



CIVIL ENGINEERING SITE BASED STORMWATER MANAGEMENT PLAN

PROPOSED DEVELOPMENT

PROPOSED LOT 102

FLAGSTONE LOGISTICS ESTATE

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1 INTRODUCTION AND SCOPE

1.1 Introduction

This Site Based Stormwater Management Plan (SBSMP) has been prepared on behalf of CH Hydrangea Pty Ltd (Applicant) in support of a development application over land at 4499-4651 Mount Lindesay Highway, North MacLean QLD 4280 and described as Lot 39 on SP258739 (site). This Priority Development Area (PDA) Development Application seeks approval from the Minister of Economic Development Queensland for the following aspects of development:

- Development Permit for Reconfiguring a Lot (ROL) - 1 into 6 Lots plus access easement; and
- Development Permit for a Material Change of Use (MCU) for Warehouse (Distribution Centre)

This Site Based Stormwater Management Plan (SBSMP) has also been prepared on behalf of the Applicant to support the proposed material change of use aspect of development located over part of the site (Proposed Lot 102).

The site is located on the proposed Lot 102 at 4499-4651 Mount Lindesay Hwy, North MacLean QLD 4280. The site is located on the corner of Crowson Lane and Mount Lindesay Highway within the Greater Flagstone EDQ Priority Development Area (PDA) and Logan City Council (LLC) Local Government Area (LGA). The proposed development is for the construction of a warehouse and associated hardstand area, office area, and car parking.

Works involve construction of a single level warehouse building with ancillary office space, truck circulation and loading/unloading areas and associated car parking, and stormwater management for the site.

This SBSMP provides a summary of the design principles and planning objectives for stormwater management for the development. The stormwater management has been prepared to demonstrate that the requirements of the Queensland State Planning Policy 2017 have been met. The plan demonstrates that the water quality and water quantity criteria will be satisfied for the site.

The site falls within the boundaries of the Logan City Council (LCC) Local Government Area and therefore the stormwater management and civil engineering design is also consistent with the Water Sensitive Urban Design, Technical Design Guidelines for Southeast Queensland (2006).

The site is also part of the previously approved Priority Development Area (PDA) Development Approval DEV2018/961 and subsequent modification DEV2018/961/4 dated 2 August 2023. Reference should be made to the Queensland Government PDA approval and the *Site Based Stormwater Management Plan (Quantity)* referenced EAG001-30109334-AAR dated 19 June 2024 and *Site Based Stormwater Quality Management Plan* referenced EAG003-30109334-AAR dated 16 February 2024 prepared by Arcadis for the overall Flagstone Logistics Estate.

1.2 Consultation

Considerations in accordance with requirements by affected stakeholders has been made in relation to the development during the assessment period. The Minister of Economic Development Queensland has included a *Further Issues Letter* for this development (refer **Appendix F**).

Table 1.1 provides a summary of response to the Further Issues Letter which relates to flooding and stormwater.

Table 1.1. Key Consideration from Further Issues Letter

Item No	Consideration	How it is Addressed	Location within this Report
9a	Provide evidence that proposed sizing strategy of detention tank is consistent with Arcadis modelling intent.	A preliminary hydrological assessment has been made for the site. Preliminary design for an On-Site Detention (OSD) system has been sized in accordance with the catchment modelling completed by Arcadis. The OSD system on proposed Lot 102 has been confirmed via DRAINS modelling completed by Costin Roe.	Refer to Section 6.2 for details regarding the proposed OSD tank.
9b	Provide details on detention tank outlet pipe size, scour protection details, invert level and whether this detention tank configuration will achieve free drainage conditions.	On-site detention system sizing is based on hydrological modelling completed by Arcadis for catchment INTNL-2WC to determine the minimum OSD tank size required. Primary discharge (up to the 100-yr flow or 1% AEP flow) is via an existing open flow channel along the south-eastern boundary through a headwall. Secondary discharge (up to the 100-yr ARI flow or 1% AEP flow) is via an existing manhole connection along the north-eastern boundary of the site. Primary discharge (i.e. channel) will be designed to cater for the all flows up to the 10-yr flow or 10% AEP flow. No flows are expected to discharge through the secondary discharge point (i.e. road) up to and including the 10-yr flow or 10% AEP flow. The proposed discharge location to the open flow channel is achieving free drainage conditions and is documented on the Arcadis drawings as Structure 1/65. Scour protection details is in the form of a rock apron as	Refer to Section 6.2 for details regarding discharge point and proposed OSD details. Refer to Arcadis drawing 30109334-AAP-P301OP-CV-DRG-0444 for invert levels. Refer to Arcadis drawing 30109334-AAP-P301OP-CV-DRG-0215 for scour protection details.

		shown on drawing 30109334-AAP-P301OP-CV-DRG-0215. No additional scour protection is proposed nor required as part of this application. The invert level at discharge point is noted to be IL 23.55 as shown on the Arcadis drawing 30109334-AAP-P301OP-CV-DRG-0444.	
9c	Confirm the size rainwater tanks given this forms part of treatment strategy.	Rainwater harvesting is proposed for this development with re-use for non-potable applications. The aim is to reduce the water demand for the development, not stormwater treatment. Sizing of rainwater tanks has not been undertaken and will be defined in future detail design based on a water balance assessment.	Refer to Section 5.1 for treatment strategy and Section 5.3 for rainwater tank requirements.

2 SITE CHARACTERISTICS

2.1 Location

The proposed development is located on proposed Lot 102 at 4499-4651 Mount Lindesay Hwy, North MacLean QLD 4280 in the suburb of North Maclean as shown in **Figure 2.1**.

The proposed Lot 102 development is part of the Flagstone Logistics Estate which is bounded by Crowson Lane to the North and Mount Lindesay Highway to the East and adjoining rural properties to the South and West.

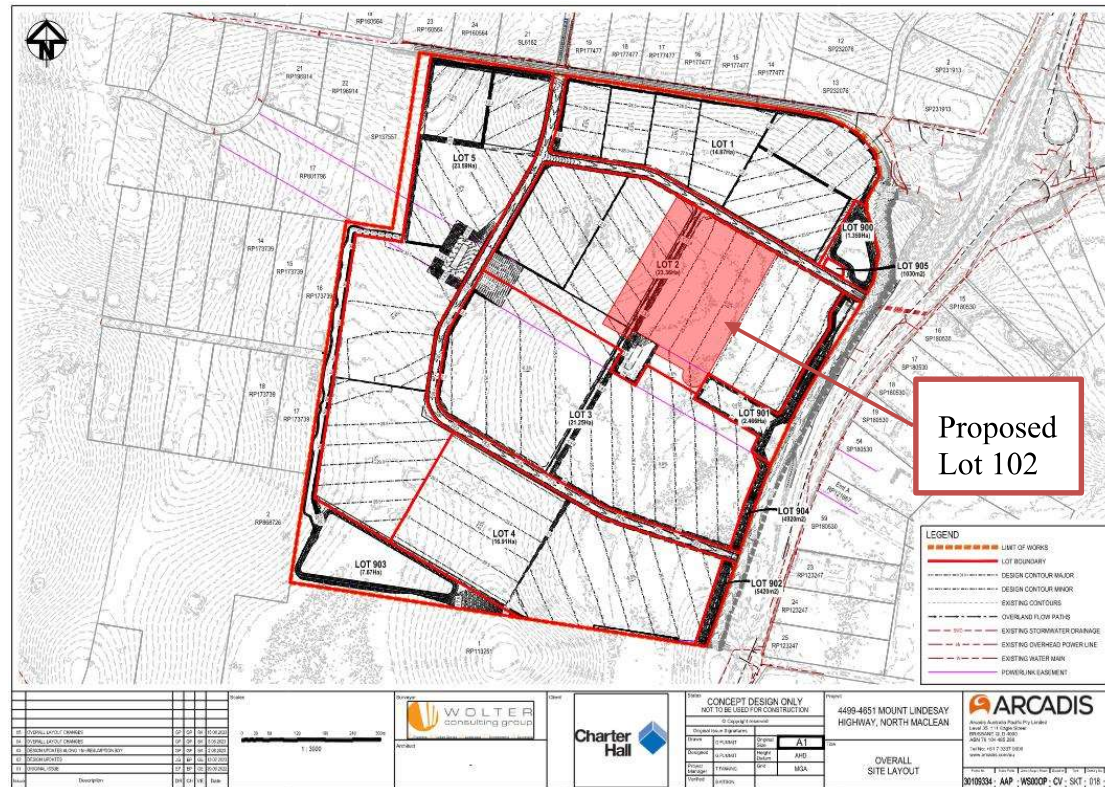


Figure 2.1. Locality Map (Source: Arcadis, August 2023)

