Vault Floor	○ Yes	○ No	Details:
Quantity of Sediment Removed (estimate?):			
Replace Cartridges	○ Yes	○ No	Details:
Minor Structural Repairs	○ Yes	○ No	Details:
Residuals (debris, sediment) Disposal Methods:			
Notes/Problems:			

ENVIROPOD MAINTENANCE ACTIVITIES

Number of Bags Replaced:	Clogged EnviroPods/Bags: ○ Yes ○ No
Comments:	

SFEP Treatment Train Inspection Data Sheet

Stormwater360 AUSTRALIA

It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the sub-merged cartridges are severely plugged, large amounts of sediments should be present, very little flow will be discharging from the drainage pipes, and it is likely that the cartridges need to be replaced during major maintenance.

Date:	Location:	GPS COORD:
System size:	Type: ○ Cast-in-place ○ Precast ○ Linear	
Number of Cartridges:	Type of Cartridge: ○ 460mm ○ 690mm ○ 310mm	
Filter Media: ○ ZPG ○ Perlite		
Type of EnviroPods:		Number of EnviroPods:
Personnel Attending Inspection:		

STORMFILTER SYSTEM OBSERVATIONS
Last service:
Sediment Depth on Vault Floor:
Structural Damage:
Cartridges submerged: ○ Yes ○ No How deep:
Comments:

ENVIROPOD SYSTEM OBSERVATIONS
Last service:
Amount of Sediment in Basket:
Structural Damage:
Comments:

DRAINAGE AREA REPORT			
Excessive Oil and Grease Loading	○ Yes	○ No	Source:
Sediment Accumulation on Pavement	○ Yes	○ No	Source:
Erosion of Landscaped Areas	○ Yes	○ No	Source:
Comments:			

Next steps

Learn more

For more detailed technical information about Stormwater360 products and solutions, visit **www.stormwater360.com.au**

Connect with us

With more than 12 years experience in developing, installing and maintaining innovative and efficient site-specific stormwater management solutions, Stormwater360's highly qualified engineers and consultants can assist you with every aspect of your stormwater project.

Whether it's an initial in-house technical presentation, a request to inspect and clean your existing facility, or assistance with designing a specific stormwater management solution for your site, simply complete the enquiry form at **stormwater360.com.au** or call **1300 354 722** to speak to a Stormwater360 consultant.

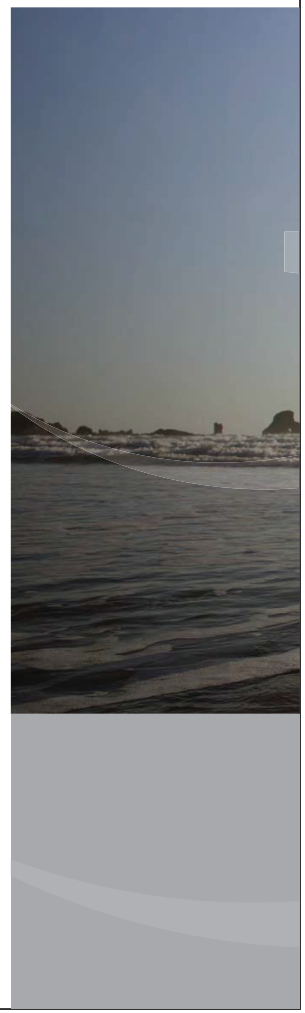
Start a project

If you are ready to begin a project, our engineering team will provide you with everything you need, from a free preliminary design to MUSIC modelling, CAD drawings to maintenance frequency and associated costs schedules. To find out more, simply visit **www.stormwater360.com.au/custom-solutions** and complete the Design Information Request form.

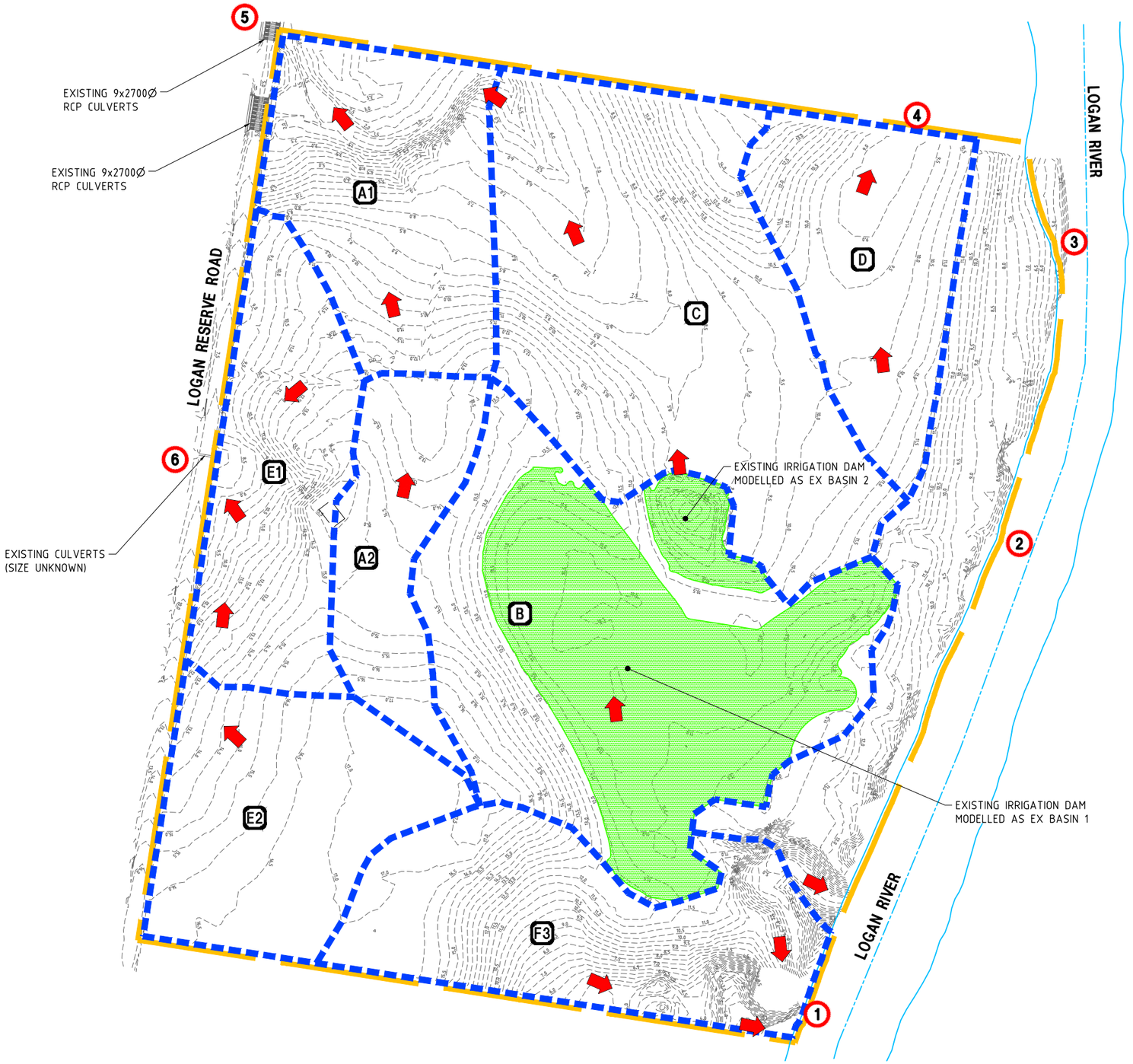
Stormwater360 supplies and maintains a complete range of filtration, hydrodynamic separation, screening and oil/water separation technologies.

Call 1300 354 722

www.stormwater360.com.au



APPENDIX F CALIBRE CONSULTING CONCEPT DRAWINGS



EXISTING CATCHMENT PLAN

SCALE 1:2000 (A1)

SCALE 1:4000 (A3)

N

EXISTING CATCHMENT DATA

CATCHMENT	AREA (ha)	FRACTION IMPERVIOUS (%)
A1	4.68	0.94%
A2	2.69	0.29%
B	10.19	0.13%
C	9.48	0%
D	3.91	0%
E1	4.13	1.12%
E2	4.48	0%
F3	5.40	0%

LEGEND:

- SITE BOUNDARY
- 10 EXISTING CONTOURS
- EXISTING CATCHMENT BOUNDARY
- A EXISTING CATCHMENT LABEL
- FLOW DIRECTION
- 2 DISCHARGE LOCATIONS
- EXISTING IRRIGATION DAM

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-000483-01.
2. EXISTING IRRIGATION DAMS WERE ONLY INCLUDED IN THE EXISTING SCENARIO WBNM (I.E. NOT INCLUDED IN CALIBRATION SCENARIO) AND ONLY THE VOLUME ABOVE THE RESPECTIVE WEIRS HAVE BEEN INCLUDED.

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

FILE: 15-000483-SK100.dwg DATE: 03-12-2015 TIME: 10:26
Xref's: X_15-000483.01_TITLE X_15-000483.01_BASE X_15-000483.01_CONTS X_15-000483_BASE EARTHWORKS USR: Kelsey Osborne

AMENDMENTS	FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
		KO	SL	29.10.15	
	A				
	B				
	C				
	D				
	E				
	F				

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)

1:2000 20 0 20 40 60 80 100 A1

1:4000 A3

MICROFILM No.

PROJECT No. 15-000483

APPROVED

MATTHEW STARR RPEQ 9485

FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT: HALCYON DEVELOPMENTS PTY LTD

PROJECT: 252 LOGAN RESERVE ROAD LOGAN RESERVE

calibre CONSULTING

CONSULT AUSTRALIA

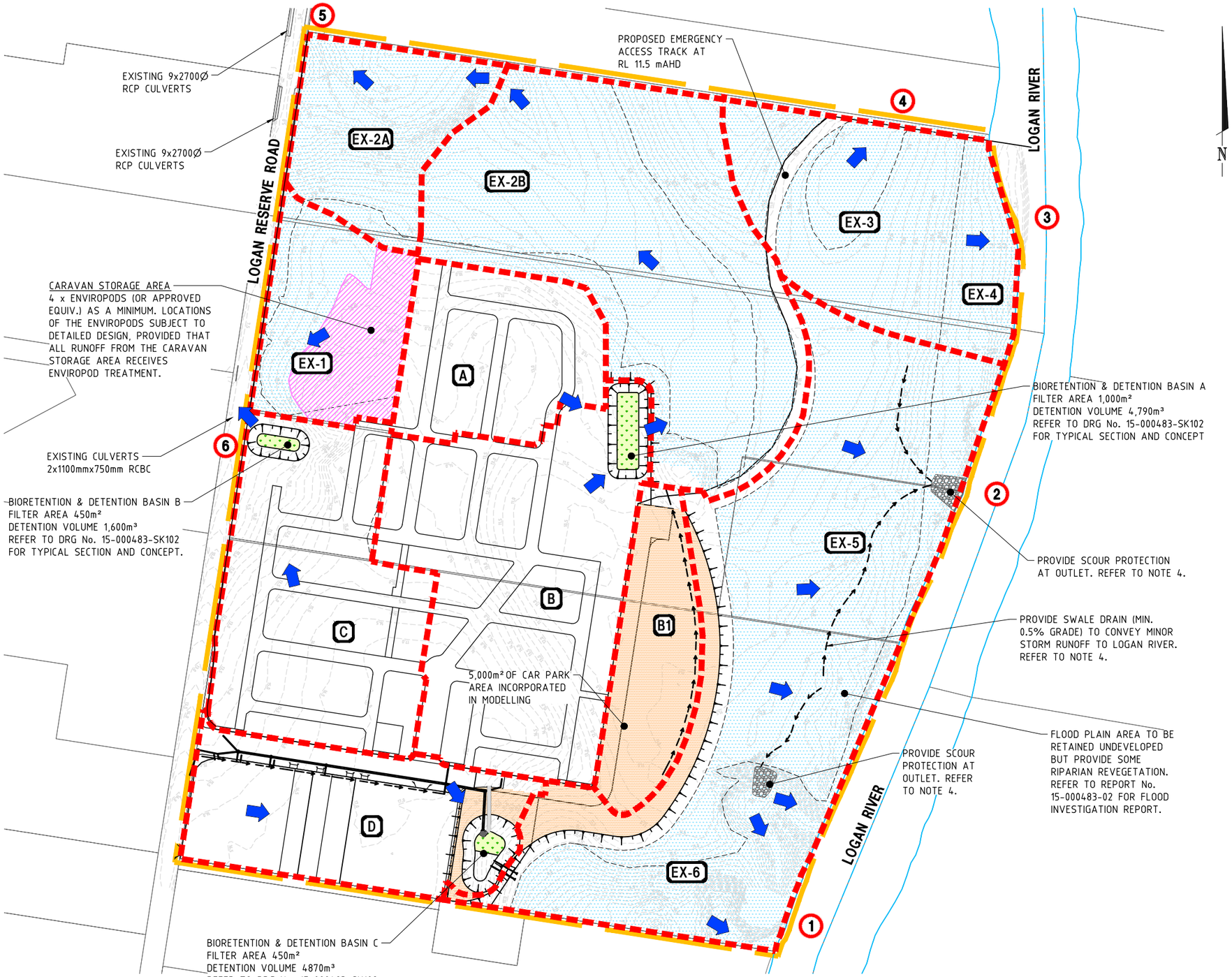
Calibre Consulting (QLD) Pty Ltd
Ground Floor, 545 Queen St, Brisbane, QLD Australia 4000
Telephone: 07 3895 3444 Facsimile: 07 3895 3403
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast

Quality Environment Company ISO 9001 Lic-4081

DRAWING TITLE: EXISTING CATCHMENT PLAN

DRAWING NUMBER: 15-000483-SK100

ISSUE:



DEVELOPED CATCHMENT DATA

CATCHMENT	AREA (ha)	FRACTION IMPERVIOUS (%)
A	2.73	60%
B	6.67	60%
B1	1.84	0%
C	5.12	55%
D	3.81	74%
EX-1	2.45	20%
EX-2A	2.58	0%
EX-2B	8.19	0%
EX-3	3.40	5%
EX-4	1.29	0%
EX-5	8.32	0%
EX-6	3.61	0%

LEGEND:

- SITE BOUNDARY
- CONCEPT DESIGN CONTOURS (9.0)
- DEVELOPED CATCHMENT BOUNDARY
- CONCEPT SWALE DRAIN
- (A) DEVELOPED CATCHMENT LABEL
- CONCEPTUAL FLOW ARROWS (MAJOR STORM EVENT)
- (2) DISCHARGE LOCATION
- PROPOSED BIORETENTION BASIN FILTER MEDIA
- PARK AREA
- FLOOD PLAIN AREA

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-000483-01.
2. THE LOCATION, SIZE AND OTHER INFORMATION OF THE STORMWATER QUALITY IMPROVEMENT DEVICES AND PEAK FLOW MITIGATION BASINS ARE CONCEPTUAL ONLY. THEY ARE SUBJECT TO DETAILED DESIGN.
3. BIORETENTION FILTER MEDIA AREAS TO BE SPLIT INTO MAX. 800m² CELLS AND PROVIDED WITH APPROPRIATE PRE-TREATMENT VIA SEDIMENT FOREBAYS.
4. FINAL OUTLET LOCATIONS AND SWALE ALIGNMENTS SUBJECT TO DETAILED DESIGN.

DEVELOPED CATCHMENT PLAN

SCALE 1:2000 (A1)
SCALE 1:4000 (A3)

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

FILE: 15-000483-SK101.dwg DATE: 08-12-2015 TIME: 14:22
Xref's: X_15-000483.01_TITLE X_15-000483.01_BASE X_15-000483.01_CONTS X_15-000483_BASE EARTHWORKS USR: Kelsey Osborne

AMENDMENTS	FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
	A	KO	SL	02.12.15	UPDATED BASIN CONFIGURATION
	B	CS	SL	05.04.16	UPDATED BASIN C AND MINOR LAYOUT AMENDMENTS
	C	CS	SL	16.05.16	UPDATED LAYOUT
	D	BP	RH	27.10.17	UPDATE FOR OPERATIONAL WORKS SUBMISSION
	E	MP	RH	21.08.18	UPDATED LAYOUT
	F	MP	MP	29.11.18	UPDATED LAYOUT

DESIGN CHECK
DRAWN CHECK
SCALE (METRES) 1:2000 20 0 20 40 60 80 100 A1; 1:4000 A3
MICROFILM No.
PROJECT No. 15-000483
APPROVED MATTHEW STARR RPEQ 9485
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD
CLIENT HALCYON DEVELOPMENTS PTY LTD
PROJECT 252 LOGAN RESERVE ROAD LOGAN RESERVE

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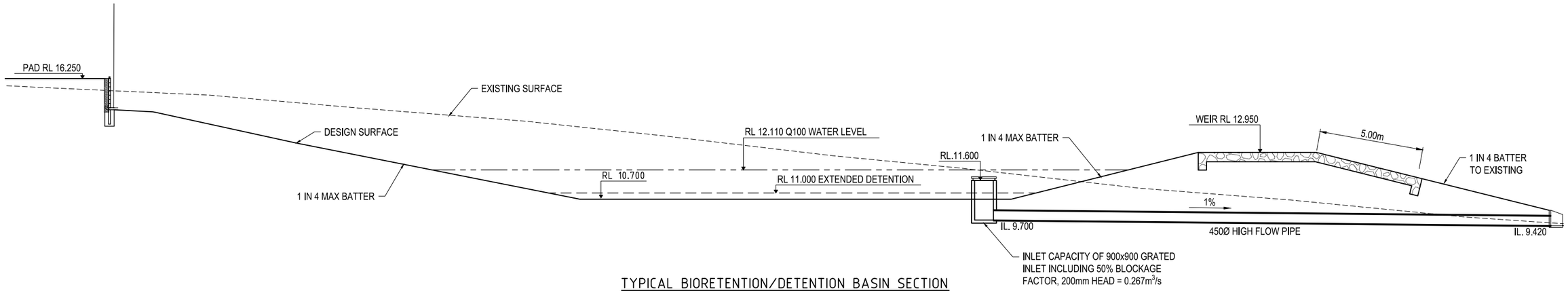
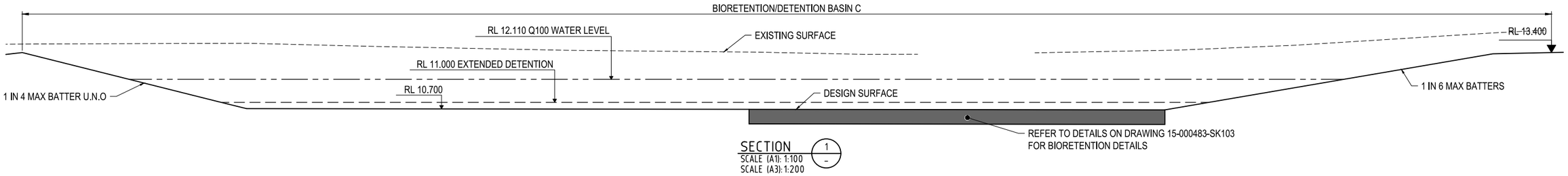
Quality Environment Company ISO 9001 Lic-10014

DRAWING TITLE: DEVELOPED CATCHMENT PLAN
DRAWING NUMBER: 15-000483-SK101
ISSUE: F



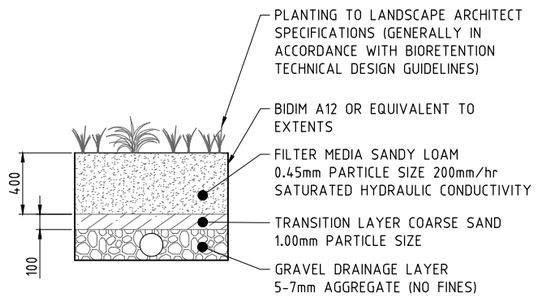
TYPICAL BIORETENTION/DETENTION BASIN SECTION

SCALE 1:100 (A1)
SCALE 1:200 (A3)



SECTION 1-1

SCALE (A1): 1:100
SCALE (A3): 1:200



TYPICAL BIORETENTION SECTION

SCALE 1:20 (A1)
SCALE 1:40 (A3)

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-000483-01.
2. REFER TO DRAWING NO. 15-000483-SK101 FOR THE CONCEPTUAL LOCATIONS OF THE BIORETENTION & DETENTION BASINS A, B & C.
3. THE DETAILS OF THE STORMWATER QUALITY IMPROVEMENT DEVICES AND PEAK FLOW MITIGATION BASINS ARE CONCEPTUAL ONLY. THEY ARE SUBJECT TO DETAILED DESIGN.
4. BIORETENTION FILTER AREAS TO BE SPLIT INTO MAX. 800m² CELLS AND PROVIDED WITH APPROPRIATE PRE-TREATMENT VIA SEDIMENT FOREBAYS. (SUBJECT TO DETAILED DESIGN).
5. MAXIMUM BATTER SLOPE IS 1 in 4. INCORPORATE 1 in 6 BATTERS WHERE POSSIBLE.

TABLE 1: CONCEPTUAL BASIN PARAMETERS

PARAMETER	BASIN A	BASIN B	BASIN C
VOLUME AVAILABLE (m³)	4790	1535	4870
FILTER AREA (m²)	1000	450	450
BASIN IL/FILTER SL (mAHD)	11.200	9.40	10.700
PIT 1 SIZE (mm x mm)	900 x 900	900 x 900	900 x 900
PIT 1 SL (mAHD)	11.500	9.7	11.000
PIPE 1 IL (mAHD)	10.200	8.475	9.775
PIPE 1 DIA (mm)	1 x 375	1 x 375	1 x 225
PIT 2 SIZE (mm x mm)	1200 x 1200	900 x 900	900 x 900
PIT 2 SL (mAHD)	12.020	10.25	11.600
PIPE 2 IL (mAHD)	10.125	8.4	9.775
PIPE 2 DIA (mm)	1 x 1200	1 x 900	1 x 450
WEIR WIDTH (m)	10	4	10
WEIR RL (mAHD)	12.900	10.7	12.950
EMBANKMENT RL (mAHD)	13.300	11.000	13.400
BASIN DEPTH (m)	2.100	1.700	2.700
100YR ARI WSL (mAHD)	12.630	10.72	12.110
50YR ARI WSL (mAHD)	12.59	10.66	12.00

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

FILE: 15-000483-SK103.dwg DATE: 03-12-2015 TIME: 09:24
Xref's: X_15-000483.01_TITLE USR: Kelsey Osborne

FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
A	KO	JW	29.10.15	
B	KO	SL	3.12.15	UPDATED BASIN CONFIGURATION
C	CS	SL	05.04.16	UPDATED BASIN CONFIGURATION
D	BP	RH	27.10.17	UPDATE FOR OPERATIONAL WORKS SUBMISSION
E	MP	RH	21.08.18	AMENDMENT FOR LAYOUT CONFIGURATION
F				

AMENDMENTS

DESIGN CHECK
DRAWN CHECK

SCALE (METRES)
1:20 0.2 0 0.2 0.4 0.6 0.8 1 A1
1:40 A3
1:50 1 0.5 0 1 2 A1
1:100 A3

MICROFILM No.

PROJECT No. 15-000483

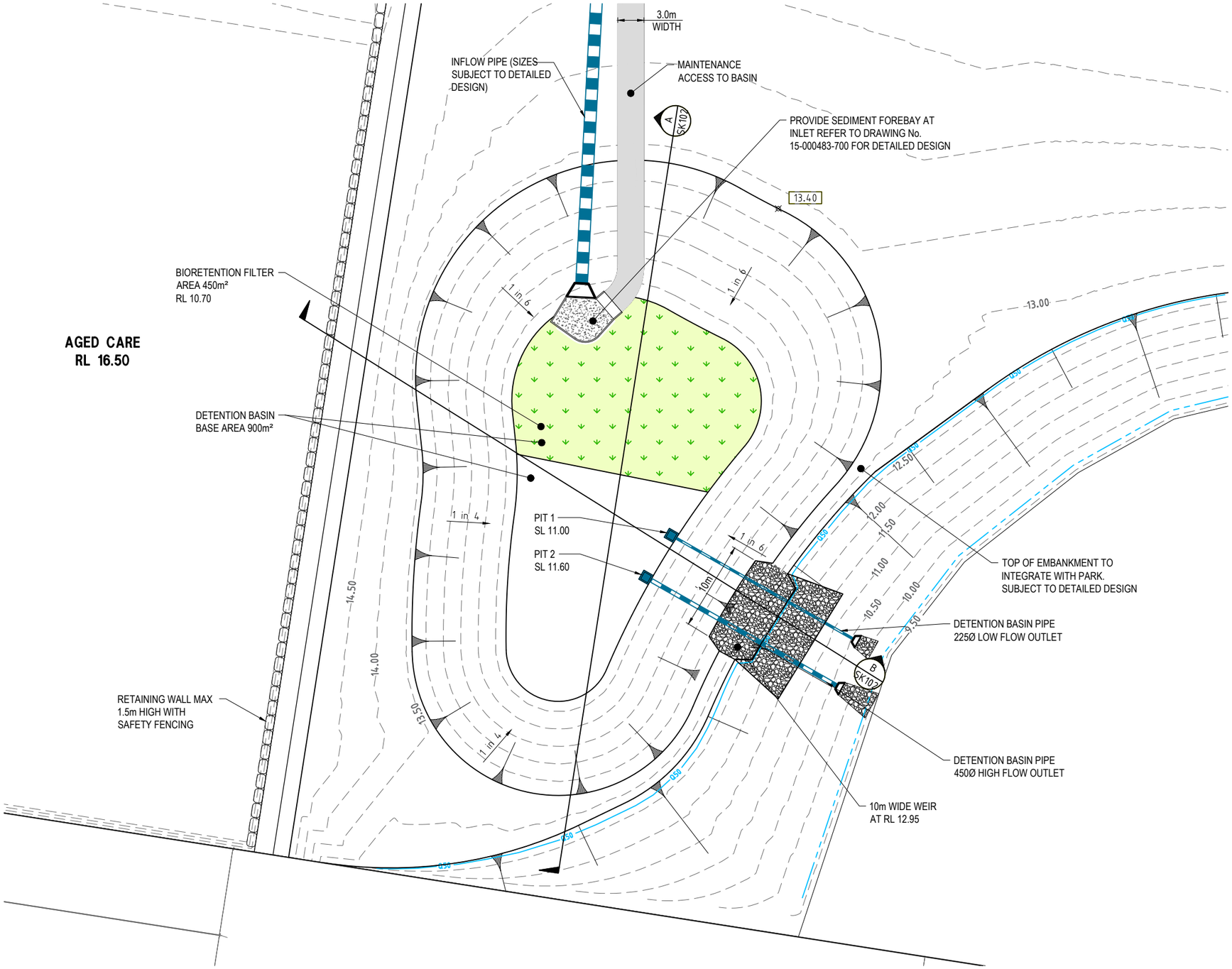
APPROVED
MATTHEW STARR RPEQ 9485
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT: HALCYON DEVELOPMENTS PTY LTD
PROJECT: 252 LOGAN RESERVE ROAD LOGAN RESERVE

calibre CONSULTING

CONSULT AUSTRALIA
Calibre Consulting (Qld) Pty Ltd
Ground Floor, 545 Queen St, Brisbane, QLD Australia 4000
Telephone: 07 3895 3444 Facsimile: 07 3895 3488
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast
Quality Environment Community ISO 9001 Lic 4967

DRAWING TITLE: BIORETENTION & DETENTION BASIN SECTIONS
DRAWING NUMBER: 15-000483-SK102
ISSUE: D



LEGEND:

- DEVELOPED CONTOURS (CONCEPT ONLY)
- PROPOSED BIORETENTION BASIN FILTER MEDIA
- Q50 FLOOD LINE (RL 12.90m AHD)
- Q10 FLOOD LINE (RL 9.61m AHD)
- SCOUR PROTECTION
- RETAINING WALL

NOTES:

1. THE LOCATION, SIZE AND OTHER INFORMATION OF THE STORMWATER DEVICES ARE CONCEPTUAL ONLY. THEY ARE SUBJECT TO DETAILED DESIGN.
2. ALL LEVELS ARE TO m AHD

DETENTION BASIN C

SCALE 1:250 (A1)
SCALE 1:500 (A3)

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

FILE: 15-000483-SK101.dwg DATE: 08-12-2015 TIME: 14:22
Xref's: X_15-000483.01_TITLE X_15-000483.01_BASE X_15-000483.01_CONTS X_15-000483_BASE EARTHWORKS USR: Kelsey Osborne

FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
	CS	CS	05.04.16	
A	BP	RH	30.10.17	UPDATE FOR OPERATIONAL WORKS SUBMISSION
B				
C				
D				
E				
F				

AMENDMENTS

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)
1:250 5 0 5 10 A1
1:500 A3

MICROFILM No.

PROJECT No. 15-000483

APPROVED
MATTHEW STARR RPEQ 9485
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT
HALCYON DEVELOPMENTS PTY LTD

PROJECT
252 LOGAN RESERVE ROAD
LOGAN RESERVE

calibre CONSULTING

CONSULT AUSTRALIA
Calibre Consulting (QLD) Pty Ltd
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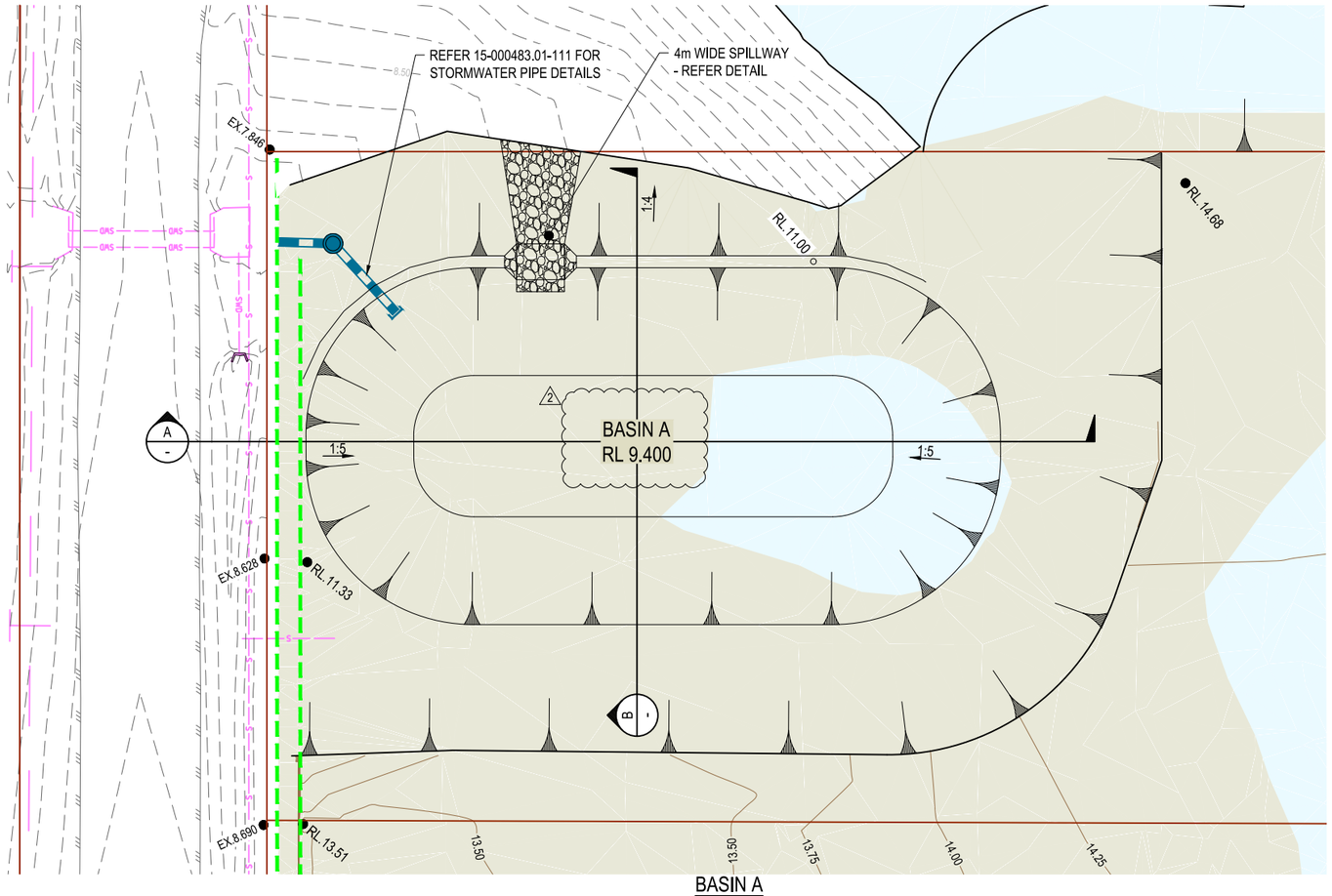
Quality Endorsed Company ISO 9001:2008 Lic-4081

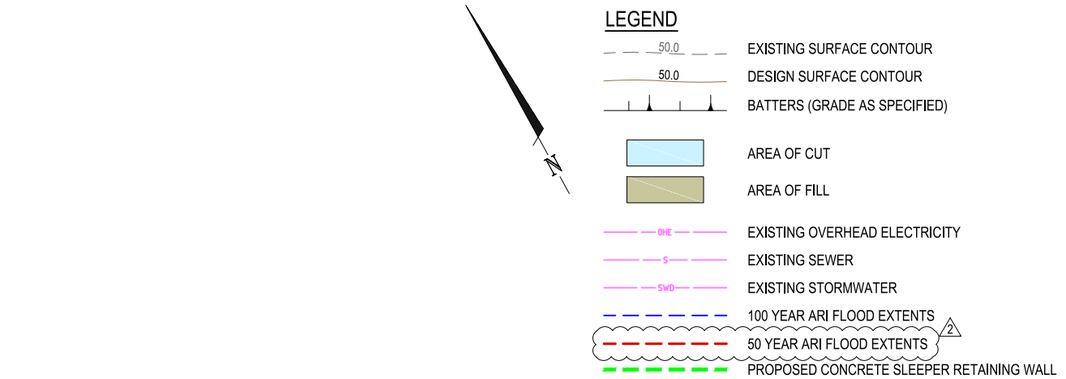
DRAWING TITLE
DETENTION BASIN C
RE-SHAPED

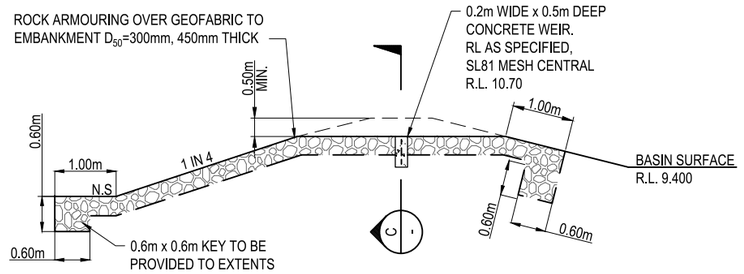
DRAWING NUMBER 15-000483-103

ISSUE A

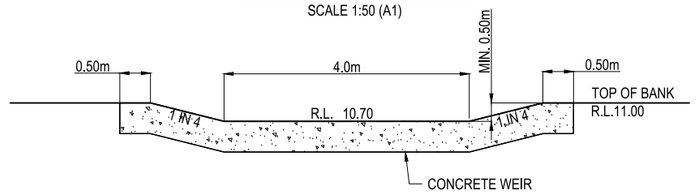


BASIN A
SCALE 1 : 250 (A1)
SCALE 1 : 500 (A3)

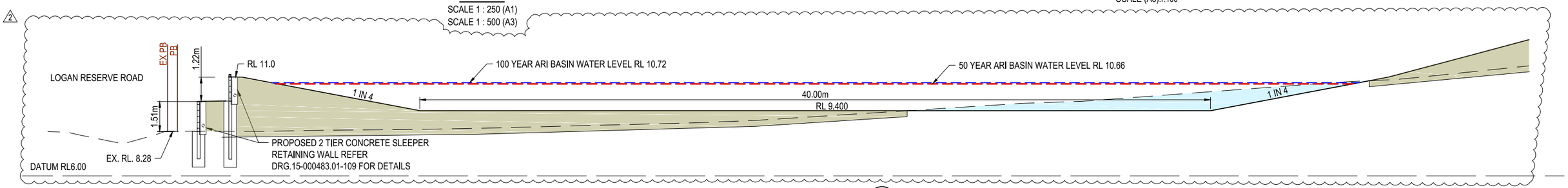




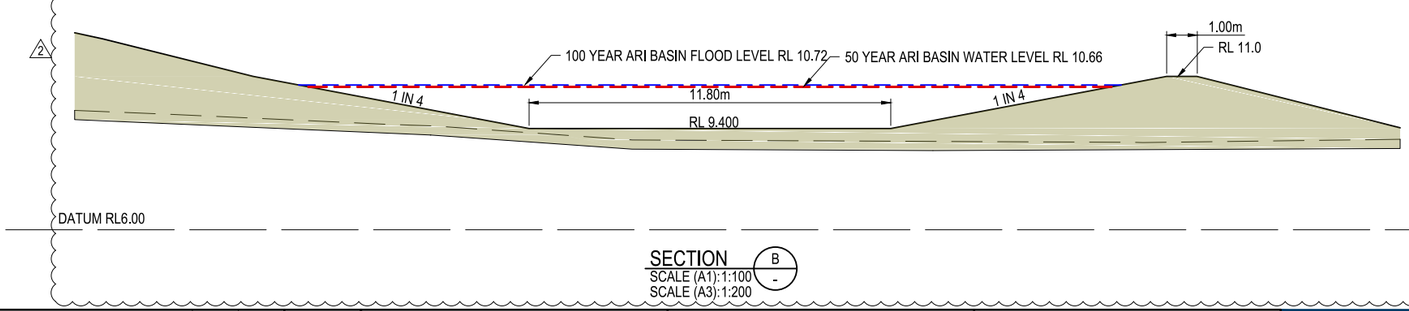
TYPICAL SPILLWAY DETAIL
SCALE 1:50 (A1)



SECTION C -
SCALE (A1):1:50
SCALE (A3):1:100



SECTION A -
SCALE (A1):1:100
SCALE (A3):1:200



SECTION B -
SCALE (A1):1:100
SCALE (A3):1:200

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	05.07.18	FOR OPERATIONAL WORKS APPROVAL	LS	LS
2	10.09.18	SECTIONS AMENDED AS PER COUNCIL RFI 31.07.18	LS	LS
3				
4				
5				
6				
7				
8				

DRAWN: AA
DESIGN: AA

STATUS: NOT FOR CONSTRUCTION

APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE
1:50 1 0.5 0 1 2 A1
1:100 A3
1:100 1 0 1 2 3 4 5 A1
1:200 A3
1:250 5 0 5 10 A1
1:500 A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

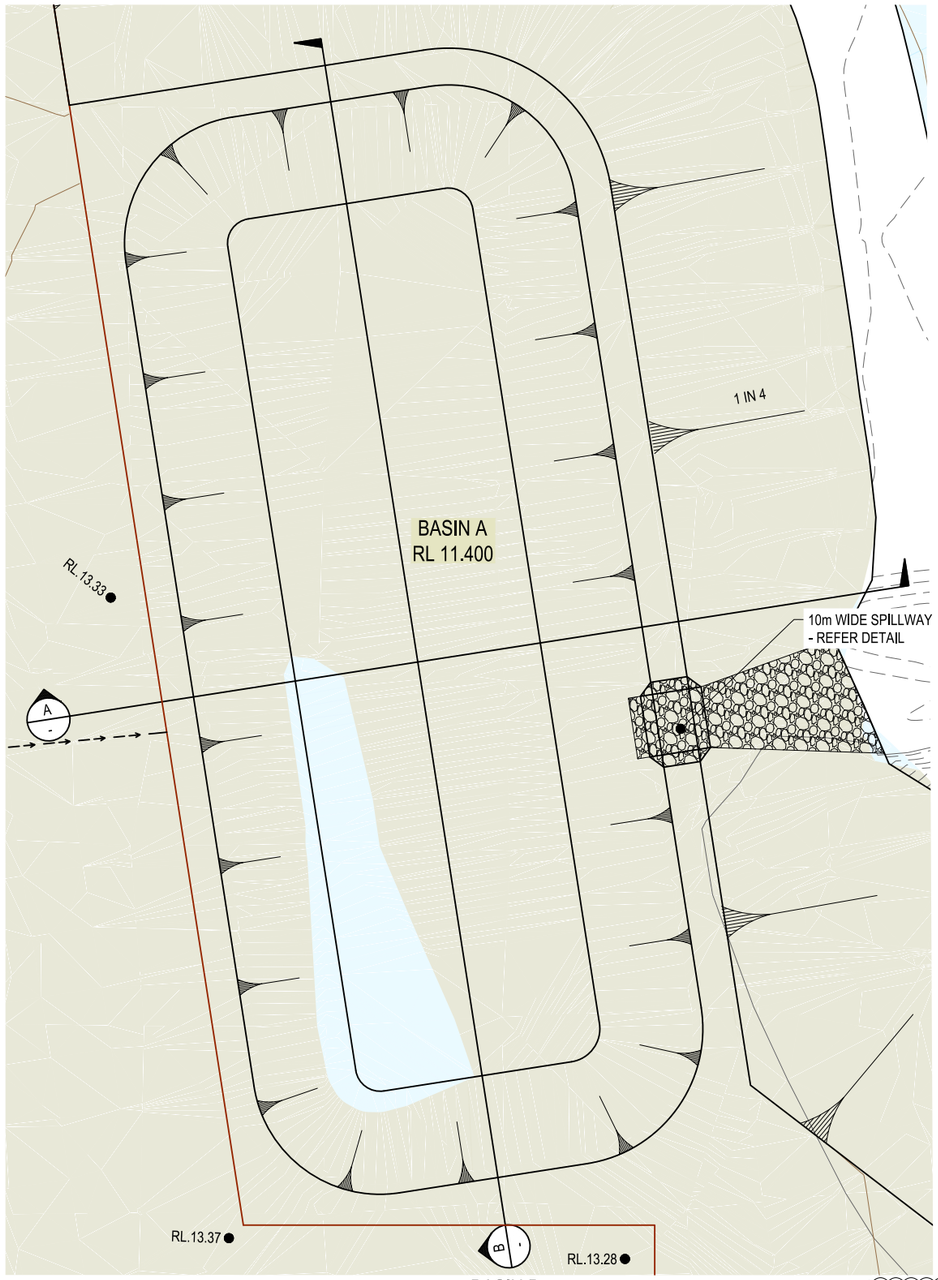
calibre
calibregroup.com

PROJECT: HALCYON
LOGAN RESERVE
BULK EARTHWORKS

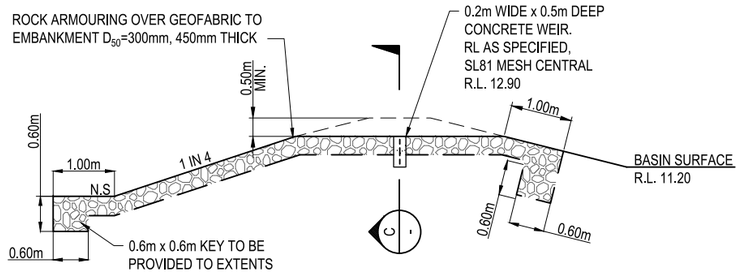
DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: BASIN B DETAILS PLAN

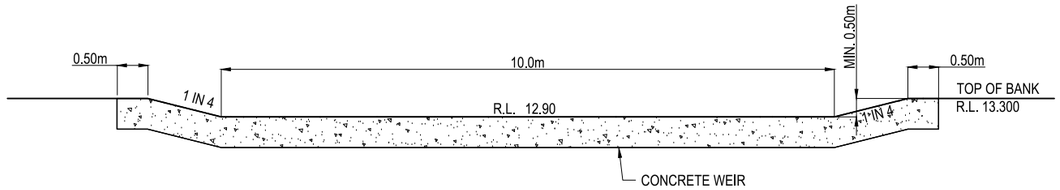
PROJECT No.	DRAWING No.	REVISION
15-000483.03	110	2



BASIN B
SCALE 1 : 250 (A1)
SCALE 1 : 500 (A3)



TYPICAL SPILLWAY DETAIL
SCALE 1:50 (A1)



SECTION C -
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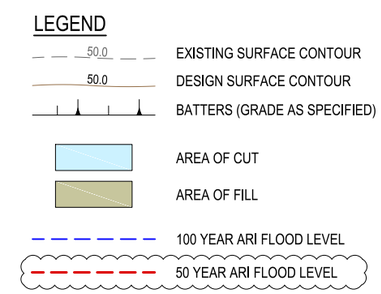
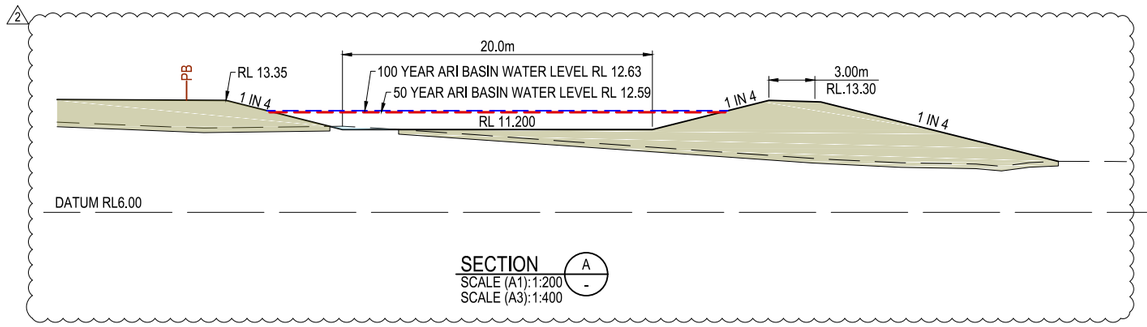
SCALE (A3):1:100





SECTION A -
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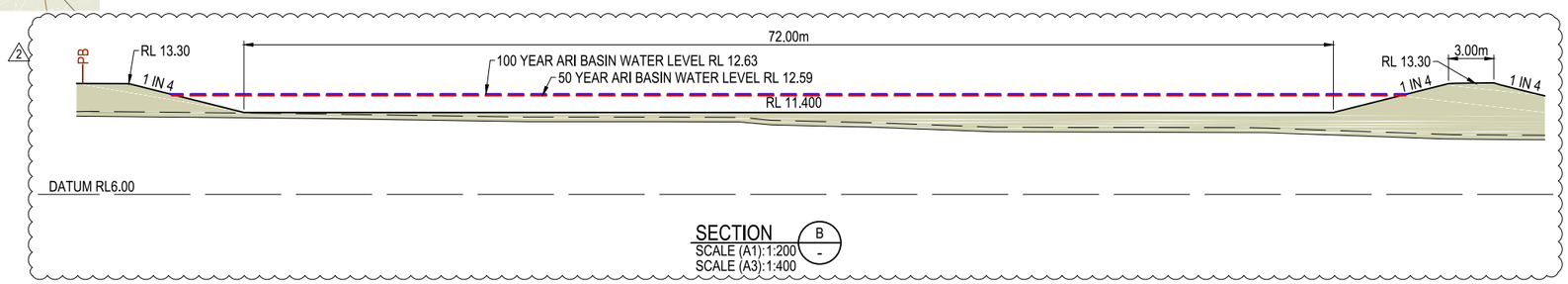
SCALE (A3): 1:400



SECTION B -
SCALE (A1): 1:200
SCALE (A3): 1:400

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	05.07.18	FOR OPERATIONAL WORKS APPROVAL	LS	LS
2	10.09.18	SECTIONS AMENDED AS PER COUNCIL RFI 31.07.18	LS	LS
3				
4				
5				
6				
7				
8				

DRAWN: aa
DESIGN: aa

STATUS: NOT FOR CONSTRUCTION

APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE
1:250 5 0 5 10 A1
1:500 A3
1:200 2 0 2 4 6 8 10 A1
1:400 A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

PROJECT: HALCYON
LOGAN RESERVE
BULK EARTHWORKS

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: BASIN A DETAILS PLAN

PROJECT No.	DRAWING No.	REVISION
15-000483.03	112	2

APPENDIX G SAFETY IN DESIGN FOR BASIN A

SAFETY IN DESIGN

Project: Logan Reserve Project No: 15-000483
Design Stage: Basin A Concept Design Date: 31/03/2016
Completed By: Chamindri Samarakoon Position: Engineer
Principal Designer:

Potential Hazard Areas – consider life cycle duty holders including those who construct, use, maintain, and demolish the structure:

- [x] Site access & security
- [x] Slips & trips
- [x] Falls from a height
- [ ] Falling objects
- [x] Excavations
- [x] Reticulated Services
- [ ] Confined Space
- [ ] Traffic Management (road, rail, shipping, etc.)
- [x] Structural integrity (precast, alterations, demolition, etc.)
- [ ] Hazardous Manual Tasks
- [ ] Hazardous Substances and / or dangerous goods
- [ ] Environmental exposure (noise, temperature, vibration)
- [x] Water or other liquid (drowning, diving)
- [x] Emergency Management (Fire, Flood, Medical)

Report:

Does the design create a risk to the health or safety of persons who are to carry out any construction work on the structure or part? [x] Yes [ ] No

Are the risks associated with this particular design and not with other designs of the same type of structure? [ ] Yes [x] No

*If **yes** is answered to both questions, a* Safety in Design Report *should be prepared for and submitted to the Client by the Principal Designer.*

Is a Safety in Design Report required? [ ] Yes [x] No

But have completed one any way

Summary of unusual or atypical design features:

- 20 Year ARI ponding depth in Basin A is 1.28m. LCC guidelines require 1.20m.