2.2 Proposed Development

The proposed development is for a single level warehouse, along with associated truck loading and circulation hardstands, ancillary office (two storeys) and car parking areas. The indicative layout for the development produced by Watson Young has been included in **Figure 2.2**.

The proposed site comprises parking area and office spaces along the northern portion of the site. Hardstands for truck loading/unloading are proposed to the eastern and western portion of the site. Truck circulation will also be provided through the southern area of the site. Access into the site will be provided via crossovers proposed along the new Estate Road to the north as shown in the below figure.

Civil works will include minor earthworks to suit the proposed building layout and external falls, stormwater drainage, retaining walls and pavements.

2.5 Flooding

As part of the infrastructure works approved under DEV2018/961/4 dated 2 August 2023, the existing flood ways are proposed to be re-aligned to ensure the development lots are free of flooding. Reference should be made to the flood modelling completed by Arcadis in the *Site Based Stormwater Management Plan (Quantity)* referenced EAG001-30109334-AAR dated 19 June 2024.

In addition to the above, reference should also be made to the Technical Local Planning Instruments (TPLI) flood memo prepared by Arcadis titled *Flagstone Estate: LCC TLPI No. 1/2023 Response – Flood Overlay Code* (EAG001-30109334-AAR-02 TLPI Technical Note Rev 02) dated 1 March 2024 which provides a better definition of the flood hazard mapping for this development. In particular, the TPLI flood memo addressed the changes in the flood mapping as a result of the proposed level changes (approved bulk earthworks) on Lot 39.

2.6 Proposed Stormwater Drainage System

As per general engineering practice and the guidelines of EDQ & LCC, the proposed stormwater drainage system for the development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development.

The piped drainage system has been designed to accommodate all storms up to and including the 1 in 100-year ARI storm event (Q100). Refer to **Section 6** for further discussion on water quantity management.

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, the standards of LCC and accepted engineering practice. Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage. Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication “Australian Rainfall and Runoff” (2019 Edition), Volumes 1 and 2 (AR&R).

The proposed development intends to discharge minor flows to proposed channel (proposed Lot 901) through an OSD tank on Southeast of the site. An existing manhole connection F1/61 (Refer to FLAGSTONE LOGISTICS ESTATE – STAGE 1 by Arcadis, Drawing No: 30109334-aap-p301op-CV-DRG-0206) is to be used to discharge minor flows to the channel. The major flows will be discharged to proposed road drainage network (Estate Road) via an existing manhole connection F1/75 (Refer to FLAGSTONE LOGISTICS ESTATE – STAGE 1 by Arcadis, Drawing No: 30109334-aap-p301op-CV-DRG-0201). Reference should be made to drawing **Co14547.03-DA400** included in **Appendix A** for details.

Specific drainage elements and description of the drainage system are as follows:

The proposed development and access road will discharge to separate underground on-site detention tanks prior to connecting to the open channel (proposed Lot 901) on the east. The primary discharge connection into the open channel has been sized to accommodate flows up to the 1 in 10 year ARI storm event (Q10). A secondary discharge connection is proposed to discharge into to the road drainage network on the north-east of the development site which caters for flows above the 1 in 10 year ARI storm event (Q10) and up to the 1 in 100 year ARI storm event (Q100). The stormwater detention tanks will also incorporate treatment chambers to meet the Watler Quality requirements in accordance with Chapter 2 of the *DRAFT Best Practice Management Guidelines – Urban Stormwater (DERM 2009)* for South East Queensland and Logan City Council.

Surface water in hardstand, parking and storage areas are conveyed to the underground stormwater tanks. Pre-treatment of surface water will also be provided using pit inserts in all surface inlet pits and some roofwater collection pits. These will remove gross pollutants from the system and prevent the overloading of the filtration cartridges within the stormwater tank chamber. Further discussion on the water quality provisions has been made in **Section 4** and **Section 5** of this report.

The proposed stormwater layout is shown on drawing **Co14547.03-DA400**.

3 STORMWATER MANAGEMENT OBJECTIVES

In order to meet the requirements of State Planning Policy 2017 (SPP 2017), relevant water quality objectives were defined based on the best practice guidelines nominated in Appendix 2 of SPP 2017.

The guideline considers two criteria as described below:

Stormwater Quality Management (refer **Section 5**)

There is a need to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on the receiving waters. The proposed water quality measures noted following will focus on the proposed warehouse facility.

The required load-based reduction targets for the development can be seen below:

Gross Pollutants	90%
Total Suspended Solids	80%
Total Phosphorus	60%
Total Nitrogen	45%
Total Hydrocarbons	90%

The required level of pollutant removal meets the load-based reduction targets adopted by EDQ & Logan City Council.

Stormwater Quantity Management (refer **Section 6**)

The intent of this criterion is to reduce the impact of urban development to ensure the cumulative effect of development does not have a detrimental effect on the existing stormwater infrastructure and watercourses located within their LGA downstream from the particular site.

The proposed management system for this development adopts the stormwater quantity strategy proposed in the Arcadis SBSMP (Report no: EAG001-30109334-AAR, Revision 12 dated 19 June 2024).

The requirements for on-site detention will be discussed in **Section 6** of this report.

4 WATER QUALITY CONTROLS FOR CONSTRUCTION PHASE

4.1 Background

During the construction phase of the development, an Erosion and Sediment Control Program will be implemented to minimise water quality impacts. A detailed Erosion and Sediment Control Program will be employed throughout the site. A site layout and typical details can be seen on drawings prepared by Arcadis in **Appendix D**. The program shall include measures such as silt fences, cut-off drains for polluted stormwater and diversion channels for clean stormwater run-off.

The following sections provide information to identify controls and procedures that will be incorporated into the Erosion and Sediment Control program.

4.2 Pre-Construction

The following minimum requirements are to be met prior to commencement of construction:

- Sediment fences are to be constructed on the upstream edges of the designated buffer strips and at the base of fill embankments.
- Areas for plant and construction material storage are to be designated along with associated drains and spillage holding ponds.
- Diversion banks are to be created at the upstream boundaries of construction activities to ensure upstream runoff is diverted around any exposed areas. Catch drains are to be created at the downstream boundary of construction activities.
- Silt fences and/or sand bags are to be placed along the catch drains to slow flow, reduce scour and capture some sediment from runoff.
- Construction of temporary sediment basins.
- Site personnel are to be educated to the sediment and erosion control measures implemented on site.