Comments:

- Risk mitigation strategies will be provided via:
  1. Warning sings
  2. Flood depth markers
  3. Landscaping
  4. Emergency access points.

Refer to "Site Based Stormwater Management Plan" Report No. 15-000483-01B.

Potential Sub-Hazard	Potential Risk
Site access & security	
Unauthorised access	Being assaulted by a person/s
Unsafe access	Being hit by moving objects
	Falls from one height to another
	Falls on the same level
	Fractures
	Intracranial injuries
	Uncontrolled access
	Vehicle collision
	Wounds, lacerations, amputations & internal organ damage

Slips & trips	
Slippery / uneven surfaces	Falls on the same level
	Fractures
	Injury to nerves & spinal cord
	Intracranial injuries
	Traumatic joint / ligament & muscle / tendon injury
	Wounds, lacerations, amputations & internal organ damage

Falls from a height	
Work at a height greater than 2m	Being hit by falling objects
Unsafe access	Being trapped between stationary and moving objects
	Falls from one height to another
	Fatality
	Fractures
	Hitting moving objects
	Hitting stationary objects
	Injury to nerves & spinal cord
	Intracranial injuries
	Traumatic joint / ligament & muscle / tendon injury
	Wounds, lacerations, amputations & internal organ damage

Falling Object	
Work at a height greater than 2m	Being hit by falling objects
	Fatality
	Fractures
	Injury to nerves & spinal cord
	Intracranial injuries
	Traumatic joint / ligament & muscle / tendon injury
	Wounds, lacerations, amputations & internal organ damage

Excavation	
Confined space	Being hit by falling objects
Excavation depth greater than 1.5m	Being trapped between stationary and moving objects
Exposure to contaminated materials	Contact with live services
Powered mobile plant	Engulfment
Work on or near a tunnel	Falls from one height to another
Unsafe access	Fatality
	Fractures
	Hitting stationary objects
	Injury to nerves & spinal cord
	Intracranial injuries
	Musculoskeletal and connective tissue diseases
	Slide or cave-in
	Structural instability / collapse
	Traumatic joint / ligament & muscle / tendon injury
	Wounds, lacerations, amputations & internal organ damage

Reticulated services	
Electrical services	Burns
Excavation work	Contact with chemical or substance
Exposure to contaminated materials	Contact with electricity / electrocution
Exposure to pressurised gas distribution mains or piping	Contact with hot objects
Exposure to water or other liquid that poses a drowning risk	Contact with live services
Precast concrete	Drowning
Telecommunication services	Explosion
Water services	Falls from one height to another
Work on or near chemical, fuel or refrigerant lines	Falls on the same level
Work on a telecommunication tower	Fractures
Unsafe access	Hitting moving objects
	Being hit by falling objects
	Being hit by moving objects
	Being trapped between stationary and moving objects
	Hitting stationary objects
	Musculoskeletal and connective tissue diseases
	Rollover of non-road vehicle
	Slide or cave-in
	Structural instability / collapse
	Traumatic joint / ligament & muscle / tendon injury
	Wounds, lacerations, amputations & internal organ damage

Potential Sub-Hazard	Potential Risk
Hazardous substances / Dangerous Goods	
Disturbance of asbestos	Burns
Explosives	Chronic illness / Disease
Exposure to a flammable atmosphere	Circulatory system diseases
Exposure to contaminated materials	Contact with chemical or substance
Exposure to radiation	Neoplasms (cancer)
Work on or near chemical, fuel or refrigerant lines	Respiratory system diseases
	Skin & subcutaneous tissue diseases
	Wounds, lacerations, amputations & internal organ damage

Traffic Management	
Aviation corridor or flight path	Being trapped between stationary and moving objects
Construction loadings	Fractures
Powered mobile plant	Hitting moving objects
Railway corridor	Hitting stationary objects
Shipping corridor	Injury to nerves & spinal cord
Traffic corridor	Intracranial injuries
	Rollover of non-road vehicle
	Structural instability / collapse
	Traumatic joint / ligament & muscle / tendon injury
	Vehicle collision
	Wounds, lacerations, amputations & internal organ damage

Structural Integrity	
Construction loadings	Being hit by falling objects
Demolition of a load bearing structure	Being trapped between stationary and moving objects
Excavation work	Contact with live services
Exposure to vibration	Falls from one height to another
Precast concrete	Falls on the same level
Structural alterations or repairs to temporary supports	Fractures
Tilt-up precast concrete	
Unsafe access	Injury to nerves & spinal cord
Work at a height greater than 2m	Intracranial injuries
Work on a telecommunication tower	Musculoskeletal and connective tissue diseases
	Slide or cave-in
	Structural instability / collapse
	Traumatic joint / ligament & muscle / tendon injury
	Wounds, lacerations, amputations & internal organ damage

Manual Handling	
Exposure to vibration	Musculoskeletal and connective tissue diseases
High or sudden force	
Repetitive movement	
Repetitive or sustained force	
Sustained or awkward posture	

Confined Space	
Enclosed or partially enclosed space	Engulfment
Excavation work	Unsafe oxygen level
Exposure to a flammable atmosphere	
Exposure to contaminated materials	
Vats, tanks, pits, pipes, ducts, flues, chimneys, silos, containers, pressure vessels, underground sewers, wet or dry wells, shafts, trenches, tunnels or other similar enclosed or partially enclosed structure	

Environmental Exposure	
Exposure to contaminated materials	Being bitten by an animal
Exposure to extremes of temperature	Burns
Exposure to noise exceeding exposure standards	Chronic illness / Disease
Exposure to radiation	Engulfment
Exposure to vibration	Exposure to environmental heat
	Insect and spider bites and stings
	Neoplasms (cancer)
	Respiratory system diseases
	Unsafe oxygen level

Work on or near Water	
Diving work	Drowning
Exposure to water or other liquid that poses a drowning risk	
Unsafe access	

Emergency Management	
Confined space	Drowning
Construction loadings	Engulfment
Fire emergency	Explosion
Flood emergency	Falls from one height to another
Medical Emergency	Fatality
Unsafe access	Fractures
	Rollover of non-road vehicle
	Slide or cave-in
	Structural instability / collapse
	Traumatic joint / ligament & muscle / tendon injury
	Vehicle collision
	Wounds, lacerations, amputations & internal organ damage

Note:
1. The information included in these tables is indicative only and additional hazards and risks may apply.

SAFETY IN DESIGN HAZARD REPORT

Project No. / Name: 15-000483.01 – Logan Reserve Bioretention & Detention Basin A Concept Design

Date: 30 March 2016

Stage of Review: 100% review

Designer: Chamindri Samarakoon

	Name	Organisation	Role
Participants:	Chamindri Samarakoon	Calibre Consulting	Engineer
	Andrew McPhail	Calibre Consulting	Principal Engineer
Distribution:			

Safety in Design Report Requirement: ☐(yes) / ☑ (no):

☑ Does the structure create a risk to the health and safety of persons who are to carry out any construction work on the structure or part?

☐ Are the risks associated only with this particular design and not other designs of the same type of structure?

Notes:

1) If yes is answered to both questions, a Safety in Design Report must be provided to the Person Conducting a Business or Undertaking (PCBU) who commissioned the design (i.e. the Client);
2) If no is answered to either question, a Safety in Design report does not need to be provided to the PCBU who commissioned the design, however relevant information regarding management of identified hazards, if any, must be kept;
3) The purpose of this report is to document and communicate the hazards associated with the design including the nominated control for either eliminating or minimising the risk to health and safety as far as is reasonably practicable;
4) Considerations that are not applicable are to be removed from the final report.

Legend:

Calibre Consulting | Principal Contractor | Client | Other (Specify)

Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
Existing site conditions:					
Contaminated materials including biological hazards	☐	Choose an item.			
Existing services including relocations	☑	Potential injury/death due to striking of existing services located along roads, external intersections	Appropriate warning notes provided on engineering plans. DBYD investigation undertaken and design has been undertaken to minimise risk due to existing services. Contractor to locate all services prior to ground disturbance/excavation.	Designer / Contractor	Complete on plans/ Ongoing for construction
Existing site uses and users	☐	No existing users			
Adjacent land uses and users	☑	Risk of unauthorised entry and works near public road.	Contractor/Principal to provide adequate site controls (including fencing if required) to perimeter of the site to limit access and reduce risks associated with unauthorised entry	Contractor/ Principal	Prior to Construction
Geotechnical conditions and likely method of excavation	☑	Conventional, however deep excavations are likely and additional control measures may be required by contractor	All works to be undertaken in accordance with standards and WH&S requirements.	Contractor	During Construction
Ground water	☑	Likely to be encountered in low lying areas and gullies.	To be managed by contractor and superintendent during construction.	Contractor/ Superintendent	During Construction
Susceptibility to flooding including overland flow paths and floodways	☑	Several overland flowpath exist, with the potential for significant flooding along the main gullies	Gullies and channels to be avoid during times of high rainfall	Contractor	During Construction
Existing provision for access including traffic, residential, pedestrian, equestrian, etc.	☑	Hazards associated with existing road surrounding the site.	Appropriate traffic management to be implemented by the contractor throughout the duration of the construction works	Contractor	During Construction
Existing bus routes and bus stops	☐				
Existing features of cultural, archaeological, heritage and / or environmental significance	☐	No associated with Central Basin			

Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
Design:					
Unusual or atypical design features	☑	Fall hazard associated with high retaining walls, deep excavations and works around services.	Landscape architect to specify pedestrian safety fence in public areas. Engineering design to specify interim star picket safety fencing during detailed design. Contractor and superintendent to identify risk prior to construction occurring.	Designer/ Landscape Architect/Contractor	During Construction
Construction:					
Method of construction	☑	Conventional All hazards associated with subdivision works applies	All works to be undertaken in accordance with the requirements of the subdivision guidelines and in accordance with WH&S requirements.	Contractor	During Construction
Access	☑	Access to the site via public roads and requires adequate traffic management	Engineering plans refer to provision of adequate traffic control by the contractor in accordance with WH&S requirements	Contractor	During Construction
Crane / Plant requirements	☑	All hazards associated with plant operations for subdivision works applies	All works to be undertaken in accordance with WH&S requirements including work method statements for operation of plant as required	Contractor	During Construction
Maintenance:					
Method of maintenance	☑	Addressed in Concept Stormwater Management Construction and Maintenance Plan	All structures will be designed in accordance with Council standards.	Designer	Complete
Demolition:					
Method of demolition	☐	Choose an item.	Best Practice/ Compliance		
High Risk Construction Activities:					
A person could fall more than 2m	☑	Injury/Death resulting from falling from retaining walls/deep excavations	Safety fencing to all walls over 1m specified on drawings. Contractor to ensure adequate fall protection (temporary fencing) is provided to retaining walls over 1m in height Landscape architect to provide pedestrian fences in public areas where hazard exists	Designer/Contractor /Landscape Architect	Ongoing
Work is on a telecommunication tower	☐				

Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
Involves demolition of an element of a structure that is load-bearing or otherwise related to the physical integrity of the structure	☐				
Involves, or is likely to involve, the disturbance of asbestos	☐	Choose an item.			
Involves structural alterations or repairs that require temporary support to prevent collapse	☐				
In or near a confined space	☑	Structures and manholes	Design undertaking in accordance to Council standards. Construction procedures to be undertaken in accordance with WH&S requirements.	Designer / Contractor	Ongoing
In or near a shaft or trench with an excavated depth greater than 1.5m or is carried out in or near a tunnel	☑	Excavation depths are anticipated to exceed 1.5m	Design undertaking in accordance to Council standards. Construction procedures to be undertaken in accordance with WH&S requirements.	Designer/ Contractor	Ongoing
Involves the use of explosives	☐				
Is carried out in or near	☐				
– Pressurised gas distribution mains or piping	☐				
– Chemical, fuel or refrigerant lines	☐				
– Energised electrical installations or services	☐				
Involves tilt-up or precast concrete	☑	Precast stormwater manholes	All works to be undertaken in accordance with WH&S requirements including work method statements	Contractor	During Construction
On, in or adjacent to a road, railway, shipping lane or other traffic corridor that is in use by traffic other than pedestrians	☑	Potential injury or death to existing road users as the result of construction works	Engineering plans refer to provision of adequate traffic control by the contractor in accordance with WH&S requirements. This may also include interim fencing for the site including signage	Contractor	During Construction
In an area at a workplace in which there is any movement of powered mobile plant	☑	All hazards associated with plant operations applies	All works to be undertaken in accordance with WH&S requirements including work method statements for operation of plant as required and site inductions for all visitors	Contractor	During Construction

Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
In an area in which there are artificial extremes of temperature	☐				
In or near water or other liquid that involves a risk of drowning	☑	Basin A is a detention basin. This may pose a potential drowning risk.	Appropriate safety fencing and warnings signs to be erected during construction. Area to be avoid during periods of rainfall. The following safety measures will be incorporated into the basin design • Warning signs. • Flood depth markers. • Thick planting around the perimeter of the basin to discourage entry into the basin. • Fencing along retaining walls over 1m in height. • Access point no steeper than 1 in 6 slope. • Side batters no steeper than 1 in 4, with 1 in 6 batters as much as possible.	Contractor Designer	During Construction Complete on plans
Involves diving work	☐				
Emergency Management					
Fire / Bushfire	☐				
Emergency Services Access	☑	Potentially required throughout the duration of construction	Contractor to ensure that clear access is available at all times for emergency vehicles.	Contractor	Ongoing
Hazardous Manual Tasks:					
A task that requires a person to lift, lower, push, pull, carry or otherwise move, hold or restrain any person, animal or thing involving one or more of the following: – repetitive or sustained force	☑	Accident/Injury/Death resulting from manual task.	Contractor to ensure all works on-site comply the WH&S requirements and that Safe Work Method Statements (SWMS) are prepared for each activity as required.	Contractor	Ongoing

Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
– high or sudden force	☑	Accident/Injury/Death resulting from manual task.	Contractor to ensure all works on-site comply the WH&S requirements and SWMS are prepared for each activity as required.	Contractor	Ongoing
– repetitive movement	☑	Accident/Injury/Death resulting from manual task.	As above	Contractor	Ongoing
– sustained or awkward posture	☑	Accident/Injury/Death resulting from manual task	As above	Contractor	Ongoing
– exposure to vibration	☑	Accident/Injury/Death resulting from manual task.	As above	Contractor	Ongoing
Earthworks:					
Staging	☐				
Method of excavation & plant requirements	☑	Conventional plant required for excavation works	Contractor to ensure all works on-site comply the WH&S requirements and SWMS are prepared for each activity as required.	Contractor	Ongoing
Earthworks balances and location of stockpile material	☑	spoil area for topsoil	As above	Contractor	Ongoing
Depth of excavations	☑	Deep excavations for services	As above	Contractor	Ongoing
Adjacent properties affected by earthworks / excavations	☑	Damage or injury to adjacent residents/unauthorised access to site.	Contractor to ensure all works on-site comply the WH&S requirements and SWMS are prepared for each activity as required. Contractor to ensure that adjacent properties are protected at all times during construction. Site controls to be implemented to avoid unauthorised access.	Contractor	Ongoing
Road / Pavement / Carpark Design:					
Road alignment and cross section	☐				
Pavement materials	☐				
Provision for pedestrians, cyclists, public transport, heavy vehicles, emergency vehicles, maintenance operations	☐				
Noise generation	☐				
Lighting	☐				

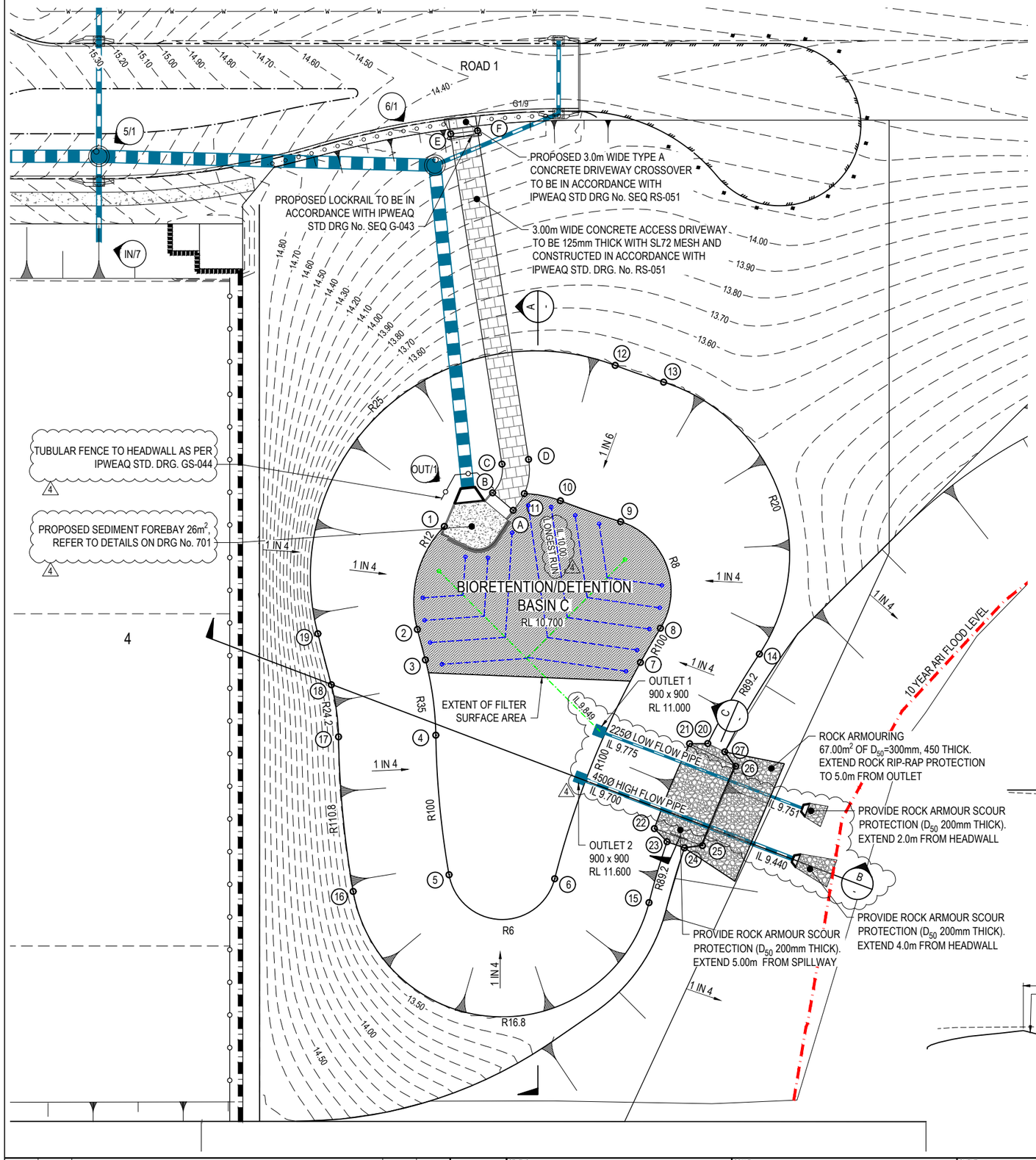
Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
Crime prevention	☐				
Edge protections / guardrails / barriers	☐				
Drainage	☑	Conventional	Comply to Standards	Designer	Complete
Stormwater, Water and Sewer Design:					
Flow capacity of pipes and structures	☑	Compliance	Comply to Standards	Designer	Complete
Structural capacity of pipes and structures	☑	Compliance	Comply to Standards	Designer	Complete
Cast in-situ structures	☑	Compliance	Comply to Standards	Designer	Complete
Pre-cast structures	☑	Compliance	Comply to Standards	Designer	Complete
Access to pipes and structures – i.e. ladder and fall protection requirements	☑	Compliance	Comply to Standards	Designer	Complete
Stormwater Pond Design:					
Access to stormwater ponds including restricted access and access for maintenance	☐				
Stormwater pond water quality	☐				
Permanent pond design	☐				
Temporary pond design	☐				
Wall Design:					
Handrails / edge protection	☑	Fall hazard	All walls exceeding 1m in height to be appropriate fenced.	Designer/ Landscape Architect	
Product selection. Consider sustainability, constructability, maintainability and manual handling	☑	Concrete and Boulder walls	Standard Construction methods	Contractor	Complete
Fall protection requirements such as provision of anchorage points	☑	Fall hazard	All walls exceeding 1m in height to be appropriate fenced.	Designer/ Landscape Architect	
Workplace space and layout for constructing wall	☑	High wall construction	Contractor to comply with all WH&S requirements during construction	Contractor	During Construction

Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
Depth of footings	☑	Conventional	Contractor to comply with all WH&S requirements during construction and structural certification to verify wall construction.	Contractor	During Construction
Possible future works around footings	☐				
Load bearing restrictions	☑	Load restrictions on retaining walls	Load restrictions specified on typical retaining wall deigns. Contractor to comply or provide alternative design certification for alternative products.	Designer/ Contractor	Ongoing
Bridge Design:					
Structural capacity	☐				
Cast in-situ versus precast	☐				
User separation including handrails and guardrails – consider misuse	☐				
Edge protection including safety / noise screens – consider misuse	☐				
Load bearing restrictions	☐				
Product selection. Consider sustainability, constructability, maintainability and manual handling	☐				
Provision for lifting points and anchorage points	☐				
Provision and location of proposed services	☐				
Underpass Design:					
Users and access requirements	☐				
Susceptibility to flooding	☐				
Crime prevention	☐				
Product selection. Consider sustainability, constructability, maintainability and manual handling	☐				

Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
Building Design:					
Structural capacity	☐				
Product selection. Consider sustainability, constructability, maintainability and manual handling	☐				
Cast in-situ versus precast	☐				
Load bearing restrictions	☐				
Provision for lifting points and anchorage points	☐				
Provision and location of proposed services	☐				
Basement design	☐				
Geotechnical constraints	☐				
Ground water	☐				
Re-design	☐				
Demolition	☐				
Landscape Design:					
Crime prevention	☑		By Others		
Visibility	☑		By Others		
Interaction with services	☑		By Others		
Product selection. Consider sustainability, constructability, maintainability and manual handling	☑		By Others		

Consideration	App? ☑ ☐	Hazard / Comment	Controlling Action	Action By	Action Status
Proposed Services:					
Location and design of proposed services including Interaction with existing services as well as those from adjacent developments	☑	Potential safety issues associated with work near existing live services including, water reticulation, electrical reticulation and gas reticulation	All services identified on the engineering plans and contractor to undertake works in accordance with industry best practice and provide work method statements for works near mains. All services to be identified prior to excavation works occurring	Designer	
Depth of proposed services	☑	Proposed excavations exceed 1.5m in depth	Contractor to comply with WH&S requirements during construction and provide SWMS where required. Design to be undertaken to reduce trench depths where possible.	Designer/ Contractor	Ongoing
Geotechnical impact on trench excavations	☑	Injury/death resulting from trench collapse.	All works to be undertaken in accordance with the requirements of the subdivision guidelines and in accordance with WH&S requirements.	Contractor	Ongoing
Protection of existing services	☑		Contractor to comply with WH&S requirements during construction and provide and identify all existing services prior to commencing construction. SWMS where required.	Contractor	Ongoing
Accessibility to services including pits / manholes / sumps for future maintenance. Consider location, access in, within and out.	☐	Confined space risks	Contractor to comply with WH&S requirements during construction and provide SWMS where required.	Contractor	Ongoing
Location of substations	☐				

APPENDIX H STAGE 1 OPERATIONAL WORKS DRAWINGS



BIO RETENTION/DETENTION BASIN SETOUT

POINT No.	EASTING	NORTHING	RL
1	1803.248	35188.610	10.710
2	1798.533	35177.782	10.700
3	1798.895	35174.305	10.700
4	1798.751	35165.869	10.700
5	1797.818	35150.344	10.700
6	1809.338	35148.101	10.700
7	1822.431	35170.352	10.700
8	1825.211	35173.766	10.700
9	1822.663	35186.125	10.700
10	1816.418	35189.446	10.700
11	1812.580	35190.838	10.707
12	1824.737	35203.351	13.400
13	1829.760	35200.688	13.400
14	1835.624	35169.242	13.400
15	1819.275	35143.871	13.400
16	1787.020	35150.152	13.400
17	1788.054	35167.353	13.400
18	1788.153	35173.186	13.400
19	1787.546	35179.011	13.400

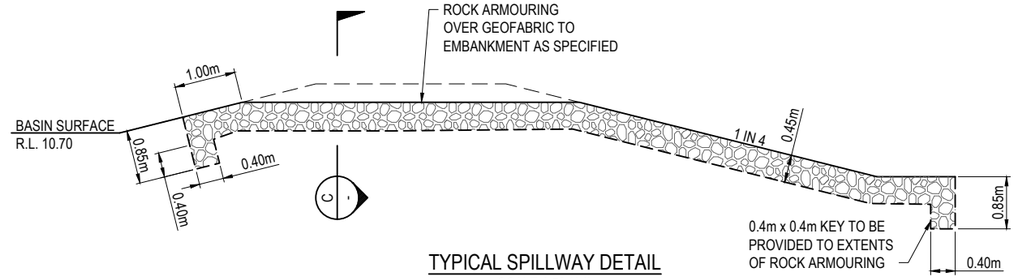
WEIR SETOUT

POINT No.	EASTING	NORTHING	RL
20	1828.431	35160.312	13.400
21	1826.439	35160.603	12.950
22	1821.128	35151.895	12.950
23	1822.291	35150.244	13.400
24	1824.098	35149.268	13.400
25	1826.105	35149.206	12.950
26	1831.116	35157.344	12.950
27	1830.158	35159.109	13.400

BASIN DRIVEWAY SETOUT

POINT No.	EASTING	NORTHING	RL
A	1811.074	35189.202	10.700
B	1809.119	35191.477	10.800
C	1810.633	35194.461	11.303
D	1813.632	35194.526	11.360
E	1810.646	35231.537	14.430
F	1813.645	35231.430	14.409

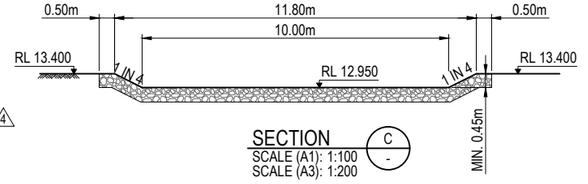
NOTE:
REFER DRG. 002 FOR LEGEND AND DRG. 701 FOR NOTES AND DETAILS



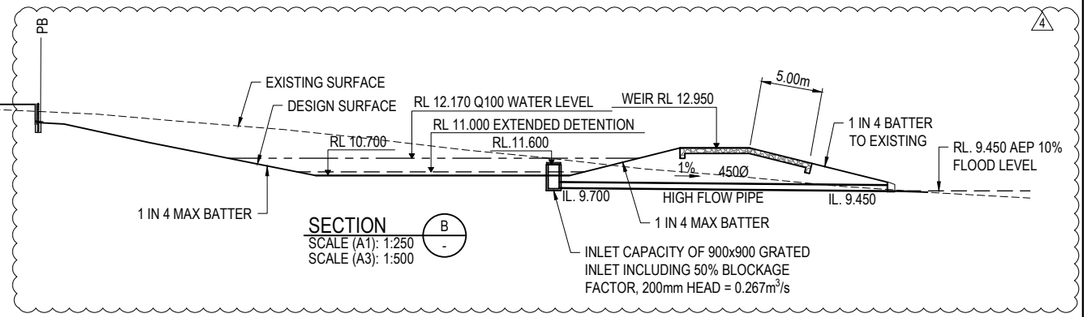
TYPICAL SPILLWAY DETAIL
SCALE 1:50 (A1)

BIORETENTION/DETENTION BASIN C DETAILS

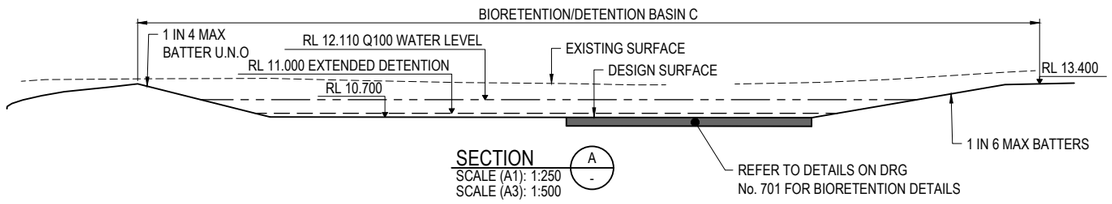
PARAMETER	BASIN
FILTER SURFACE AREA (m²)	450
FILTER SURFACE LEVEL (m)	10.700
TEMPORARY PONDING DEPTH (mm)	300
STORAGE VOLUME (m3)	4,870
TOP OF EMBANKMENT (m)	13.400
EMERGENCY WEIR LEVEL (m)	12.95



SECTION C
SCALE (A1): 1:100
SCALE (A3): 1:200



SECTION B
SCALE (A1): 1:250
SCALE (A3): 1:500



SECTION A
SCALE (A1): 1:250
SCALE (A3): 1:500

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	SECTION B REVISED, NOTES AMENDED AND INVERT LEVELS AMENDED	LS	LS

DRAWN
DESIGN

STATUS: NOT FOR CONSTRUCTION

APPROVED
LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE
1:250 5 0 5 10 A1
1:500 A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

calibre
calibregroup.com

PROJECT: HALCYON LOGAN RESERVE STAGE 1

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: BIO RETENTION AND DETENTION BASIN C LAYOUT PLAN

PROJECT No.	DRAWING No.	REVISION
15-000483	700	4

BIO RETENTION BASIN CONSTRUCTION SEQUENCE NOTES:

THE CONSTRUCTION AND ESTABLISHMENT OF BIO RETENTION BASINS IS TO BE STAGED AS FOLLOWS:

1. FUNCTIONAL INSTALLATION - ONCE THE MAJORITY OF THE SUBDIVISION WORKS ARE COMPLETE, THE BASIN CONSTRUCTION INCLUDING EARTHWORKS, INLETS, OUTLET STRUCTURES, SUBSOIL DRAINAGE, TRANSITION LAYERS, FILTER MATERIAL, PROTECTIVE LAYERS AND EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE UNDERTAKEN BY THE CIVIL CONTRACTOR. THE FILTER MEDIA WITHIN THE BIO RETENTION BASIN IS TO BE COVERED WITH A PROTECTIVE GEOFABRIC LAYER (BIDIM A12 OR EQUIVALENT), THEN COVERED WITH 75mm OF TOPSOIL AND TURFED OR GRASS SEEDED TO THE SATISFACTION OF COUNCIL. SILT FENCES ARE TO BE ERECTED AROUND THE OUTSIDE OF THE BASIN. ACCEPTANCE OF THE COMPLETED SUBDIVISION WORKS ON AND OFF MAINTENANCE BY COUNCIL IS TO EXCLUDE THE PROTECTIVE LAYERS WITHIN THE BIO BASINS.
2. BUILDING CONSTRUCTION - THE PROTECTIVE GEOFABRIC AND GRASS LAYER AND THE EROSION AND SEDIMENT CONTROL MEASURES ARE TO REMAIN IN PLACE DURING THE BUILDING CONSTRUCTION PHASE. THE BUILDING CONSTRUCTION PHASE IS TO BE THE TIME FOR COMPLETION OF 75% OF THE BUILDING CONSTRUCTION AND SITE ESTABLISHMENT WORKS ON ALLOTMENTS OR 12 MONTHS FOLLOWING COMPLETION OF THE SUBDIVISION WORKS, WHICHEVER IS SHORTER. THE MAINTENANCE OF THE BASINS INCLUDING INLETS, OUTLETS AND EROSION AND SEDIMENT CONTROL MEASURES IS TO BE UNDERTAKEN BY THE CIVIL CONTRACTOR FOR THE DURATION OF THE BUILDING CONSTRUCTION PHASE.
3. OPERATIONAL ESTABLISHMENT - FOLLOWING COMPLETION OF THE BUILDING CONSTRUCTION PHASE, THE TURF, TOPSOIL AND PROTECTIVE GEOFABRIC IS TO BE REMOVED AND THE BASIN RE-PLANTED WITH VEGETATION AND LANDSCAPING AS PER THE LANDSCAPE DESIGN DRAWINGS. WORKS UNDERTAKEN FOR OPERATIONAL ESTABLISHMENT ARE TO BE UNDERTAKEN BY OTHERS AND WILL BE SUBJECT TO A SEPARATE ACCEPTANCE BY COUNCIL FOR ON AND OFF MAINTENANCE.
4. IN-SITU INFILTRATION TEST - AN IN-SITU INFILTRATION TEST WILL BE REQUIRED PRIOR TO ON-MAINTENANCE BEING GRANTED BY COUNCIL. THE TEST WILL NEED TO ACHIEVE AN AVERAGE RATE OF 180mm/h INFILTRATION (WITHIN APPROPRIATE TOLERANCES) WITH AT LEAST 4 SAMPLE LOCATIONS AROUND THE BASIN. ANOTHER IN-SITU INFILTRATION TEST WILL BE REQUIRED FOR OFF-MAINTENANCE.

BIO RETENTION PARTICLE SIZE DISTRIBUTION AND PROPERTIES GUIDE:

SOURCE: (BIOFILTRATION MEDIA GUIDELINES (VERSION 3.01), PREPARED BY THE FACILITY FOR ADVANCING WATER BIOFILTRATION (FAWB), JUNE 2009.) & (BIO-RETENTION TECHNICAL DESIGN GUIDELINES (VERSION 1.1) PREPARED BY 'WATER BY DESIGN' (OCTOBER 2014)

MATERIAL COMPOSITION RANGE GUIDE:

CLAY AND SILT	<3%	(<0.05mm)
VERY FINE SAND	5-30%	(0.05-0.15mm)
FINE SAND	10-30%	(0.15-0.25mm)
MEDIUM TO COARSE SAND	40-60%	(0.25-1.0mm)
COARSE SAND	7-10%	(1.0-2.0mm)
FINE SAND	<3.0%	(2.0-3.4mm)

WHILE TOTAL CLAY AND SILT CONTENT OF 3% IS RECOMMENDED, A CLAY AND SILT CONTENT UP TO 6% IS ACCEPTABLE PROVIDED:

- THE SATURATED HYDRAULIC CONDUCTIVITY IS BETWEEN 100mm/hr & 300mm/hr AND
- THE REMAINING MATERIAL MEETS THE COMPOSITION RANGE SPECIFIED ABOVE.

SOIL SPECIFICATIONS:

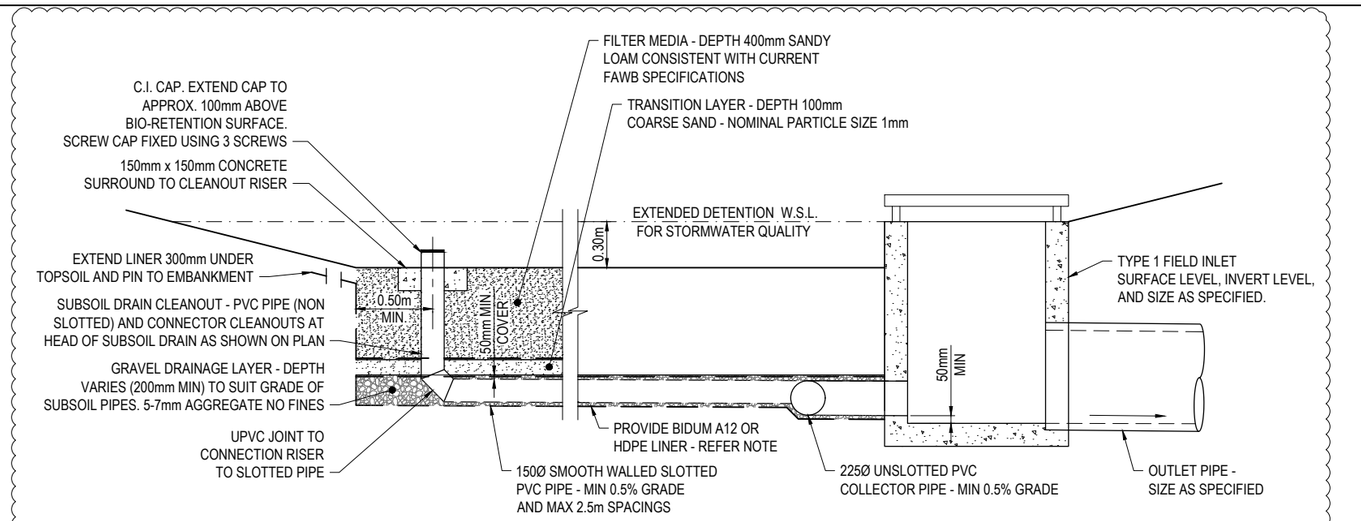
- TOTAL NITROGEN CONTENT - <1000mg/kg
- ORTHOPHOSPHATE CONTENT - <80mg/kg SOILS WITH TOTAL PHOSPHORUS CONCENTRATIONS >100mg/kg SHOULD BE TESTED FOR POTENTIAL LEACHING. WHERE PLANTS WITH MODERATE PHOSPHORUS SENSITIVITY ARE TO BE USED, TOTAL PHOSPHORUS CONCENTRATIONS SHOULD BE <20mg/kg)
- ORGANIC MATTER CONTENT - AT LEAST 3% (w/w). AN ORGANIC CONTENT LOWER THAN 3% IS LIKELY TO HAVE TOO LOW A WATER HOLDING CAPACITY TO SUPPORT HEALTHY PLANT GROWTH. IN ORDER TO COMPLY WITH BOTH THIS AND THE TOTAL NITROGEN AND ORTHOPHOSPHATE CONTENT REQUIREMENTS, A LOW NUTRIENT ORGANIC MATTER WILL BE REQUIRED.
- pH - AS SPECIFIED FOR 'NATURAL SOILS AND SOIL BLENDS' 5.5-7.5 (pH 1:5 IN WATER)
- ELECTRICAL CONDUCTIVITY - AS SPECIFIED FOR 'NATURAL SOILS AND SOIL BLENDS' <1.2 dS/m.

BIO RETENTION INSTALLATION NOTES:

THE PLACEMENT OF DRAINAGE, TRANSITION AND FILTER MEDIA LAYERS MUST BE UNDERTAKEN CAREFULLY TO ENSURE CORRECT DEPTH, SLOPE AND COMPACTION:
DEPTH: FILTER MEDIA SHOULD BE INSTALLED AND COMPACTED IN TWO LIFTS FOR DEPTHS OVER 500mm.
SLOPE: THE TOP SURFACE OF THE DRAINAGE LAYER, TRANSITION LAYER AND FILTER MEDIA LAYER SHOULD BE FLAT. A SPREADER BAR SHOULD LEVEL THE SURFACE OF EACH LAYER.
COMPACTION: THE FILTER MEDIA MUST BE LIGHTLY COMPACTED DURING INSTALLATION TO PREVENT THE MIGRATION OF FINE PARTICLES. THIS CAN BE ACHIEVED WITH A SINGLE PASS OF A LIGHT ROLLER SUCH AS A DRUM LAWN ROLLER. A VIBRATING PLATE CAN ALSO BE USED TO COMPACT SMALL BIO RETENTION SYSTEMS OR 'POZITRACK' BOBCATS CAN BE USED FOR LARGE SYSTEMS. ENSURE ONLY ONE COMPACTING PASS IS MADE OVER THE MEDIA FOR LIGHT COMPACTION.