4.3 During Construction

The following minimum requirements are to be met during construction:

- Progressive re-vegetation of filled areas and filled batters.
- Construction activities are to be confined to the necessary construction areas.
- The provision of a construction exit (truck shaker) to minimise the tracking of debris from tyres of vehicles leaving the site onto public roads. Only one construction exit will be nominated to limit the movement of construction equipment.
- Topsoil and temporary stockpile location will be nominated to coincide with areas already disturbed. A sediment fence is to be constructed around the downstream side of the stockpile and a diversion drain at the upstream side if required.
- Regular inspection and maintenance of silt fences, sediment basins and other erosion control measures are to be made. Following rainfall events greater than 50mm inspection of erosion control measures and removal of collected material should be undertaken. Replacement of any damaged measures should be performed immediately.

4.4 Post Construction

The following minimum requirements are to be met post construction:

- The contractor/ developer will be responsible for the maintenance of erosion and sediment control devices from the possession of the site until the site is accepted “Off Maintenance” or until stabilisation has occurred to the satisfaction of the superintendent and council.
- Key stormwater areas requiring maintenance for operational phase of the project following construction are piped stormwater system, OSD tank, field inlet pit inserts. **Section 5** and **Appendix C** further details the requirements for maintenance.

5 WATER QUALITY CONTROLS FOR OPERATIONAL PHASE

5.1 Proposed Stormwater Treatment Measures

Stormwater Quality Improvement Devices (SQID's) are proposed for the development site. The SQID's have been sized to treat the run-off collected by the newly paved, roofed and landscaped areas.

Stormwater generated from roofs, paved surface areas (truck loading and circulation areas, car parking, landscaped areas etc) will be conveyed via crossfall and a pit and pipe system to the stormwater treatment system proposed at the east of the site. Pre-treatment of surface water will be achieved at-source via pit inserts for all pits in hardstand and parking areas. This will reduce the potential for overloading of the tertiary stormwater treatment cartridges, removing suspended solids, some nutrients and gross pollutants prior to stormwater entering the treatment tank.

Following pre-treatment of surface water runoff via pit inserts, tertiary treatment of the stormwater runoff is provided by Stormfilters within the on-site detention tank.

The location and extent of proposed on-site detention tank and Stormfilters have been shown on drawing **Co14547.03-DA400**.

5.2 Water Quality Modelling

5.2.1 Introduction

MUSIC modelling software has been released by the Cooperative Research Centre for Catchment Hydrology (CRCCH) and is a standard industry model for this purpose. MUSIC (the *Model for Urban Stormwater Improvement Conceptualisation*) is suitable for simulating catchment areas of up to 100 km² and utilises a continuous simulation approach to model water quality.

By simulating the performance of stormwater management systems, MUSIC can be used to predict if these proposed systems and changes to land use are appropriate for their catchments and are capable of meeting specified water quality objectives (CRC 2002). The water quality constituents modelled in MUSIC and of relevance to this report include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN). A diagram of the model is located in **Appendix B**.

The MUSIC model "*14547.03_Rev2 (OP EDIT).sqz*" was set up to examine the effectiveness of the water quality treatment train and to determine if LCC requirements have been achieved for the proposed development. The layout of the MUSIC model is presented in **Appendix B**.

5.2.2 Model Parameters

Pollutant loads for industrial land use areas (split catchment) in South East Queensland have been adopted based on the Water by Design MUSIC Modelling Guidelines, 2010. This information was used to create the source nodes used in the MUSIC model for roofed, landscaped and paved areas.

5.2.3 Source Nodes

The MUSIC model has been setup with a treatment train approach the catchments shown in **Table 5.1** below.

Catchment	Area (Ha)	Source Node	% Impervious	Stormwater Treatment
Roof-Warehouse	4.70	Roof	100	Filters
Paved Area	2.39	Paved	95	OG + Filters
Access Road	0.47	Sealed road	100	OG + Filters
Total	7.56			

Table 5.1. MUSIC Source Node Catchments

5.2.4 Treatment Nodes

Gross pollutant trap (GPT), rainwater tank and filtration devices nodes have been used in the modelling of the development.

Gross Pollutant Trap (GPT) – OceanGuard (x52)

Parameter	Value
Low Flow Bypass	0
High Flow Bypass	0.80 m ³ /s per OG
Pollutant	Input (mg/L) Output (mg/L)

To Ocean Protect Specifications

Generic Treatment Node – Stormfilters (PSORB) (x95)

Parameter	Value
Low Flow Bypass	0
High Flow Bypass	0.113 m ³ /s
Pollutant	Input (mg/L) Output (mg/L)

To Ocean Protect Specifications

The water quality devices proposed for this development are proprietary devices such as Ocean Protect Stormfilters or approved equivalent. The proposed water quality devices meet the requirements of the QUDM and have been proven to achieve the percentage removal rates adopted for the MUSIC modelling. Reference should be made to the Ocean Protect “A Review of the application of Stormfilter in Australia” (2021) which provided an analysis of the application of Stormfilter technology as a stormwater treatment asset within Australia.

We understand that Stormfilters are currently in the process of being approved as a SQIDEP product. We note that the proprietary filters may also be changed to the SPEL Filter (now Atlan Filter) product which is SQIDEP approved.

5.2.5 Results

Table 5.2 shows the results of the MUSIC analysis. The reduction rate is expressed as a percentage and compares the post-development pollutant loads without treatment versus post-development loads with treatment.

	Source	Residual Load	% Reduction	Criteria Satisfied?
Flow (ML/yr)	80.3	80.3	0	n/a
Total Suspended Solids (kg/yr)	8210	1100	86.6	Y
Total Phosphorus (kg/yr)	21	8.26	60.7	Y
Total Nitrogen (kg/yr)	194	103	46.9	Y
Gross Pollutants (kg/yr)	1880	0	100	Y

Table 5.2. MUSIC analysis results

It can be seen from the results of the MUSIC analysis that the proposed SQID's have been predicted to reduce the pollutants present in the collected run-off to levels which will meet council's percentage reduction in pollutants.

We note that pollutants which are not measured in MUSIC modelling, such as heavy metals, are typically found to be attached to suspended solids and sediments. The MUSIC modelling demonstrates that the proposed SQIDS's with their high treatment efficiencies for suspended solids will effectively remove these heavy metals and attached pollutants from the collected stormwater runoff.

Hydrocarbon removal is also not measured in the MUSIC software. Hydrocarbons are typically attached to fine sediments, and it is well documented that significant hydrocarbon removal will be facilitated by the capture of fine sediment in the pit inserts and within the storm filters.

5.3 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Runoff from the stormwater drainage system can be classified as either rainwater, where the flow is from roof areas only, or stormwater, where the flow is from all areas of the development.

Rainwater harvesting is proposed for this development with re-use for non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation. The aim is to reduce the water demand for the development.

Sizing of rainwater tanks has not been undertaken. These would be defined in future detail design based on a water balance assessment.

In general terms the rainwater harvesting systems are expected to comprise an in-line tank for the collection and storage of rainwater. At times when the rainwater storage tank is full rainwater can pass through the tank and continue to be discharged via gravity into the stormwater drainage system. Rainwater from the storage tank will be pumped for distribution throughout the development in a dedicated non-potable water reticulation system. This however would be, as noted, subject to future detail design.

5.4 Stormwater System Maintenance and Monitoring

A maintenance and monitoring schedule has been prepared for the components of each of the SQID's and overall drainage system (Refer **Appendix C**).

At a minimum, the SQID's are to be inspected at 3 month intervals or following any major storm event for the first year of operation and at 4 month intervals (or as noted in the schedule) for the second year of operation. Details of the type and amount of pollutants are to be logged, with the details kept on site. Upon completion of the first two years of operation, if required, the maintenance schedule can be adjusted to suit site conditions based on the recommendations of the manufacturer and the logged data, with cleaning and removal of trapped pollutants from the devices.

5.5 Management & Handover Procedures for SQID's

In the event of change of tenancy or other event which requires a handover of the management responsibility of the SQID's, the following minimum measures are recommended:

- The new management is to be supplied with an approved maintenance plan and inspection form for the SQID's.
- The new management is to be supplied with costings to support the maintenance plan (e.g., cost per cleanout, cost per annum).
- The new management is to be supplied with as built drawings and specifications of the stormwater quality improvement devices.
- The quality improvement device must be handed over in a well maintained condition that is consistent with the relevant Council development conditions and the maintenance plan.
- A handover meeting is to take place between the asset owner, previously responsible maintenance personnel and the new management.

6 STORMWATER QUANTITY MANAGEMENT

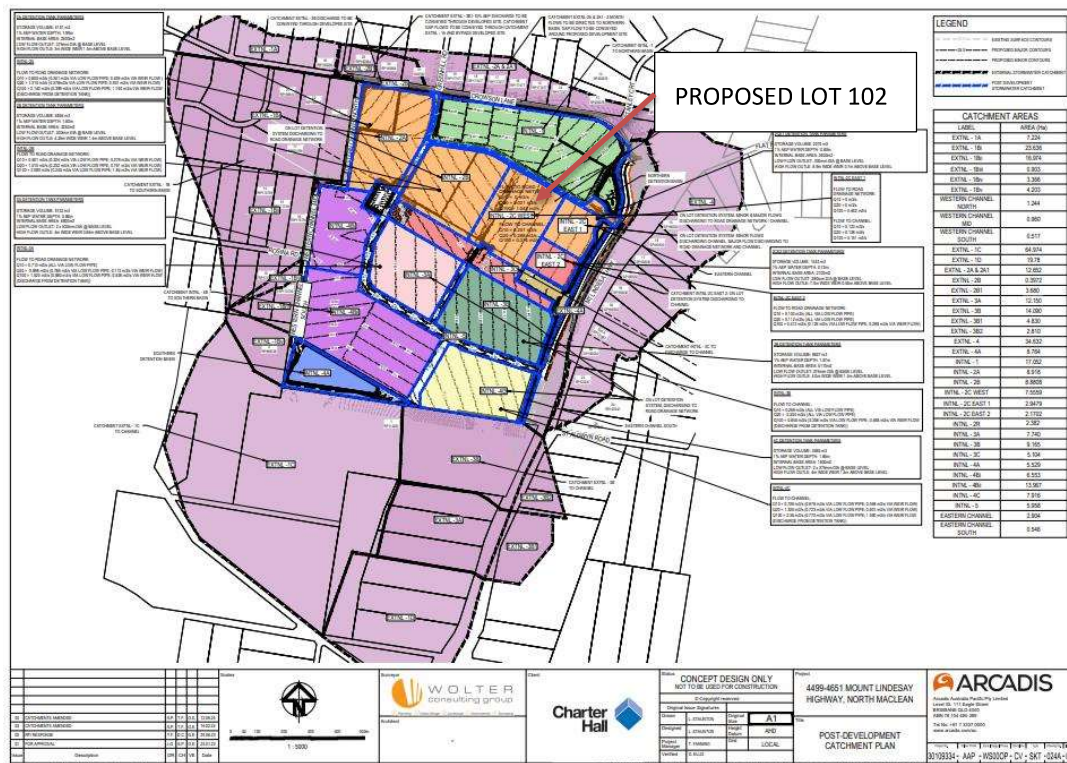
6.1 General Design Principles

Water quantity management is required to be considered as part of development in the EDQ PDA and Logan City Council LGA.

Logan City Council policy requires consideration of stormwater quantity management with the intent of minimising flooding from the increased stormwater run-off due to the development. Water quantity management may be made by providing a stormwater detention system (i.e. on-site detention), to limit the runoff discharged from private property or to provide an assessment which confirms on-site detention is not necessary for the development.

Management of Stormwater Quantity has been considered for the overall Flagstone Logistics Estate as part of the SBSMPQ prepared by Arcadis referenced *EAG001-30109334-AAR* dated 19 June 2024.

This development site forms part of the approved SBSMPQ assessment completed by Arcadis. The proposed Lot 102 development site falls within the sub-catchment INTNL-2C West in the overall estate as shown in **Figure 6.1**.



6.2 Proposed On-Site Water Quantity Management

A preliminary assessment has been undertaken to determine water quantity measures on site in accordance with Arcadis' catchment stormwater quantity modelling. A storage volume of 4,883m³ has been determined as the minimum required storage for the catchment INTNL-2CW for a catchment of 7.56 Ha.

The nominated combined OSD and water quality tank design for the proposed development at Lot 102 has the following parameters:

- Minimum Storage Volume required = 4,883m³
- Storage Volume provided = 4,950m³

Two OSD tanks have been proposed for Lot 102 for the warehouse and access road respectively, as follows:

On-Site Detention Tank 1 – Proposed Warehouse

- Storage Volume provided = 4,600m³
- Base I.L 23.85 mAHD and top of wall R.L 26.50 mAHD
- 450mm dia outlet at IL. 23.70 mAHD.

On-Site Detention Tank 2 – Proposed Access Road

- Storage volume provided = 350m³
- Base I.L. = 23.60 mAHD and top of wall RL 25.00 mAHD
- 300mm dia outlet at IL. 23.58 mAHD.

Refer to drawing **CO14547.03-DA400** for the indicative drainage layout plan.

The required detention storage volume has been confirmed via DRAINS modelling in accordance with the information provided in the Arcadis SBSMP.

7 CONCLUSION

This *Site Based Stormwater Management Plan* has been prepared for the proposed warehouse development at Lot 102 on the Flagstone Logistics Estate. A stormwater quantity and quality management strategy has been developed to reduce pollutant loads in stormwater leaving this site in accordance with *Logan City Council Planning Scheme (2015)* and *State Planning Policy 2017*, and which ensures no increase in water quantity as a result of the development.

The stormwater management assessment has considered both stormwater quality and quantity.

- **Stormwater Quality**

During the construction phase, an Erosion and Sediment Control Plan will be in place which ensures the downstream drainage system and receiving waters are protected from sediment laden runoff.

During the operational phase of the development, a treatment train incorporating the use of pit inserts on lot for primary stormwater treatment, and tertiary treatment being performed by filtration cartridges is proposed. The measures implemented will mitigate the likely increase in stormwater pollutant load generated by the development.

Best Management Practices have been applied to the development to ensure that the quality of stormwater runoff is not detrimental to the receiving environment.

- **Stormwater Quantity**

During the operational phase of the development, an on-site detention system will be provided to ensure no increase in water quantity as a result of the development.

Given the above, it can be concluded that the stormwater management for the development has been designed in accordance with the EQD requirements, the *Logan City Council Planning Scheme (2015)* and *State Planning Policy 2017 (SPP 2017)* for both construction and operational phases.

8 REFERENCES

Australian Standards, "AS 3500.3.2003, Plumbing and drainage, Part 3: Stormwater Drainage"

Logan Planning Scheme (2015), Logan City Council

The Queensland State Planning Policy (SPP 2017),

Healthy Waterways Partnership's Water by Design MUSIC Modelling Guidelines – Consultation Draft 2018.