ROCK ARMOURING NOTES:

1. ROCKS TO BE DURABLE BLUE STONE OR OTHERWISE APPROVED BY SUPERINTENDENT.
2. EACH ROCK SHALL BE:
   - ANGULAR IN SHAPE (PROMOTES INTERLOCKING)
   - FREE FROM OVERBURDEN, SPOIL, SHALE AND ORGANIC MATERIAL.
3. NEITHER BREADTH NOR THICKNESS OF A SINGLE ROCK SHALL BE LESS THAN ONE HALF ITS LENGTH (ie THE ROCK SHALL BE CHUNKY RATHER THAN FLAT).
4. ROCKS TO BE PLACED AND INTERLOCKED INTO POSITION AND BUILT UP TO FINAL LEVELS SHOWN, ENSURING COVERAGE OF GEOFABRIC.
5. GAPS BETWEEN THE ROCKS ARE TO BE FILLED BY DROPPING SMALL ROCKS INTO GAPS AND LOCKING INTO POSITION WITH A CROWBAR.
6. ALL ROCKWORK TO BE PLACED OVER BIDIM A24 OR EQUIVALENT.
7. FOR ROCK SIZED SPECIFIED AS D_{50} ON THE DRAWINGS, THIS CORRESPONDS TO THE MEDIAN DIAMETER OF WHICH HALF OF THE ROCK SIZES SHALL BE GREATER AND HALF OF THEM SHALL BE SMALLER. THE ROCK SHALL BE WELL GRADED AND HAVE A MAXIMUM SIZE NO GREATER THAN 30% AND A MINIMUM SIZE NO LESS THAN 30% SMALLER THAN D_{50}. FOR EXAMPLE IF D_{50} = 400mm IS SPECIFIED, THE EQUIVALENT ROCK DIAMETER RANGES FROM 280 to 520mm.



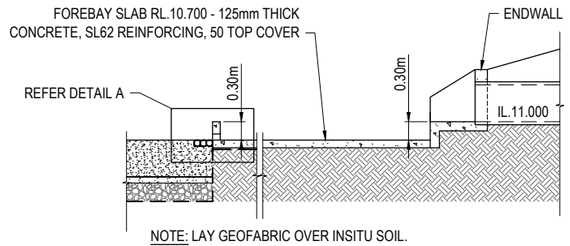
TYPICAL BIO RETENTION BASIN SUBSOIL DRAIN CLEAN OUT AND FILTER MEDIA SPECIFICATIONS

SCALE 1:20 (A1)

NOTE:
APPROPRIATENESS OF GEOTEXTILE LINER AS AN ALTERNATIVE TO HDPE LINER TO BE ASSESSED BY GEOTECHNICAL ENGINEER AT CONSTRUCTION STAGE FOLLOWING TESTING OF INSITU SOILS.

NOTES:

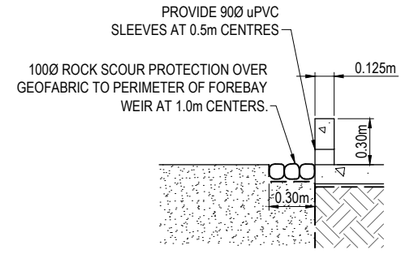
1. BIO RETENTION BASINS HAVE BEEN DESIGNED IN ACCORDANCE WITH WSUD DETAILS AND SPECIFICATIONS.
2. REFER LANDSCAPE ARCHITECT'S DRAWINGS FOR BASIN VEGETATION DETAILS.
3. REFER DRAWING 700 FOR BASIN SECTIONS AND DETAILS.
4. REFER DRAWING 200-202 FOR EARTHWORKS NOTES AND DETAILS.



NOTE: LAY GEOFABRIC OVER INSITU SOIL. (EXTEND MINIMUM 300mm UNDER FOREBAY) PIN GEOFABRIC TO INSITU SOIL AND FORM CONCRETE ONTO GEOFABRIC.

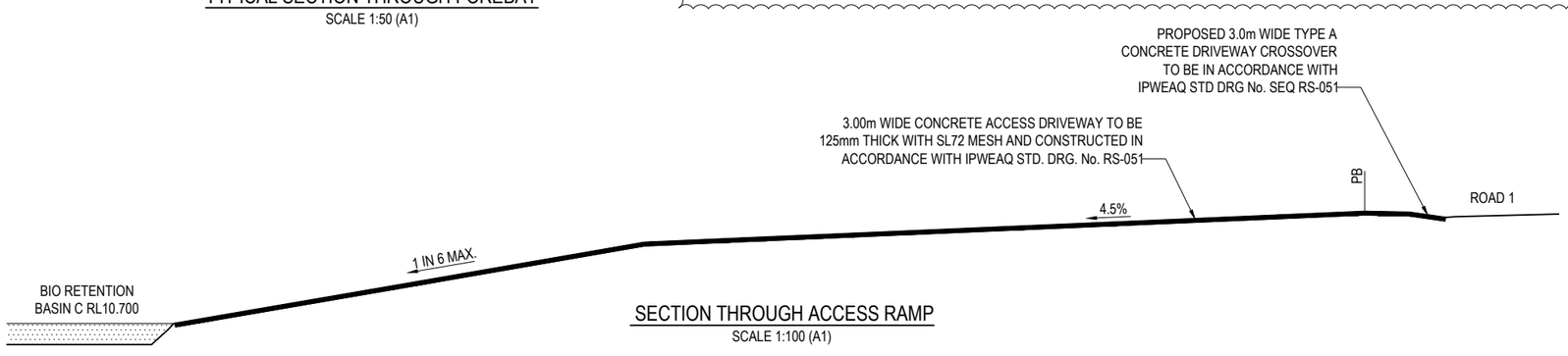
TYPICAL SECTION THROUGH FOREBAY

SCALE 1:50 (A1)



DETAIL A

SCALE 1:20 (A1)



SECTION THROUGH ACCESS RAMP

SCALE 1:100 (A1)

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	SECTION ADDDED AND DETAILS AMENDED	LS	LS

DRAWN
DESIGN
STATUS: NOT FOR CONSTRUCTION
APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD
SCALE: AS SHOWN
CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD
calibre
 calibregroup.com
PROJECT: HALCYON LOGAN RESERVE STAGE 1
DISCLAIMER: ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.
DRAWING TITLE: BIO RETENTION AND DETENTION BASIN C NOTES AND DETAILS
PROJECT No.: 15-000483
DRAWING No.: 701
REVISION: 4

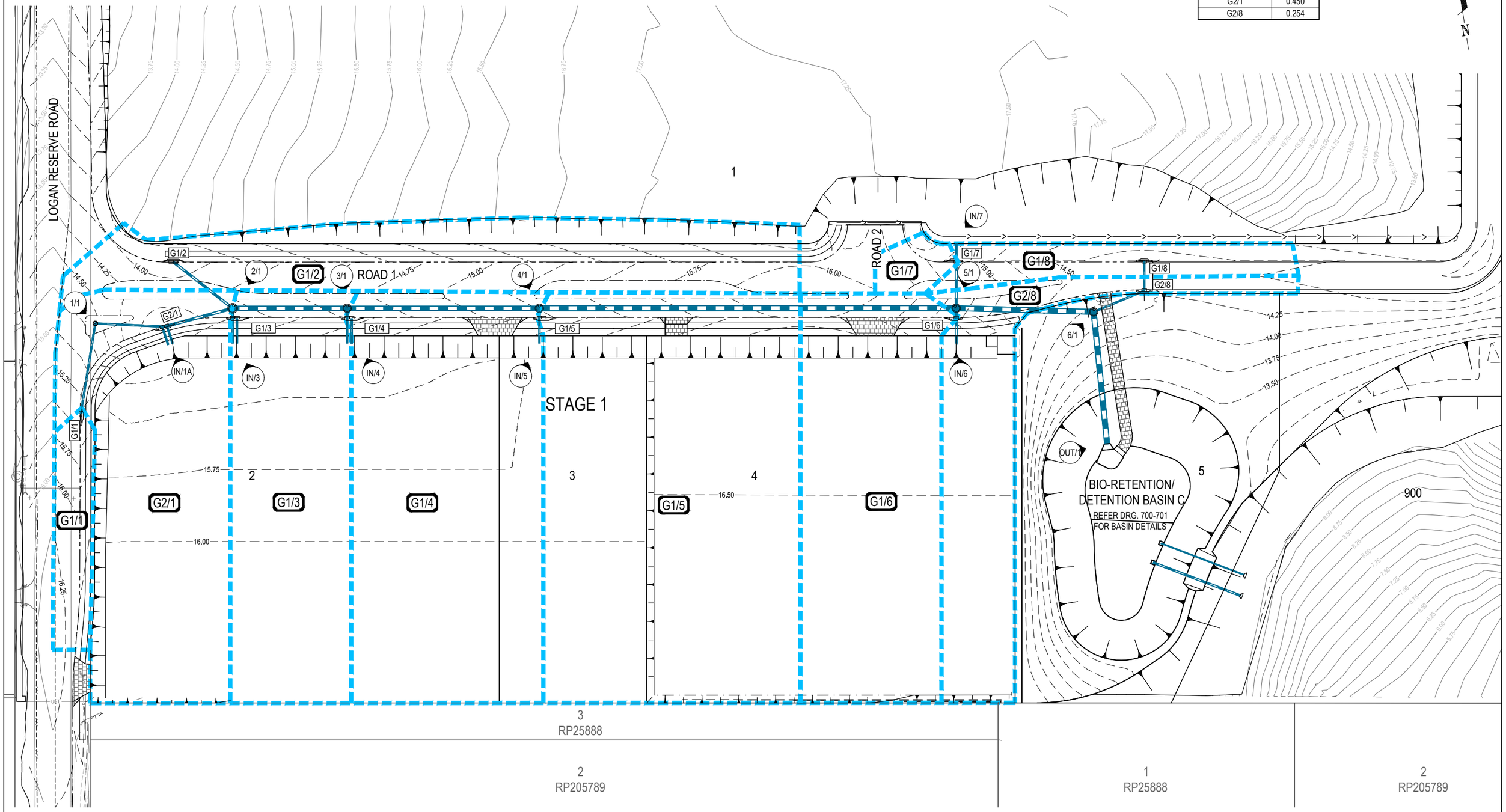
NOTE:
THIS PLAN DEPICTS CATCHMENTS FOLLOWING THE COMPLETION OF WORK SPECIFIED ON THESE DRAWINGS.

CATCHMENT TABLE

CATCHMENT	AREA
G1/1	0.068
G1/2	0.364
G1/3	0.364
G1/4	0.579
G1/5	0.775
G1/6	0.426
G1/7	0.027
G1/8	0.091
G2/1	0.450
G2/8	0.254

NOTE:
REFER DRG. 002 FOR LEGEND AND NOTES

N



REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	17.08.17	STORMWATER AMENDED	NA	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	STORMWATER DRAINAGE LAYOUT AMENED	LS	LS

DRAWN: LS
DESIGN: LS

STATUS: NOT FOR CONSTRUCTION

APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE: 1:500 / 1:1000 — 10 5 0 10 20 — A1 / A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

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PROJECT: HALCYON LOGAN RESERVE STAGE 1

DISCLAIMER
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DRAWING TITLE: INTERIM STORMWATER CATCHMENT PLAN

PROJECT No.	DRAWING No.	REVISION
15-000483	320	4

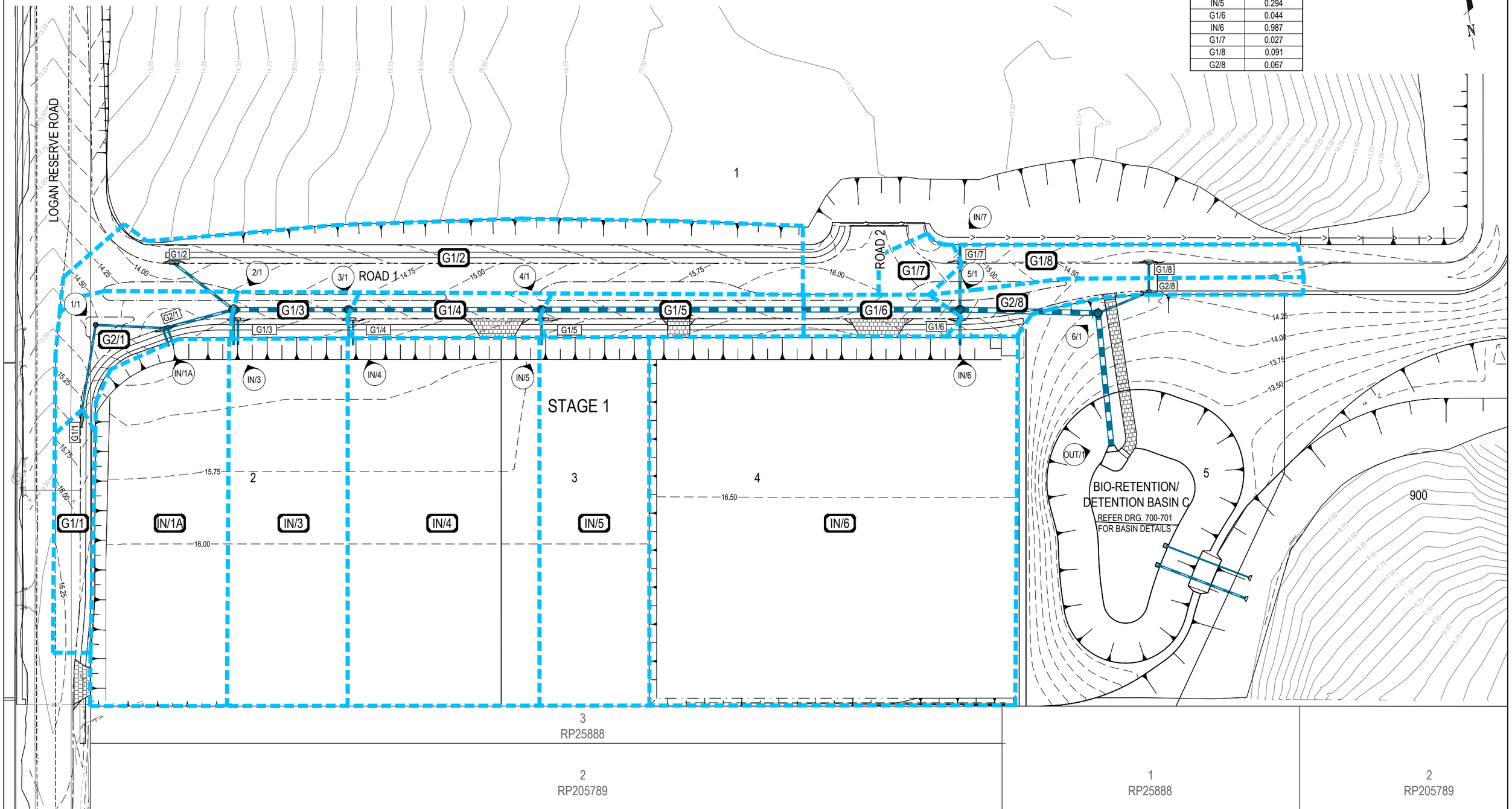
NOTE:
THIS PLAN DEPICTS CATCHMENTS FOLLOWING THE DEVELOPMENT OF LOTS 2, 3 AND 4 TO THERE ULTIMATE STATE

CATCHMENT TABLE

CATCHMENT	AREA
G1/1	0.068
G2/1	0.093
IN/1A	0.348
G1/2	0.364
G1/3	0.039
IN/3	0.321
G1/4	0.060
IN/4	0.516
G1/5	0.079
IN/5	0.294
G1/6	0.044
IN/6	0.987
G1/7	0.027
G1/8	0.091
G2/8	0.067

NOTE:
REFER DRG. 002 FOR LEGEND AND NOTES

N



REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	PLAN NAME AND LAYOUT AMENDED	LS	LS

DRAWN
DESIGN

STATUS: NOT FOR CONSTRUCTION

APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE
1:500 10 5 0 10 20 A1
1:1000 A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

calibre
calibregroup.com

PROJECT: HALCYON
LOGAN RESERVE
STAGE 1

DISCLAIMER
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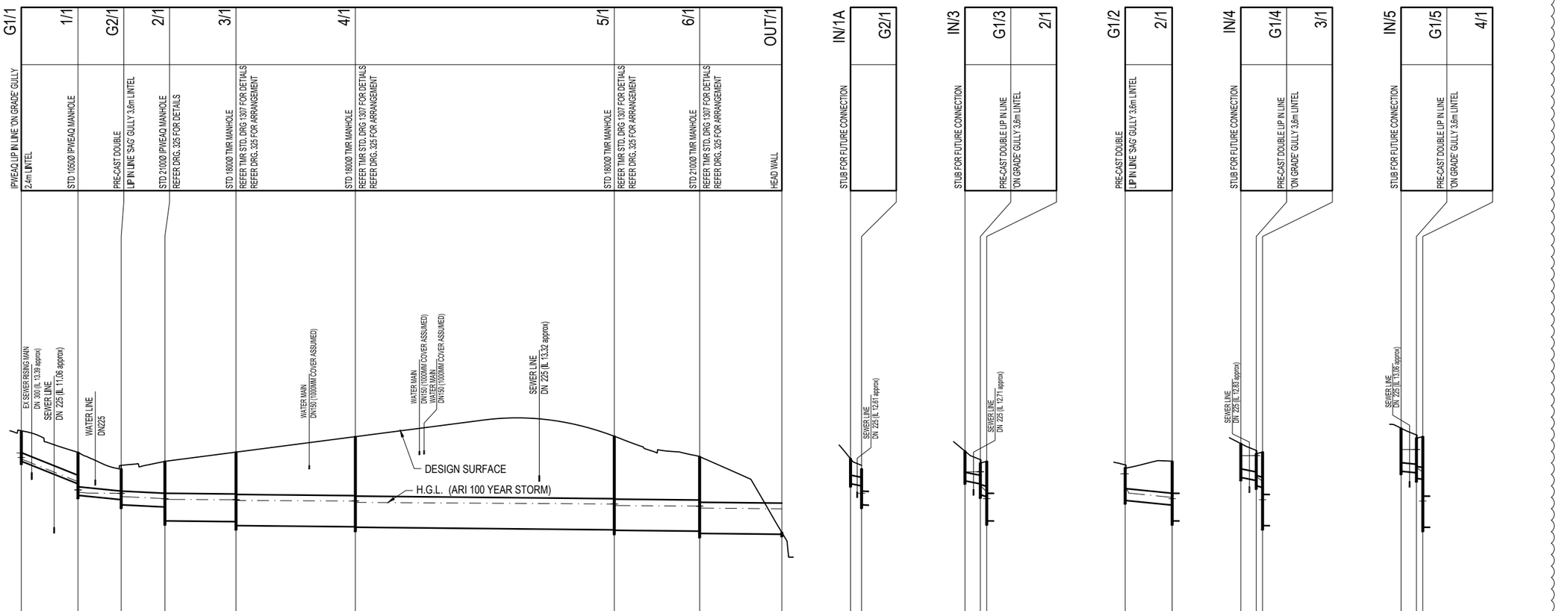
DRAWING TITLE: ULTIMATE STORMWATER CATCHMENT PLAN

PROJECT No.	DRAWING No.	REVISION
15-000483	321	4

STRUCTURE NAME	G1/1	1/1	G2/1	2/1	3/1	4/1	5/1	6/1	OUT/1	IN/1A	G2/1	IN/3	G1/3	2/1	G1/2	2/1	IN/4	G1/4	3/1	IN/5	G1/5	4/1
STRUCTURE DESCRIPTION	IPWEAQ LIP IN LINE ON GRADE GULLY 2.4m LINTEL	STD 10500 IPWEAQ MANHOLE	PRE-CAST DOUBLE LIP IN LINE 'SAG' GULLY 3.6m LINTEL	STD 21000 IPWEAQ MANHOLE REFER DRG. 325 FOR DETAILS	STD 18000 TMR MANHOLE REFER TMR STD. DRG 1307 FOR DETIALS REFER DRG. 325 FOR ARRANGEMENT	STD 18000 TMR MANHOLE REFER TMR STD. DRG 1307 FOR DETIALS REFER DRG. 325 FOR ARRANGEMENT	STD 18000 TMR MANHOLE REFER TMR STD. DRG 1307 FOR DETIALS REFER DRG. 325 FOR ARRANGEMENT	STD 21000 TMR MANHOLE REFER TMR STD. DRG 1307 FOR DETIALS REFER DRG. 325 FOR ARRANGEMENT	HEAD WALL	STUB FOR FUTURE CONNECTION		STUB FOR FUTURE CONNECTION	PRE-CAST DOUBLE LIP IN LINE 'ON GRADE' GULLY 3.6m LINTEL		PRE-CAST DOUBLE LIP IN LINE 'SAG' GULLY 3.6m LINTEL		STUB FOR FUTURE CONNECTION	PRE-CAST DOUBLE LIP IN LINE 'ON GRADE' GULLY 3.6m LINTEL		STUB FOR FUTURE CONNECTION	PRE-CAST DOUBLE LIP IN LINE 'ON GRADE' GULLY 3.6m LINTEL	
PIPE SIZEmm (Class)		375(3)	375(3)	600(3)	1200(3)	1350(3)	1350(3)	1350(3)	1350(3)		2 x 375(3)		2 x 375(3)	450(3)		525(3)		2 x 375(3)	450(3)		375(3)	525(3)
PIPE GRADE %		4.00%	1.00%	0.50%	0.10%	0.10%	0.10%	0.10%	0.10%		2.00%		2.00%	3.00%		1.00%		2.00%	3.00%		1.00%	1.50%
PIPE SLOPE 1 in X		25.00	100.00	200.00	999.99	1000.00	1000.00	1000.01	1000.01		50.00		50.00	33.33		100.00		50.00	33.33		100.00	66.67
FULL PIPE FLOW VELOCITY (m/s)													0.00					0.00			0.00	
PART FULL FLOW VELOCITY (m/s) DATUM RL 1.0		2.27 (1.60 1y)	1.39 (0.98 1y)	1.65 (1.17 1y)	1.14 (0.79 1y)	1.24 (0.86 1y)	1.31 (0.93 1y)	1.32 (0.95 1y)	1.35 (0.98 1y)					3.01 (1.99 1y)		2.16 (1.53 1y)			3.33 (2.28 1y)			2.61 (1.91 1y)
WATER LEVEL IN STRUCTURE	14.550	12.937	12.787	12.552	12.509	12.453	12.321	12.229	12.110	13.207	12.787	13.729	13.729	12.552	13.640	12.552	14.435	14.435	12.509	14.700	14.700	12.463
HYDRAULIC GRADE LEVEL	14.550	14.287 / 12.937	12.839 / 12.787	12.648 / 12.552	12.520 / 12.509	12.473 / 12.453	12.392 / 12.321	12.254 / 12.229	12.143 / 12.110	13.207	13.207 / 12.787	13.729	13.729 / 13.729	13.173 / 12.552	13.640	12.995 / 12.552	14.435	14.435 / 14.435	13.571 / 12.509	14.700	14.700 / 14.700	13.958 / 12.453
PIPE FLOW (Cumecs)		0.052	0.052	0.295	0.751	1.057	1.362	1.414	1.643		0.000		0.000	0.219		0.313		0.000	0.332		0.000	0.359
DEPTH TO INVERT	1.288	1.376	1.876	1.338	1.563 / 1.992	2.599 / 3.035	3.208 / 3.935	3.955 / 4.087	4.107 / 3.253	3.353 / 0.076	1.090	0.738	1.296	0.909	1.384 / 1.542	1.424	1.910	1.477	1.165	1.390 / 1.548	1.880	1.517 / 1.760	1.863
INVERT LEVEL OF DRAIN	14.190	13.199	12.699	12.510	12.285 / 12.190	11.583 / 11.551	11.378 / 11.326	11.306 / 11.193	11.173 / 11.136	11.036 / 11.000	13.207	13.110	13.332	13.198	12.723 / 12.640	12.477	12.272	13.481	13.346	13.121 / 13.038	13.750	13.683 / 13.440	13.398
DESIGN SURFACE LEVEL	15.478	14.575	13.848	14.182	14.586	15.261	15.280	14.389	11.076	14.297	13.848	14.628	14.107	14.182	13.901	14.182	14.958	14.511	14.586	15.630	15.200	15.261
SETOUT COORDINATES	1532.727 / 35243.325	1540.269 / 35266.928	1558.731 / 35263.096	1577.712 / 35265.273	1608.421 / 35260.496	1659.944 / 35252.480	1771.696 / 35235.094	1808.373 / 35228.377	1806.490 / 35192.498	1559.518 / 35258.318	1558.731 / 35263.096	1576.252 / 35255.886	1577.287 / 35262.538	1577.712 / 35265.273	1563.777 / 35280.345	1577.712 / 35265.273	1606.961 / 35251.108	1607.996 / 35257.761	1608.421 / 35260.496	1658.484 / 35243.093	1659.519 / 35249.745	1659.944 / 35252.480
RUNNING CHAINAGE	0.000	24.779 / 24.779	18.855 / 43.634	19.105 / 62.739	31.078 / 93.817	52.143 / 145.960	113.096 / 259.056	37.286 / 296.342	35.928 / 332.270	0.000	4.842 / 4.842	0.000	6.732 / 6.732	2.768 / 9.500	0.000	20.525 / 20.525	0.000	6.733 / 6.733	2.768 / 9.501	0.000	6.732 / 6.732	2.768 / 9.500
LINE		1								1A		3			2		4			5		



REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	24.08.17	FOR CO-ORDINATION	NA	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	STORMWATER LONGITUDINAL SECTIONS UPDATED	LS	LS

DRAWN

DESIGN

STATUS: NOT FOR CONSTRUCTION

APPROVED: LESLIE ROCHE RPEQ 14843

FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE
1:1000 10 0 10 20 30 40 50 A1
1:2000 A3
HORIZONTAL
1:100 2 1 0 2 4 A1
1:200 A3
VERTICAL

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

calibre

calibregroup.com

PROJECT: HALCYON LOGAN RESERVE STAGE 1

DISCLAIMER
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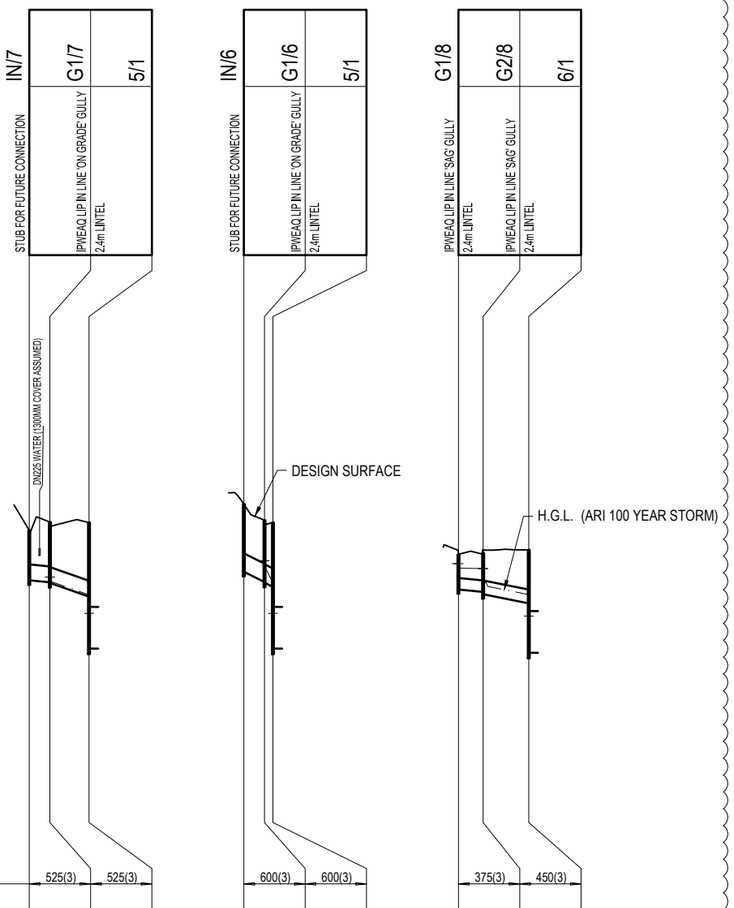
DRAWING TITLE: STORMWATER LONGITUDINAL SECTIONS SHEET 1 OF 2

PROJECT No.	DRAWING No.	REVISION
15-000483	322	4

STRUCTURE NAME	IN/7	G1/7	5/1	IN/6	G1/6	5/1	G1/8	G2/8	6/1
STRUCTURE DESCRIPTION	STUB FOR FUTURE CONNECTION	IPWEAQ LIP IN LINE 'ON GRADE' GULLY	2.4m LINTEL	STUB FOR FUTURE CONNECTION	IPWEAQ LIP IN LINE 'ON GRADE' GULLY	2.4m LINTEL	2.4m LINTEL	IPWEAQ LIP IN LINE 'SAG' GULLY	2.4m LINTEL
PIPE SIZEmm (Class)		525(3)	525(3)		600(3)	600(3)		375(3)	450(3)
PIPE GRADE %		1.00%	3.50%		5.00%	5.00%		1.00%	2.00%
PIPE SLOPE 1 in X		100.00	28.57		20.00	20.00		100.00	50.00
FULL PIPE FLOW VELOCITY (m/s)					0.00			0.70(0.19 1y)	
PART FULL FLOW VELOCITY (m/s) DATUM RL -1.0			1.61 (1.09 1y)			3.07 (2.36 1y)			2.77 (1.84 1y)
WATER LEVEL IN STRUCTURE	13.399		13.505	12.321	13.678		14.037	12.321	13.941		13.779	12.229
HYDRAULIC GRADE LEVEL	13.399	13.399	13.505	13.372	12.321	12.254	13.678	13.678	14.037	13.921	12.321	12.254	13.941	13.795	13.779	13.394	12.229	12.143
PIPE FLOW (Cumecs)			0.000	0.022			0.000	0.132			0.077	0.295						
DEPTH TO INVERT		1.629	1.967	1.987	2.415		2.205	2.014	2.034	2.097		1.132	1.265	1.340	1.743			
INVERT LEVEL OF DRAIN		13.399	13.332	13.312	12.865		13.678	13.341	13.321	13.183		13.099	13.019	12.944	12.646			
DESIGN SURFACE LEVEL	15.028		15.299		15.280		15.883	15.355		15.280		14.231	14.284		14.389			
SETOUT COORDINATES	1774.692 35254.352		1773.659 35247.710		1771.696 35235.094		1770.236 35225.707	1771.269 35232.362		1771.696 35235.094		1824.075 35239.877	1822.834 35231.919		1808.373 35228.377			
RUNNING CHAINAGE	0.000	6.722	6.722	12.768	19.490		0.000	6.734	6.734	2.765	9.499		0.000	8.054	8.054	14.888	22.942	
LINE		7						6						8				



4

REFERENCE POINT LOCATION FOR DRAINAGE STRUCTURES

STRUCTURE TYPE	HORIZONTAL CONTROL (REFERENCE POINT LOCATION)	VERTICAL CONTROL (REFERENCE LEVEL)
MANHOLE	℄ OF MAIN SHAFT	FINISHED SURFACE LEVEL
GULLY PIT	INTERSECTION OF PIT ℄ AND INVERT KERB LINE	KERB INVERT LEVEL
HEADWALL	INTERSECTION OF HEADWALL FACE AND PIPE ℄	TOP OF HEADWALL

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	26.05.17	FOR CLIENTS INFORMATION	NA	LS
2	24.08.17	FOR CO-ORDINATION	LS	LS
3	15.09.17	FOR OPERATIONAL WORKS APPROVAL	LS	LS
4	13.11.17	STORMWATER LONGITUDINAL SECTIONS UPDATED	LS	LS

DRAWN LS

DESIGN LS

STATUS: NOT FOR CONSTRUCTION

APPROVED LESLIE ROCHE RPEQ 14843

FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE
1:1000 10 0 10 20 30 40 50 A1
1:2000 A3 HORIZONTAL
1:100 2 1 0 2 4 A1
1:200 A3 VERTICAL

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

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PROJECT: HALCYON LOGAN RESERVE STAGE 1

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DRAWING TITLE: STORMWATER LONGITUDINAL SECTIONS SHEET 2 OF 2

PROJECT No.	DRAWING No.	REVISION
15-000483	323	4

Appendix D Flood Investigation Report

Reference 15-000483-02E

PREPARED FOR HALCYON DEVELOPMENTS PTY LTD
DECEMBER 2018
15-000483-02E
ORIGINAL
WATER & ENVIRONMENT

252 Logan Reserve Road, Logan Reserve

Flood Investigation Report

COMMERCIAL IN CONFIDENCE

Calibre Consulting
Ground Floor, 545 Queen Street
BRISBANE QLD 4000

Ph: (07) 3895 3444

DOCUMENT CONTROL
15-000483-02E

Issue	Date	Issue Details	Author	Checked	Approved
A	05/11/2015	For DA Submission	KO/CS	CS	AMcP (RPEQ 6921)
B	17/05/2016	Information Request Response	KO/CS	MS (RPEQ 9485)	MS (RPEQ 9485)
C	11/09/2018	For DA Submission	MP	AV	AV (RPEQ 19033)
D	15/10/2018	Updated Layout	MP	AV	AV (RPEQ 19033)
E	04/12/2018	Updated Layout	MP	AV	AV (RPEQ 19033)

EXECUTIVE SUMMARY

This report demonstrates that the proposed development at 216-232, 234-252, 254-264 and 266-294 Logan Reserve Road, Logan Reserve will not create any adverse or detrimental impacts on flood conditions to any external private properties. TUFLOW hydraulic modelling and subsequent analysis has been undertaken for the site in its existing and developed conditions based on hydrological and hydraulic data supplied by Logan City Council.

Issue A of this report was originally submitted for the DA (COM/6/2016). Issue B of this report was updated with the updated development layout and highlights the critical duration modelled for each recurrence interval in response to *Item 6.1* of Council's *Information Request* dated 19 February 2016. No changes were made to the analysis. Issue C of this report was updated to incorporate the development of 254-264 Logan Reserve Road, additional immunity for the Caravan Storage Area and the latest Master Plan earthworks Strategy.

This current Issue (E) was updated with the latest development layout as presented in **Appendix A**. The layout was updated to document the location of the Caravan Storage Area, which remains consistent with those represented in the Issue C analysis. Hence no changes were required to the analysis.

Flood map plans provided within this report illustrate existing and developed flood depths, velocities and associated differences between the two scenarios for the 10 through to the 100 year ARI storm events. Analysis also included a new 20 year ARI flood immune emergency access track connecting the proposed development site to Schmidts Road to the north of the development.

Discussions in regards to the flood level changes are presented within **Section 4** of this report and the minimum development finished floor level is included within **Section 5**.

The analysis demonstrated that appropriate development levels can be provided and the flood level changes will not cause detrimental impacts to external private properties.

It is recommended that this flood investigation be approved and the management strategies presented within this report be incorporated into future detailed design. Detailed design may result in changes to the concept, however the design objectives presented within this report are to remain unchanged.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

Calibre Consulting (Qld) Pty Ltd has been commissioned by Halcyon Developments Pty Ltd to undertake a *Flood Investigation* to support the proposed development at 216-232, 234-252, 254-264 and 266-294 Logan Reserve Road, Logan Reserve. Refer to the conceptual development layout shown in **Appendix A**. For clarity and consistency from hereon in, the abovementioned development in Logan Reserve will be referred to as the "site".

This report has been specifically prepared to demonstrate that the proposed development will not result in adverse flood impacts to adjoining premises, infrastructure and the environment. Design objectives for the proposed development are:

- Will not result in people and premises being at an additional risk during the defined flood event;
- Will not worsen the extent or severity of flooding or flood risk; and
- Will not add to the emergency management or evacuation burden during and after a flood event.

The flood investigation presented in this report has been undertaken based on the TUFLOW hydraulic model supplied by the Logan City Council. The results from the flood modelling undertaken for this report will also be utilised to nominate minimum allotment levels for the proposed development.

1.1 PREVIOUS VERSIONS

Issue A of this report was originally submitted for the DA (COM/6/2016). Issue B of this report was updated with the updated development layout and highlights the critical duration modelled for each recurrence interval in response to *Item 6.1* of Council's *Information Request* dated 19 February 2016. No changes were made to the analysis. Issue C of this report was updated to incorporate the development of 254-264 Logan Reserve Road, additional immunity for the Caravan Storage Area and the latest Master Plan earthworks Strategy. Issue D of this report was updated to incorporate the updated layout plan in the report, the changes to the layout did not impact the flooding surrounding the development.

This current Issue (E) was updated with the latest development layout as presented in **Appendix A**. The layout was updated to document the location of the Caravan Storage Area, which remains consistent with those represented in the Issue C analysis, hence no changes were required to the analysis.

The only changes made to the Issue E report from the previous issues is the layout presented in **Appendix A**. As the Issue C report documented significant updates from previous issues, the changes made to the Issue C report are highlighted with *Italicised* text. No other updates have been made to the report.

1.2 INFORMATION REQUEST ITEMS

The *Information Request* items addressed in this updated report and the relevant report section are outlined below.

6.1 Clarify why different durations have been used in the post-developed scenario, vs the existing case, and clarify what durations have been used for the design of the detention basins.

Response: The same duration storms have been modelled in TUFLOW for pre- and post-developed scenarios for the 10, 20, 50 and 100 year ARIs. That is:

- 10 year ARI 30 hour storm event has been modelled for pre- and post-developed scenario.
- 20 year ARI 72 hour storm event has been modelled for pre- and post-developed scenario.
- 50 year ARI 72 hour storm event has been modelled for pre- and post-developed scenario.
- 100 year ARI 72 hour storm event has been modelled for pre- and post-developed scenario.

The detention basins were modelled for 15 to 180 minute standard durations for 1 to 100 year ARIs. Refer to *Site Based Stormwater Management Plan* (Report No. 15-000483-01D) dated April 2018.

2 SITE CHARACTERISTICS

2.1 LOCATION

The site is located within the Logan City Council local government area. **Figure 2-1** illustrates the site location. The real property descriptions of the site are Lot 3 on RP210941, Lot 2 on RP25887, Lot 1 on RP25886 and Lot 41 on MAR618. The site has a total footprint area of 48.97ha.

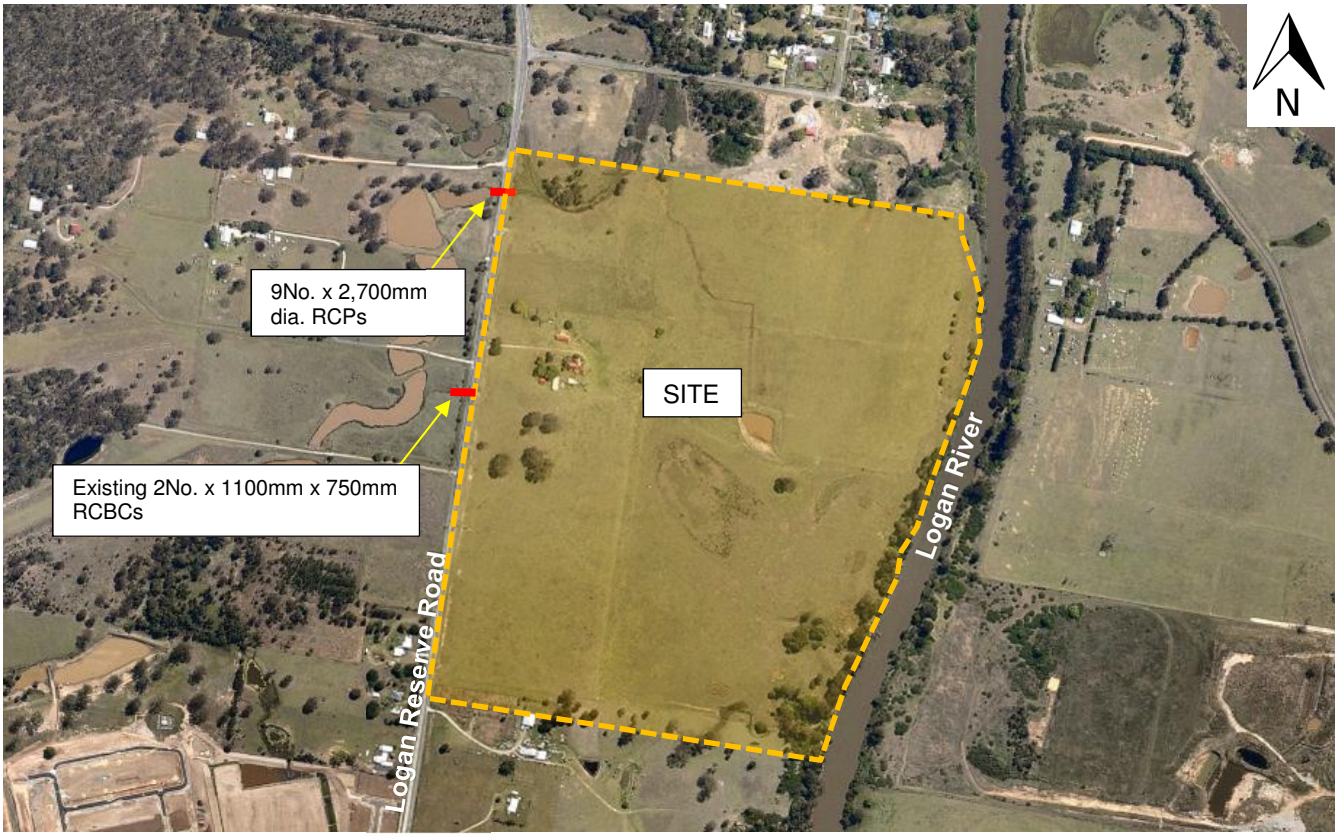


Figure 2-1: Site Location (Source: Nearmap)

As can be seen from **Figure 2-1**, the site is bound by Logan River to the east, Logan Reserve Road to the west, and private properties to the north and south. The site under existing conditions (i.e. pre-development) is significantly pervious with rural residential dwellings located near Logan Reserve Road.

2.2 EXISTING TOPOGRAPHY AND DRAINAGE

The existing site slopes in multiple directions with a ridge line running south to north approximately through the middle of the site. Refer to **Appendix B** for the existing site survey.

The site located within the Logan River floodplain. The only existing municipal stormwater drainage infrastructure on site are the 9No. x 2,700mm diameter RCPs under Logan Reserve Road at the northwest corner, and 2No. x 1100mm x 750mm RCBCs at 254-264 Logan Reserve Road. There is existing municipal stormwater drainage along Logan Reserve Road to the west.

3 FLOOD INVESTIGATION

The TUFLOW flood modelling undertaken for the proposed development has been based on a cut-down copy of Council's Logan River TUFLOW flood model. The revised copy of Council's flood model, including the hydrological inflow data has been purchased specifically for this project. No catchment-wide hydrological analysis was undertaken. The following sections discuss the hydraulic modelling.

3.1 MODEL SETUP

3.1.1 TOPOGRAPHICAL DATA AND PROJECTION

The Digital Terrain Model (DTM) provided by Council and the projection files provided by Council as part of the revised flood model have been used in TUFLOW. No changes were made to Council's DTM and the projection files provided.

3.1.2 2D MODEL AREA

The 2D model area for the analysis presented in this report is shown in the image below. A 2D grid size of 20m combined with 4 second time step was used for modelling.

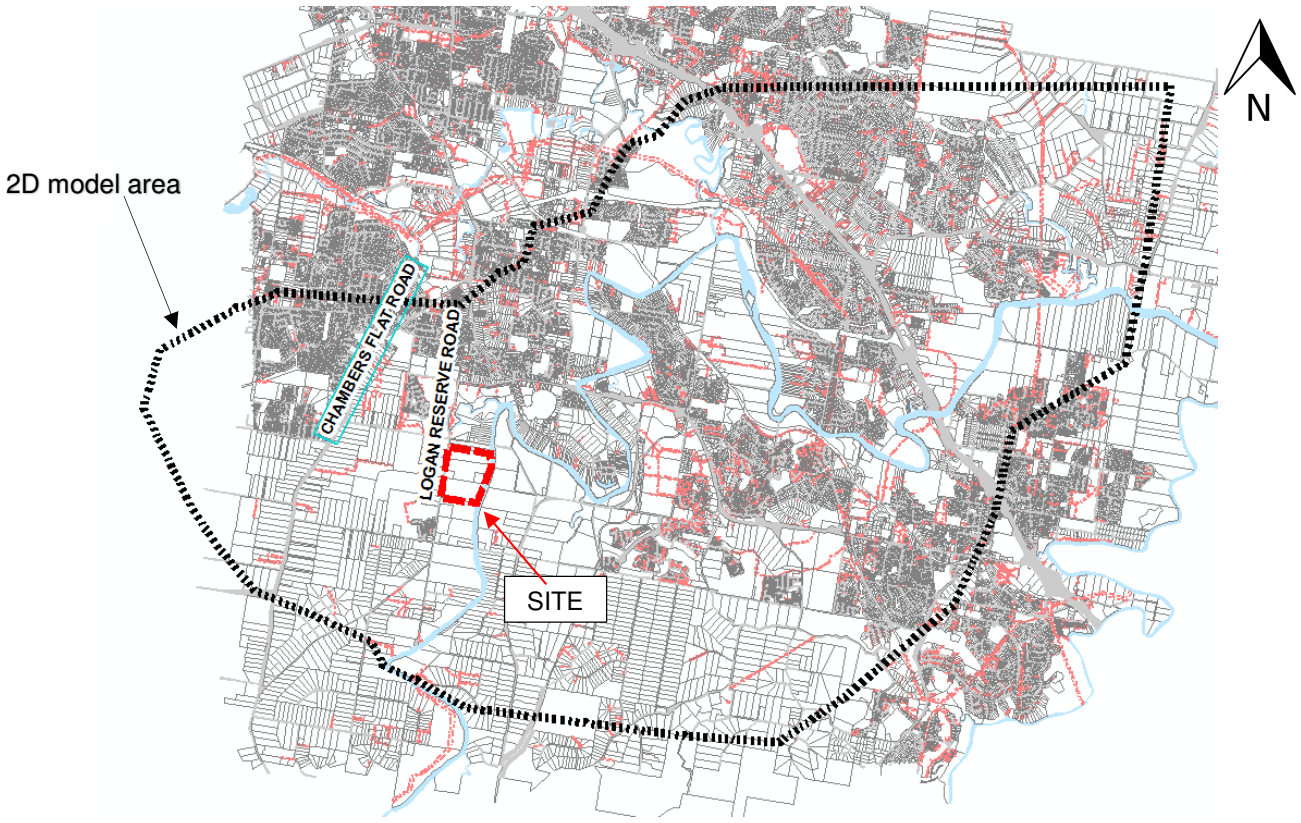


Figure 3-1: TUFLOW Model Area

3.1.3 MANNING'S N VALUES

Various Manning's n roughness values have been utilised to represent the 2D topographical areas within the flood model. The Manning's n values provided by LCC have been retained. The subject site area has been represented by a Manning's n value of 0.045 for the Existing Scenario.

3.1.4 1D MODEL ELEMENTS

The culverts and other major drainage structures part of the study area has been represented by 1D elements with bridge structures modelled as 2D flow constrictions. All 1D elements incorporate SX connections to dynamically link to the 2D floodplain. These have been retained as per Logan City Council's original model.

3.1.5 BOUNDARY CONDITIONS

There are two inflow boundaries for the runoff from upstream catchments outside of the 2D model extent, and one downstream outflow boundary. The inflows for catchments within the 2D model area were entered into catchment polygons. All boundary elements are shown in **Figure 3-2** below.

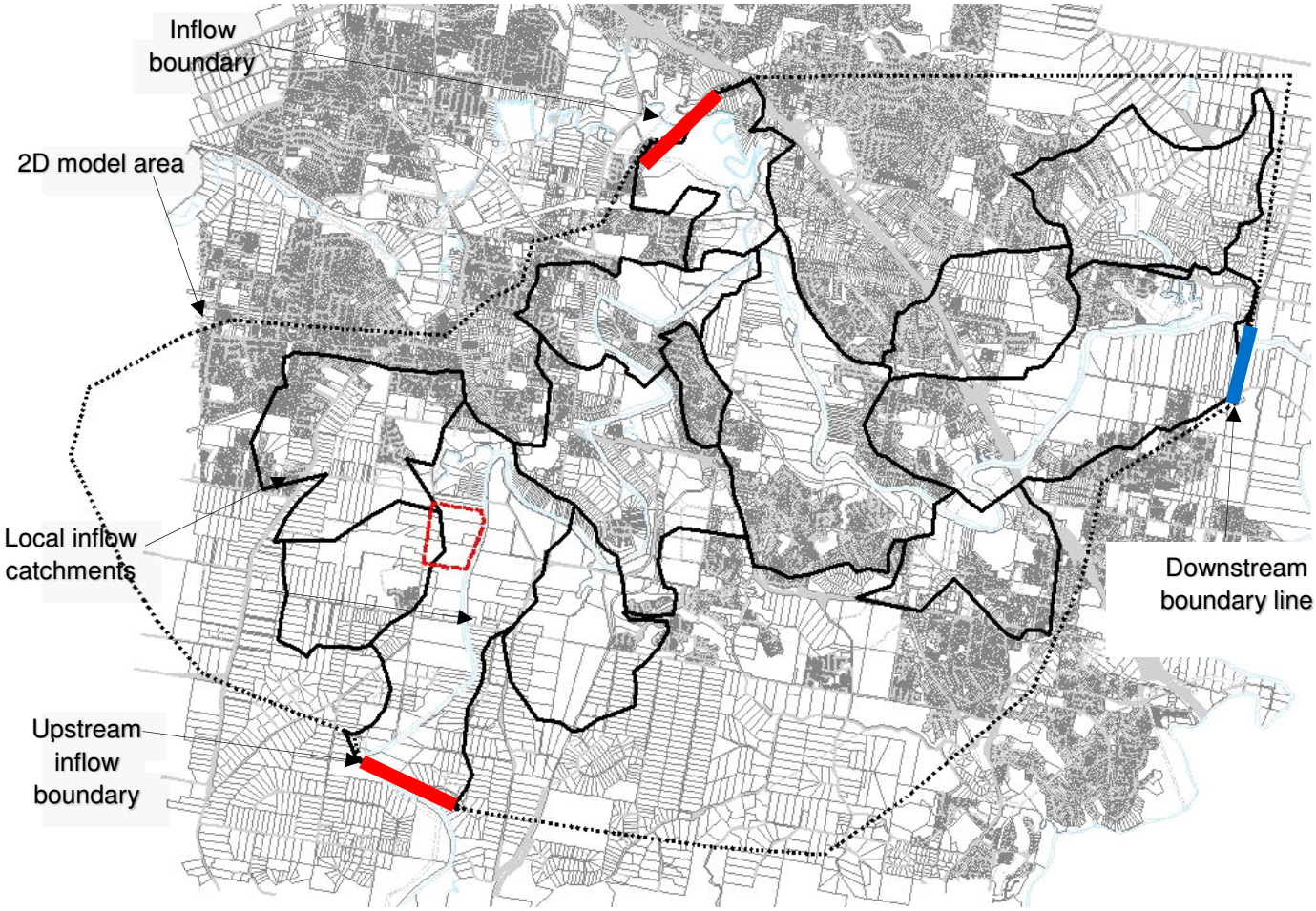


Figure 3-2: Inflow and Outflow Boundaries

The inflow hydrographs (time vs flow) and tailwater graphs (time vs water level) for the following Average Recurrence Interval (ARI) storm events have been provided by Logan City Council.

- 100 year ARI 72 hour storm event;
- 50 year ARI 72 hour storm event;
- 20 year ARI 72 hour storm event; and
- 10 year ARI 30 hour storm event.

The storm durations noted above are the peak durations for their corresponding recurrence interval storm.

Tailwater levels for the revised model were set using a downstream HT boundary. The HT boundary sets the water surface level in relation to time. For the 1% AEP, the water surface level increases from 1.8m at time 0 to 5.76m after 85hrs. Once the model passes an 85 hour duration, the downstream tailwater level will remain at 5.76m.

3.2 EXISTING SCENARIO FLOODING

Existing Scenario flood plans are provided in **Appendix C.** Flood modelling results are consistent with Council's flood mapping (based on the entire Logan River model). **Table 3-1** below tabulates the maximum flood level on site for the 10, 20, 50 and the 100 year ARI peak storm events.

Table 3-1: Existing Maximum Flood Levels on Site

ARI	Existing Scenario Max. Flood Level (m AHD)
10	9.63
20	11.29
50	12.93
100	13.36

Note: This level corresponds to upstream boundary of the proposed development.

The maximum flood velocities have also been mapped as shown in **Appendix C**. **Table 3-2** provides the maximum velocities experienced within the site.

Table 3-2: Existing Maximum Flood Velocities on Site

ARI	Existing Scenario Max. Flood Velocity (m/s)
10	1.94
20	2.35
50	2.33
100	2.21

Note: This velocity is experienced on site floodplain to the east of the proposed development.

3.3 DEVELOPED SCENARIO FLOODING

This section of the report has been updated for Issue C. The developed scenario flood model was updated to incorporate the "Future Development Area", additional immunity for the Caravan Storage area, the latest Master Plan earthworks strategy and the incorporation of the RCBC under the emergency access embankment. Other than the update design surface TIN incorporating the aforementioned items and the additional 1D model elements, no further changes were incorporated to the previously documented flood model.

The proposed development layout for the site is shown in **Appendix A.** Although the total site footprint is 48.97ha, the development will be limited to an area of approximately 21.4ha. The flood modelling undertaken demonstrates that the proposed development:

- Will not result in people and premises being at an additional risk during the defined flood event;
- Will not worsen the extent or severity of flooding or flood risk; and
- Will not add to the emergency management or evacuation burden during and after a flood event.

Refer to **Section 4** and **Appendix F** for the responses to Logan City Council's *Flood Hazard Overlay Code* (2015). The following sections present modelling of the proposed development in TUFLOW and results.

3.3.1 PROPOSED WORKS

3.3.1.1 EARTHWORKS

Earthworks are required to create the development area on site. In accordance with Logan City Council's *Flood Hazard Overlay Code* (2015), compensatory earthworks have been undertaken to ensure the development fill does not reduce the flood storage or affect the capacity of the floodplain. The compensatory excavation has been undertaken within the floodplain area on site, but predominately limited to above the 10 year ARI flood level of 9.59m AHD. Refer to Drawing No. **15-000483-SK701** in **Appendix D** for the concept bulk earthworks plan.

There is minor fill encroachment into the 10 year ARI flood extent at the northeast corner of the development pad. However, the flood modelling results demonstrate that this minor fill does not affect the 10 year ARI flood conditions.

Through modelling iterations it had been determined that the extent of flow allowed to travel to the northwest via the site (toward Chambers Flat Road) needs to be maintained similar to existing conditions. Therefore, careful consideration has been given to the balancing the excavation and filling in the northern portion of the site. This area is identified on Drawing No. **15-000483-SK701** in **Appendix D.**

While the majority of the floodplain area above the 10 year ARI flood level will be utilised as 'open space' recreational area, revegetation of the riparian corridor is proposed to assist with flow velocities during higher ARI storm events and also to provide a buffer between the development and Logan River.

3.3.1.2 STORMWATER DRAINAGE

*Culverts are proposed under the emergency access bund to convey flows and alleviate flood impacts upstream of the site. Seven (7) 2.1m x 1.5m RCBCs are proposed to convey flows between the eastern and western sides of the bund. Refer to the flood plans presented in **Appendix D** and **Appendix E** for further details of the culvert location and configuration.*

3.3.2 TUFLOW MODEL CHANGES

The following changes have been made to the TUFLOW model to represent developed conditions of the subject site:

- *Updated design TIN to represent site earthworks which consist of fill for the development and compensatory cut within the floodplain. The updated design TIN also incorporates the fill associated with the Future Development Area and the increased level of the Caravan Storage Area to provide Q20 flood immunity;*
- The Manning's n value has been changed in some isolated areas within the site's floodplain to represent vegetation of the riparian corridor. As stated in *Table C.5* of Brisbane City Council's *Natural Channel Design Guidelines,* a Manning's n value of 0.07 represents *"trees at 5m spacing, no low branches, few shrubs, walking may be difficult in some areas."*
- *The proposed culverts under the emergency access bund have been modelled by a 1D element with SX connections to dynamically link to the 2D floodplain.*

No other changes were made to the TUFLOW model, including the inflow hydrographs. That is the following inflow hydrographs (time vs flow) and tailwater graphs (time vs water level) for the corresponding ARIs have been modelled.

- 100 year ARI 72 hour storm event;
- 50 year ARI 72 hour storm event;
- 20 year ARI 72 hour storm event; and
- 10 year ARI 30 hour storm event.

Hydrology was not changed as on-site stormwater mitigation will be provided for the development. Therefore, the peak flow rate discharging out of the site will not exceed the existing peak flow rate for ARIs up to and including the 100 year storm event. Refer to Calibre Consulting Report No. **15-000483-01D**.

3.3.3 DEVELOPED FLOOD RESULTS

The maximum flood levels on site for the Developed Scenario are presented in **Table 3-3**.

Table 3-3: Developed Scenario Max. Flood Levels at Upstream Development Boundary

ARI	Existing Scenario Max. Flood Level (m AHD)	Developed Scenario Max. Flood Level (m AHD)	Difference (mm)
10	9.63	9.63	0
20	11.29	11.28	-10
50	12.93	12.91	-20
100	13.36	13.36	0

Note: This level corresponds to upstream boundary of the proposed development.

Table 3-3 *has been amended to reflect the updated developed maximum flood levels on Site.*

Developed Scenario flood modelling results are provided in **Appendix D** in terms of flood levels, flood extents and velocities.

Differences between existing and developed flood levels and velocities have been mapped and are included within **Appendix E**. Mapping shows that the majority of the model areas have no perceivable change in flood level for 10, 20, 50 and 100 year ARIs. However, a few locations have been identified where changes of more than 5mm have occurred. The identified flood changes will not cause adverse impacts to the wider community. Each location has been discussed within **Section 4** of this report.

3.3.4 SENSITIVITY ANALYSIS

In accordance with *Section 2.5.1* of Council's *Logan Planning Scheme SC6.2.5 Planning Scheme Policy 5 – Infrastructure,* a sensitivity analysis has been undertaken to assess the influence of an increased Manning's n value within the site. As per this requirement, all Manning's 'n' values within the site have been increased by 10% to 20%. The 100 year ARI duration storm has been analysed incorporating the above increase in site Manning's 'n' values.

Table 3-4: Sensitivity Scenario Max. Flood Levels on Site

ARI	Developed Scenario Max. Flood Level on Site (m AHD)	Sensitivity Scenario Max. Flood Level on Site (m AHD)
100	13.35	13.38

Note: This level corresponds to the upstream boundary of the proposed development.

Table 3-4 *has been amended to reflect the updated developed maximum flood levels on Site. As demonstrated above, there is a 30mm change in the maximum flood level on site due to an increase in Site Manning's. Refer to the updated Drawing No.* **15-000483-S100A** in **Appendix D**.

The results from the sensitivity analysis was used to ensure the freeboard nominated is appropriate. Refer to **Section 5** for the nominated development levels.

4 FLOOD CHANGES

This section of the report has been updated for Issue C. Since the Issue B report, the updated flood modelling has resulted in changes to the previously approved results. Although the following results do slightly differ from those previously presented, all analysis and proposed strategies still meet the required objectives.

This section provides discussions regarding flood impacts outside of the subject site. Since the Issue B report and associated flood modelling, the impacts to the flood levels outside the site boundary has been updated, and the two "key" areas identified when flood changes occur are shown in **Figure 4-1** below. Hydraulic modelling also indicated reductions in flood level downstream of the site.

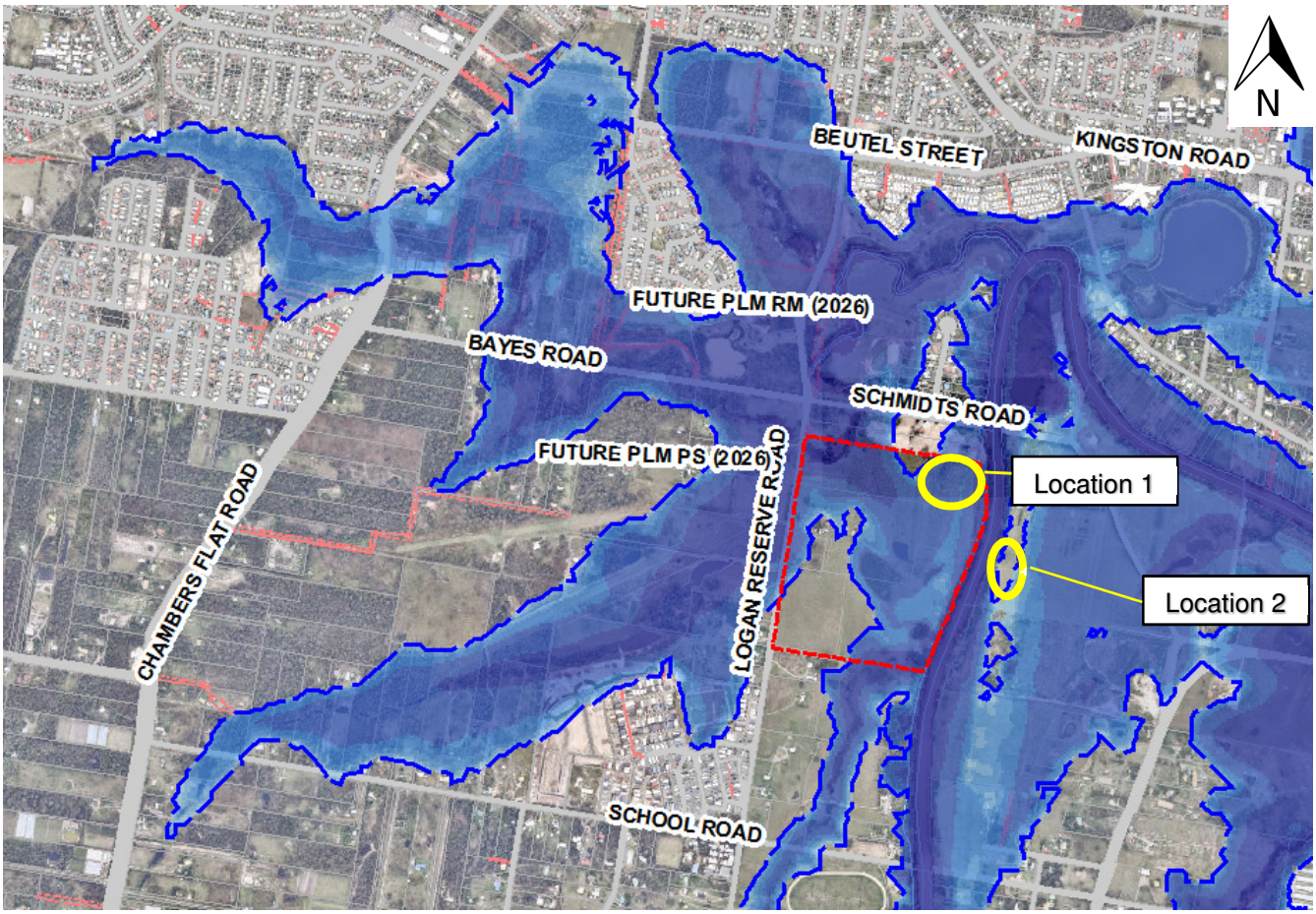


Figure 4-1: Flood Change Locations

Table 4-1 below provides a summary of the flood impacts observed at the areas of change.

Table 4-1: Flood Differences

ARI	**Location 1** Neighbouring Property to the north at 208 Schmidts Rd	**Location 2** Neighbouring Property to the East at 21 Deer Lane
10	• No perceivable change in flood level or velocity.	• No perceivable change in flood level or velocity.
20	• Up to 80mm increase in flood level, decreasing towards the north for approximately 60m. • No perceivable change in velocity, with the exception of a 0.3m/s increase at an isolated location to the north of the site	• Up to 20mm flood level increase. • No perceivable change in velocity
50	• Up to 5.6mm increase in flood level at an isolated location to the north of the site. • Up to 0.5m/s increase in velocity at an isolated location to the north of the site	• Up to 12mm flood level increase outside on the opposing bank of the Logan River in an isolated location. • Generally no change in velocity with decreases of up to 0.2m/s at an isolated location.
100	• No perceivable change in flood level. • Generally no perceivable change in velocity with some isolated decreases in velocity of up to 0.2m/s	• Up to 16mm flood level increase in an isolated location. Generally there is no perceivable change in flood level. • Generally no perceivable change in velocity with some isolated decreases in velocity of up to 0.2m/s

Flood changes presented in **Table 4-1** are illustrated on drawings provided in **Appendix E.** The following sections discuss why the abovementioned increases are not considered 'adverse' flood impacts.

In summary it has been concluded the proposal provides an acceptable solution in accordance with *PO7* of the *Flood Hazard Overlay Code* (2015). That is, the proposed development at 216-232, 234-252, 254-264 and 266-294 Logan Reserve Road, Logan Reserve does not result in "*loss of conveyance capacity and storage of the waterway to adversely affect other premises, infrastructure and the environment."* Further details are provided in subsequent **Sections 4.1** to **4.3.**

4.1 LOCATION 1

Location 1 refers to adjoining property to the north at 208 Schmidts Road and specifically to its eastern side. Results of hydraulic modelling in this area are summarised below.

Flood Level Impact: There are no changes in flood conditions during the 10 year and the 100 year ARI storm events. There is a minor afflux of 5.6mm in the 50 year ARI storm event which is considered to cause a negligible flood impact.

Although minor flood level affluxes occur in the 20 year ARI storm event, the flood extents have not discernibly changed in this area, as illustrated in **Figure 4-2**. With flood depths in excess of 2m for this event, the property at 208 Schmidts Road has a 'high' flood risk category classification and the additional 0.080m depth will not change the flood characteristics or adversely impact on the property's development potential.

Further impacts within Logan River have been assessed and increases remain contained within the eastern banks of the river. Refer to flood impact Drawings Numbered **15-000483-WSL01, WSL02** and **WSL03** in **Appendix E** for impact assessment at Location 1 and other locations along Logan River.

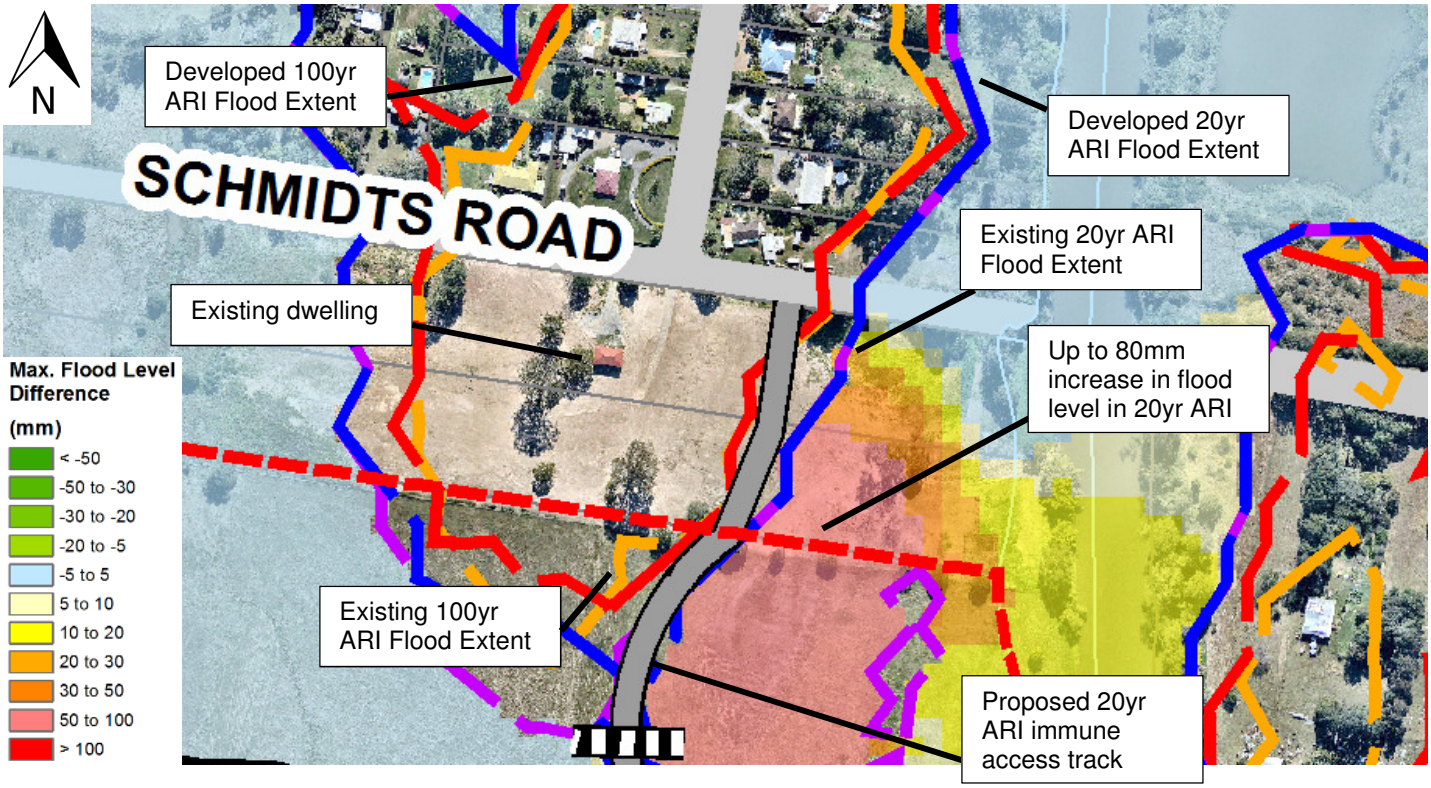


Figure 4-2: Flood Level Change at Location 1 (20 year ARI)

Peak Flow Impact: No significant changes will occur to peak discharges as the development peak flows will be mitigated via on-site detention basins. Refer to **Table 4-2** for peak flow rates along the Logan River adjacent to 208 Schmidts Road.

Table 4-2: Peak Flow at Location 1

ARI	Existing Scenario		Developed Scenario	
	Peak Flow (m^3/s)	Time to Peak (hour)	Peak Flow (m^3/s)	Time to Peak (hour)
10	1,201	67.9	1,197	67.9
20	1,623	73.5	1,650	73.9
50	2,054	68.1	2,006	73.2
100	2,127	72.1	2,112	70.5

As can be seen, no perceivable changes were noted to the magnitude or timing of the peak flow at Location 1.

Velocity Impact: The velocity increases at Location 1 are generally minor and in isolated areas, with general decreases in velocity more commonly observed. Refer to velocity difference plans in **Appendix E.**

Stormwater Quality: The proposed development will be provided with stormwater quality improvement devices and new riparian vegetation, so it will not impact the existing water quality, sedimentation or scouring at adjoining property.

In summary, increases of up to 80mm and 5.6mm afflux at Location 1 during the 20 and the 50 year ARIs respectively are not detrimental because:

- No changes in flood level during the 100 year ARI event;
- Changes do not affect the extent of flooding at the location;
- Changes do not decrease the flood resilience at 208 Schmidts Road;
- Changes do not change the existing flood risk category;
- Changes do not affect the peak flows;
- Changes do not cause significant changes to velocities;
- Changes do not affect stormwater quality; and

Changes will not affect the future development potential of the neighbouring property.Therefore, Location 1 achieves the principle of no worsening as outlined in *PO11* in *Table 4.1.1* of the Logan City Council's *SC6.2.5 Planning Scheme Policy 5 – Infrastructure 4.1 Guidelines for Satisfying Flood Hazard Overlay Code* (2015) and the *QUDM* (2013).

4.2 LOCATION 2

Location 2 refers to the floodplain from the eastern boundary of the site to the opposing bank of the Logan River as shown on **Figure 4-1.**

Flood Risk Impact: Generally there is no increase in flood level for the 50 year and 100 year storm event with isolated increases of 12mm and 16mm respectively within the eastern bank of the Logan River. As demonstrated in **Figure 4-3**, no existing dwellings are impacted by this minor afflux.

The only increases in flood level for the 20 year ARI storm event are within the Logan River along the eastern boundary of the site (see Drawing No **15-000483-D020D** in **Appendix F)** with affluxes of up to 13mm and 18mm to the north east and south east of the site respectively. This afflux does not impact any existing dwelling and will not change the flood risk nor result in a noticeable change in flood conditions during a 20 year ARI storm event.

Furthermore, the isolated flood impacts documented above occur in locations where existing flood levels exceed 3m for the respective storm events. Hence these affluxes will be imperceptible and will not result in adverse impacts.

Peak Flow Impact: As demonstrated in **Section 4.1**, the isolated afflux outlined above will not result in an increase in peak flows downstream of the site. As such the development of the site and associated works will not increase result in an adverse impact to peak flows.

Velocity Impact: There is no increases in velocity noted for any design event.

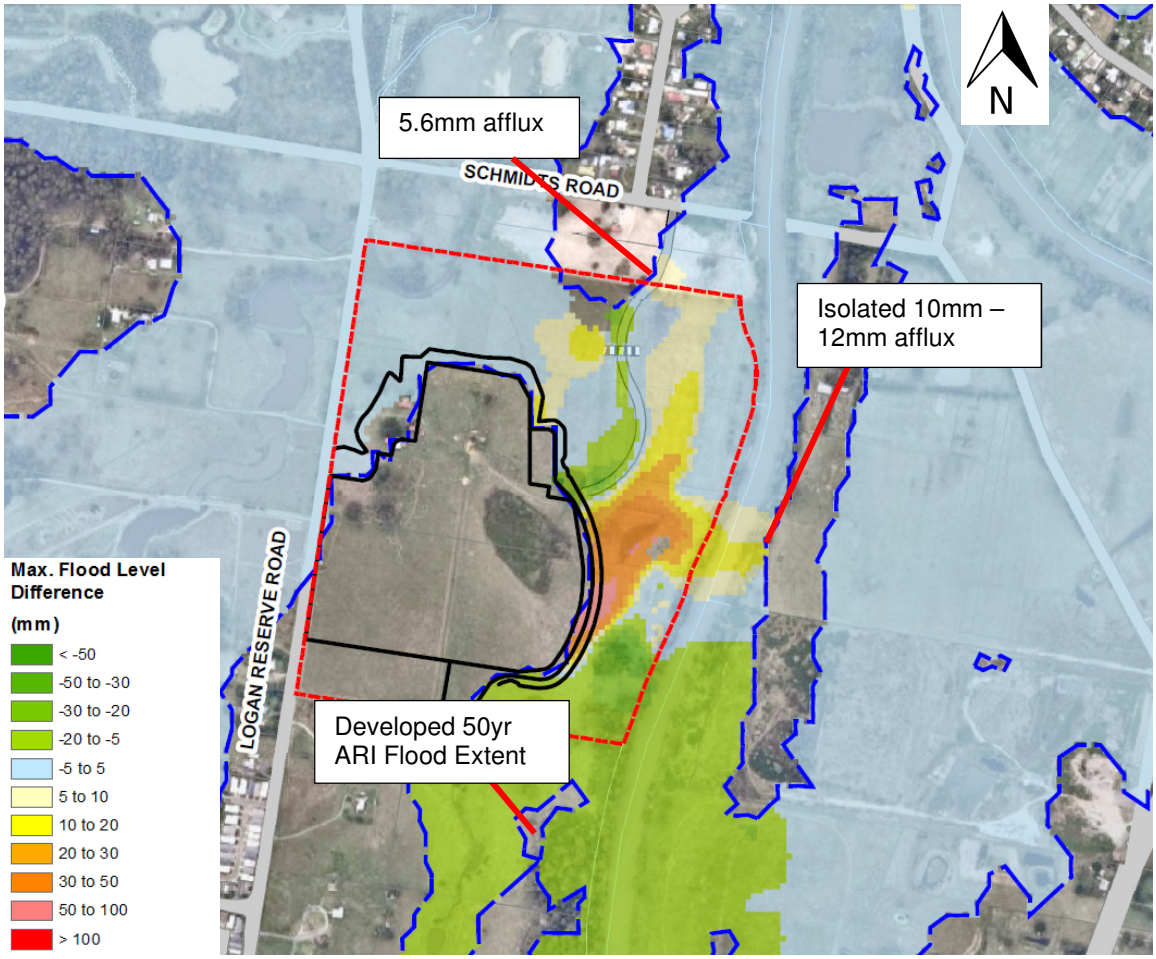


Figure 4-3: Flood Level Change at Location 2 (50 year ARI)

Stormwater Quality: The proposed development will be provided with stormwater quality improvement devices and new riparian vegetation, so it will not impact the existing water quality, sedimentation or scouring at adjoining property.

In summary, afflux at Location 2 in will not be detrimental because:

- No changes in flood level during the 100 year ARI event;
- Changes do not affect the extent of flooding at the location;
- Increase in the 50 year and 100 year ARI storm events are contained within the banks of the Logan River;
- Changes do not decrease the flood resilience of properties in Location 2;

- Changes do not change the existing flood risk category;
- Changes do not affect the peak flows;
- Changes do not cause significant changes to velocities;
- Changes do not affect stormwater quality; and
- Changes will not affect the future development potential of the properties.

Therefore, Location 2 achieves the principle of no worsening as outlined in *PO11* in *Table 4.1.1* of the Logan City Council's *SC6.2.5 Planning Scheme Policy 5 – Infrastructure 4.1 Guidelines for Satisfying Flood Hazard Overlay Code* (2015) and the *QUDM* (2013).

4.3 FLOOD LEVEL REDUCTIONS

Flood level reductions have occurred for over 4km south along Logan River in the 50 year ARI. **Figure 4-4** illustrates the reductions in the 50 year ARI.

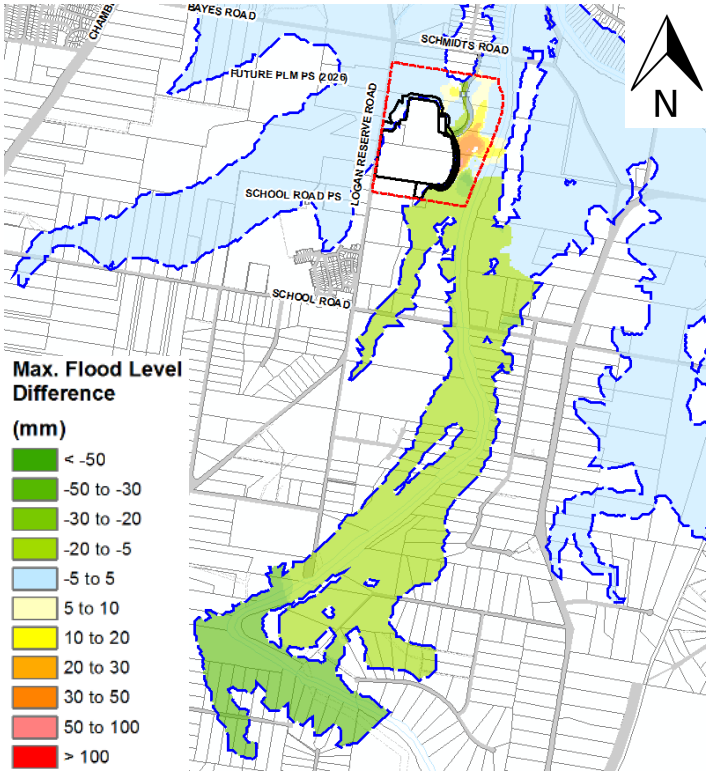


Figure 4-4: Flood Level Reduction in 50 year ARI

Although some increase occur in the water surface levels as discussed in **Sections 4.1** to **4.3**, there are areas of flood level reductions occurring in all modelled ARI events. There are over 30mm reductions in the 50 year ARI. This provides a net community benefit to a wide area.

4.4 FILLING BELOW 10 YEAR ARI

There is minor fill encroachment into the 10 year ARI flood extent at the northeast corner of the development pad as can be seen on Drawing No. **15-000483-SK701** in **Appendix D.**

The solution still complies with *PO14* of the *Flood Hazard Overlay Code* (2015) because:

- The 10 year ARI flooding in the area of fill is from backwater;
- As can be seen from Drawing No. **15-000483-E010B** in **Appendix C**, the existing peak 10 year ARI velocity at this area is between 0 to 0.5m/s;
- Hydraulic modelling demonstrates that the minor fill encroachment will not cause perceivable impacts to the 10 year ARI flood conditions. Refer to 10 year ARI flood impact plans in **Appendix E;**
- Design earthworks batters will be limited to 1 in 4; and
- Exposed earth surface will be landscaped with erosion resistant vegetation cover.

The above demonstrates that an acceptable outcome for *PO14* of the *Flood Hazard Overlay Code* (2015) will be achieved.

5 MINIMUM DEVELOPMENT LEVELS

Minimum development allotment levels have been established based on developed flood levels affecting the proposed development. The minimum development habitable floor level has been designated in accordance with *Section 3.6.2.2* of Council's *Logan Planning Scheme - SC6.2.5 Planning Scheme Policy 5 – Infrastructure* and requires a minimum freeboard of 500mm. Refer to **Table 5-1** for minimum development floor levels.

Table 5-1: Minimum Allotment Floor Levels

ARI Storm Event	Location	Developed Flood Level (m AHD)	Minimum Development Level (incl. 500mm Freeboard) (m AHD)
100yr	1	13.21	13.71
	2	13.21	13.71
	3	13.22	13.72
	4	13.37	13.87
	5	13.36	13.86

Note: Locations in this table correspond those illustrated on **Figure 5-1**.

Sensitivity scenario modelling discussed in **Section 3.3.4** confirm that the minimum development level of 13.86m AHD will not be exceeded.

The caravan storage area as depicted on **Figure 5-1** will be set at the 20 year ARI developed flood level of 11m AHD.

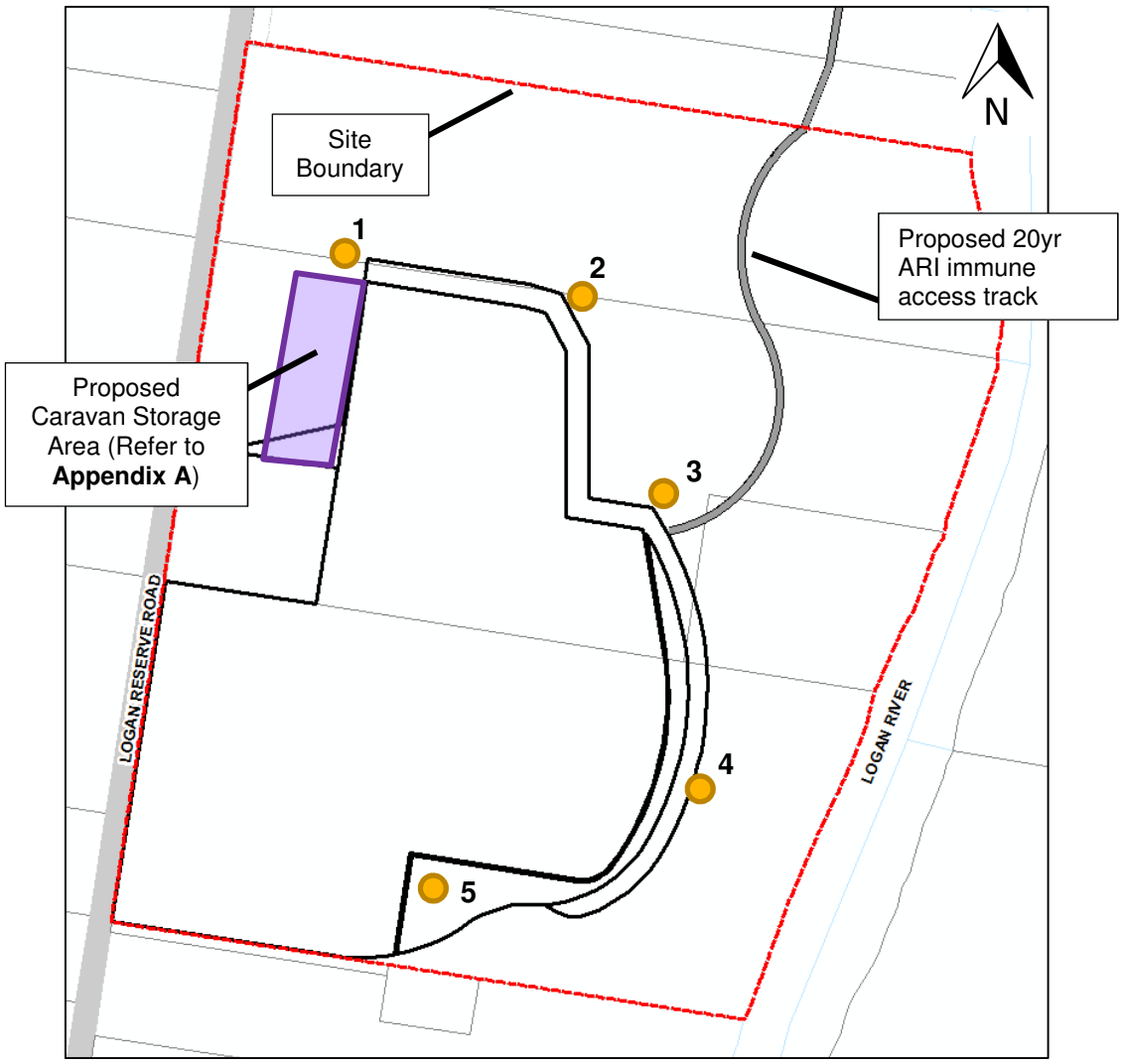


Figure 5-1: 100yr Flood Level Locations

6 CONCLUSION

This report has demonstrated that the proposed Logan Reserve development will not create any adverse or detrimental impacts on flood conditions to any external private properties. The hydraulic analysis has been undertaken for the site in its Existing and proposed Developed Scenario using the hydrological and hydraulic data supplied by Logan City Council.

The following storm events were analysed in TUFLOW for pre- and post-developed scenarios.

- 10 year ARI 30 hour storm event has been modelled for pre- and post-developed scenario.
- 20 year ARI 72 hour storm event has been modelled for pre- and post-developed scenario.
- 50 year ARI 72 hour storm event has been modelled for pre- and post-developed scenario.
- 100 year ARI 72 hour storm event has been modelled for pre- and post-developed scenario.

The analysis determined the following:

- The proposed development and filling works do not result in an adverse flood impact to external private properties as discussed in **Section 4**;
- The proposed development will not compromise the development potential of downstream properties;
- Minor filling below the 10 year ARI flood level will not cause perceivable impacts to the 10 year ARI flood conditions;
- Provision of a 20 year ARI immune access track connected to Schmidts Road will not adversely impact the neighbouring property to the north. The track will provide a net benefit to the wider community by improving flood resilience; and,
- The proposed allotments levels are in accordance with Logan City Council freeboard requirements provided within **Section 5**.

In summary, this flood investigation has provided discussion regarding the impact of the proposed development at 216-232, 234-252, 254-264 and 266-294 Logan Reserve Road in Logan Reserve on local flood conditions. Changes in flood condition are not adverse, with increases being minor and isolated in nature and flood level reductions being observed for a considerable reach of the system. Ultimately, there is a net community benefit on flood conditions due to the proposed development.

7 RECOMMENDATIONS

It is recommended that this flood investigation be approved and all management strategies presented within this report be incorporated in the future detailed design. Detailed design may result in changes to the concept, however the design objectives presented within this report are to remain unchanged.

8 REFERENCES

- Brisbane City Council (2003), *Natural Channel Design Guidelines*;
- Logan City Council (2015), *Flood Hazard Overlay Code*; and
- Logan City Council (2015), *Logan Planning Scheme SC6.2.5 Planning Scheme Policy 5 – Infrastructure.*

9 DISCLAIMER

This report has been prepared on behalf of and for the exclusive use of Halcyon Developments Pty Ltd and is subject to and issued in accordance with the agreement between Calibre Consulting (QLD) Pty Ltd.