The Queensland Urban Drainage Manual (QUDM)

Economic Development Queensland (EDQ) PDA guidelines

Environmental Protection (Water) Policy (2009)

Healthy Waterways (2010), "Deemed to Comply Solutions – Stormwater Quality Management (South East Queensland)"

Healthy Waterways (2006), "Water Sensitive Design Technical Design Guidelines for South East Queensland"

Institution of Engineers Australia, "Australian Rainfall & Runoff, 2019"

Landcom, "Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition, March 2004"

Natural Resources and Water, Queensland Government, "Queensland Urban Drainage Manual, 2008"

APPENDIX A

COSTIN ROE CONSULTING PTY LTD DRAWINGS

PROPOSED LOT 102, FLAG STONE LOGISTICS ESTATE

NORTH MACCLEAN, QLD, 4280

CIVIL DESIGN DEVELOPMENT APPLICATION

DRAWING LIST

DRAWING NO	DRAWING TITLE
C014.54.7.03-D-0100	DRAWING LIST AND GENERAL NOTES
C014.54.7.03-D-0200	EROSION & SEDIMENT CONTROL PLAN
C014.54.7.03-D-0250	EROSION & SEDIMENT CONTROL DETAILS SHEET 1
C014.54.7.03-D-0251	EROSION & SEDIMENT CONTROL DETAILS SHEET 2
C014.54.7.03-D-0300	BULK EARTHWORKS PLAN
C014.54.7.03-D-0351	BULK EARTHWORKS SECTIONS
C014.54.7.03-D-0400	STORMWATER DRAINAGE PLAN
C014.54.7.03-D-0450	STORMWATER DRAINAGE DETAILS SHEET 1
C014.54.7.03-D-0451	STORMWATER DRAINAGE DETAILS SHEET 2
C014.54.7.03-D-0500	FINISHED LEVELS PLAN
C014.54.7.03-D-0551	POWERLINK OVERHEAD POWERLINE SECTION
C014.54.7.03-D-0552	POWERLINE EASEMENT CLEARANCE PLAN & SECTIONS
C014.54.7.03-D-0553	POWERLINE EASEMENT CLEARANCE SECTIONS
C014.54.7.03-D-0610	POWERLINK RETAINING WALL ELEVATION

GENERAL NOTES:

- THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL ARCHITECTURAL AND OTHER CONSULTANTS' DRAWINGS AND SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.
- ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE RELEVANT AND CURRENT STANDARDS AUSTRALIA CODES AND WITH THE BY-LAWS AND ORDINANCES OF THE RELEVANT BUILDING AUTHORITIES EXCEPT WHERE VARYED BY THE PROJECT SPECIFICATION.
- ALL DIMENSIONS SHOWN SHALL BE VERIFIED BY THE BUILDER ON SITE. ENGINEER'S DRAWINGS SHALL NOT BE SCALED FOR DIMENSIONS.
- DURING CONSTRUCTION THE STRUCTURE SHALL BE MAINTAINED IN A STABLE CONDITION AND NO PART SHALL BE OVERSTRESSED. TEMPORARY BRACING SHALL BE PROVIDED BY THE BUILDER TO KEEP THE WORKS AND EXCAVATIONS STABLE AT ALL TIMES.
- UNLESS NOTED OTHERWISE ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES.
- ALL WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH ACCEPTABLE SAFETY STANDARDS & APPROPRIATE SAFETY SIGNS SHALL BE INSTALLED AT ALL TIMES DURING

BOND OF PROFESSIONAL DEVELOPER'S OF THE JOB

XAVIER CLURE (0950 23822)

WATSON YOUNG (04) 3234 1755

Stamp Date: 05/07/24

EXISTING SERVICES NOTES:

- DURING THE EXECUTION OF WORKS, THE CONTRACTOR SHALL MAINTAIN THE INTEGRITY OF EXISTING SERVICES. THE CONTRACTOR SHALL REPAIR ANY DAMAGE CAUSED TO THE EXISTING SERVICES TO THE SATISFACTION OF THE SUPERINTENDENT AND THE RELEVANT SERVICE AUTHORITY, AT NO COST TO THE PRINCIPAL.
- WHERE IT IS NECESSARY TO REMOVE, DIVERT OR CUT INTO ANY EXISTING SERVICE, THE CONTRACTOR SHALL GIVE AT LEAST THREE (3) DAYS NOTICE OF ITS REQUIREMENTS TO THE SUPERINTENDENT, WHO WILL ADVISE WHAT ARRANGEMENTS SHOULD BE MADE FOR THE ALTERATION OF SUCH EXISTING WORKS.
- EXISTING SERVICES HAVE BEEN PLOTTED FROM SUPPLIED DATA. THE ACCURACY IS NOT GUARANTEED. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO ESTABLISH THE LOCATION AND LEVEL OF ALL EXISTING SERVICES PRIOR TO COMMENCING WORK. ALL CLEARANCES AND APPROVALS SHALL ALSO BE OBTAINED FROM THE RELEVANT SERVICE AUTHORITY PRIOR TO THE COMMENCEMENT OF WORK.
- ALL NEW AND EXHUMED SERVICES THAT CROSS EXISTING AND FUTURE ROADS/PAVEMENTS WITHIN THE SITE SHALL BE BACKFILLED WITH DGB20 MATERIAL TO SUBGRADE LEVEL AND COMPACTED TO 98% STANDARD DENSITY RATIO. SUBJECT TO PRIOR APPROVAL FROM RELEVANT AUTHORITY.
- ON COMPLETION OF SERVICES INSTALLATION, ALL DISTURBED AREAS SHALL BE RESTORED TO ORIGINAL, INCLUDING KERBS, FOOTPATHS, CONCRETE AREAS, GRAVEL AREAS, GRASSSED AREAS AND ROAD PAVEMENTS.
- CARE TO BE TAKEN WHEN EXCAVATING NEAR UTILITY SERVICES. NO MECHANICAL EXCAVATION TO BE UNDERTAKEN OVER SERVICES. LIAISE WITH RELEVANT AUTHORITY. THE CONTRACTOR SHALL ALLOW FOR THE CAPPING OFF, EXCAVATION AND REMOVAL IF REQUIRED OF ALL EXISTING SERVICES IN AREAS AFFECTED BY THE WORKS WITHIN THE CONTRACT AREA AS SHOWN ON THE DRAWINGS UNLESS DIRECTED OTHERWISE BY THE SUPERINTENDENT. ALL TO REGULATOR AUTHORITY STANDARDS AND APPROVAL.
- THE CONTRACTOR IS TO MAINTAIN EXISTING STORMWATER DRAINAGE FLOWS THROUGH THE ROADS AT ALL TIMES. PANE DUE ALLOWANCE FOR ALL SIGHT FLOWS AT ALL TIMES, PRIOR TO COMMENCEMENT OF ANY WORKS THE CONTRACTOR SHALL OBTAIN THE SUPERINTENDENT'S APPROVAL OF THE PROGRAM FOR THE RELOCATION/CONSTRUCTION OF TEMPORARY SERVICES.
- EXISTING SERVICES SHALL CONSTRUCT TEMPORARY SERVICES AS REQUIRED TO MAINTAIN EXISTING SUPPLY. BUILDINGS REMAINING OPERATIONAL DURING WORKS TO THE SATISFACTION AND APPROVAL OF THE SUPERINTENDENT. ONCE DIVERSION'S COMPLETE AND COMMISSIONED THE CONTRACTOR SHALL REMOVE ALL SUCH TEMPORARY SERVICES AND MAKE GOOD TO THE SATISFACTION OF THE SUPERINTENDENT.
- INTERUPTION TO SUPPLY OF EXISTING SERVICES SHALL BE DONE SO AS NOT TO CAUSE ANY INCONVENIENCE OR DAMAGE TO THE ADJACENT RESIDENTS. CONTRACTOR TO GAIN APPROVAL OF THE SUPERINTENDENT FOR THE OF INTERUPTION.
- THE CONTRACTOR SHALL UNDERTAKE A DIAL BEFORE YOU DIG (DBYO 1100) SERVICES SEARCH BEFORE THE COMMENCEMENT OF ANY WORKS.

ELECTRONIC INFORMATION NOTES:

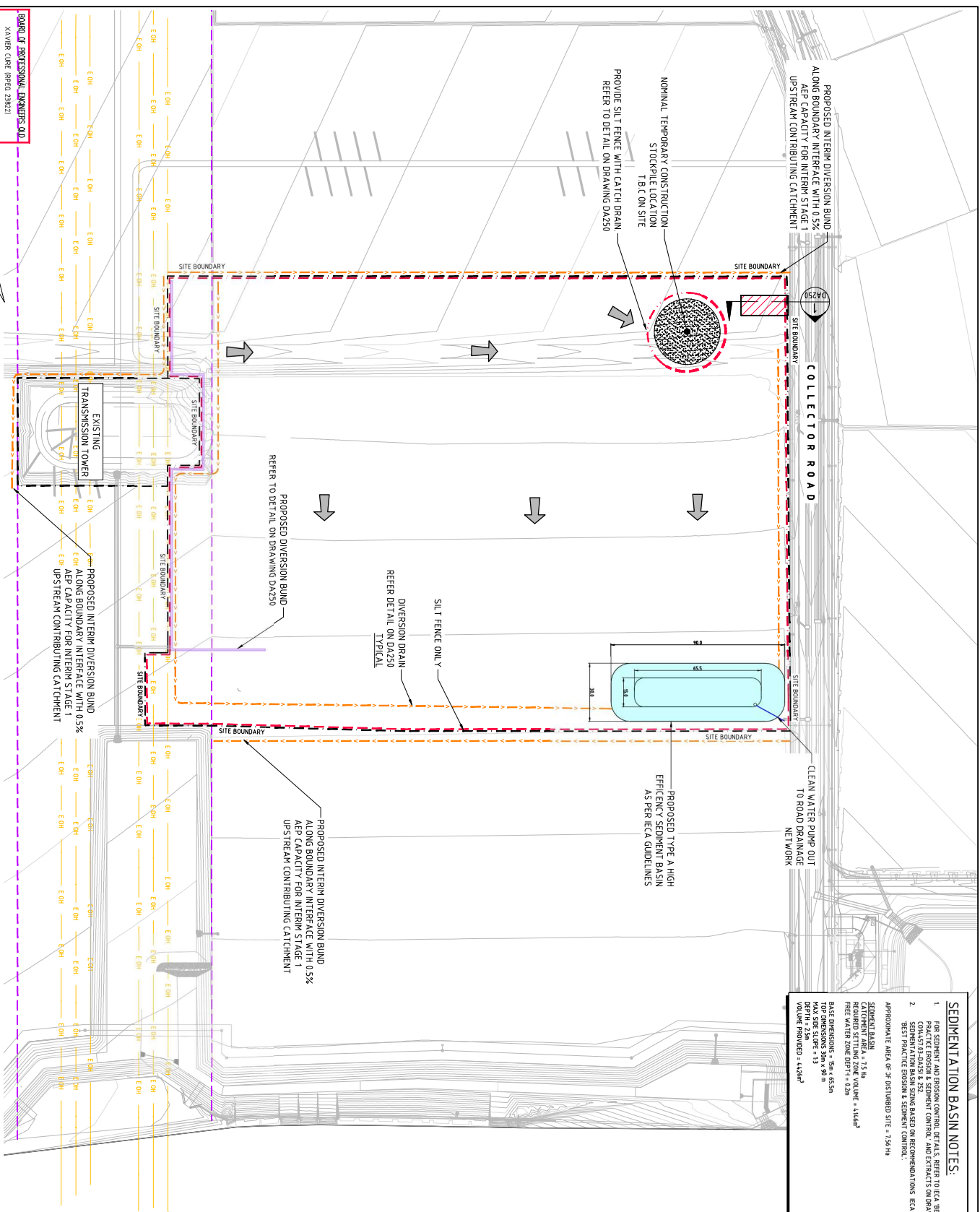
- THE ISSUED DRAWINGS IN HARD COPY OR PDF FORMAT TAKE PRECEDENCE OVER ANY ELECTRONICALLY ISSUED INFORMATION, LAYOUTS OR DESIGN MODELS.
- THE CONTRACTOR'S DIRECT AMENDMENT OR MANIPULATION OF THE DATA OR INFORMATION THAT MIGHT BE CONTAINED WITHIN AN ENGINEER-SUPPLIED DIGITAL TERRAIN MODEL AND ITS SUBSEQUENT USE TO UNDERTAKE THE WORKS WILL BE SOLELY AT THE DISCRETION OF AND THE RISK OF THE CONTRACTOR.
- THE CONTRACTOR IS REQUIRED TO HIGHLIGHT ANY DISCREPANCIES BETWEEN THE DIGITAL TERRAIN MODEL AND INFORMATION PROVIDED IN THE CONTRACT AND/OR DRAWINGS AND IS REQUIRED TO SEEK CLARIFICATION FROM THE SUPERINTENDENT.
- THE ENGINEER WILL NOT BE LIABLE OR RESPONSIBLE FOR THE POSSIBLE ON-GOING NEED TO UPDATE THE DIGITAL TERRAIN MODEL, SHOULD THERE BE ANY AMENDMENTS OR CHANGES TO THE DRAWINGS OR CONTRACT INITIATED BY THE CONTRACTOR.



LOCALITY PLAN
NTS

FOR DEVELOPMENT APPLICATION

ISSUED FOR DEVELOPMENT APPLICATION	DATE	ARCHITECT	CLIENT	PROJECT	CONSULTANT	COSTIN ROO CONSULTING	DRAWING TITLE
ISSUED FOR DEVELOPMENT APPLICATION	04.04.24	E	Watson Young	FLAG STONE LOGISTICS ESTATE	CONSULTANT	COSTIN ROO CONSULTING	DRAWING LIST AND GENERAL NOTES
ISSUED FOR DEVELOPMENT APPLICATION	10.05.24	C	Charter Hall	NORTH MACCLEAN, QLD, 4280	PROPOSED LOT 102	COSTIN ROO CONSULTING	
ISSUED FOR DEVELOPMENT APPLICATION	23.04.24	B					
ISSUED FOR DEVELOPMENT APPLICATION	30.12.23						
AMENDMENTS	DATE	ISSUE					

SEDIMENTATION BASIN NOTES:

1. FOR SEDIMENT AND EROSION CONTROL DETAILS, REFER TO IECA 'BEST PRACTICE EROSION & SEDIMENT CONTROL' AND EXTRACTS ON DRAWING CO14457.03-DA251 & 252.
2. SEDIMENTATION BASIN SIZING BASED ON RECOMMENDATIONS IECA 'BEST PRACTICE EROSION & SEDIMENT CONTROL'.