Our investigation and analysis has been specifically catered for the particular requirements of Halcyon Developments Pty Ltd and may not be applicable beyond this scope. For this reason, any other third parties are not authorised to utilise this report without further input and advice from Calibre Consulting (QLD) Pty Ltd.

Calibre Consulting (QLD) Pty Ltd accepts no liability or responsibility whatsoever for the report in respect of any use of or reliance upon this report by any third party.

The investigation and analysis has relied on information provided by others. We accept no responsibility for accuracy of material supplied by others. The accuracy of the investigation, analysis and report is dependent upon the accuracy of this information.

APPENDICES

Appendix A – Site Layout
Appendix B – Existing Site Survey
Appendix C – Existing Flood Plans
Appendix D – Developed Flood Plans
Appendix E – Developed Flood Changes
Appendix F – Flood Hazard Overlay Code Response

APPENDIX A SITE LAYOUT

PROPOSAL PLAN

NOT TO BE USED FOR ENGINEERING DESIGN OR CONSTRUCTION

NOTES

This plan was prepared as a conceptual layout only. The information on this plan is not suitable for any other purpose.

Property dimensions, areas, numbers of lots and contours and other physical features shown have been compiled from existing information and may not have been verified by field survey. These may need verification if the development application is approved and development proceeds, and may change when a full survey is undertaken or in order to comply with development approval conditions.

No reliance should be placed on the information on this plan for detailed subdivision design or for any financial dealings involving the land.

Pavements and centrelines shown are indicative only and are subject to Engineering Design.

Saunders Havill Group therefore disclaims any liability for any loss or damage whatsoever or howsoever incurred, arising from any party using or relying upon this plan for any purpose other than as a document prepared for the sole purpose of accompanying a development application and which may be subject to alteration beyond the control of the Saunders Havill Group. Unless a development approval states otherwise, this is not an approved plan.

LEGEND

- Site Boundary
- Residential Allotments - 8.847 ha
- Sales Office - 1905 m²
- Leisure Facilities - 1.0 ha
- Caravan Storage - 1.609 ha
- Neighbourhood Centre & Child Care Centre - 1.480 ha
- Accommodation Activity - 9914m²
- Community Facility - 642m²
- Logan River Corridor & Metropolitan Recreation Park - 18.401 ha
- Private Open Space - 12.063 ha
- Detention Basin - 7850 m²
- Public Detention Basin - 6771 m²
- Pedestrian Link
- Extent of Level Caravan Storage Pad - RL 11.50
- Q50 Floodline
- Q100 Floodline

RP DESCRIPTION: Lots 2 & 3 on RP25887, 1 on RP25886, 3 on RP210941 & 41 on MAR618

SCALE @A1 1:2000 @A3 1:4000 - LENGTHS ARE IN METRES

20 0 20 40 60 80 100 120 140 160 180 200 220

saunders havill group

HALCYON MANAGEMENT PTY LTD, ATF HALCYON MANAGEMENT UNIT TRUST

216-294 LOGAN RESERVE ROAD, LOGAN RESERVE • 28/11/2018 • 7801 P 10 PP C

NOTES

This plan was prepared as a provisional layout to accompany a development application. The information on this plan is not suitable for any other purpose.

Property dimensions, areas, numbers of lots and contours and other physical features shown have been compiled from existing information and may not have been verified by field survey. These may need verification if the development application is approved and development proceeds, and may change when a full survey is undertaken or in order to comply with development approval conditions.
No reliance should be placed on the information on this plan for detailed subdivision design or for any financial dealings involving the land.

The Saunders Havill Group therefore disclaims any liability for any loss or damage whatsoever or howsoever incurred, arising from any party using or relying upon this plan for any purpose other than as a document prepared for the sole purpose of accompanying a development application and which may be subject to alteration beyond the control of the Saunders Havill Group. Unless a development approval states otherwise, this is not an approved plan.

* This note is an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and not suitable for use.

N

18 RP110452
A RP178268
27 RP110452
26 RP110452
19 RP110452
20 RP110452
21 RP110452
22 RP110452
23 RP110452
25 RP110452
24 RP110452
RP110452
8 RP110452
7 RP110452
6 RP110452
5 RP110452
4 RP110452
3 RP110452
2 RP110452
1 RP110452
AP1684
1 SP154735
A SP168641
2 RP210941
493·2
150·37
RP2
2 RP136814
0.5m WIDE ROAD RESUMPTION ALONG LOGAN RESERVE ROAD
356·0
1 RP150260
4 RP224555
3 RP25887
134·1
120·7
134·1
LOGAN RESERVE ROAD
0.5m WIDE ROAD RESUMPTION ALONG LOGAN RESERVE ROAD
92·717
17 RP897272
1 RP162124
0.5m WIDE ROAD RESUMPTION ALONG LOGAN RESERVE ROAD
1 RP160429
2 RP165534
1 RP205789
2 RP205789
RP25888
STAGE 2
STAGE 1
1
26·39 ha
901
7·07 ha
900
10·0 ha
(Excluding Detention Basin and New Road)
33·3
29·7
269·7
262·7
228·4
NEW ROAD
179·7
25·0
134·5
NEW ROAD
2
1·08 ha
85·3
80·0
111·0
3
3984 m²
40·0
40·0
4
9951m²
99·95
99·95
99·5
5
6771 m²
61·5
44·4
69·5
42·3
(10·6)
DETENTION BASIN
312·1
Logan River
2 WD6013
319 MAR6115

STATISTICS - STAGE 1

No. of Proposed Lots.....	4
Length of New Road.....	260 m
Area of New Road.....	7015m²
Area of Road Dedication.....	151m²
Total Area of Subdivision....	3.878 ha

STATISTICS - STAGE 2

No. of Proposed Lots.....	3
Length of New Road.....	380 m
Area of New Road.....	7190m²
Area of Road Dedication.....	178m²
Area of Park (Lot 900).....	10.0 ha
Total Area of Subdivision....	44.79 ha

STATISTICS

No. of Proposed Lots.....	6
Length of New Road.....	640 m
Area of New Road.....	1.421ha
Area of Road Dedication.....	329m²
Area of Park (lot 900).....	9.391 ha
Total Area of Subdivision....	48.67 ha

Scale 1:4000 – Lengths are in Metres.

50 0 50 100 150 200 250 300

Revision	No.	by	Date	Description
	C	TBG	21.04.16	Bdys & Rd amended. 901 Added
	D	AJB	05.05.16	Lot 5 removed
	E	AJB	09.11.16	Road Dedication/Lot 900 amended
	F	AJB	14.11.16	Lot 5 & Staging added
	G	AJB	06.12.16	Road Dedication Areas added
	H	AJB	10.02.17	Lots 900 & 901 revised

Level Datum: AHD der.

Origin of Levels:
RL of Origin:

Contour Interval:

Lot Description

Lot 41 on MAR618, Lot 1 on RP25885, Lot 2 on RP25887 and Lot 3 on RP210941

Locality of Logan Reserve

saunders havill group
surveying town planning urban design environmental management landscape architecture
web www.saundershavill.com
phone (07) 3251 9444 fax (07) 3251 9455
address 9 Thompson St Bowen Hills Q 4006

Design
Date
Drawn AJB
Date 18/12/15
Checked

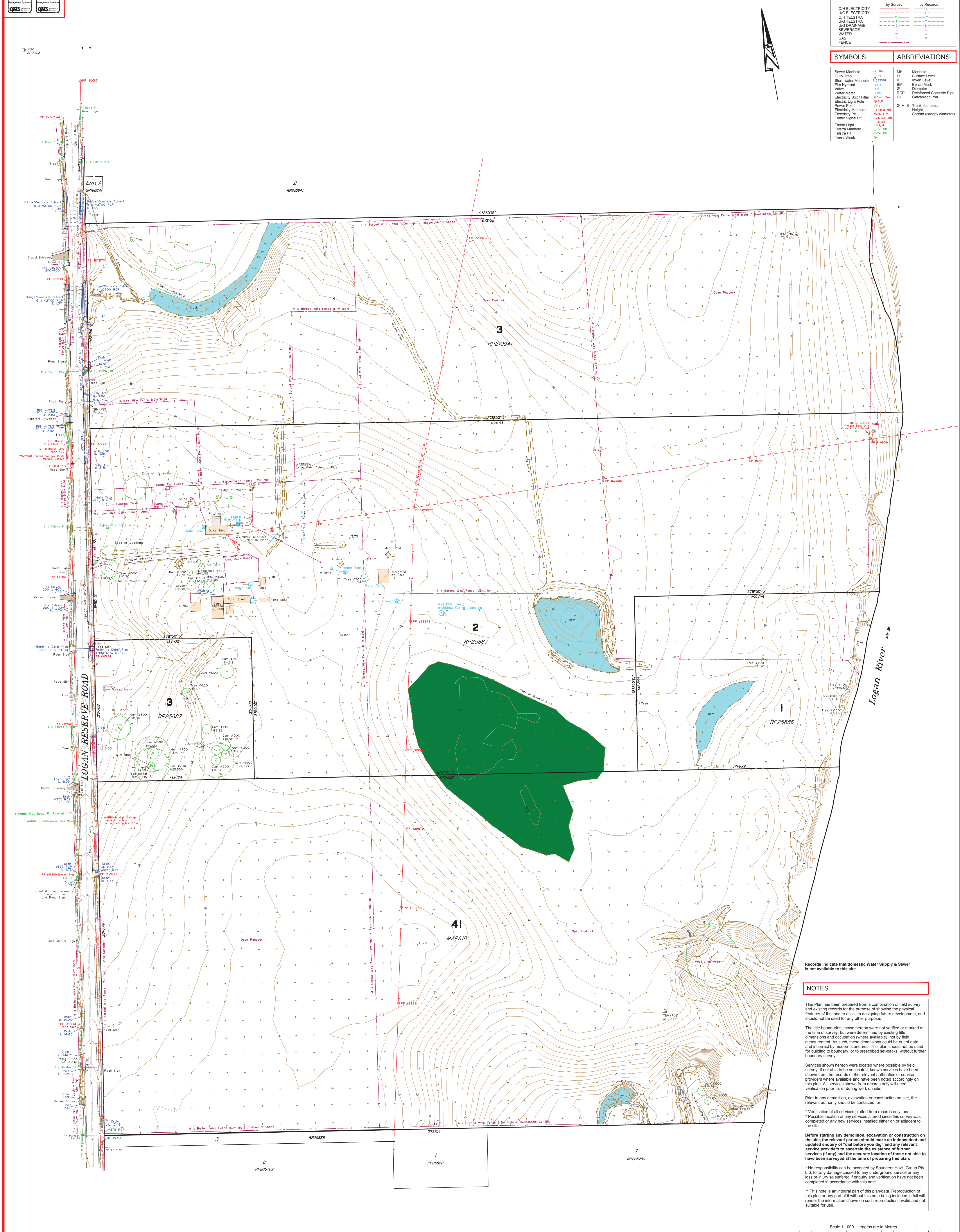
Plan of
PROPOSAL PLAN
Project LOGAN RESERVE ROAD, LOGAN RESERVE
Client L H PROPERTY PARTNERS PTY LTD

town planning

Scale @A3 1: 4000

Dwg No. 7801 P 04 PP H

APPENDIX B EXISTING SITE SURVEY



LEGEND

	by Survey	by Records
O/H ELECTRICITY	E	E
U/G ELECTRICITY	E	E
O/H TELSTRA	T	T
U/G TELSTRA	T	T
U/G DRAINAGE	D	D
SEWERAGE	S	S
WATER	W	W
GAS	G	G
FENCE	//	

SYMBOLS

Sewer Manhole	SMH
Gully Trap	GT
Stormwater Manhole	SWMH
Fire Hydrant	FH
Valve	V
Water Meter	WM
Electricity Box / Pillar	Elect Box
Electric Light Pole	ELP
Power Pole	PP
Electricity Manhole	Elect MH
Electricity Pit	Elect Pit
Traffic Signal Pit	Traffic Pit
Traffic Light	Traffic Light
Telstra Manhole	Tel MH
Telstra Pit	Tel Pit
Tree / Shrub	

ABBREVIATIONS

MH	Manhole
SL	Surface Level
IL	Invert Level
BM	Bench Mark
Ø	Diameter
RCP	Reinforced Concrete Pipe
GI	Galvanised Iron
Ø, H, S	Trunk diameter, Height, Spread (canopy diameter)

Records indicate that domestic Water Supply & Sewer is not available to this site.

NOTES

This Plan has been prepared from a combination of field survey and existing records for the purpose of showing the physical features of the land to assist in designing future development, and should not be used for any other purpose.

The title boundaries shown hereon were not verified or marked at the time of survey, but were determined by existing title dimensions and occupation (where available), not by field measurement. As such, these dimensions could be out of date and incorrect by modern standards. This plan should not be used for building to boundary, or to prescribed set-backs, without further boundary survey.

Services shown hereon were located where possible by field survey. If not able to be so located, known services have been shown from the records of the relevant authorities or service providers where available and have been noted accordingly on this plan. All services shown from records only will need verification prior to, or during work on site.

Prior to any demolition, excavation or construction on site, the relevant authority should be contacted for:

* Verification of all services plotted from records only, and
* Possible location of any services altered since this survey was completed or any new services installed either on or adjacent to the site.

Before starting any demolition, excavation or construction on the site, the relevant person should make an independent and updated enquiry of "dial before you dig" and any relevant service providers to ascertain the existence of further services (if any) and the accurate location of those not able to have been surveyed at the time of preparing this plan.

* No responsibility can be accepted by Saunders Havill Group Pty Ltd, for any damage caused to any underground service or any loss or injury so suffered if enquiry and verification have not been completed in accordance with this note.

** This note is an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and not suitable for use.

Scale 1:1000 - Lengths are in Metres.

10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140

saunders havill group

Saunders Havill Group Pty Ltd ABN 24 144 972 949
Brisbane ■ Emerald ■ Gladstone
head office 9 Thompson St Bowen Hills Q 4006
phone 1300 123 SHG web www.saundershavill.com

surveying ■ town planning ■ urban design ■ environmental management ■ landscape architecture

Issues

No.	by	Date	Description
A	CW	29/07/15	ORIGINAL ISSUE

Surveyed: DN
Date: 23/07/2015
Drawn: CW
Date: 29/07/2015
Checked: KD

Plan of

DETAIL PLAN

Project 210-294 LOGAN RESERVE ROAD, LOGAN RESERVE

Client HALCYON MANAGEMENT PTY LTD, ATF HALCYON MANAGEMENT UNIT TRUST

Level Datum: AHD der.
Origin of Levels: OPM130385
RL of Origin: 15.546
Contour Interval: 0.5m

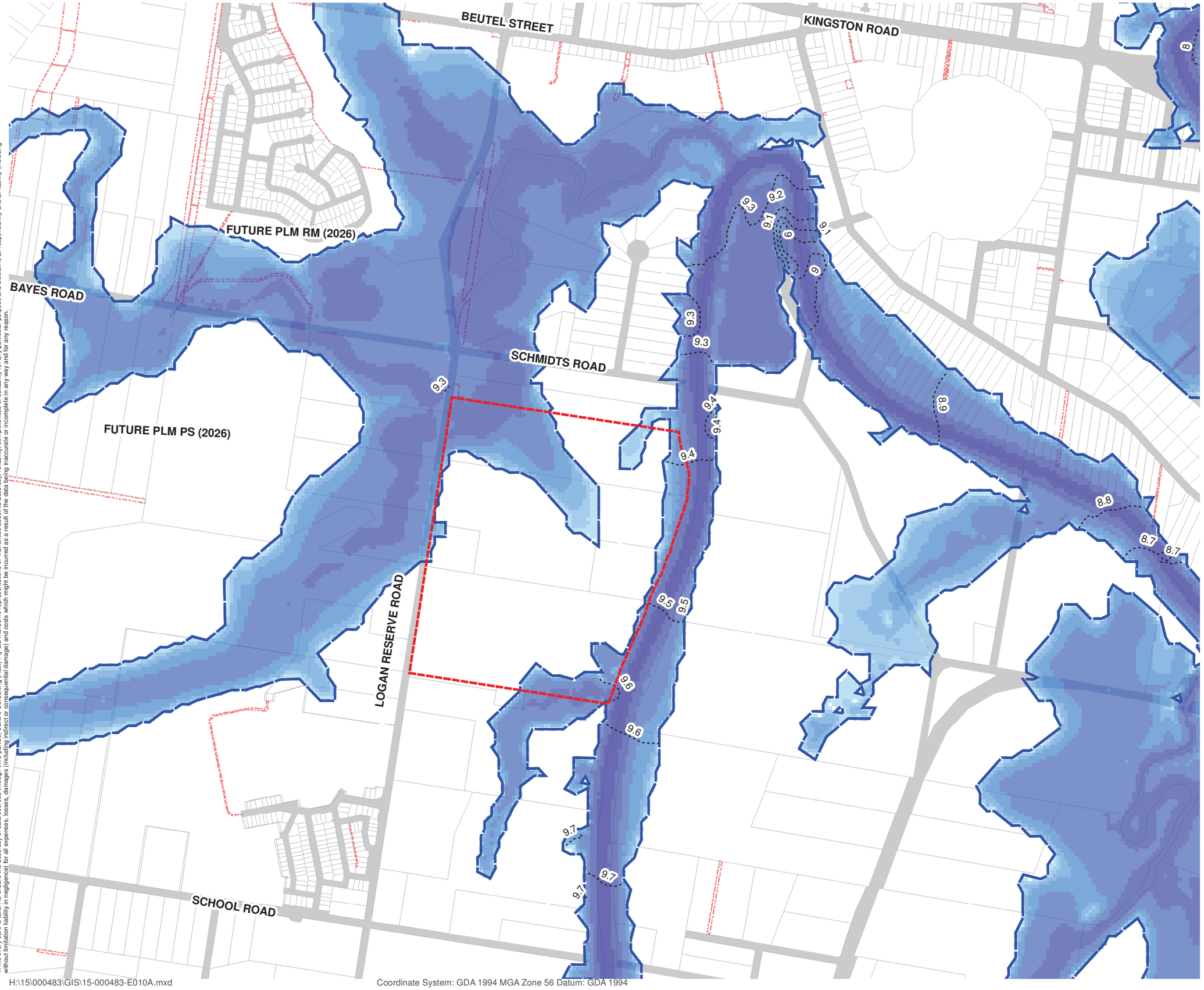
Lot Description
Lots 2 & 3 on RP25887, 1 on RP25886, 3 on RP210941 & 41 on MAR618
Locality of Logan Reserve
Parish of Mackenzie
County of Stanley

surveying

Scale @A0 1: 1000
@A2 1: 2000

Dwg No. 7801 S 02 DT A

APPENDIX C EXISTING FLOOD PLANS



H:\15\000483\GIS\15-000483-E010A.mxd

Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

calibre CONSULTING

LEGEND

- Site Boundary
- Flood Height Contours (m)
- Flood Extent

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

EXISTING SCENARIO 10 YEAR ARI MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-E010A**

ISSUE: **A**

ISS	BY	CHK	DATE	DETAILS
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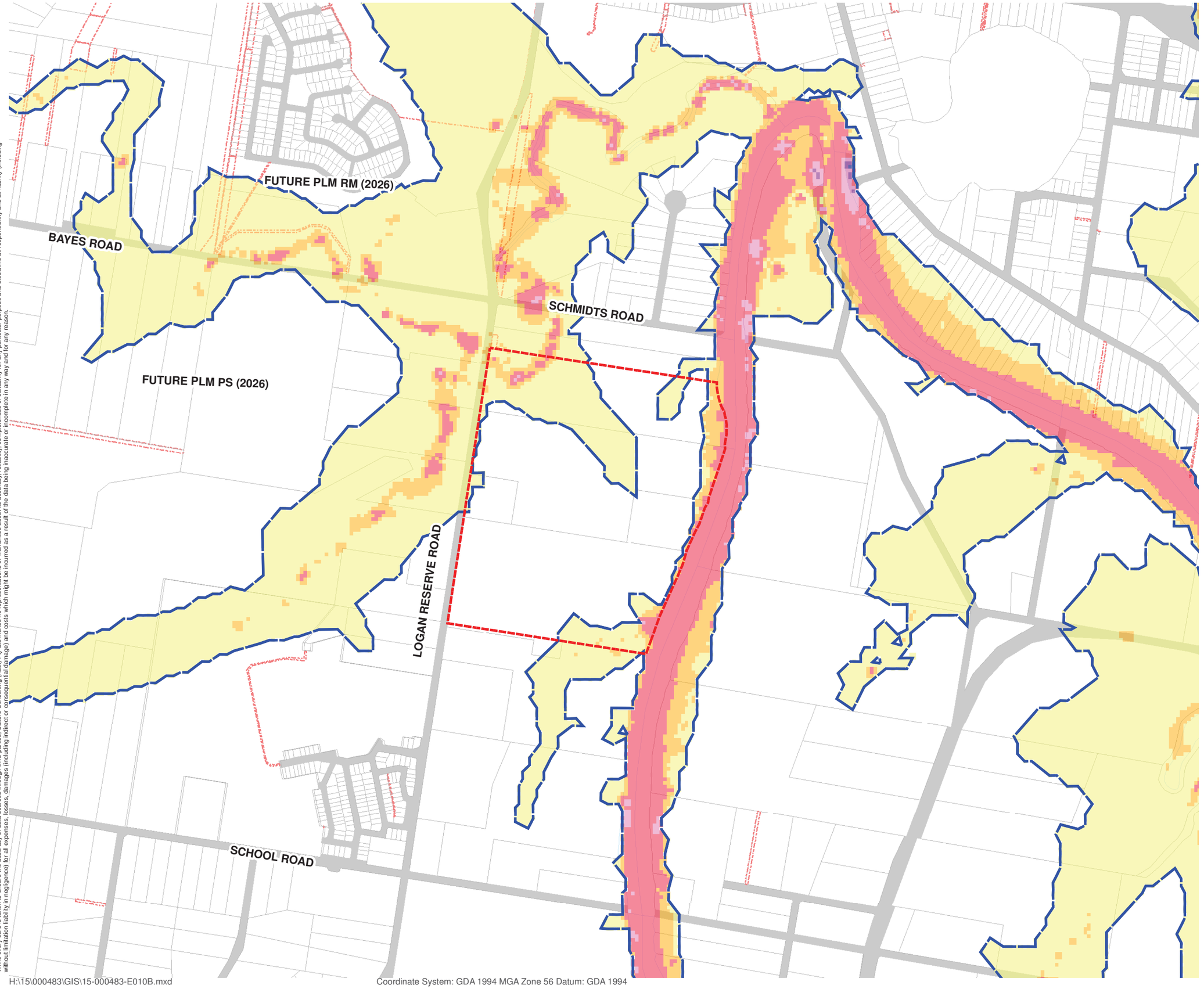

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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

calibre CONSULTING

LEGEND

- Site Boundary
- Flood Extent

Max. Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

EXISTING SCENARIO 10 YEAR ARI MAX FLOOD VELOCITY PLAN

DRAWING NO: **15-000483-E010B**

ISSUE: **A**

ISS	BY	CHK	DATE	DETAILS
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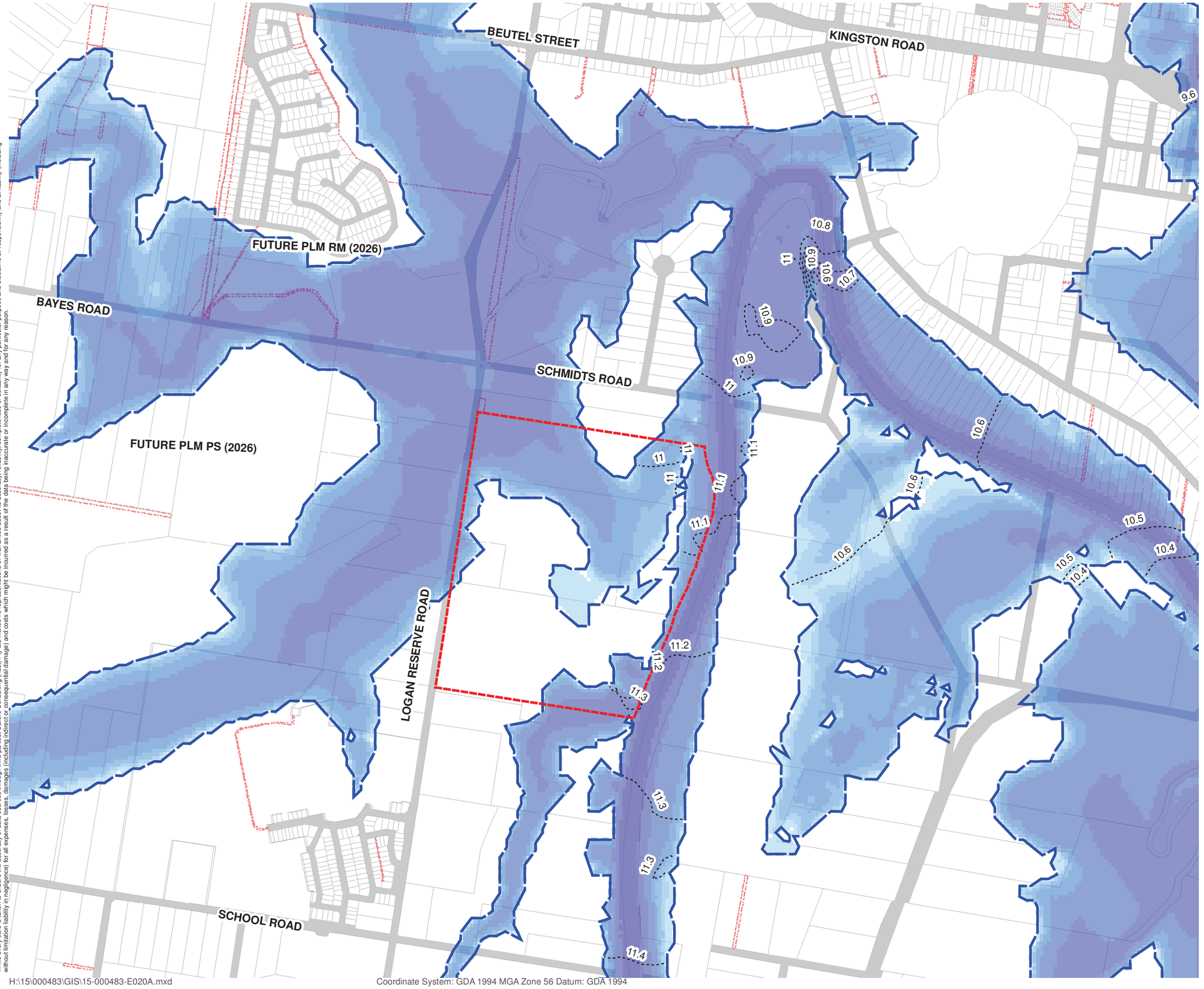

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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

calibre CONSULTING

LEGEND

- Site Boundary
- Flood Extent
- Flood Height Contours (m)

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

EXISTING SCENARIO 20 YEAR ARI MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-E020A** ISSUE: **A**

ISS	BY	CHK	DATE	DETAILS
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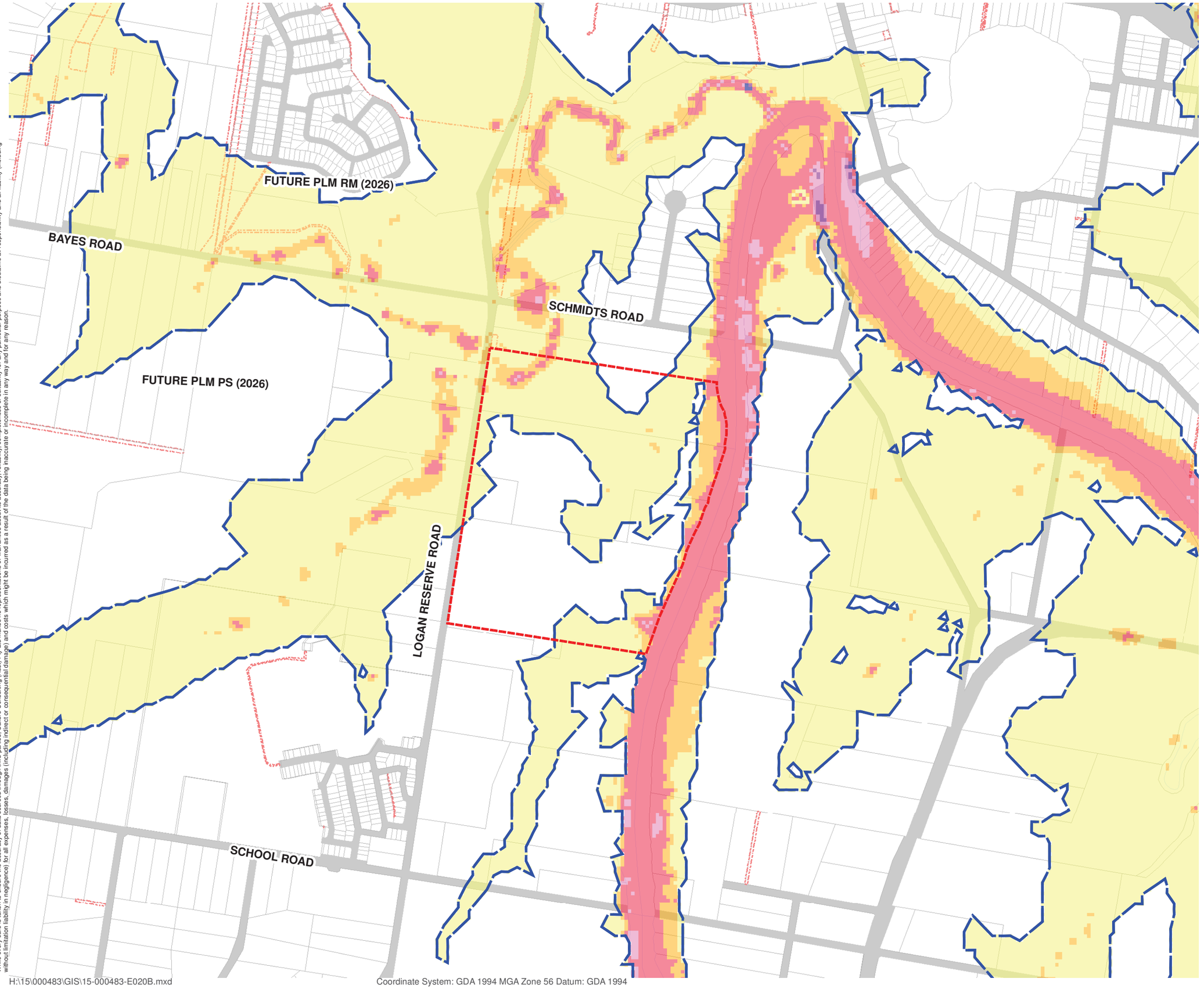

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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

calibre CONSULTING

LEGEND

- Site Boundary
- Flood Extent

Max. Flood Velocity

(m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

EXISTING SCENARIO 20 YEAR ARI MAX FLOOD VELOCITY PLAN

DRAWING NO: **15-000483-E020B**

ISSUE: **A**

ISS	BY	CHK	DATE	DETAILS
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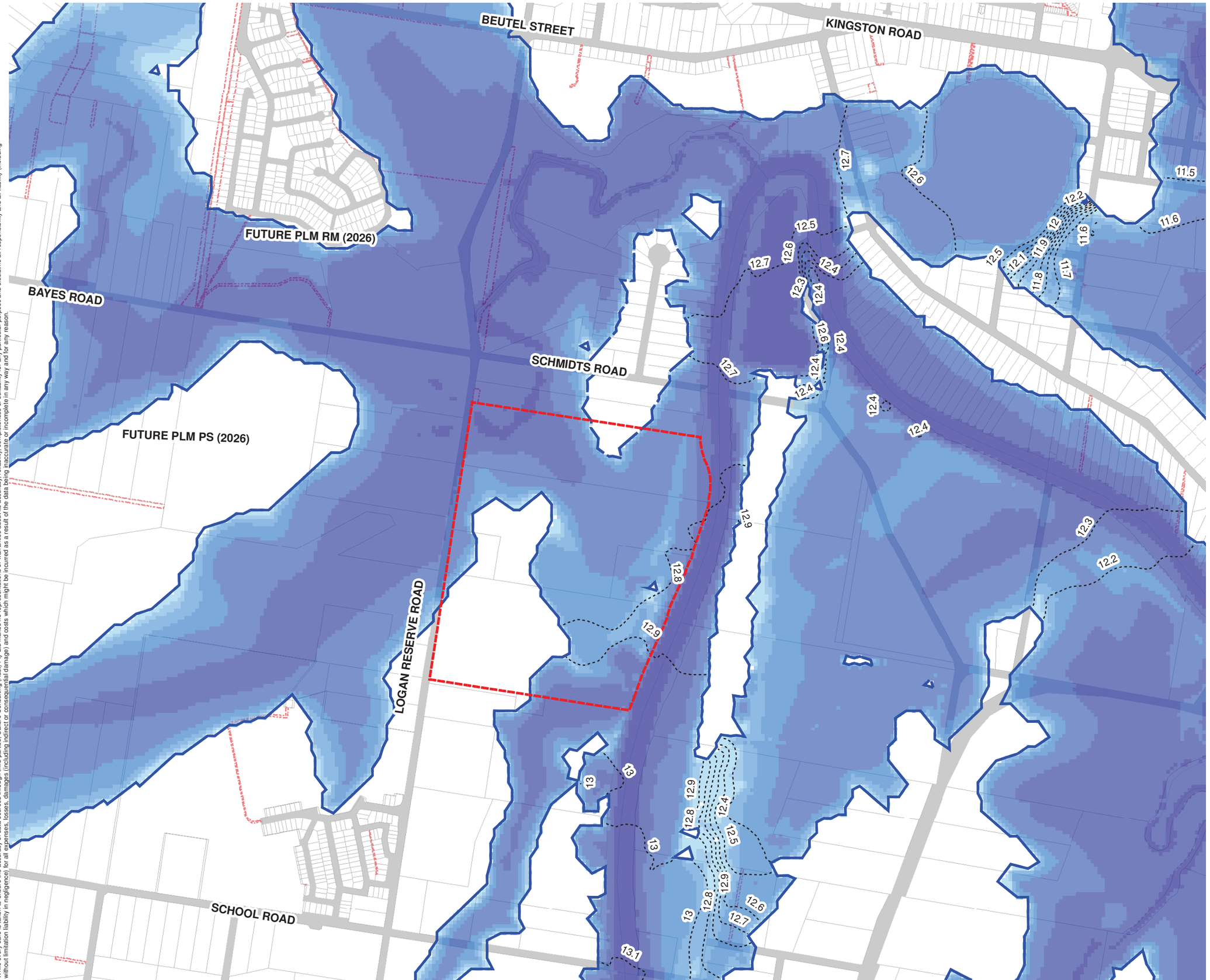

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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

calibre CONSULTING

LEGEND

- Site Boundary
- Flood Extent
- Flood Height Contours (m)

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

EXISTING SCENARIO 50 YEAR ARI MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-E050A**

ISSUE: **A**

ISS	BY	CHK	DATE	DETAILS
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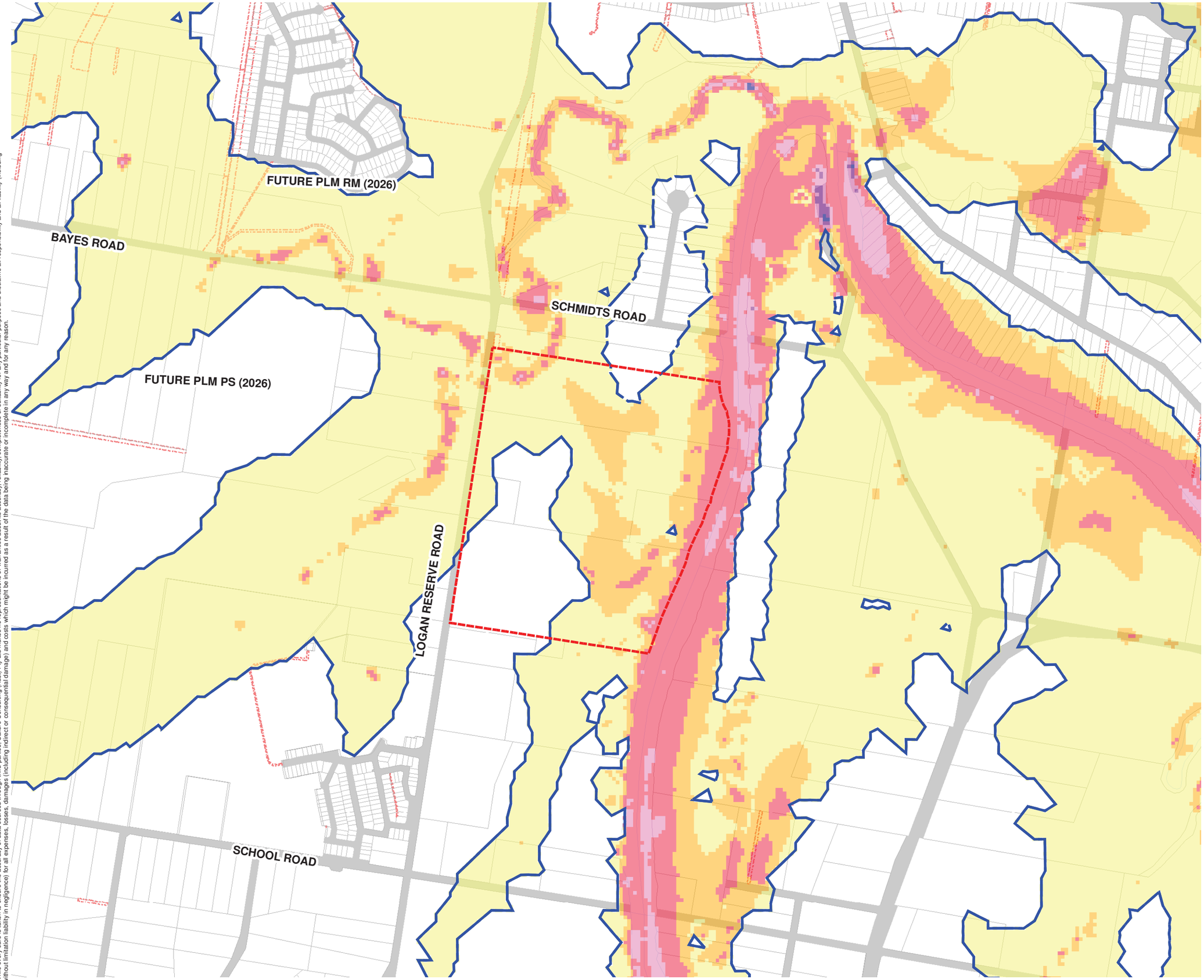

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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

calibre CONSULTING

LEGEND

- Site Boundary
- Flood Extent

Max. Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

EXISTING SCENARIO 50 YEAR ARI MAX FLOOD VELOCITY PLAN

DRAWING NO: **15-000483-E050B**

ISSUE: **A**

ISS	BY	CHK	DATE	DETAILS
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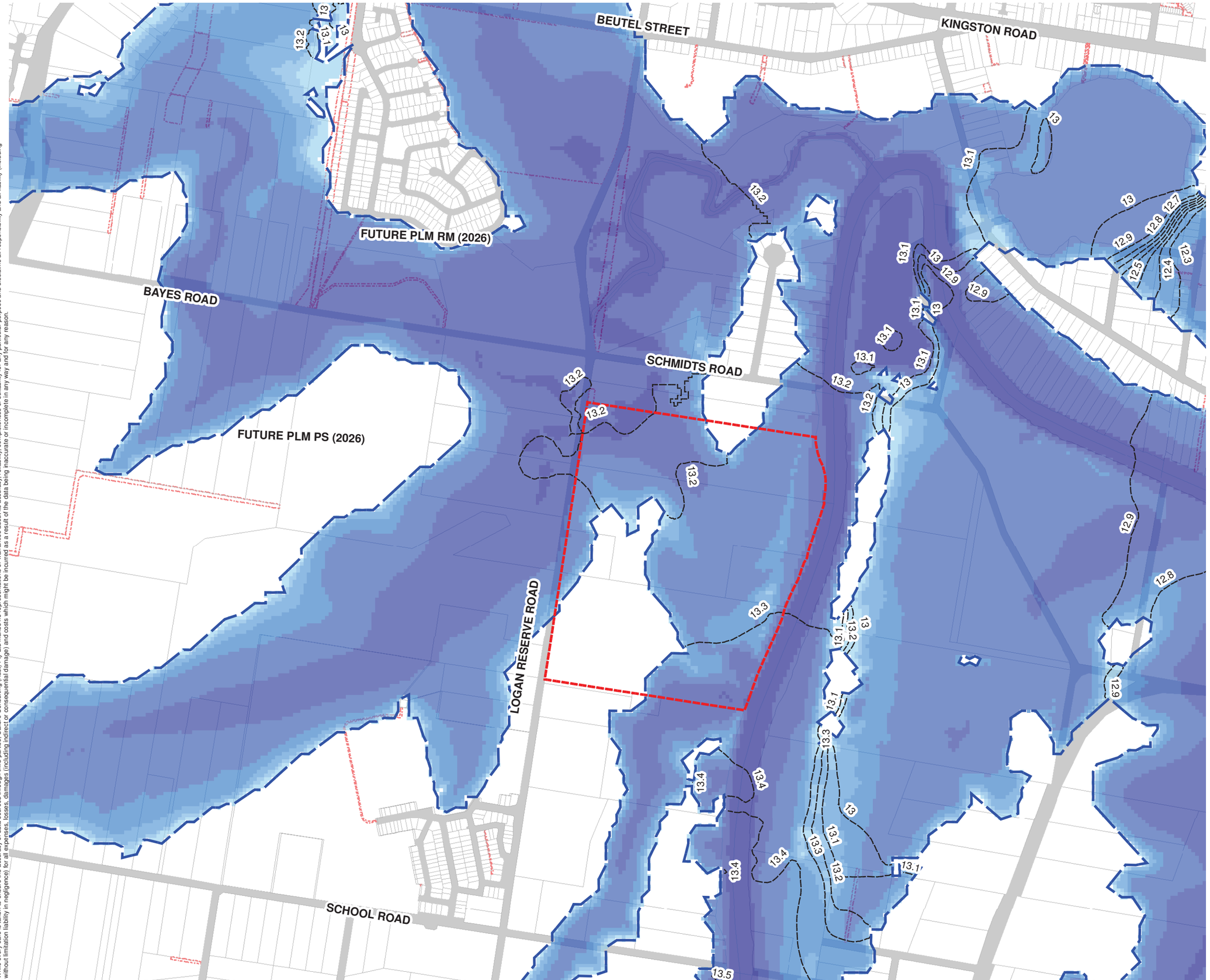

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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

calibre CONSULTING

LEGEND

- Site Boundary
- Flood Extent
- Flood Height Contours (m)

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

EXISTING SCENARIO 100 YEAR ARI MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-E100A**