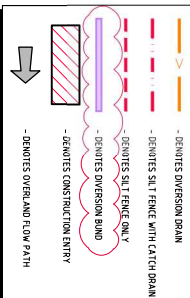
APPROXIMATE AREA OF 3F DISTURBED SITE = 7.5 ha
SEDIMENT BASIN
CATCHMENT AREA = 7.5 ha
REQUIRED SETTLING ZONE VOLUME = 4,116 m³
FREE WATER ZONE DEPTH = 0.2m
BASE DIMENSIONS = 15m x 65.5m
TOP DIMENSIONS 30m x 90 m
MAX SIDE SLOPE = 1:3
DEPTH = 2.5m
VOLUME PROVIDED = 4,426m³

EROSION CONTROL NOTES[illegible]DUST CONTROL NOTES:

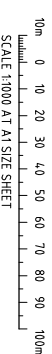
1. IT IS RESPONSIBILITY OF THE CONTRACTOR TO ENSURE DUST CONTROL MEASURES ARE APPLIED AND MAINTAINED IN ACCORDANCE WITH THE CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN.
2. THE SEVERITY OF DUSTING FROM EXISTING SUPPRESSION MEASURES MUST BE DETERMINED BY CONDUCTING A DUST SUPPRESSION ASSESSMENT. THIS ASSESSMENT MUST TAKE INTO ACCOUNT THE TYPE OF MATERIALS TO BE EXCAVATED, THE TYPE OF EXCAVATION, THE TYPE OF TRAFFIC OR AMBIENT DUST HAZARD (IE USING ARAI TESTS)
3. DUST GENERATION ASSOCIATED WITH ROAD EXPOSURE OR IN CONTROLLED ZONE WATER FURROWS MUST BE SUPPRESSED USING FINE GENERATORS, SEALANT, PLACED OVER THE ROAD SURFACE, ENGINEERING OR IN-VEGETATION.
4. THE FOLLOWING ACTIVITIES MUST BE ADAPTED, IF NECESSARY, TO MINIMIZE DUST CONTROL ON SITE:
 - SPRINKLING THE ROAD OR SURF/STORMWATER LAY OUTS
 - SPRINKLING THE ROAD OR SURF/STORMWATER LAY OUTS
 - PROGRAMMATIC WORK TO MINIMIZE THE LIFE OF STORMPITS
 - PROGRAMMATIC STABILISING LONG TERM STORMPITS
 - APPROPRIATELY STABILISING ACCESS AND TRAIL ROADS
 - MINIMISING TRAFFIC MOVEMENT ON EXPOSED SURFACES
 - SPRINKLING PAVED TRAFFIC TO BE SHOWN
 - SPRINKLING TRUCKS TO BE SHOWN
 - SPRINKLING TRUCKS TO BE SHOWN
5. LANDFILL GAS COMBUSTORS OR ANY OTHER AMMUNITION FLAMMABLE OR STORMWATER IS NOT TO BE USED FOR DUST SUPPRESSION.

LEGEND:

PROVIDE 1m RETURNS TO SILT FENCE AT 30m MAX. INTERVALS
TYPICAL (N.S.O.P.)



- DENOTES OVERLAND FLOW PATH



SCALE 1:1000 AT A1 SIZE SHEET

EROSION & SEDIMENT CONTROL PLAN

ISSUED FOR DEVELOPMENT APPLICATION
ISSUED FOR DEVELOPMENT APPLICATION
REVISED AS CLOUDED
ISSUED FOR DEVELOPMENT APPLICATION
ISSUED FOR DEVELOPMENT APPLICATION
ISSUED FOR DEVELOPMENT APPLICATION
AMENDMENTS

AR	
F	05.07.24
E	18.06.24
D	17.06.24
C	14.05.24
B	23.04.24
A	30.11.23
	DATE

CLIENT

Charter Hall 

PRODUCT	DATE	CHECKED	SIZE	SCALE	DO. RES.
FLAG STONE LOGISTICS ESTATE	OCT '23	XC	A1	AS SHOWN	COILS 47.03-04280
NORTH MACLEAN, QLD, 4280					
PROPOSED LOT 102					



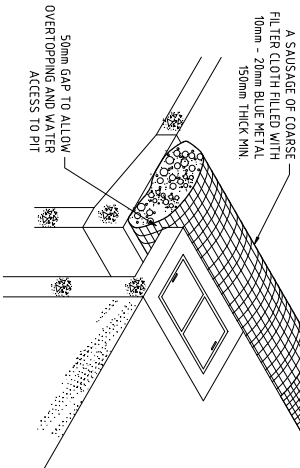
CONSULT AUSTRALIA

Costin Roe Consulting Pty Ltd
 A/N 50 003 696 446
 PO Box N419, Sydney NSW 1220
 Level 4, 8 Birchmills Street, Millers Point NSW 2000
 p: +61 2 9251 7699 f: +61 2 9241 3751
 e: mail@costinroe.com.au w: costinroe.com.au

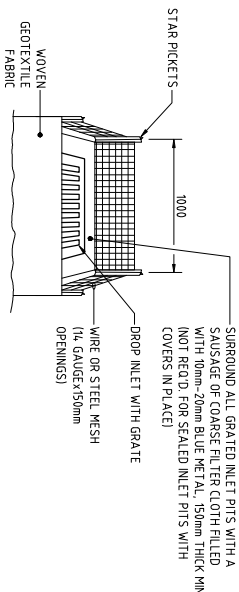
CRC
COSTIN ROE
CONSULTING
CIVIL &
STRUCTURAL
ENGINEERS

DRAWING TITLE	
EROSION & SEDIMENT CONTROL PLAN	
DRAWING No	ISSUE
C01454.7.03-DA200	1

GEOTABRIC AND GRAVEL EXTENDS 250mm PAST THE END OF THE WIRE MESH TO ENSURE SEAL WITH KERB

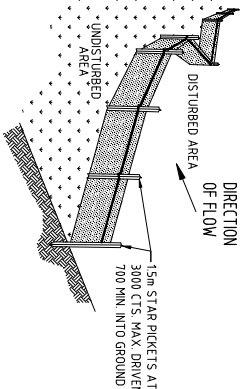


KERB INLET CONTROL
N.T.S

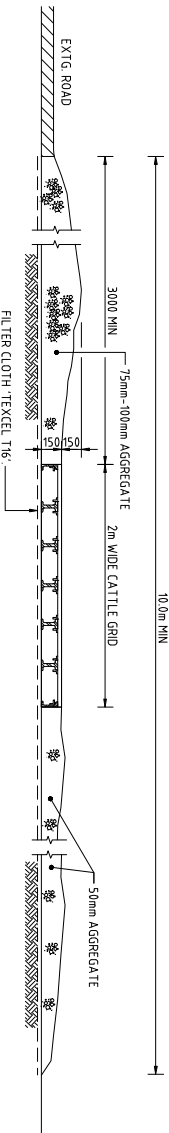


GRADED INLET PIT FILTER DETAIL
N.T.S

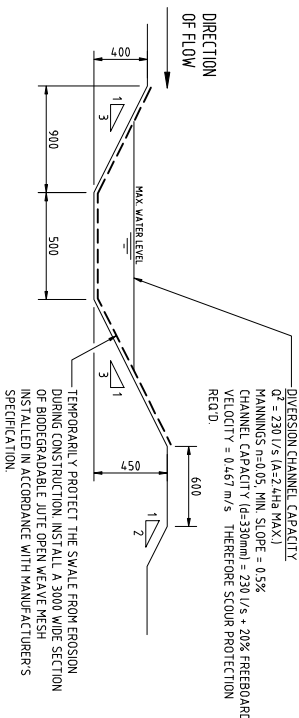
NOTE:
ADOPT ABOVE DETAILS AROUND ALL PITS WITHIN AREA ENCOMPASSED BY SILT FENCE & TO PITS ON THE ROAD ADJACENT TO SITE BOUNDARY.