ISSUE: **A**

ISS	BY	CHK	DATE	DETAILS
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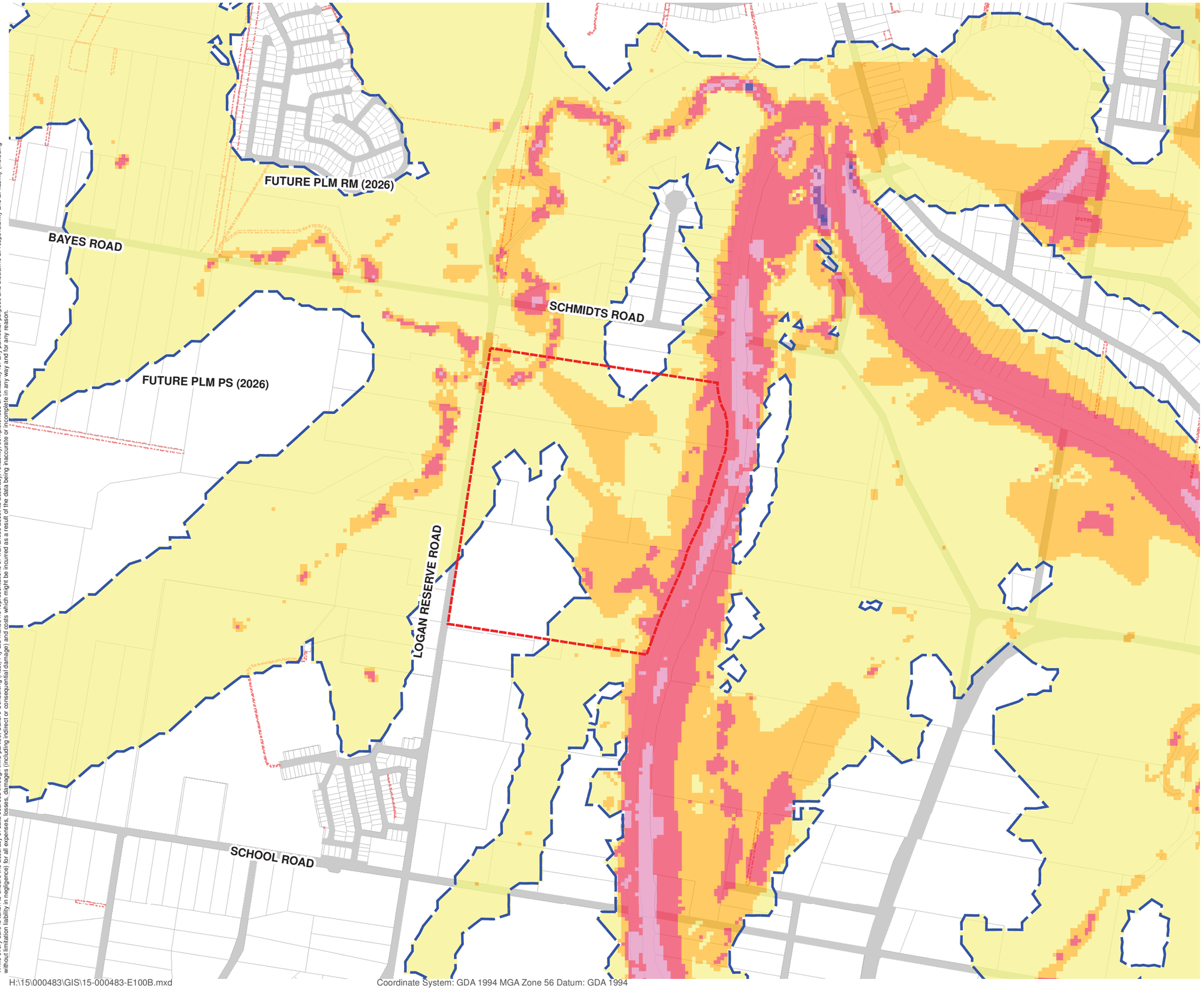

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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

calibre CONSULTING

LEGEND

- Site Boundary
- Flood Extent

Max. Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

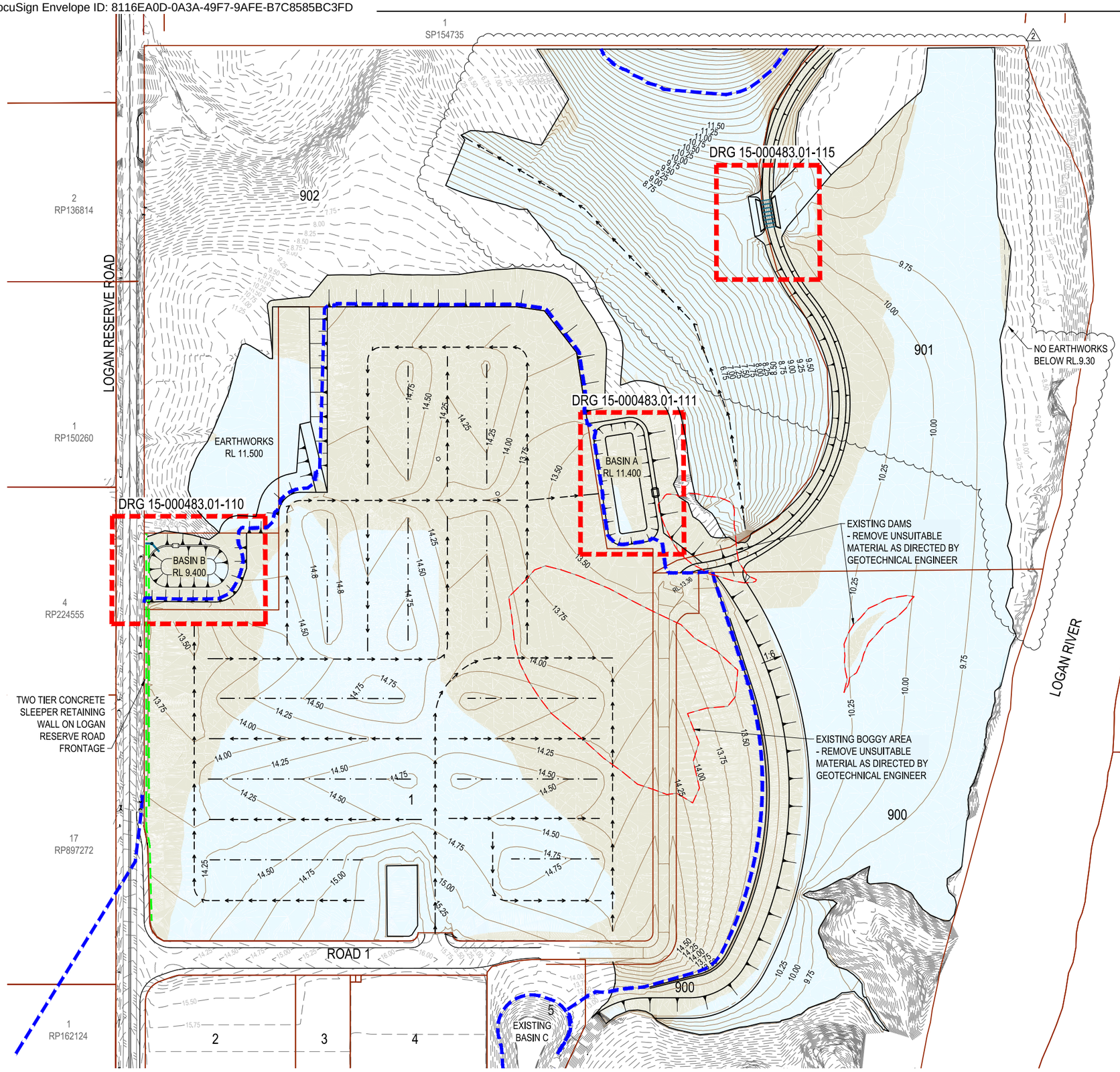
EXISTING SCENARIO 100 YEAR ARI MAX FLOOD VELOCITY PLAN

DRAWING NO: **15-000483-E100B**

ISSUE: **A**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	21.09.15	ORIGINAL

APPENDIX D DEVELOPED FLOOD PLANS



LEGEND

- PROPOSED CONCRETE SLEEPER RETAINING WALL
- 64.25 — EXISTING SURFACE CONTOUR (0.25m INTERVALS)
- 66.20 — DESIGN SURFACE CONTOUR (0.25m INTERVALS)
- AREA OF CUT
- AREA OF FILL
- RL 58.75 o — FINISHED SURFACE LEVEL
- EX58.75 x — EXISTING SURFACE LEVEL
- PROPOSED EARTHWORKS BATTER
- SWD — EXISTING STORMWATER DRAINAGE
- S — EXISTING SEWERAGE RETICULATION
- OHE — EXISTING OVERHEAD ELECTRICITY
- 100 YEAR ARI FLOOD LEVEL
- INVERT CHANGE OF GRADE
- RIDGE CHANGE OF GRADE

2 CUT TO FILL VOLUMES

CUT : 260,453m^3
FILL : 278,482m^3

CUT TO FILL VOLUMES BELOW ARI 100 FLOOD LEVEL

CUT : 148,709m^3
FILL : 58,340m^3

BULK EARTHWORKS NOTES

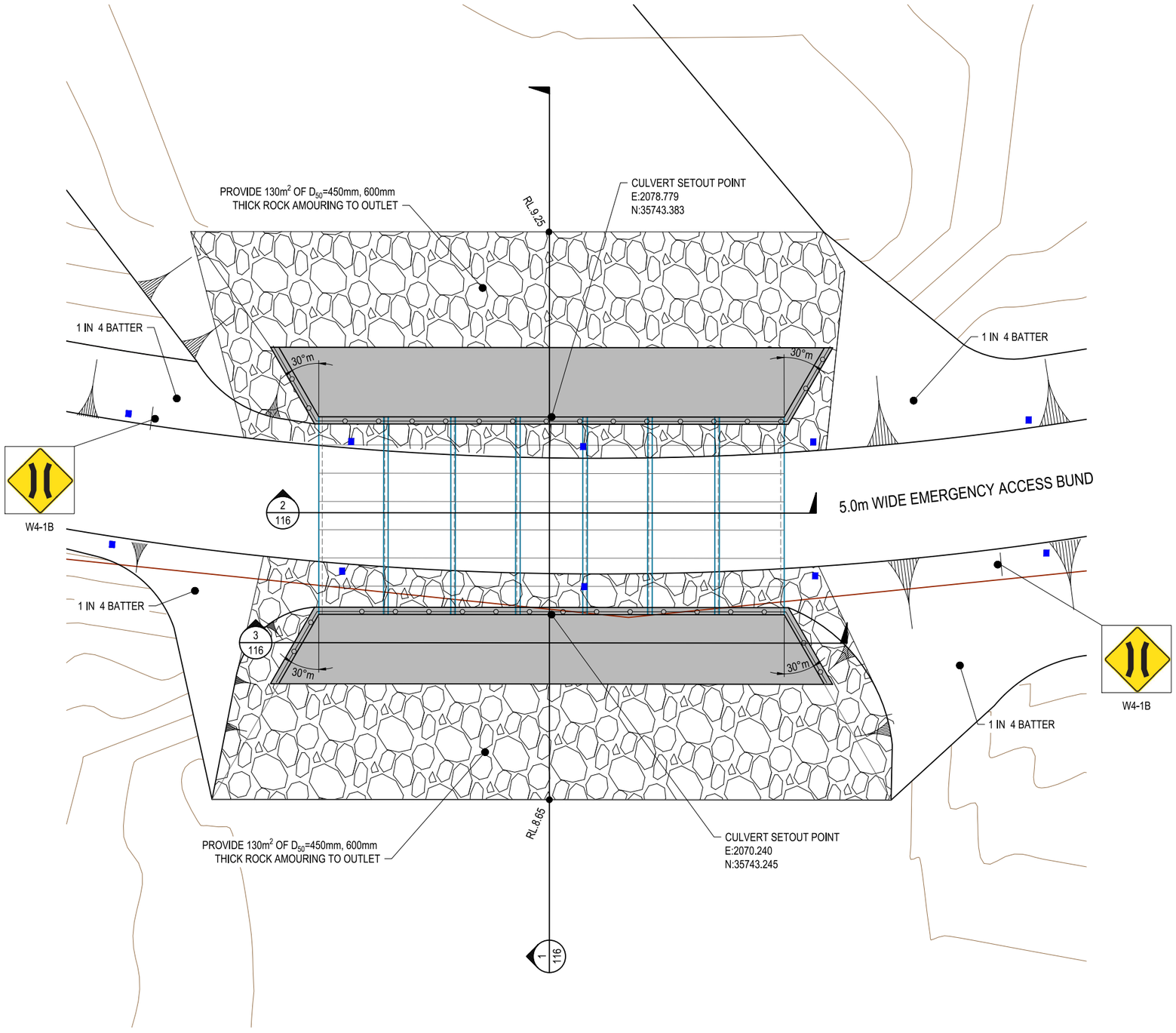
1. NOTWITHSTANDING THE LIMITS OF CUTTING AND FILLING SHOWN ON THE CROSS SECTIONS, THE ACTUAL LIMITS SHALL BE DETERMINED ON-SITE BY THE SUPERINTENDENT DURING CONSTRUCTION AND SIMILARLY THE FINISHED SURFACE CONTOURS MAY BE ADJUSTED BY WRITTEN DIRECTION OF THE SUPERINTENDENT DURING CONSTRUCTION.
2. CONTRACTOR TO LIAISE WITH ALL RELEVANT SERVICE AUTHORITIES TO ASCERTAIN SERVICES PRESENT ON-SITE. ANY ALTERATION WORKS TO SERVICES WILL BE CARRIED OUT BY THAT SERVICE AUTHORITY ONLY.
3. THE CONTRACTOR SHALL NOTIFY THE SUPERINTENDENT PRIOR TO COMMENCING THE DEMOLITION OF ANY EXISTING STRUCTURES WITHIN THE SITE AREA.
4. ALL DRAINAGE STRUCTURES TO BE PRESERVED FROM THE EFFECTS OF STRUCTURAL LOADING GENERATED BY THE EARTHWORKS.
5. ALL EXCAVATION AND FILLING SHALL BE COMPACTED TO THE REQUIREMENTS OF AS3798-2007 IN ACCORDANCE WITH THE LOCAL AUTHORITY REQUIREMENTS AND PROJECT SPECIFICATIONS. LEVEL 1 SUPERVISION IS REQUIRED.
6. ALL CLEARING SHALL BE CARRIED OUT IN STAGES TO ALLOW FOR RELOCATION OF FAUNA, COMMENCING AT THE LOWER AREAS OF THE SITE.
7. SAFE TRAFFIC CONTROL TO BE IMPLEMENTED AT ALL TIMES BY THE CONTRACTOR
8. APPROPRIATE SAFETY FENCING AND SIGNAGE TO BE PROVIDED TO SITE EXTENTS
9. CONTRACTOR TO ENSURE APPROPRIATE SAFETY FENCING IS IN PLACE TO WALLS EXCEEDING 1.0m IN HEIGHT

CONTRACTOR IS RESPONSIBLE FOR EROSION AND SEDIMENT CONTROL MEASURES. CONTRACTOR TO PREPARE CPESC CERTIFIED EROSION AND SEDIMENT CONTROL PLAN PRIOR TO PRE-START MEETING

CAUTION !!
UNDERGROUND SERVICES
UNDERGROUND SERVICES EXIST IN LOGAN RESERVE ROAD.
VERIFY LOCATIONS PRIOR TO CONSTRUCTION.
EXTREME CARE MUST BE TAKEN WHILST EXCAVATING.

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	05.07.18	FOR OPERATIONAL WORKS APPROVAL	LS	LS
2	10.09.18	EARTHWORKS EXTENTS AMENDED	LS	LS
3				
4				
5				
6				
7				
8				

DRAWN: aa
DESIGN: aa
STATUS: NOT FOR CONSTRUCTION
APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD
SCALE: 1:1500 30 20 10 0 30 60 A1 — 1:3000 A3
CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD
calibre calibregroup.com
PROJECT: HALCYON LOGAN RESERVE BULK EARTHWORKS
DISCLAIMER: ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.
DRAWING TITLE: BULK EARTHWORKS OVERALL LAYOUT PLAN
PROJECT No.: 15-000483.03
DRAWING No.: 101
REVISION: 2



LEGEND

- 64.25 — EXISTING SURFACE CONTOUR (0.25m INTERVALS)
- 66.20 — DESIGN SURFACE CONTOUR (0.25m INTERVALS)
- PROPOSED TUBULAR STEEL FENCE WITH OUT CHAIN WIRE - REFER IPWEAQ STD. DRG. GS-044 FOR DETAILS
- GUIDEPOSTS AS PER MUTCD

N

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH QUEENSLAND DEPARTMENT OF TRANSPORT AND MAIN ROADS (DTMR) REFERANCE DOCUMENTS;
   - 2.1. DEPARTMENT OF MAIN ROADS STANDARD DRAWINGS
     - 1043 - REINFORCED STEEL - STANDARD BAR SHAPES
     - 1044 - REINFORCED STEEL - LAP LENGTHS.
     - 1303 - RC BOX CULVERTS AND SLAB LINK CULVERTS - CONSTRUCTION OF HEADWALLS AND WINGWALLS HEIGHTS > 600.
     - 1316 - RC BOX CULVERTS AND SLAB LINK CULVERTS - GENERAL ARRANGEMENT AND INSTALLATION OF PRECAST UNITS HEIGHT > 600.
     - 1359 - CULVERTS - INSTALLATION, BEDDING AND FILLING/BACKFILLING AGAINST / OVER CULVERTS.
     - 1318 - RC BOX CULVERTS AND SLAB LINK CULVERTS - CONSTRUCTION OF BASES WITH RECESS AND APRONS.
   - 2.2. DTMR SPECIFICATION
     - MRTS03 - DRAINAGE, RETAINING STRUCTURES AND PROTECTIVE TREATMENTS
     - MRTS70 - CONCRETE
     - MRTS71 REINFORCED STEEL
3. CONCRETE SHALL BE IN ACCORDANCE WITH MTRS70. REQUIREMENTS FOR REINFORCED CONCRETE ARE SHOWN IN THE TABLE BELOW;

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	10.09.18	FOR OPERATIONAL WORKS APPROVAL	LS	LS
2				
3				
4				
5				
6				
7				
8				

DRAWN: AA
DESIGN: AA

STATUS: NOT FOR CONSTRUCTION

APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE: 1:100 / 1:200 — 1 0 1 2 3 4 5 — A1 / A3

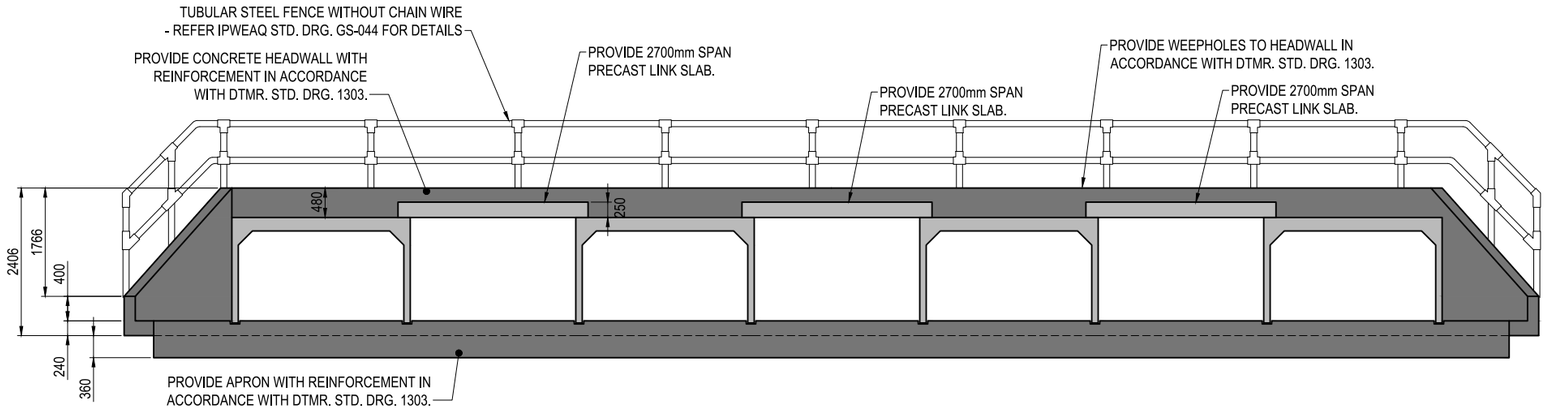
CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

PROJECT: HALCYON
LOGAN RESERVE
BULK EARTHWORKS

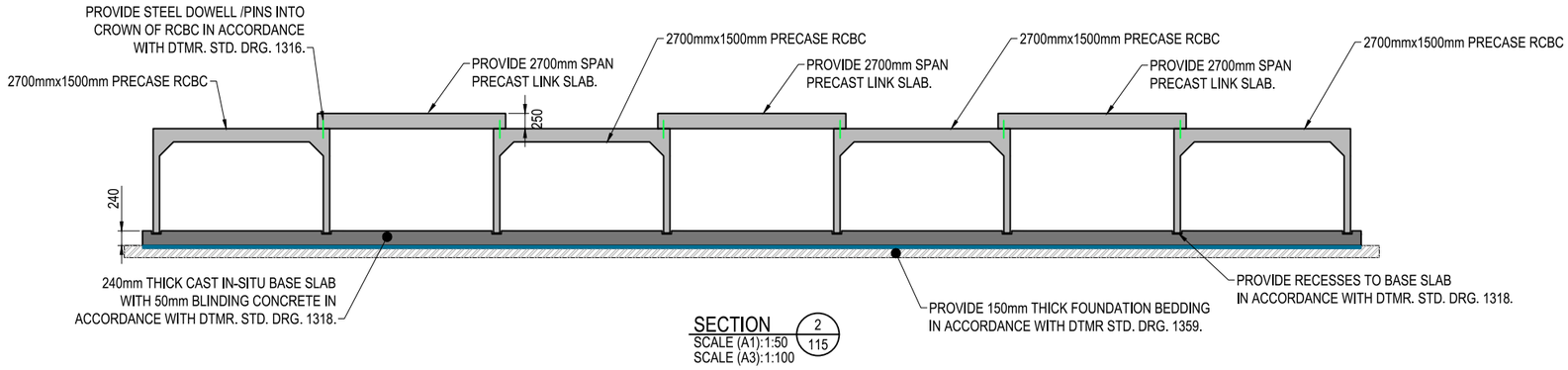
DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: CULVERT DETAILS
LAYOUT PLAN

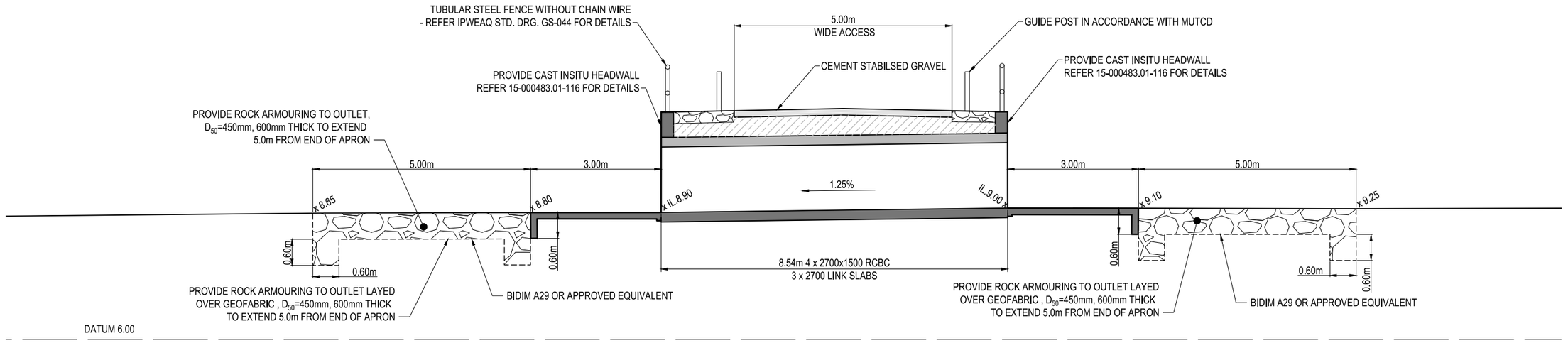
PROJECT No.	DRAWING No.	REVISION
15-000483.03	115	1



SECTION 3 / 116
SCALE (A1):1:50
SCALE (A3):1:100



SECTION 2 / 115
SCALE (A1):1:50
SCALE (A3):1:100



SECTION 1 / 116
SCALE (A1):1:50
SCALE (A3):1:100

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	10.09.18	FOR OPERATIONAL WORKS APPROVAL	LS	LS
2				
3				
4				
5				
6				
7				
8				

DRAWN: aa
DESIGN: aa

STATUS: NOT FOR CONSTRUCTION

APPROVED: LESLIE ROCHE RPEQ 14843
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE
1:50 1 0.5 0 1 2 A1
1:100 A3

CLIENT: HALCYON DEVELOPMENTS No.5 PTY LTD

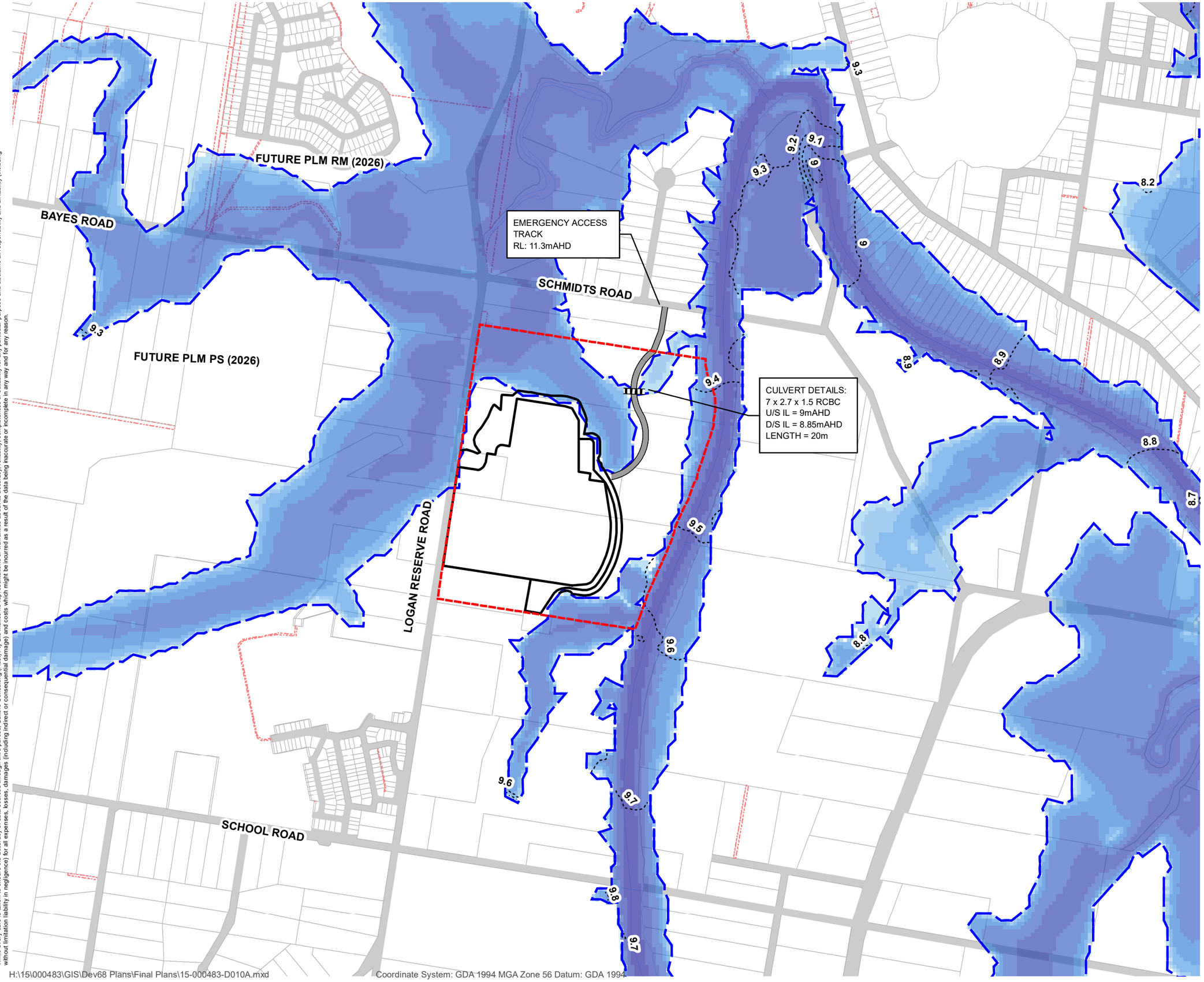
calibre
calibregroup.com

PROJECT: HALCYON
LOGAN RESERVE
BULK EARTHWORKS

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: CULVERT DETAILS
SECTIONS PLAN

PROJECT No.	DRAWING No.	REVISION
15-000483.03	116	1



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access Track
- Flood Extent

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.
2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

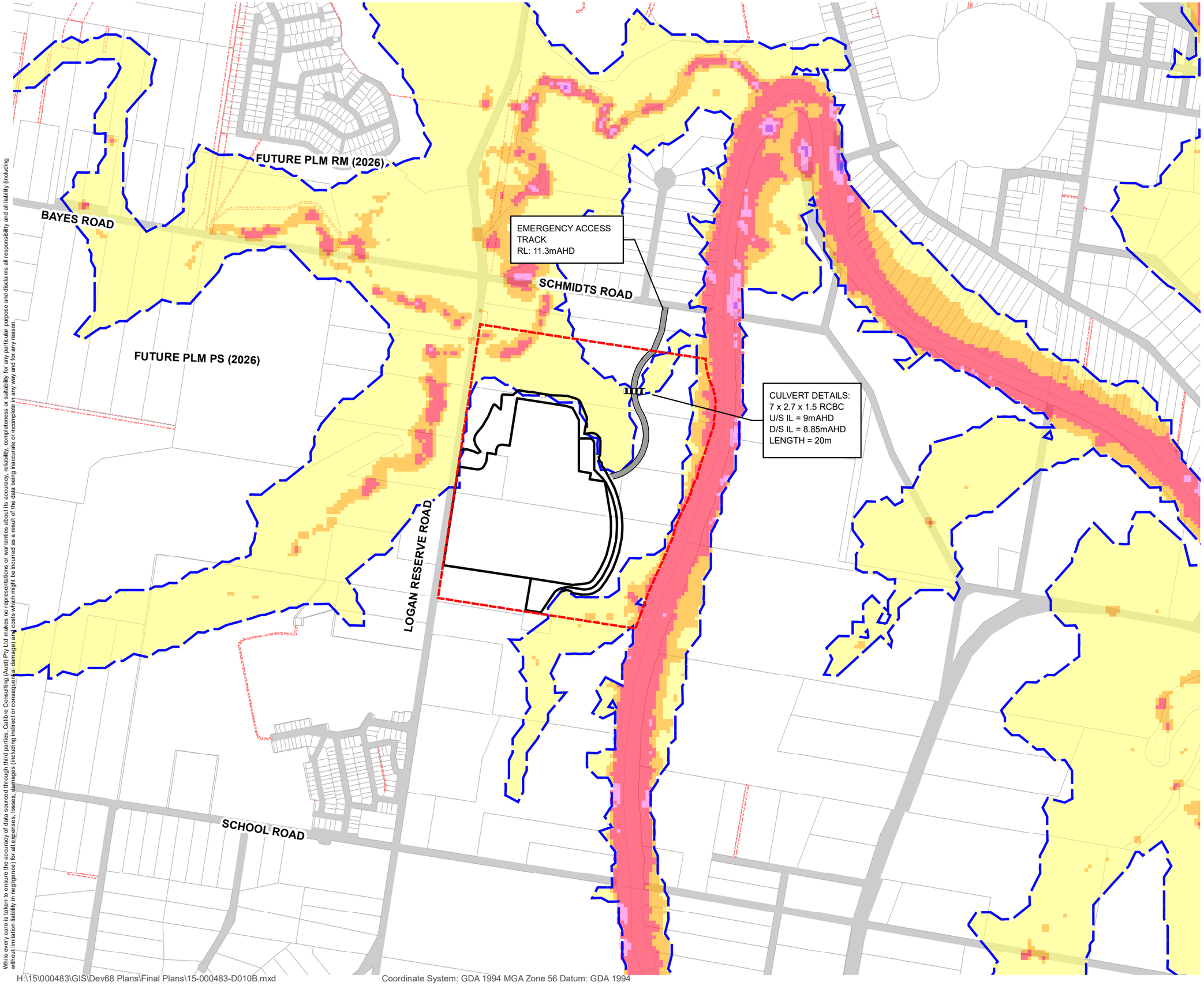
DRAWING TITLE:

DEVELOPED SCENARIO 10 YEAR ARI MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-D010A**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access
- Flood Extent

Max. Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.
2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

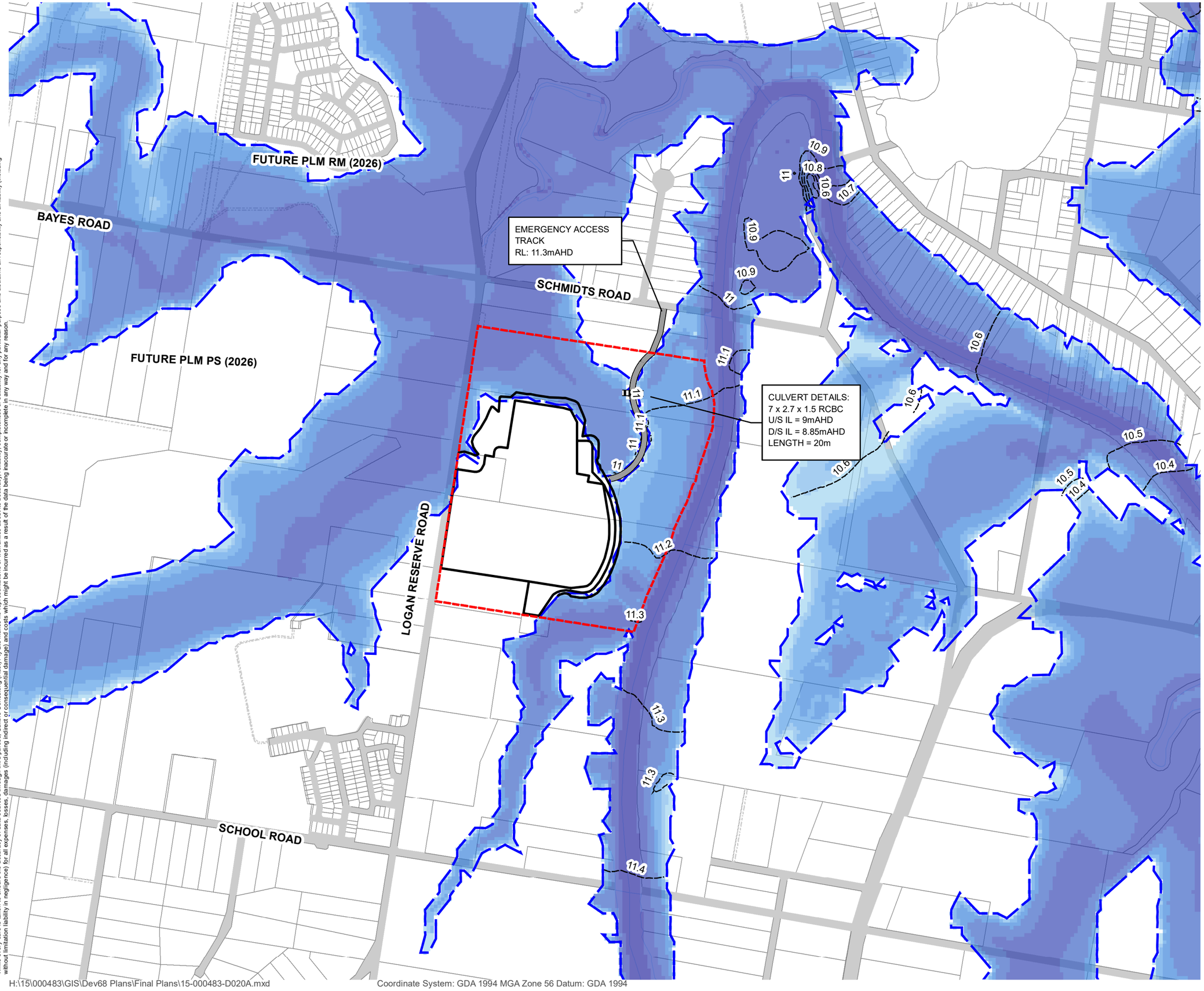
HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

DEVELOPED SCENARIO 10 YEAR ARI MAXIMUM VELOCITY PLAN

DRAWING NO: **15-000483-D010B** ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access Track
- Flood Extent

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.
2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

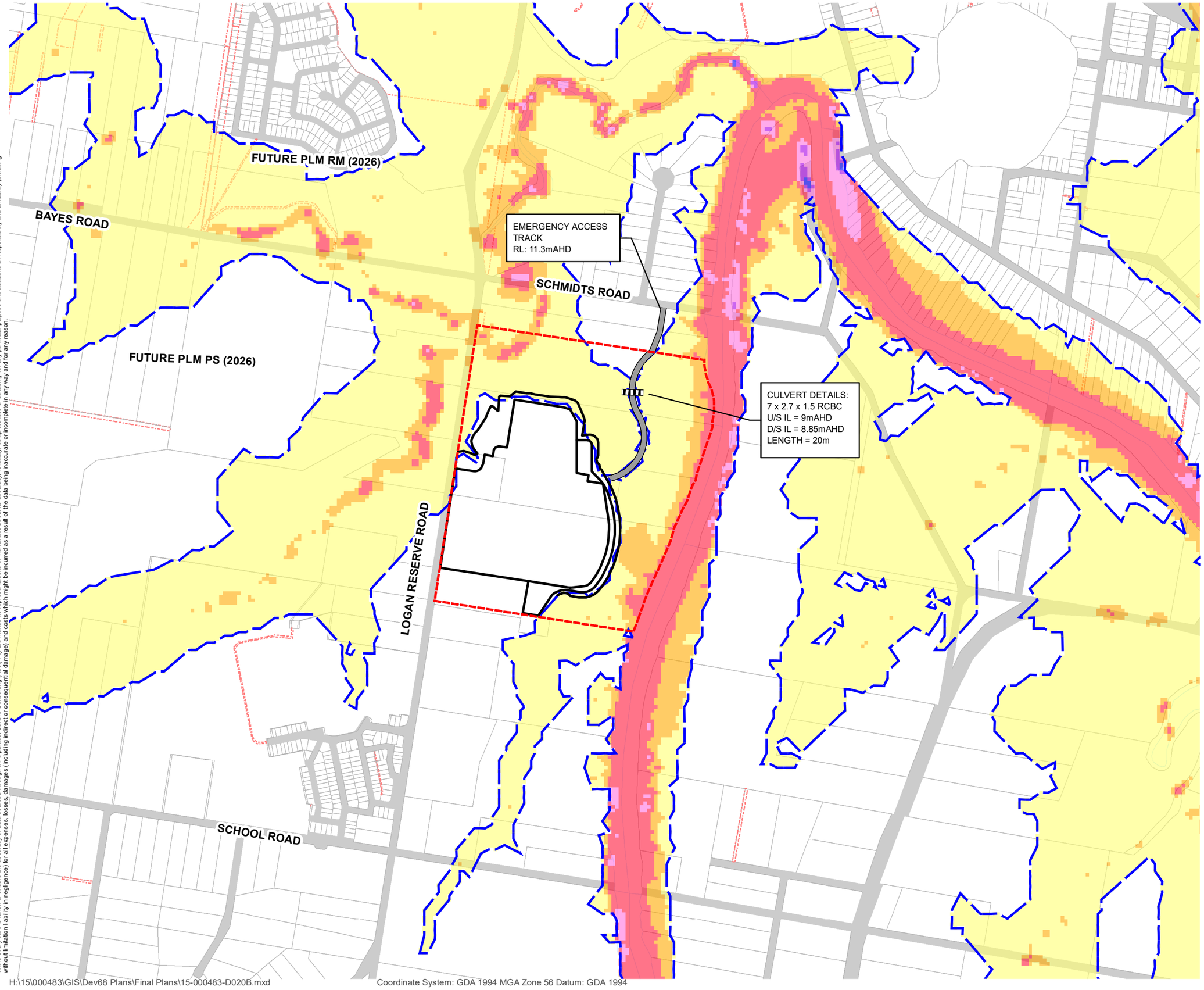
DRAWING TITLE:

DEVELOPED SCENARIO 20 YEAR ARI MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-D020A**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access
- Flood Extent

Max. Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

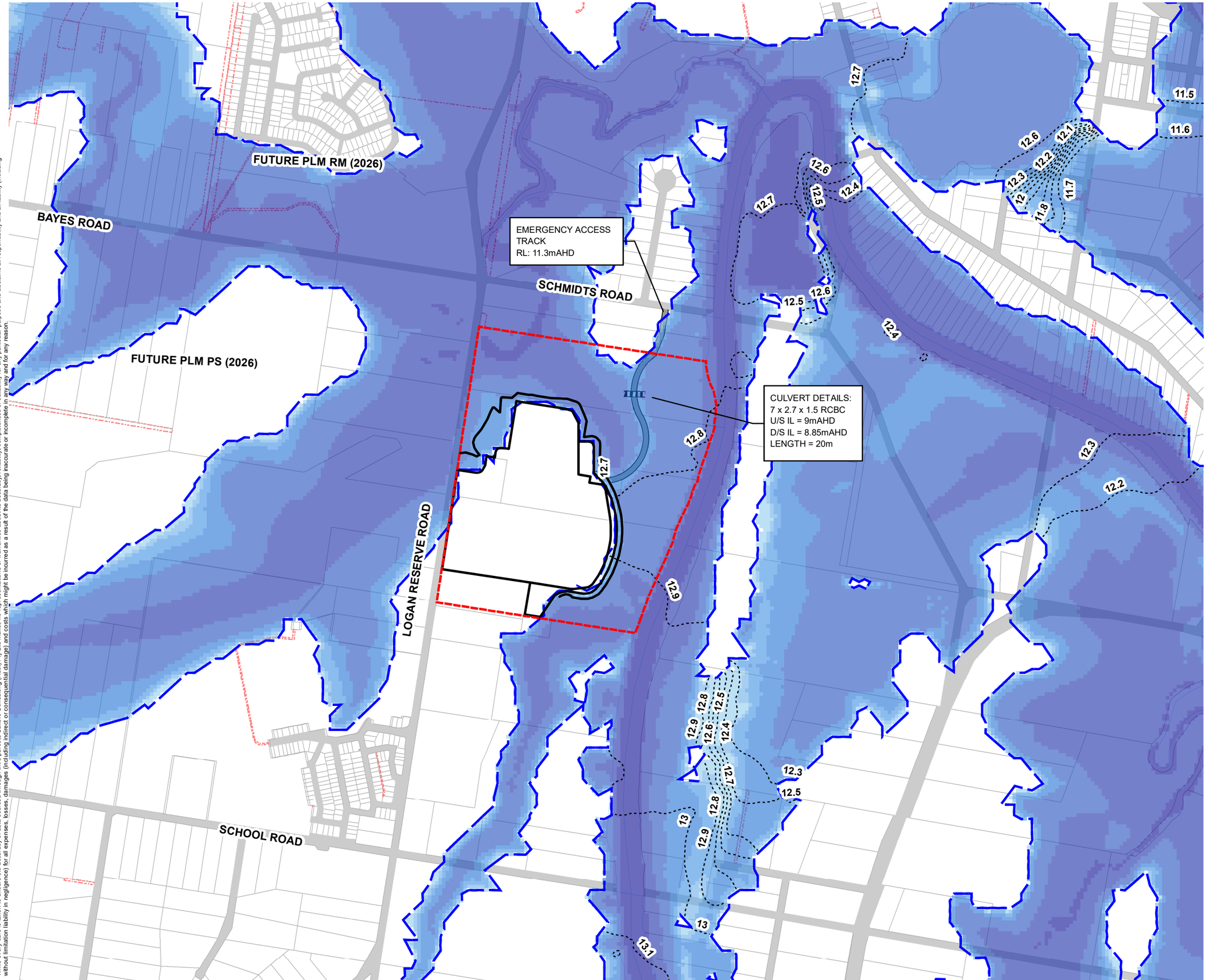
HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

DEVELOPED SCENARIO 20 YEAR ARI MAXIMUM VELOCITY PLAN

DRAWING NO: **15-000483-D020B** ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access Track
- Flood Extent

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

DEVELOPED SCENARIO 50 YEAR ARI MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-D050A** ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT

FUTURE PLM RM (2026)

BAYES ROAD

SCHMIDTS ROAD

FUTURE PLM PS (2026)

EMERGENCY ACCESS
TRACK
RL: 11.3mAHD

CULVERT DETAILS:
7 x 2.7 x 1.5 RCBC
U/S IL = 9mAHD
D/S IL = 8.85mAHD
LENGTH = 20m

LOGAN RESERVE ROAD

SCHOOL ROAD

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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Emergency Access Track
- Embankment Culverts
- Flood Extent

Max. Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

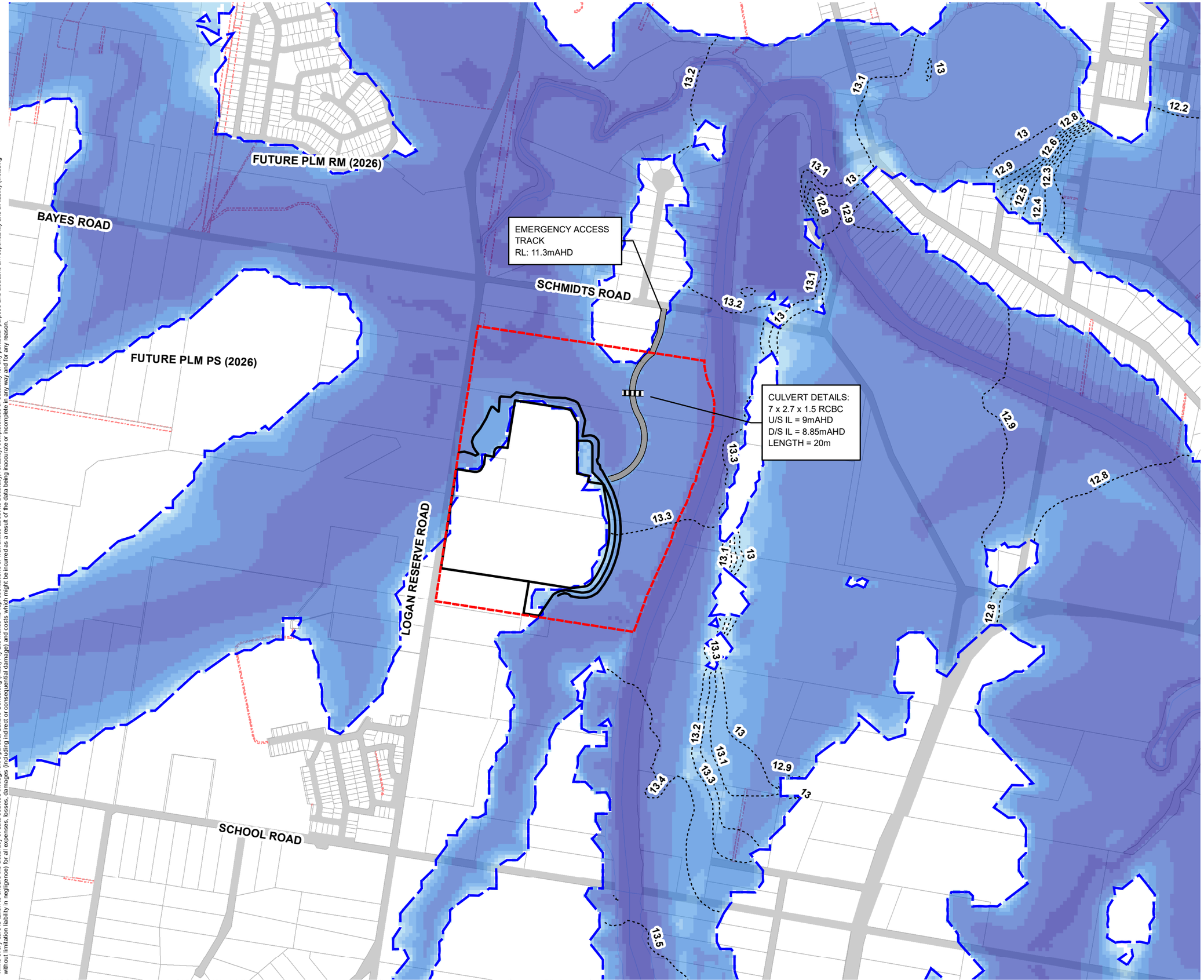
HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

**DEVELOPED SCENARIO
50 YEAR ARI
MAXIMUM VELOCITY PLAN**

DRAWING NO: **15-000483-D050B** ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access
- Flood Extent

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.
2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

DEVELOPED SCENARIO 100 YEAR ARI MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-D100A** ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT

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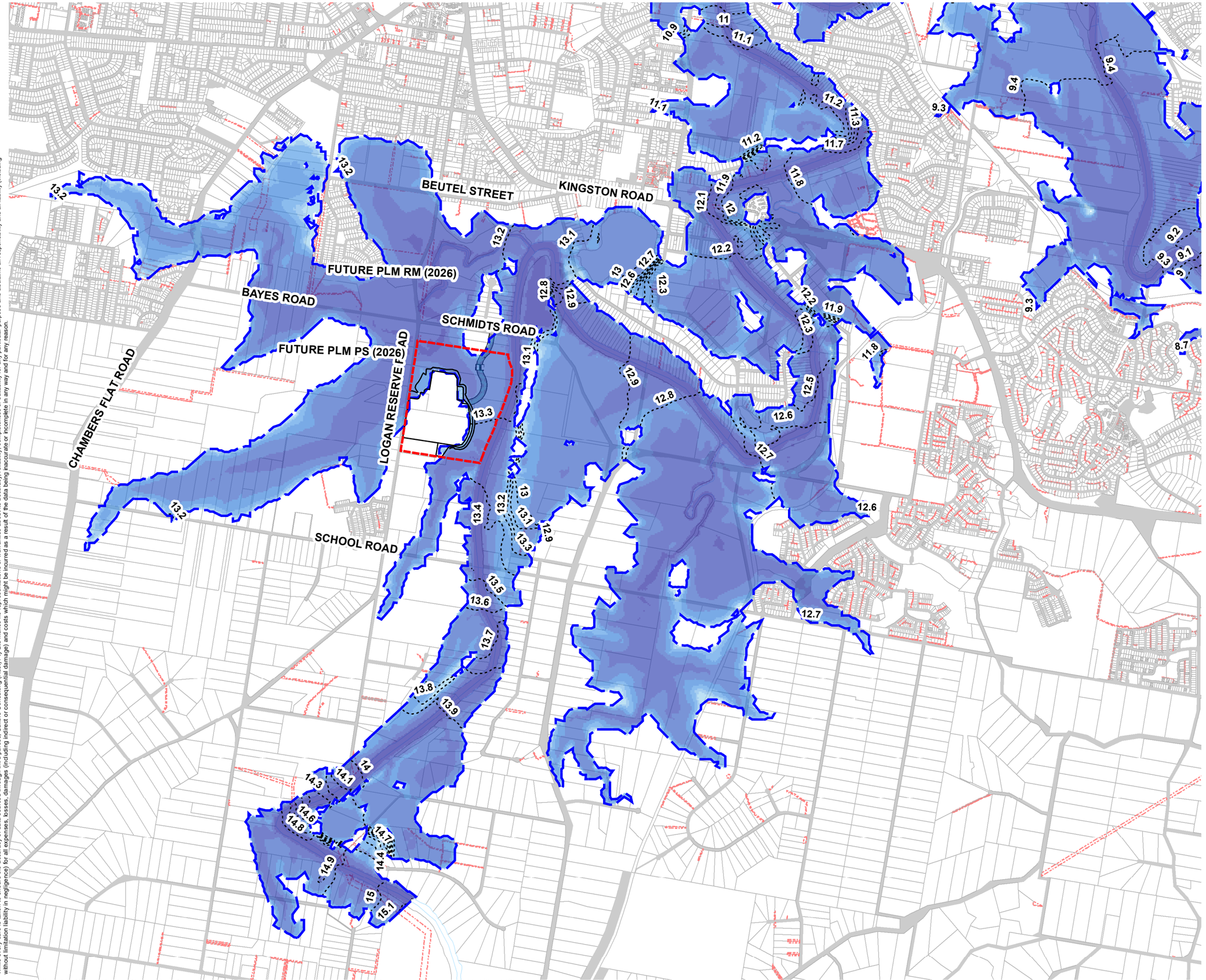
Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access
- Flood Extent

Max. Flood Depth (m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 160 320 640 m

1:25,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

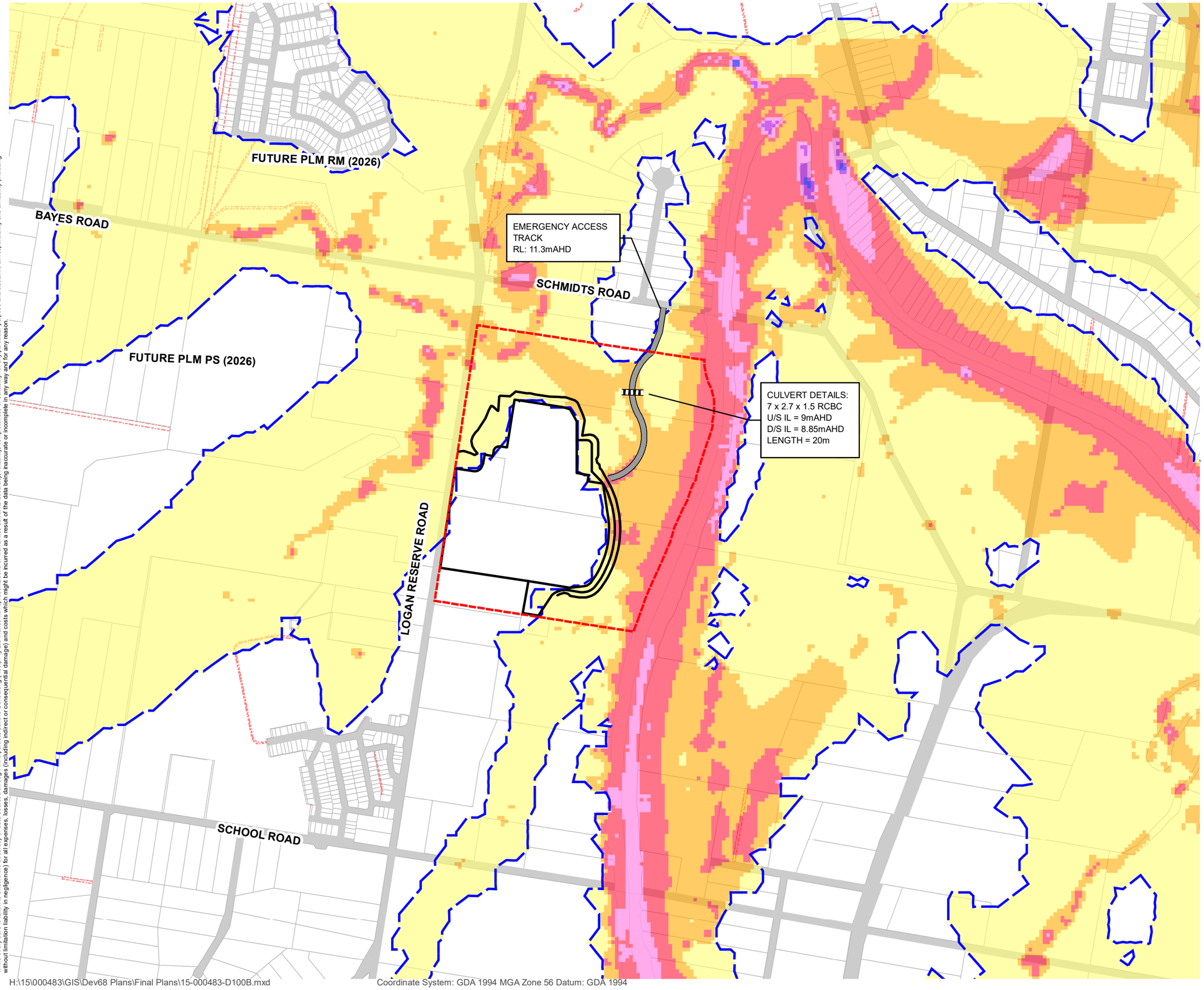
DRAWING TITLE:

DEVELOPED SCENARIO
100 YEAR ARI
MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-D100A-1**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access
- Flood Extent

Max. Developed Flood Velocity

(m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

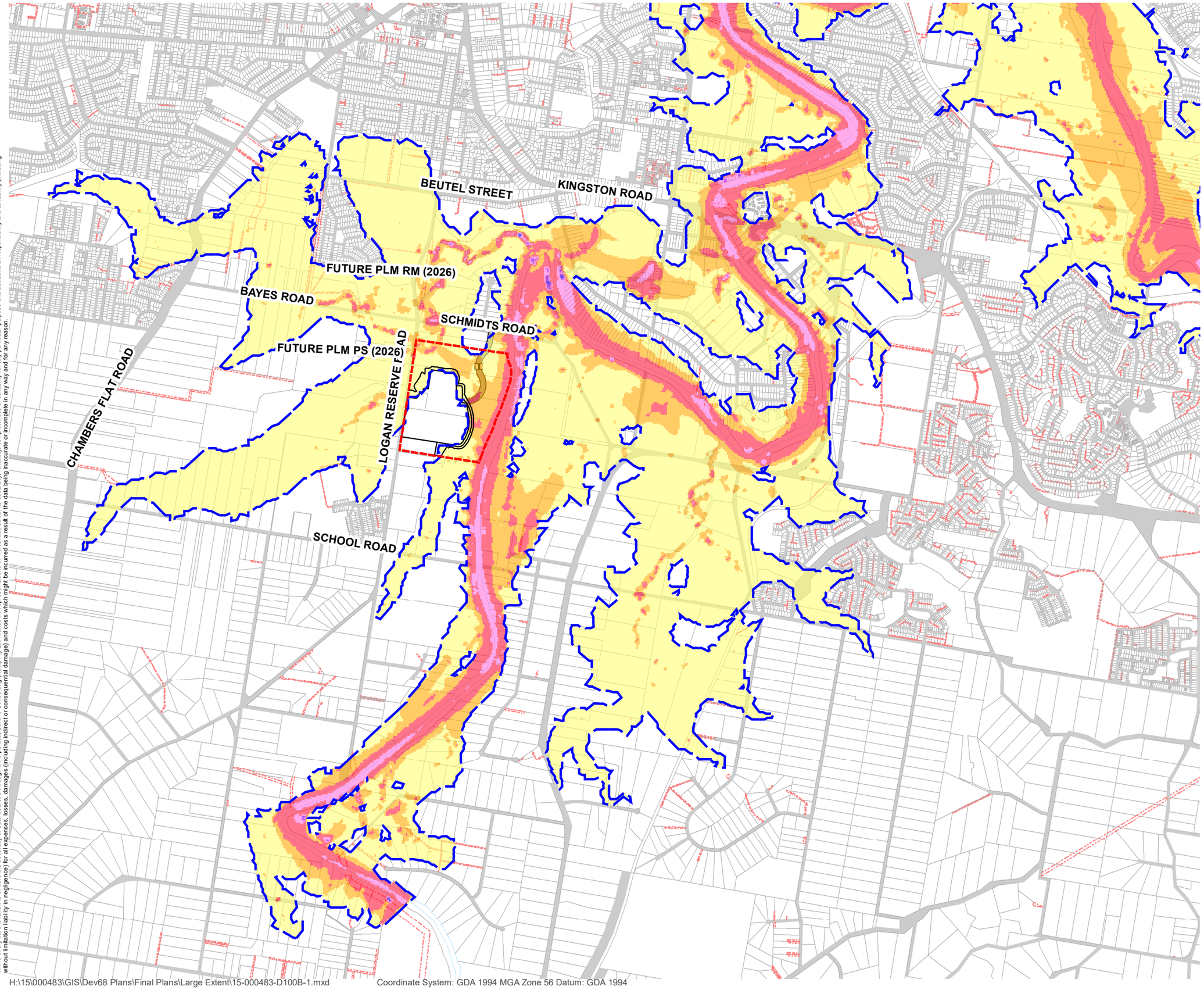
DRAWING TITLE:

DEVELOPED SCENARIO 100 YEAR ARI MAXIMUM VELOCITY PLAN

DRAWING NO: **15-000483-D100B**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	22.10.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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LEGEND

- Site Boundary
- Flood Extent
- Development Area
- Embankment Culverts
- Emergency Access

Max. Developed Flood Velocity

(m/s)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 160 320 640 m

1:25,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

DEVELOPED SCENARIO 100 YEAR ARI MAXIMUM VELOCITY PLAN

DRAWING NO: **15-000483-D100B-1**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	22.10.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT

FUTURE PLM RM (2026)

BAYES ROAD

FUTURE PLM PS (2026)

SCHMIDTS ROAD

LOGAN RESERVE ROAD

SCHOOL ROAD

EMERGENCY ACCESS
TRACK
RL: 11.3mAHD

CULVERT DETAILS:
7 x 2.7 x 1.5 RCBC
U/S IL = 9mAHD
D/S IL = 8.85mAHD
LENGTH = 20m

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access
- Flood Extent

Max. Flood Depth

(m)

- < 0.05
- 0.05 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- > 10

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

3. MANNING'S N ROUGHNESS GOBAL VALUE FOR THE SITE HAS BEEN INCREASED TO N = 0.054 FOR SENSITIVITY ANALYSIS.

4. MANNING'S N ROUGHNESS FOR PROPOSED REVEGETATION AREAS WITHIN THE SITE HAS BEEN INCREASED TO N = 0.08 FOR SENSITIVITY ANALYSIS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

SENSITIVITY SCENARIO
100 YEAR ARI
MAX FLOOD DEPTH PLAN

DRAWING NO: **15-000483-S100A** ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	22.10.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT

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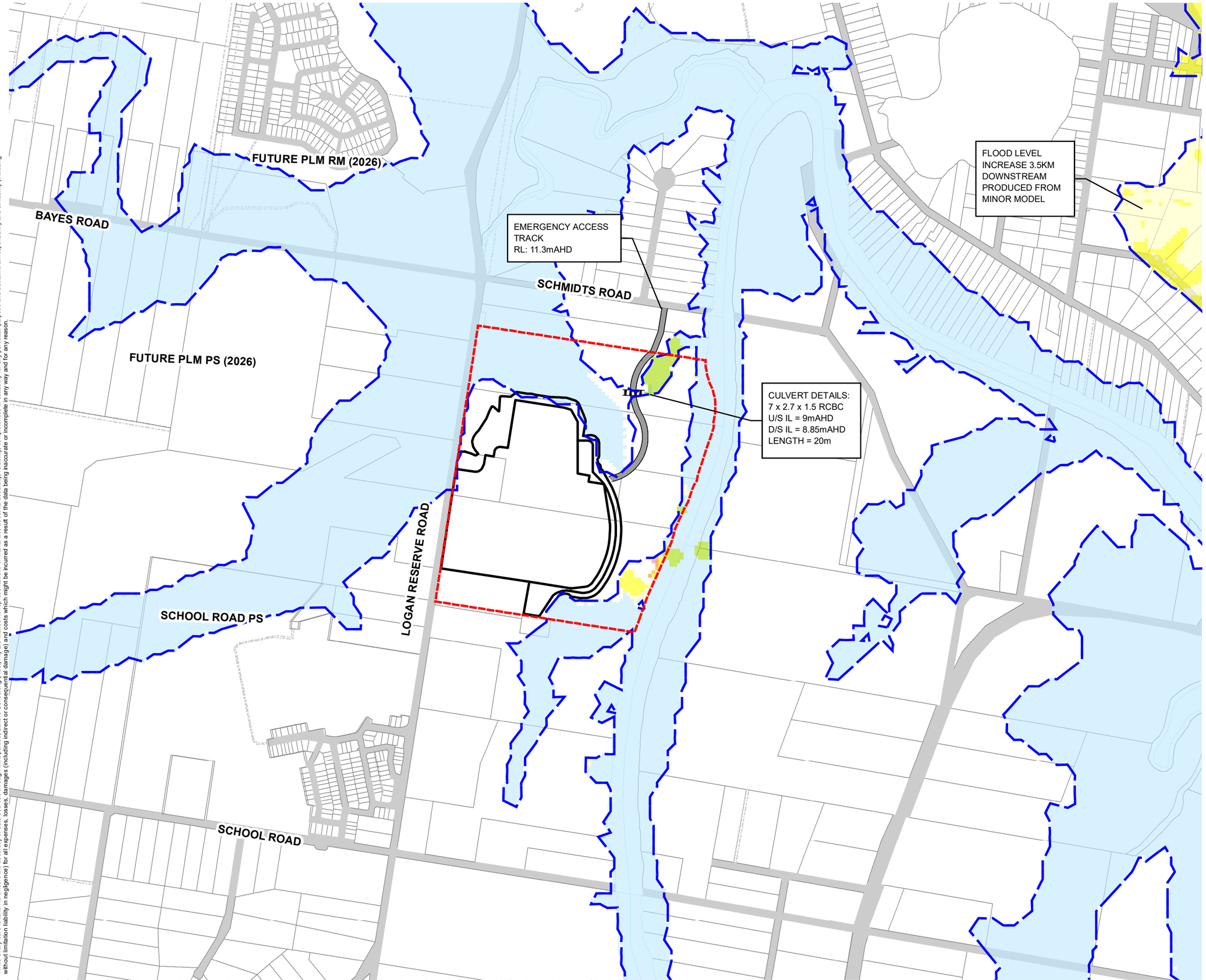
Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

APPENDIX E DEVELOPED FLOOD CHANGES



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Flood Extent
- Development Area
- Embankment Culverts
- Emergency Access

Max. Flood Level Difference

(mm)

- < -50
- -50 to -30
- -30 to -20
- -20 to -5
- -5 to 5
- 5 to 10
- 10 to 20
- 20 to 30
- 30 to 50
- 50 to 100
- > 100

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

DRAWING TITLE:

DEVELOPED SCENARIO 10YR ARI FLOOD LEVEL DIFFERENCE PLAN

DRAWING NO: **15-000483-D010D**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT

FUTURE PLM RM (2026)

BAYES ROAD

FUTURE PLM PS (2026)

EMERGENCY ACCESS TRACK
RL: 11.3mAHD

SCHMIDTS ROAD

CULVERT DETAILS:
7 x 2.7 x 1.5 RCBC
U/S IL = 9mAHD
D/S IL = 8.85mAHD
LENGTH = 20m

LOGAN RESERVE ROAD

SCHOOL ROAD

H:\15\000483\GIS\Dev68 Plans\Final Plans\15-000483-D010E.mxd

Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Flood Extent
- Development Area
- Embankment Culverts
- Emergency Access Track

Max. Flood Velocity Difference

(m/s)

- < -0.2
- -0.2 to -0.1
- -0.1 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1
- > 1

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

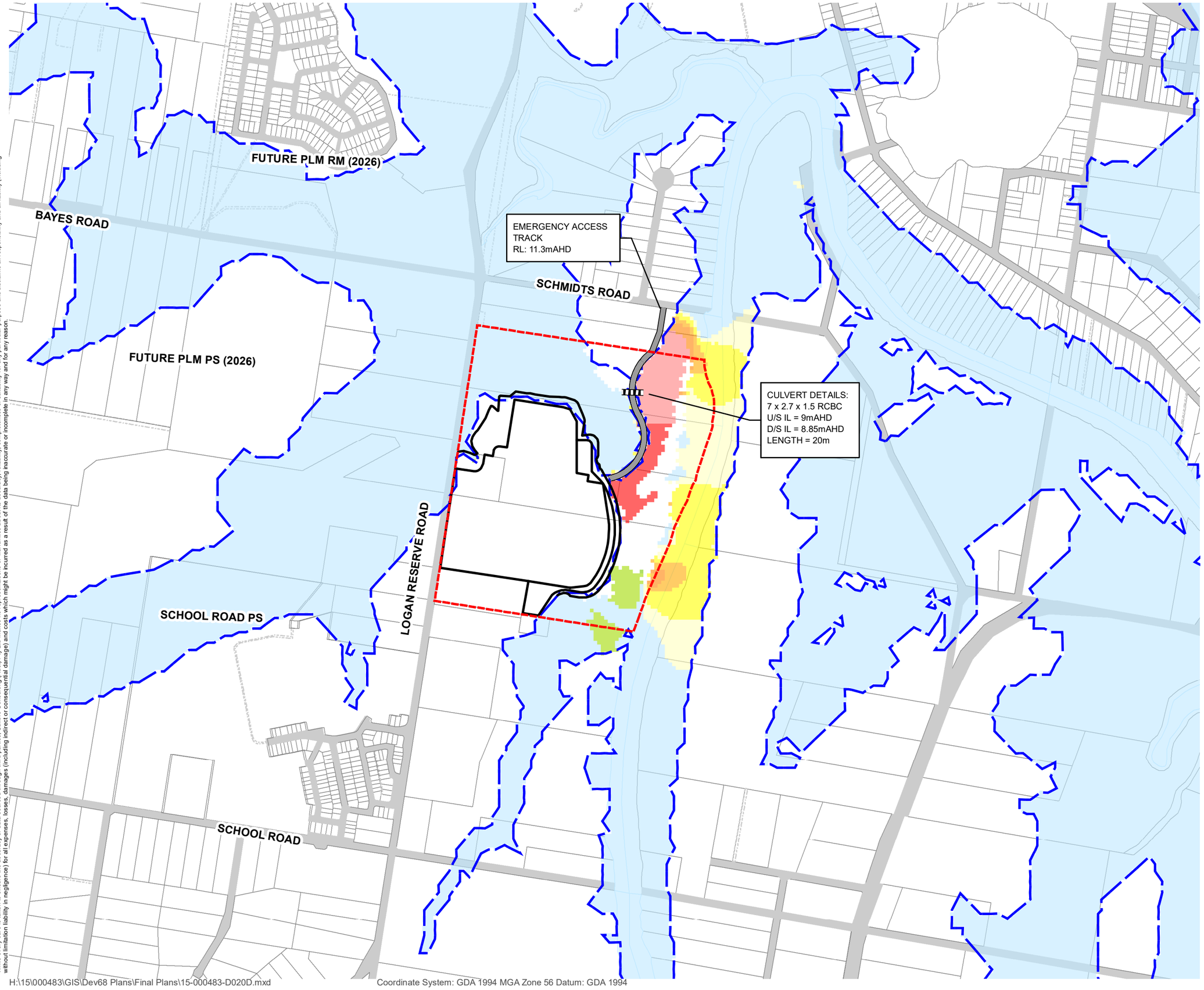
DRAWING TITLE:

DEVELOPED SCENARIO 10 YEAR ARI MAXIMUM VELOCITY DIFFERENCE PLAN

DRAWING NO: **15-000483-D010E**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access Track
- Flood Extent

Max. Flood Level Difference

(mm)

- < -50
- -50 to -30
- -30 to -20
- -20 to -5
- -5 to 5
- 5 to 10
- 10 to 20
- 20 to 30
- 30 to 50
- 50 to 100
- > 100

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.
2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

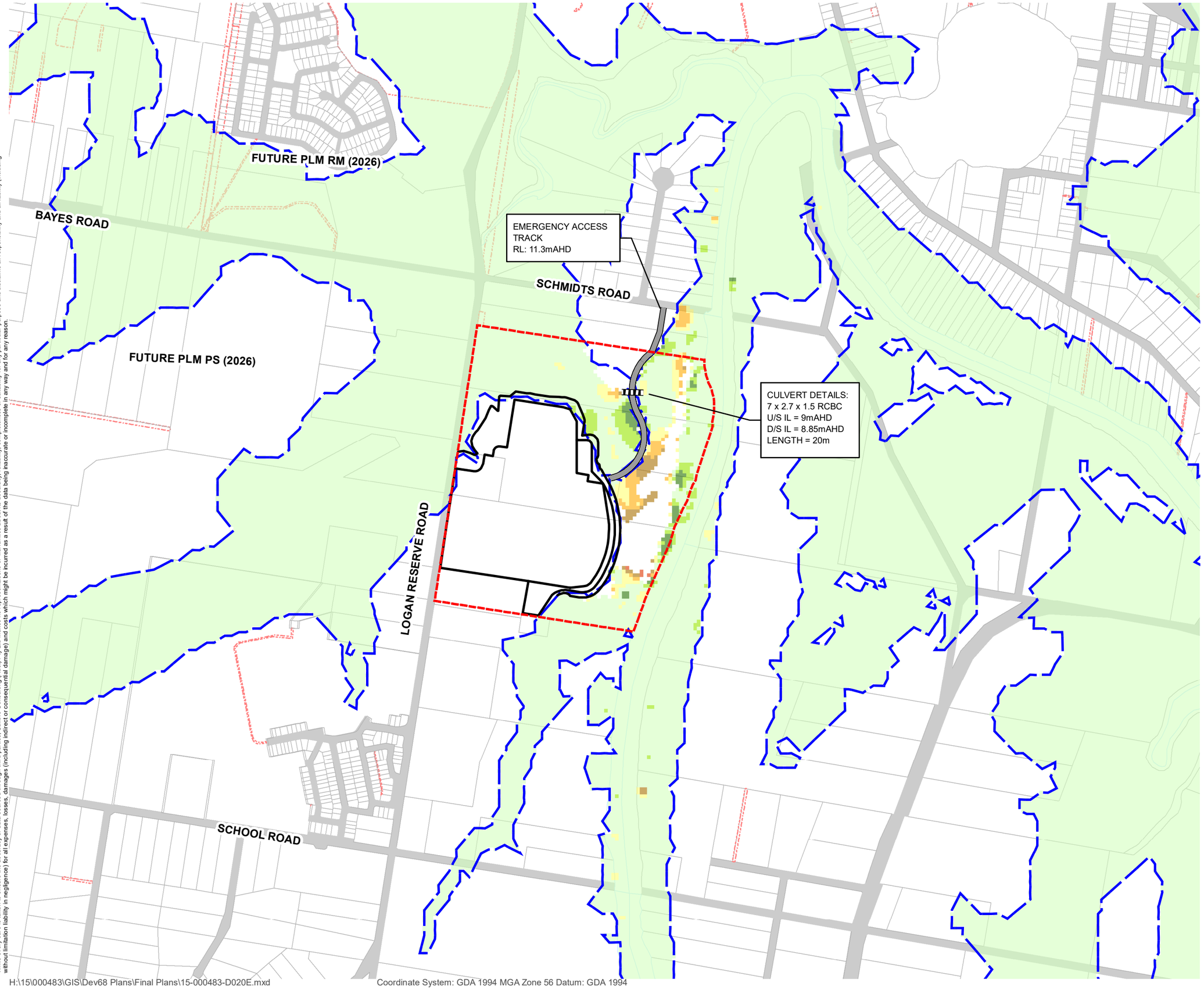
DRAWING TITLE:

DEVELOPED SCENARIO 20YR ARI FLOOD LEVEL DIFFERENCE PLAN

DRAWING NO: **15-000483-D020D**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



H:\15\000483\GIS\Dev68 Plans\Final Plans\15-000483-D020E.mxd

Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access Track
- Flood Extent

Max. Flood Velocity Difference

(m/s)

- < -0.2
- -0.2 to -0.1
- -0.1 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1
- > 1

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

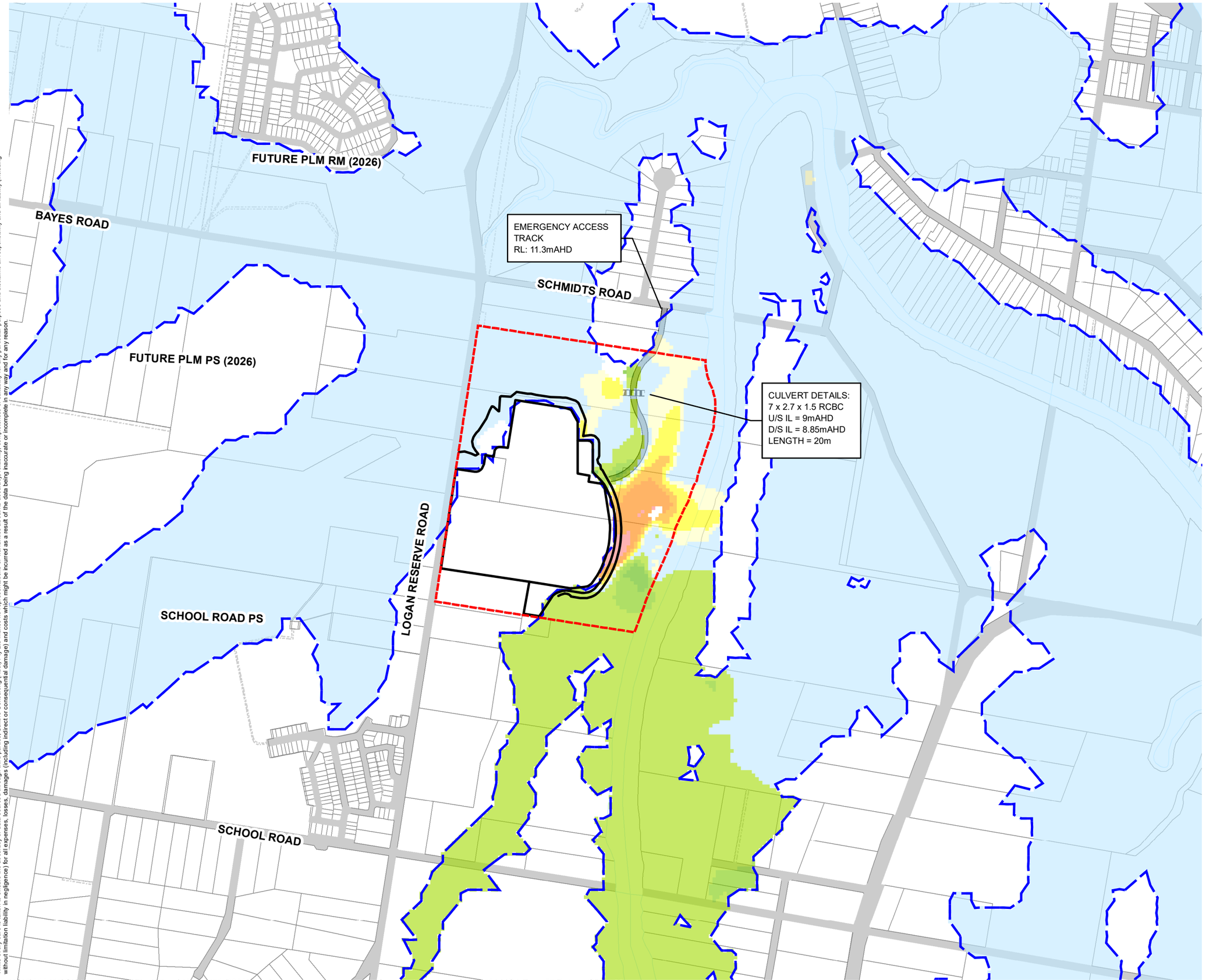
DRAWING TITLE:

DEVELOPED SCENARIO 20 YEAR ARI MAXIMUM VELOCITY DIFFERENCE PLAN

DRAWING NO: **15-000483-D020E**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access Track
- Flood Extent

Max. Flood Level Difference

(mm)

- < -50
- -50 to -30
- -30 to -20
- -20 to -5
- -5 to 5
- 5 to 10
- 10 to 20
- 20 to 30
- 30 to 50
- 50 to 100
- > 100

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

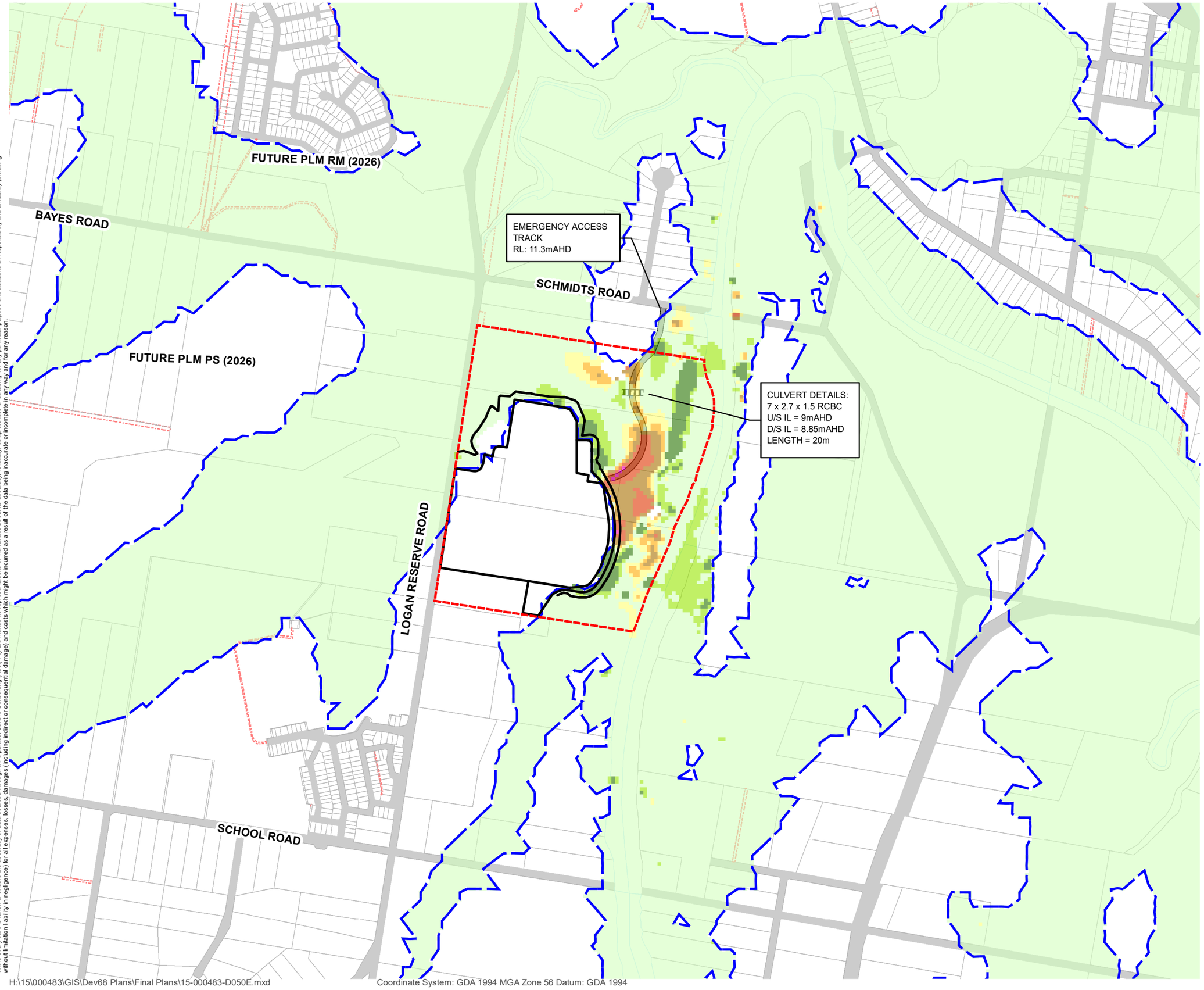
DRAWING TITLE:

DEVELOPED SCENARIO 50YR ARI FLOOD LEVEL DIFFERENCE PLAN

DRAWING NO: **15-000483-D050D**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access Track
- Flood Extent

Max. Flood Velocity Difference

(m/s)

- < -0.2
- -0.2 to -0.1
- -0.1 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1
- > 1

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

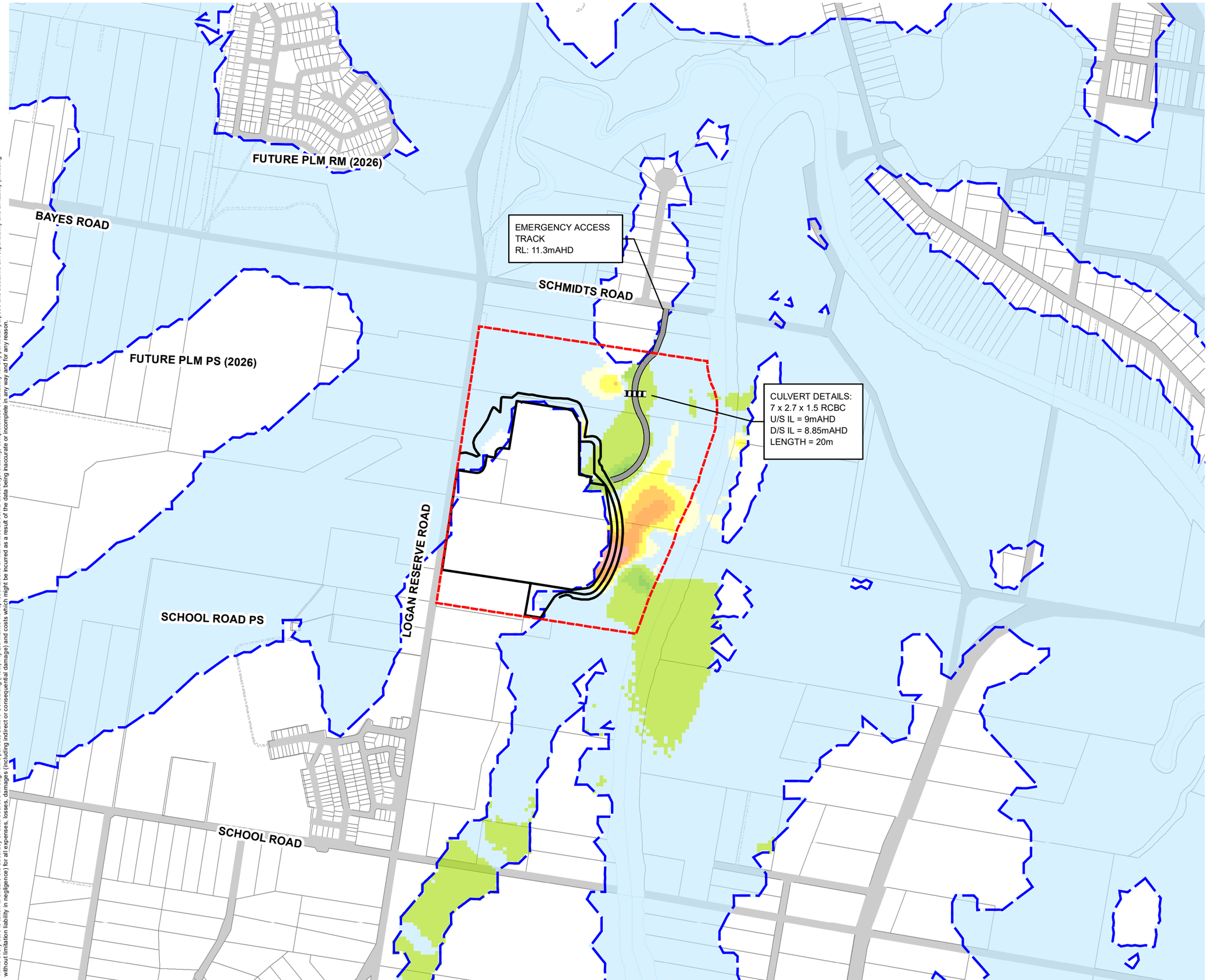
DRAWING TITLE:

DEVELOPED SCENARIO 50 YEAR ARI MAXIMUM VELOCITY DIFFERENCE PLAN

DRAWING NO: **15-000483-D050E**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access
- Flood Extent

Max. Flood Level Difference

(mm)

- < -50
- -50 to -30
- -30 to -20
- -20 to -5
- -5 to 5
- 5 to 10
- 10 to 20
- 20 to 30
- 30 to 50
- 50 to 100
- > 100

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

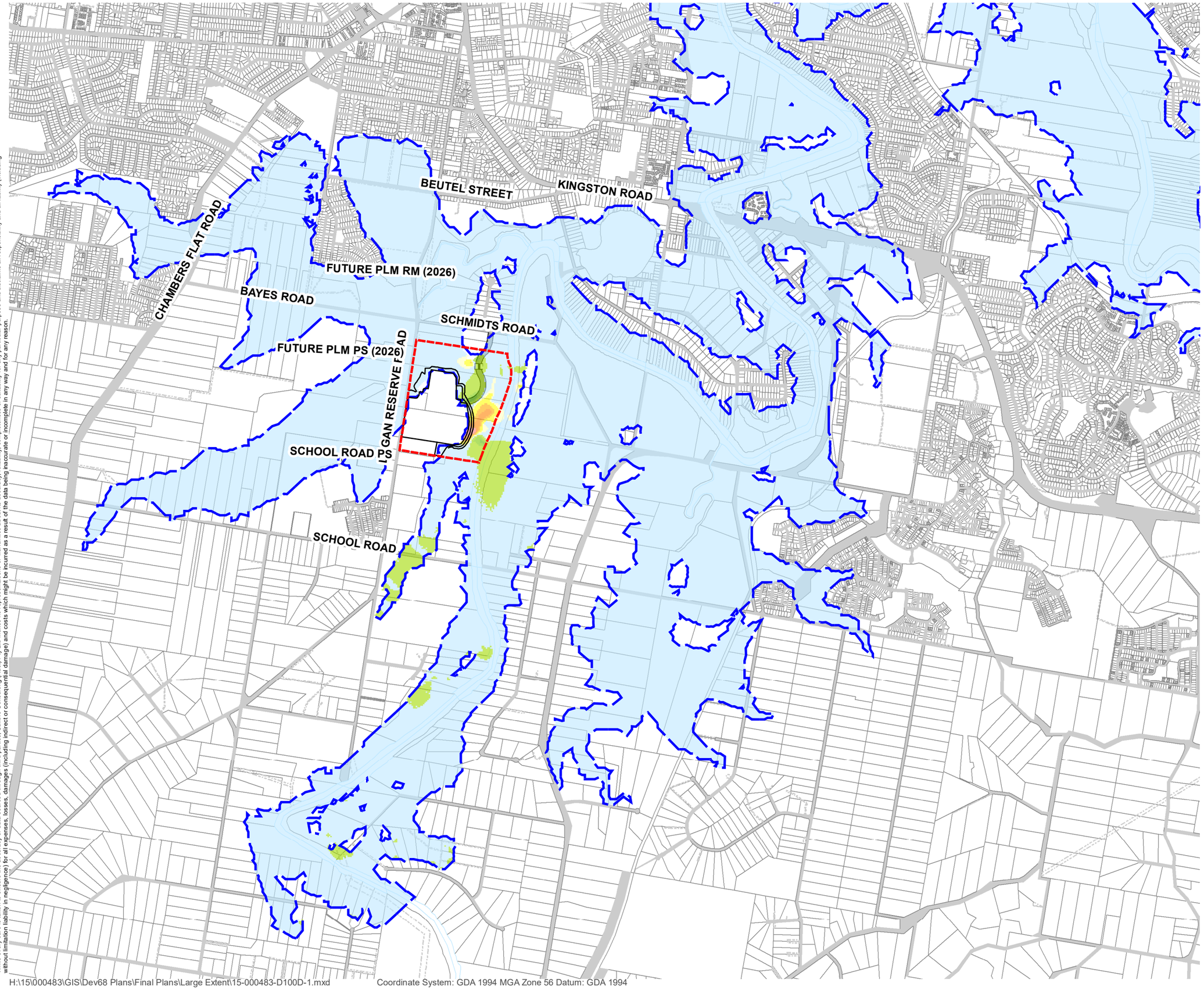
DRAWING TITLE:

DEVELOPED SCENARIO 100YR ARI FLOOD LEVEL DIFFERENCE PLAN

DRAWING NO: **15-000483-D100D**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Flood Extent

Max. Flood Level Difference

(mm)

- < -50
- -50 to -30
- -30 to -20
- -20 to -5
- -5 to 5
- 5 to 10
- 10 to 20
- 20 to 30
- 30 to 50
- 50 to 100
- > 100
- Embankment Culverts
- Emergency Access

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 160 320 640 m

1:25,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

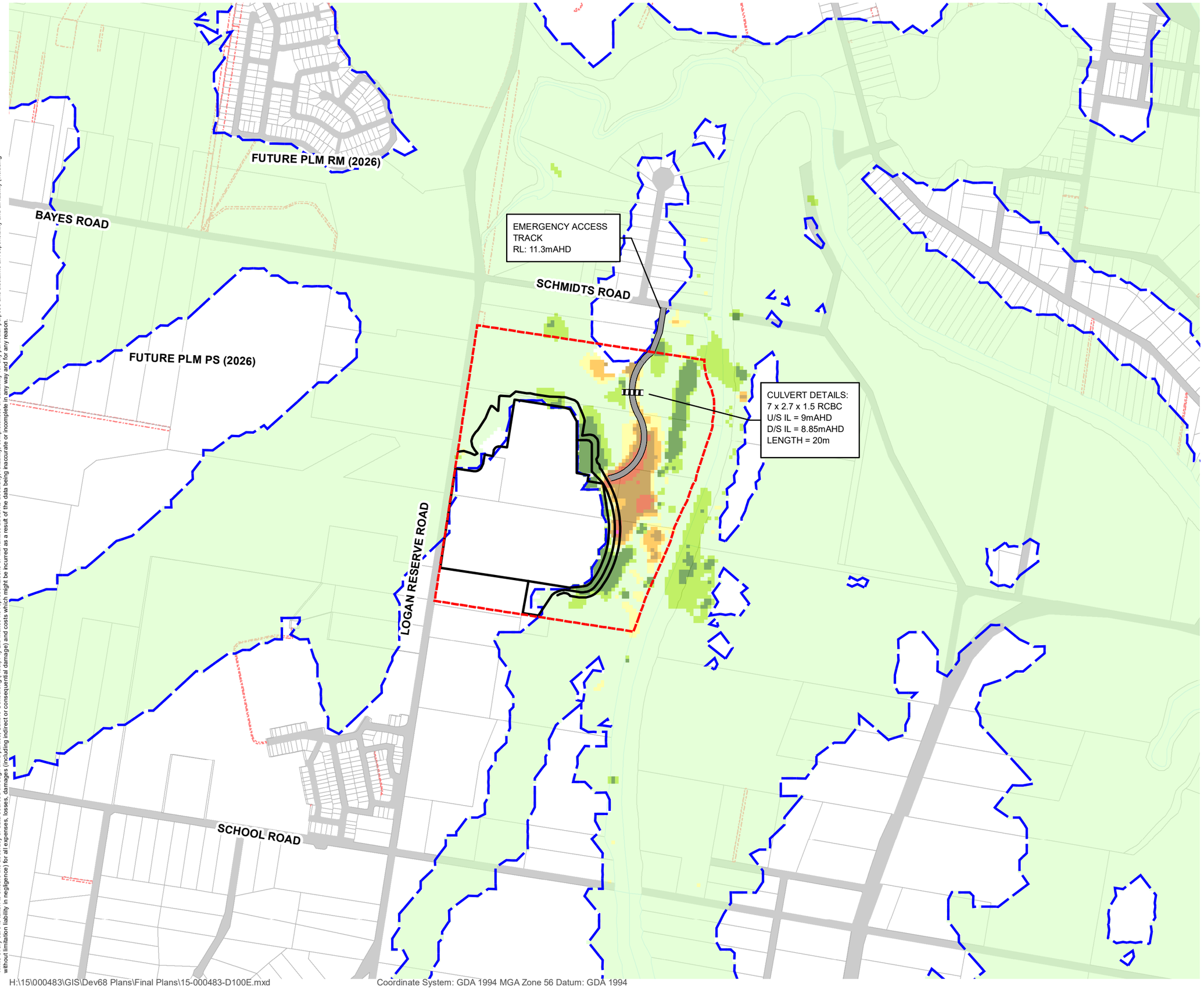
DRAWING TITLE:

DEVELOPED SCENARIO 100YR ARI FLOOD LEVEL DIFFERENCE PLAN

DRAWING NO: **15-000483-D100D-1**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



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Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Embankment Culverts
- Emergency Access
- Flood Extent

Max. Flood Velocity Difference

(m/s)

- < -0.2
- -0.2 to -0.1
- -0.1 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1
- > 1

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 62.5 125 250 m

1:10,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

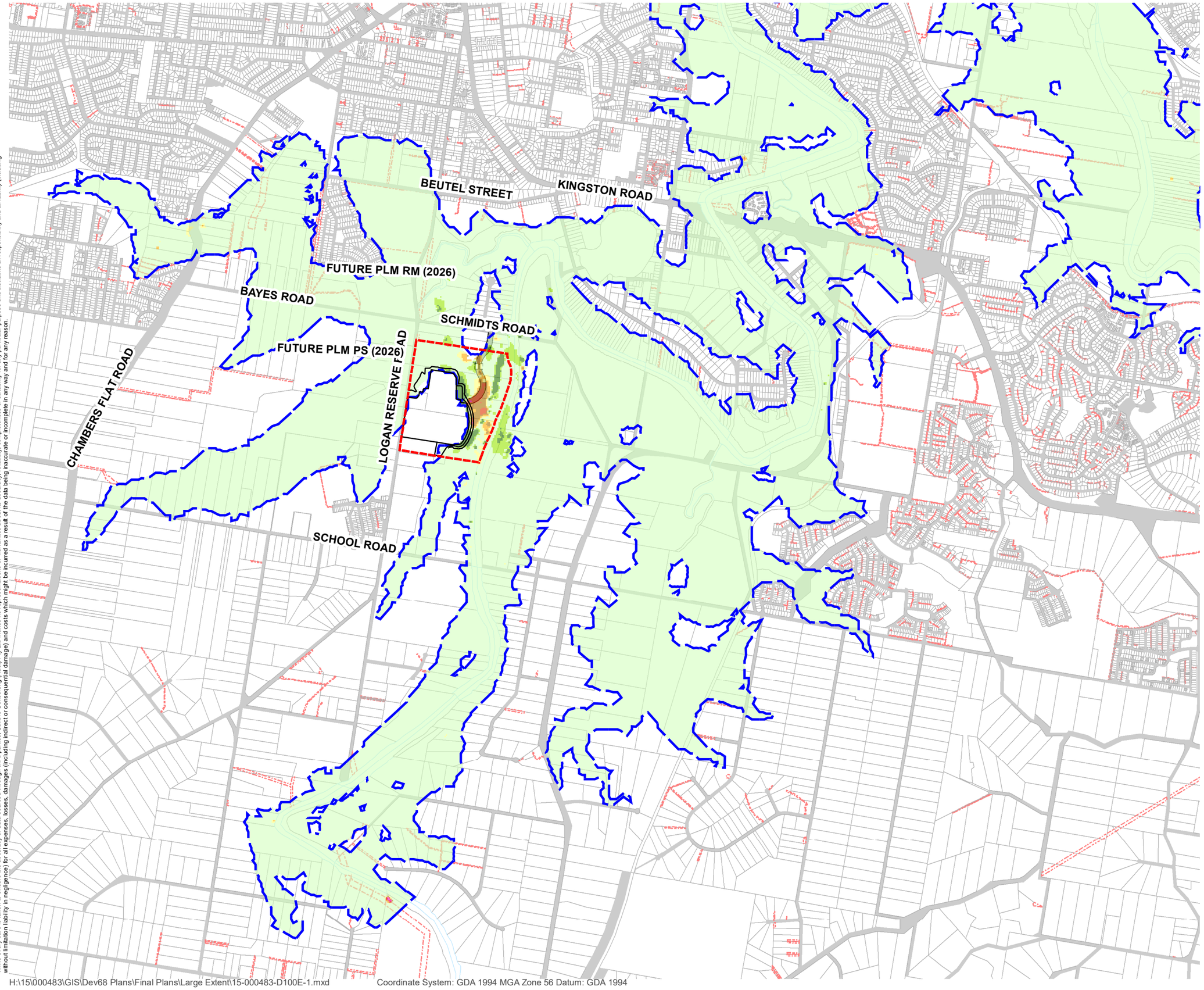
DRAWING TITLE:

DEVELOPED SCENARIO 100 YEAR ARI MAXIMUM VELOCITY DIFFERENCE PLAN

DRAWING NO: **15-000483-D100E**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



H:\15\000483\GIS\Dev68 Plans\Final Plans\Large Extent\15-000483-D100E-1.mxd Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994

LEGEND

- Site Boundary
- Development Area
- Flood Extent
- Embankment Culverts
- Emergency Access

Max. Flood Velocity Difference

(m/s)

- < -0.2
- -0.2 to -0.1
- -0.1 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1
- > 1

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-000483-02.

2. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.

0 160 320 640 m

1:25,000 (A3)

N

PROJECT:

252 LOGAN RESERVE ROAD, LOGAN RESERVE

CLIENT:

HALCYON DEVELOPMENTS PTY LTD

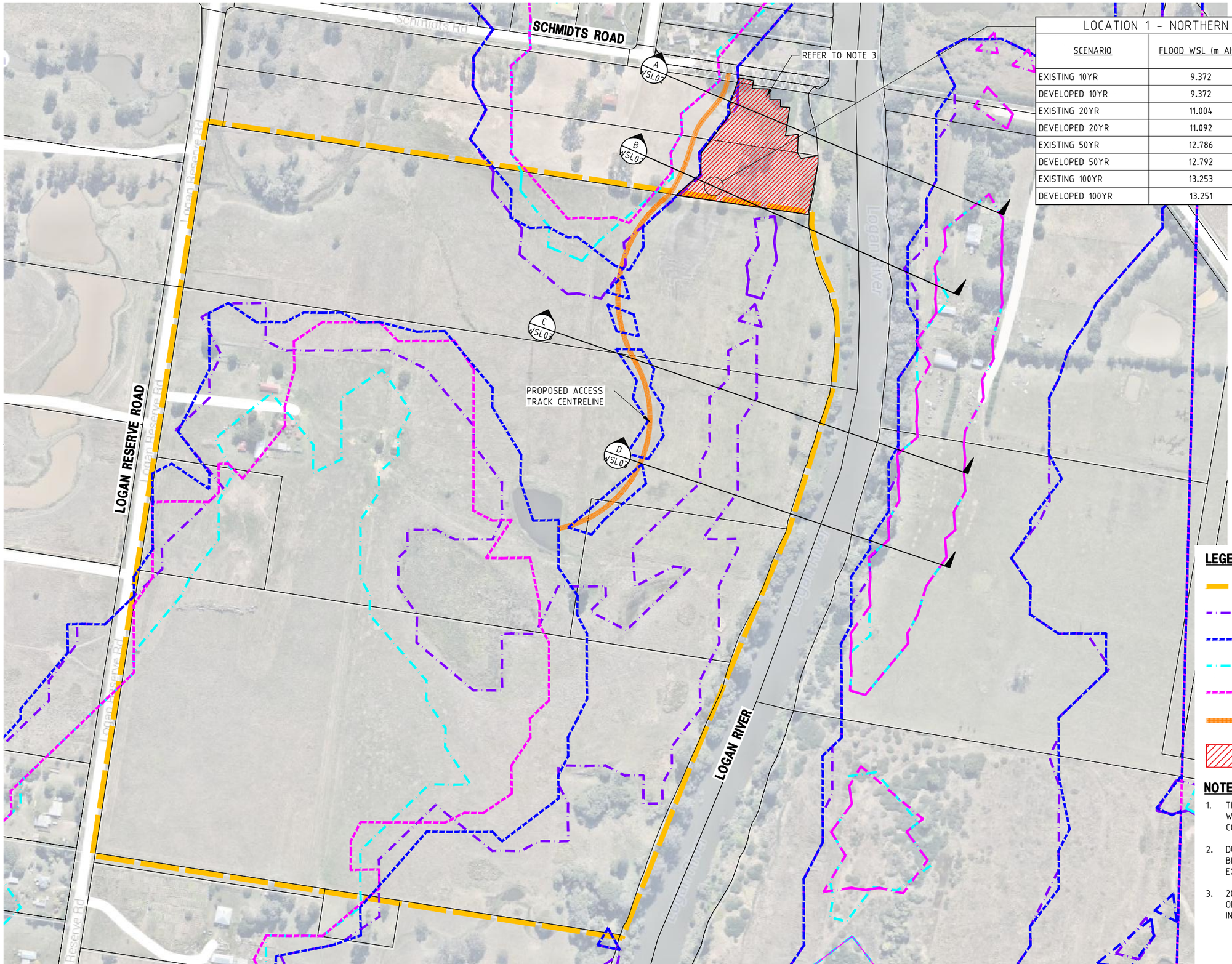
DRAWING TITLE:

DEVELOPED SCENARIO 100 YEAR ARI MAXIMUM VELOCITY DIFFERENCE PLAN

DRAWING NO: **15-000483-D100E-1**

ISSUE: **B**

ISS	BY	CHK	DATE	DETAILS
A	KO	CS	29.09.15	ORIGINAL
B	MP	MS	07.09.18	UPDATED LAYOUT



LOCATION 1 - NORTHERN LOT (MAXIMUM CHANGE)			
SCENARIO	FLOOD WSL (m AHD)	FLOOD DEPTH (m)	WSL Change (m AHD)
EXISTING 10YR	9.372	0.713	0.000
DEVELOPED 10YR	9.372	0.713	
EXISTING 20YR	11.004	2.343	+0.088
DEVELOPED 20YR	11.092	2.422	
EXISTING 50YR	12.786	1.125	+0.006
DEVELOPED 50YR	12.792	4.134	
EXISTING 100YR	13.253	4.592	-0.002
DEVELOPED 100YR	13.251	4.594	

LEGEND:

- SITE BOUNDARY
- EXISTING 20 YEAR ARI FLOOD EXTENT
- DEVELOPED 20 YEAR ARI FLOOD EXTENT
- EXISTING 100 YEAR ARI FLOOD EXTENT
- DEVELOPED 100 YEAR ARI FLOOD EXTENT
- PROPOSED ACCESS TRACK
- 20 YEAR ARI FLOOD DIFFERENCE (REFER NOTE 3)

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-000483-02.
2. DUE TO MINOR CHANGES IN FLOOD LEVELS BETWEEN SCENARIOS, DIFFERENCES IN FLOOD EXTENTS ARE NOT EVIDENT IN PLAN VIEW.
3. 20 YEAR ARI FLOOD LEVEL DIFFERENCE EXTENT ON LOT TO THE NORTH OF SITE WHERE INCREASES ARE 5mm OR GREATER.

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

FILE: 15-000483-WSL01B.dwg DATE: 27-10-2015 TIME: 16:04
Xref's: X_15-000483_TITLE USR: chamindri samarakoon

AMENDMENTS	FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
	A	KO	SL	09.10.15	CLIENT FEEDBACK
	B	KO	KO	27.10.15	UPDATED FLOOD LEVELS
	C	MP	CH	10.09.18	UPDATED FLOOD MODELLING
	D				
	E				
	F				

DESIGN CHECK
DRAWN CHECK

SCALE (METRES)
1:2000 20 0 20 40 60 80 100 A1
1:4000 A3

MICROFILM No.

PROJECT No. 15-000483

APPROVED
ANDREW McPHAIL RPEQ 6921
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT: HALCYON

PROJECT: LOGAN RESERVE

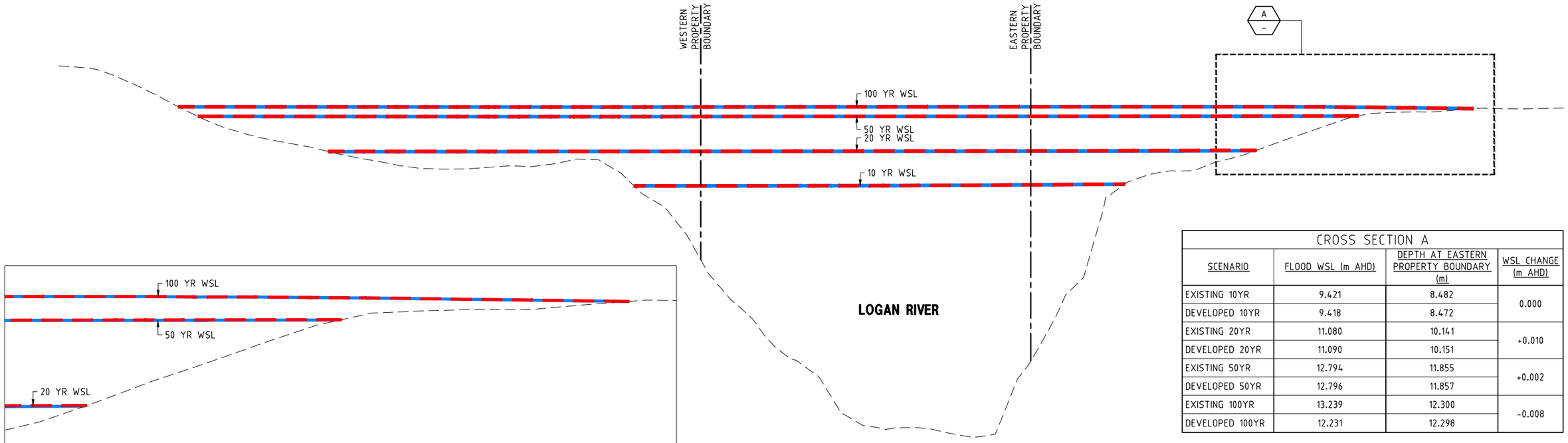
calibre CONSULTING

CONSULT AUSTRALIA
Calibre Consulting (QLD) Pty Ltd
Ground Floor, 240 Queen St, Brisbane QLD Australia 4000
Telephone: 07 3895 3444 Facsimile: 07 3895 3400
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast

DRAWING TITLE: FLOOD EXTENTS

DRAWING NUMBER: 15-000483-WSL01

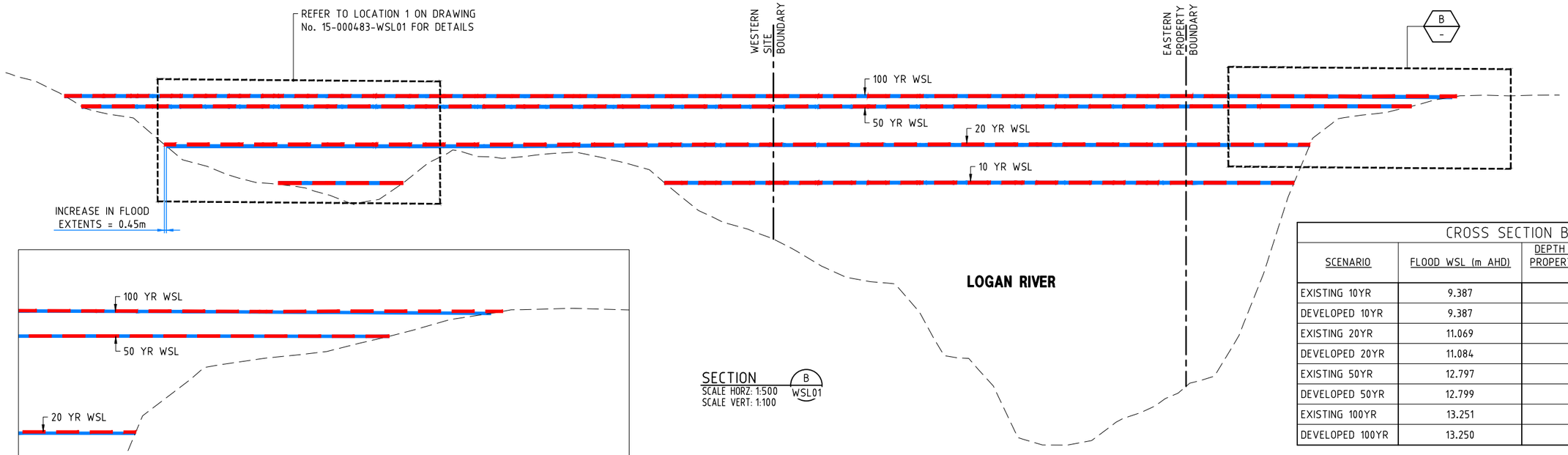
ISSUE: C



CROSS SECTION A			
SCENARIO	FLOOD WSL (m AHD)	DEPTH AT EASTERN PROPERTY BOUNDARY (m)	WSL CHANGE (m AHD)
EXISTING 10YR	9.421	8.482	0.000
DEVELOPED 10YR	9.418	8.472	
EXISTING 20YR	11.080	10.141	+0.010
DEVELOPED 20YR	11.090	10.151	
EXISTING 50YR	12.794	11.855	+0.002
DEVELOPED 50YR	12.796	11.857	
EXISTING 100YR	13.239	12.300	-0.008
DEVELOPED 100YR	12.231	12.298	

DETAIL A
SCALE (A1): 1:20
SCALE (A3): 1:40

SECTION A WSL01
SCALE HORZ: 1:500
SCALE VERT: 1:100



CROSS SECTION B			
SCENARIO	FLOOD WSL (m AHD)	DEPTH AT EASTERN PROPERTY BOUNDARY (m)	WSL CHANGE (m AHD)
EXISTING 10YR	9.387	9.071	0.000
DEVELOPED 10YR	9.387	9.071	
EXISTING 20YR	11.069	10.750	+0.015
DEVELOPED 20YR	11.084	10.764	
EXISTING 50YR	12.797	12.477	+0.002
DEVELOPED 50YR	12.799	12.479	
EXISTING 100YR	13.251	12.931	-0.001
DEVELOPED 100YR	13.250	12.930	

DETAIL B
SCALE (A1): 1:20
SCALE (A3): 1:40

SECTION B WSL01
SCALE HORZ: 1:500
SCALE VERT: 1:100

LEGEND:

EXISTING SURFACE

DESIGN SURFACE

EXISTING WATER SURFACE LEVEL (WSL)

DESIGN WATER SURFACE LEVEL (WSL)

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-000483-02.

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

FILE: 15-000483-WSL02.dwg DATE: 09-10-2015 TIME: 16:09
Xref's: X_15-000483_TITLE USR: Sam Linde

AMENDMENTS		CALCS	DRAWN	DATE	AMENDMENT DETAILS
FIRST ISSUE		KO	SL	08.10.15	
	A	KO	SL	09.10.15	CLIENT FEEDBACK
	B	KO	KO	27.10.15	UPDATED FLOOD LEVELS
	C	MP	CH	10.09.18	UPDATED LAYOUT
	D				
	E				
	F				

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)

1:20	0.2	0	0.2	0.4	0.6	0.8	1		A1
1:40									A3
1:100	1	0	1	2	3	4	5		A1
1:200									A3
1:500	10	5	0		10			20	A1
1:1000									A3

MICROFILM No.

PROJECT No. 15-000483

APPROVED
MATTHEW STARR RPEQ 9485
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT: HALCYON DEVELOPMENTS PTY LTD

PROJECT: 252 LOGAN RESERVE ROAD LOGAN RESERVE

calibre CONSULTING

CONSULT AUSTRALIA

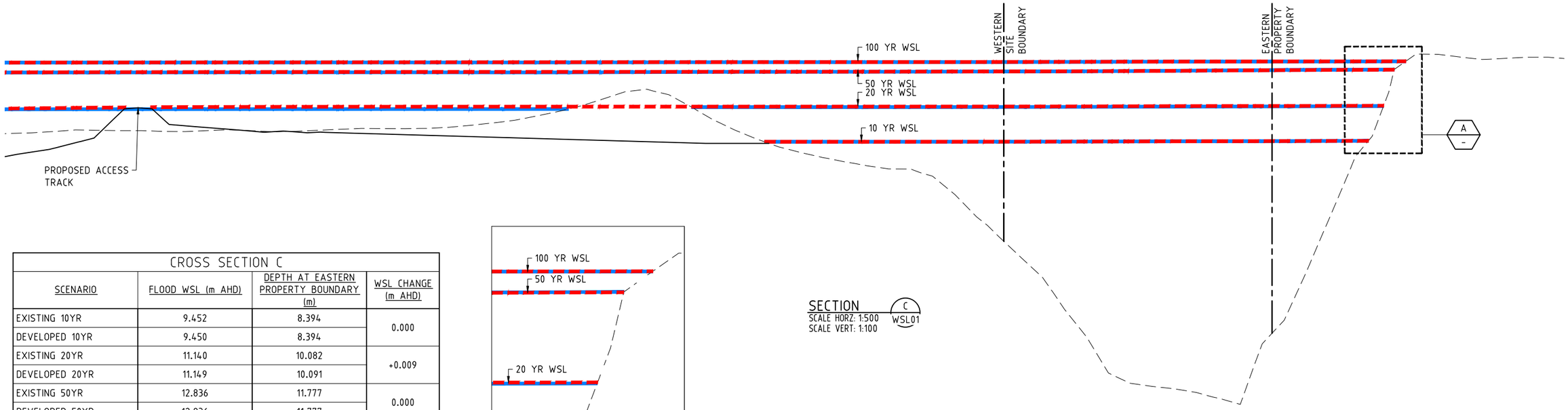
Calibre Consulting (QLD) Pty Ltd
Ground Floor, 545 Queen St, Brisbane QLD Australia 4000
Telephone: 07 3895 3444 Facsimile: 07 3895 3400
Brisbane Canberra Melbourne Sydney Singapore Christchurch

Quality Assurance Company ISO 9001 Lic-4981

DRAWING TITLE: LOGAN RESERVE CROSS SECTIONS SHEET 1 OF 2

DRAWING NUMBER: 15-000483-WSL02

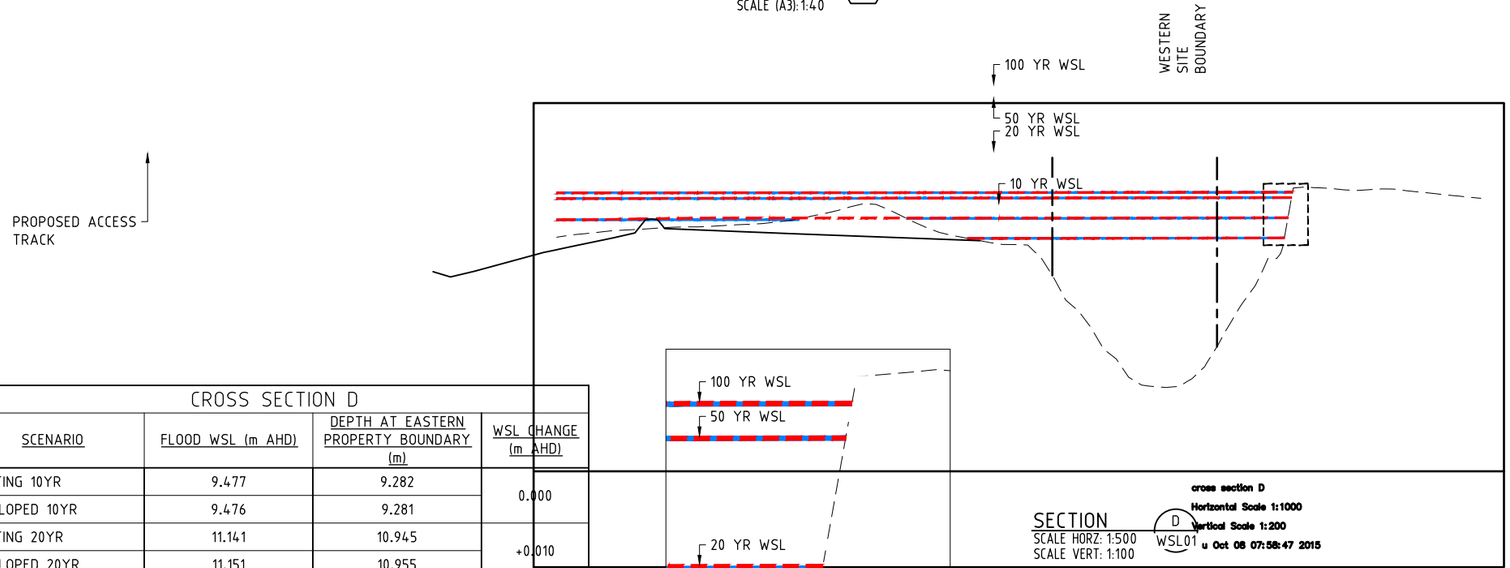
ISSUE: C



CROSS SECTION C			
SCENARIO	FLOOD WSL (m AHD)	DEPTH AT EASTERN PROPERTY BOUNDARY (m)	WSL CHANGE (m AHD)
EXISTING 10YR	9.452	8.394	0.000
DEVELOPED 10YR	9.450	8.394	
EXISTING 20YR	11.140	10.082	+0.009
DEVELOPED 20YR	11.149	10.091	
EXISTING 50YR	12.836	11.777	0.000
DEVELOPED 50YR	12.836	11.777	
EXISTING 100YR	13.328	12.270	+0.012
DEVELOPED 100YR	13.340	12.282	

DETAIL A
SCALE (A1): 1:20
SCALE (A3): 1:40

SECTION C WSL01
SCALE HORZ: 1:500
SCALE VERT: 1:100

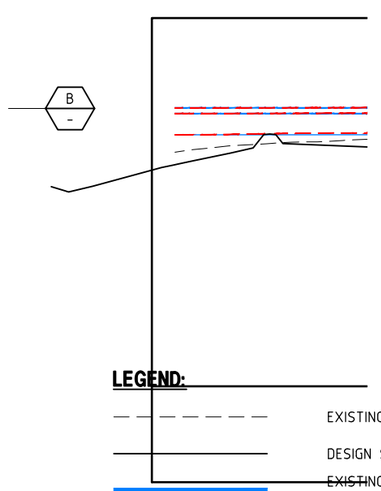


CROSS SECTION D			
SCENARIO	FLOOD WSL (m AHD)	DEPTH AT EASTERN PROPERTY BOUNDARY (m)	WSL CHANGE (m AHD)
EXISTING 10YR	9.477	9.282	0.000
DEVELOPED 10YR	9.476	9.281	
EXISTING 20YR	11.141	10.945	+0.010
DEVELOPED 20YR	11.151	10.955	
EXISTING 50YR	12.876	12.672	-0.001
DEVELOPED 50YR	12.866	12.671	
EXISTING 100YR	13.303	13.107	+0.005
DEVELOPED 100YR	13.308	13.112	

DETAIL B
SCALE (A1): 1:20
SCALE (A3): 1:40

SECTION D WSL01
SCALE HORZ: 1:500
SCALE VERT: 1:100

cross section D
Horizontal Scale 1:1000
Vertical Scale 1:200
u Oct 08 07:58:47 2015



LEGEND:

- EXISTING SURFACE
- DESIGN SURFACE
- EXISTING WATER SURFACE LEVEL (WSL)
- DESIGN WATER SURFACE LEVEL (WSL)

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-000483-02.

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

FILE: 15-000483-WSL03B.dwg DATE: 27-10-2015 TIME: 16:25
Xref's: X_15-000483_TITLE USR: chamindri samarakoon

AMENDMENTS	FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
		KO	SL	08.10.15	
	A	KO	KO	27.10.15	UPDATED FLOOD LEVELS
	B	MP	CH	10.09.18	UPDATED LAYOUT
	C				
	D				
	E				
	F				

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)

1:20	0.2	0	0.2	0.4	0.6	0.8	1		A1
1:40									A3
1:100	1	0	1	2	3	4	5		A1
1:200									A3
1:500	10	5	0	10			20		A1
1:1000									A3

MICROFILM No.

PROJECT No.
15-000483

APPROVED
ANDREW McPHAIL RPEQ 6921
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT
HALCYON

PROJECT
LOGAN RESERVE

calibre CONSULTING

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Brisbane Gladstone Melbourne Sydney Singapore Canada Coast
Quality Environment Occupancy ISO 9001 Lic 4884

DRAWING TITLE
LOGAN RESERVE
CROSS SECTIONS SHEET 2 OF 2

DRAWING NUMBER
15-000483-WSL03

ISSUE
B

APPENDIX F FLOOD HAZARD OVERLAY CODE RESPONSE

Performance outcomes	Acceptable outcomes	Solution[1]	Comments	Council Use Only
	(v) an adverse impact on the ability of traffic to use evacuation routes or unreasonably increase traffic volumes on evacuation routes; or (b) is located entirely within a development envelope area approved by an earlier development approval.			
For assessable development				
Risk to people and premises				
PO3 Development provides a development envelope area that is above the flood level during the defined flood event.	**AO3** Development provides a development envelope area above the flood level during the defined flood event with a minimum size and dimension specified in Table 8.2.5.3.2–Development envelope area.	✓	**SO3** The proposal provides a development envelope that is above the flood level during the defined flood event. Refer to Drawing No. **15-000483.03-101** for the development area and the *Flood Investigation Report* dated September 2018 prepared by Calibre Consulting (Report No. **15-000483-02C**) for additional information.	
PO4 Public safety and the environment are not adversely affected by floodwater by: (a) locating a Medium impact industry or High impact industry to be able to function safely during and immediately after flood events;	**AO4** Development: (a) for a Medium impact industry or High impact industry is above the flood level specified in column 2 of Table 8.2.5.3.3—Minimum flood levels;	**N/A**	**SO4** The proposal does not include medium or high impact industry or involve storing hazardous materials.	

Performance outcomes	Acceptable outcomes	Solution[1]	Comments	Council Use Only
(b) safely storing hazardous materials.	(b) involving the storage, sale or use of hazardous materials is located above the flood level during the defined flood event.			
PO5 A car park other than a Parking station is only located below the flood level during the defined flood event where there is no increase in risk to: (a) pedestrian and vehicular safety; (b) a building or other structure. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO5** No acceptable outcome provided.	✓	**SO5** All car parks will have 50 year and 100 year ARI flood immunity. Refer to the post-development flood plans in **Appendix D** of Calibre Consulting's *Flood Investigation Report* dated September 2018 (Report No. **15-000483-02C**).	
PO6 Development for any of the uses identified in column 1 of Table 8.2.5.3.3 – Minimum flood level, are able to function effectively during and immediately after flood events. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO6** Development for any of the uses identified in column 1 of Table 8.2.5.3.3 – Minimum flood levels is located above the flood level specified in column 2 of Table 8.2.5.3.3 – Minimum flood levels.	✓	**SO6** The development will be provided with appropriate flood immunity levels. Refer to the *Flood Investigation Report* dated September 2018 prepared by Calibre Consulting (Report No. **15-000483-02C**).	

Performance outcomes	Acceptable outcomes	Solution[1]	Comments	Council Use Only
Flood storage and discharge capacity				
PO7 An existing floodway is protected and maintained to ensure there are no losses of conveyance capacity of waterways and storage so as not to adversely affect other premises, infrastructure and the environment. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO7** No acceptable outcome provided.	**A/S**	**SO7** The proposed development requires filling in the floodplain area. However compensatory earthworks has been provided. Refer to Drawing No. **15-000483.03-101** in **Appendix D**. The earthworks will ensure there are no losses of conveyance capacity of waterways and storage so as not to adversely affect other premises, infrastructure and the environment.	
PO8 The natural conveyance of flood waters and natural overland flow paths are protected and maintained without adversely affecting adjoining premises. Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5—Infrastructure provides guidance to achieve this outcome.	**AO8** No acceptable outcome provided.	**A/S**	**SO8** The site is affected by Logan River flooding. The development will ensure that the natural conveyance of flood waters are protected & maintained without adversely affecting adjoining premises. Refer to the *Flood Investigation Report* dated September 2018 prepared by Calibre Consulting (Report No. **15-000483-02C**).	
PO9 Development (or development in combination with other development) for all flood events up to and including the	**AO9** No acceptable outcome provided.	**A/S**	**SO9** The development will not cause damage, cause ponding, adversely affect flood discharge capacity of the	

1. Solution: ✓ = Acceptable Solution
A/S = Alternative Solution
N/A = Not applicable to this proposal

Performance outcomes	Acceptable outcomes	Solution[1]	Comments	Council Use Only
defined flood event does not do any of the following: (a) cause or have the potential to cause damage; or (b) cause ponding of flood water; or (c) adversely affect the flood discharge capacity of the floodplain; or (d) decrease the flood resilience of properties and infrastructure; or (e) cause a cumulative increase in flood levels external to the premises. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.			floodplain, or decrease flood resilience of properties & infrastructure as discussed in the *Flood Investigation Report* dated September 2018 prepared by Calibre Consulting (Report No. **15-000483-02C**).	

1. Solution: ✓ = Acceptable Solution
A/S = Alternative Solution
N/A = Not applicable to this proposal

Performance outcomes	Acceptable outcomes	Solution[1]	Comments	Council Use Only
PO10 Any loss of floodplain storage is compensated with compensatory storage or excavation that: (a) is of equal volume, creating a balance of cut to fill; (b) is free draining; (c) is located within the premises; (d) does not adversely affect the hydraulic conveyance capacity of the flood channel or floodplain; (e) is provided to the corresponding flood level; (f) is landscaped to provide visual amenity and erosion control; (g) is solely for the purpose of compensatory storage. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO10** No acceptable outcome provided.	**A/S**	**SO10** Compensatory earthworks has been provided. Refer to Drawing No. **15-000483.03-101** in **Appendix D** for concept earthworks drawing. The concept design demonstrates that there will be an additional 2,878m³ flood storage outside of the development and within the site.	
PO11 Development does not adversely change the following flood characteristics for all flood events up to and including the defined flood event: (a) peak flow;	**AO11** No acceptable outcome provided.	**A/S**	**SO11** On-site detention basins will be provided to ensure the development does not change the peak flow, flow of any part of the flood before the peak or change the flood time to peak.	

1. Solution: ✓ = Acceptable Solution
A/S = Alternative Solution
N/A = Not applicable to this proposal

Performance outcomes	Acceptable outcomes	Solution[1]	Comments	Council Use Only
(b) flow of any part of the flood before the peak; (c) flood flow velocity; (d) level of flooding; (e) flood time to peak. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.			The flood impact plans in **Appendix E** demonstrate that post-development flow velocities are similar to the pre-development conditions. Refer to *Flood Investigation Report* dated September 2018 prepared by Calibre Consulting (Report No. **15-000483-02C**).	
PO12 A stormwater quality improvement device is located to retain existing flood plain storage capacity and ensure functionality of the stormwater quality improvement device.	**AO12** A stormwater quality improvement high flow outlet device is located: (a) above the five percent AEP flood event caused by local flooding; (b) above the two percent AEP flood event caused by regional flooding.	✓	**SO12** The proposal complies. Stormwater quality improvement devices will be provided and they will be located above the 50 year ARI (2% AEP) regional flood level. Refer to *Concept Site Based Stormwater Management Plan* dated September 2018 (Report No. **15-000483-01D**) prepared by Calibre Consulting.	
PO13 A stormwater quantity management device is located to retain existing flood plain storage capacity and ensure functionality of the stormwater quantity management device.	**AO13** A stormwater quantity management high flow outlet device is located above the two percent AEP flood event.	✓	**SO13** As above.	

Performance outcomes	Acceptable outcomes	Solution[1]	Comments	Council Use Only
Filling and excavation				
PO14 Filling and excavation is carried out above the flood level of the 10 percent AEP event to protect in stream and banks of a waterway and wetland. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO14.1** Earthworks are limited to areas where: (a) flooding is predominately due to backflow; (b) the peak depth average velocity is less than the maximum permissible velocity for considerable bare earth channels (typically 0.5m/sec) in accordance with Table 9.0.5.3 of the Queensland Urban Drainage Manual; (c) the cut/fill batter is not steeper than 1V:4H and the exposed earth surface is landscaped with erosion resistant vegetation cover.	**A/S**	**SO14.1** The majority of the earthworks is retained to above the 10 year ARI flood level, except for a small portion in northeast corner of the development. Although it encroaches the 10 year ARI flood level marginally, the hydraulic modelling results demonstrate the 10 year ARI flood conditions are not affected.	
	AO14.2 A filling and excavation plan is provided in accordance with section 2.2.2 of planning scheme policy 5–Infrastructure.	✓	**SO14.2** Refer to Drawing No. **15-000483.03-101.**	
Access				
PO15 Development provides vehicular access to a road network that is sufficient to enable safe access and egress. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO15** Development provides vehicular access to a road that is: (a) above the flood level during the defined flood event; or (b) below the flood level during the defined flood event where the road: (i) has a low flood hazard;	✓	**SO15** The proposal complies. The site access will be from Logan Reserve Road that is above the 100 year ARI flooding.	

Performance outcomes	Acceptable outcomes	Solution[1]	Comments	Council Use Only
	(ii) remains trafficable until another road access to the development becomes trafficable; (iii) directly connects to a road that is above the defined flood event that provides access to the road network.			
PO16 Development provides an access area to a building or fill area on which a building is to be constructed where the access is located on land classified as a low flood hazard in the defined flood event.	**AO16** Development provides access to a building or fill area that has: (a) a maximum depth of inundation of 300 mm during all flood events up to and including the defined flood event; (b) a maximum distance of inundation of 200 metres during all flood events up to and including the defined flood event; (c) a depth multiplied velocity product of less than or equal to 0.4m^2/s. Note—Velocity in flood waters is measured as the average velocity over a column of water.	✓	**SO16** The proposal complies. The development area will be located above the 100 year ARI flood level.	

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