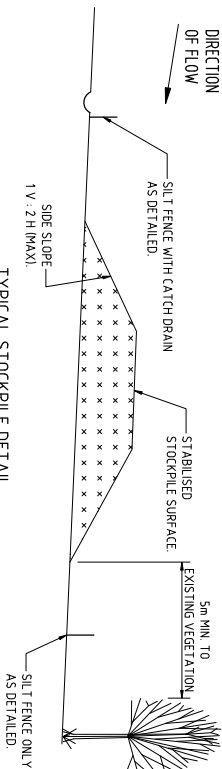
TYPICAL SILT FENCE DETAIL
N.T.S
NOTE: PROVIDE 1m RETURNS AT 30m INTERVALS. TYPICAL



SECTION 1:20 1 : STABILISED CONSTRUCTION ENTRANCE 'TRUCK SHAKER'



DIVERSION DRAIN SECTION
SCALE 1:20



TYPICAL STOCKPILE DETAIL
N.T.S

- STOCKPILE NOTES**
1. PLACE ALL STOCKPILES IN LOCATIONS MORE THAN 5m FROM EXISTING VEGETATION, ROADS & HAZARDOUS AREAS
 2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT ELONGATED MOUNDS.
 3. SLOPE TO BE 1 V : 2 H MAX.
 4. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2m IN HEIGHT.
 5. WHERE STOCKPILES ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE USING WOOD CHIP MULCH - 16 TONNE/HA
 6. CONSTRUCT SILT FENCE WITH CATCH DRAIN ON UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES & SILT FENCE ONLY 1 TO 2m DOWNSLOPE AS SHOWN

FOR DEVELOPMENT APPLICATION

BOARD OF PROFESSIONAL ENGINEERS QLD
XAVIER CLURE (BPFO 23822)
WILLIAM CHONG (BPES 044)
Date: 05 / 07 / 24

ISSUED FOR DEVELOPMENT APPLICATION	11/04/24	B
ISSUED FOR INFORMATION	30/11/23	A
AMENDMENTS	DATE	ISSUE

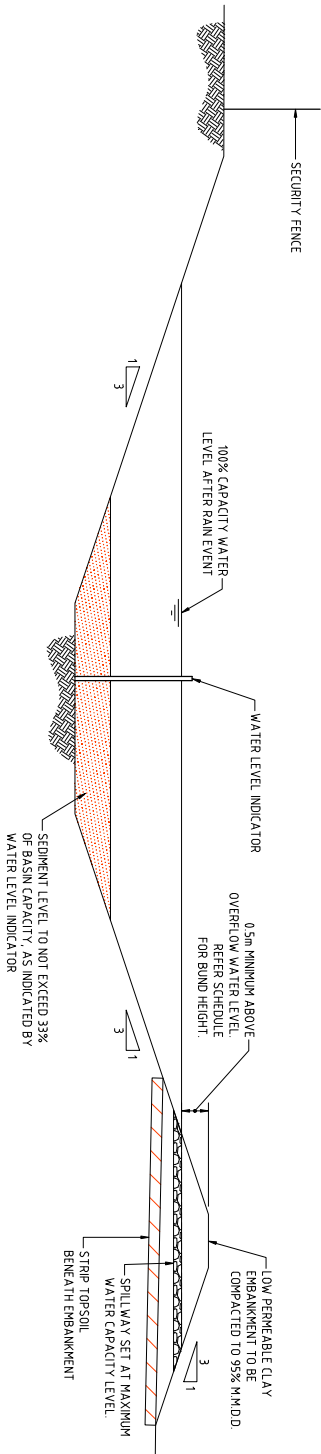
ARCHITECT
watson young

CLIENT
Charter Hall

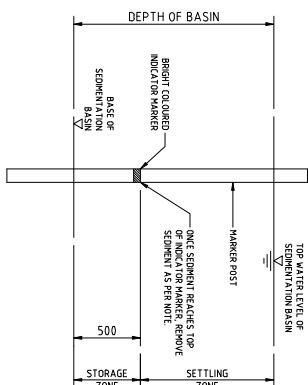
PROJECT
FLAG STONE LOGISTICS ESTATE
NORTH MACLEAN, QLD, 4280
PROPOSED LOT 102
DESIGNED DRAWN DATE
AH RN XC
OCT 23
CHECKED AT AS SHOWN
SIZE SCALE
OCT 23
OCT 23
OCT 23



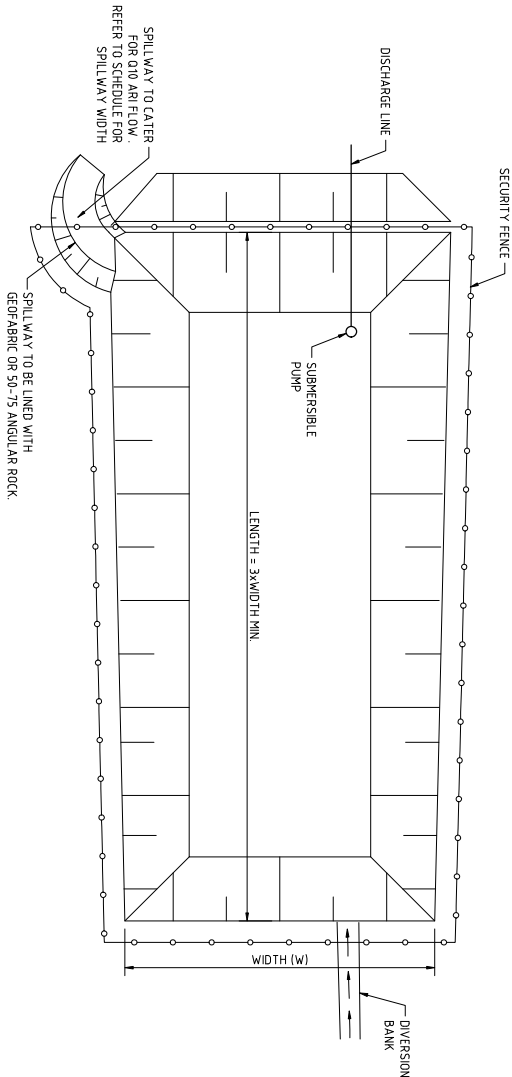
COSTIN ROE CONSULTING Pty Ltd.
ABN 69 000 696 046
PO Box 1419, Brisbane, QLD 4000
Level 4 & 5, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1208, 1209, 1210, 1211, 1212, 1213, 1214, 1215, 1216, 1217, 1218, 1219, 1220, 1221, 1222, 1223, 1224, 1225, 1226, 1227, 1228, 1229, 1230, 1231, 1232, 1233, 1234, 1235, 1236, 1237, 1238, 1239, 1240, 1241, 1242, 1243, 1244, 1245, 1246, 1247, 1248, 1249, 1250, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, 1263, 1264, 1265, 1266, 1267, 1268, 1269, 1270, 1271, 1272, 1273, 1274, 1275, 1276, 1277, 1278, 1279, 1280, 1281, 1282, 1283, 1284, 1285, 1286, 1287, 1288, 1289, 1290, 1291, 1292, 1293, 1294, 1295, 1296, 1297, 1298, 1299, 1300, 1301, 1302, 1303, 1304, 1305, 1306, 1307, 1308, 1309, 1310, 1311, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322, 1323, 1324, 1325, 1326, 1327, 1328, 1329, 1330, 1331, 1332, 1333, 1334, 1335, 1336, 1337, 1338, 1339, 1340, 1341, 1342, 1343, 1344, 1345, 1346, 1347, 1348, 1349, 1350, 1351, 1352, 1353, 1354, 1355, 1356, 1357, 1358, 1359, 1360, 1361, 1362, 1363, 1364, 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TYPICAL SEDIMENT CONTROL BASIN SECTION
SCALE 1:50



SEDIMENT STORAGE MARKER
SCALE 1:20



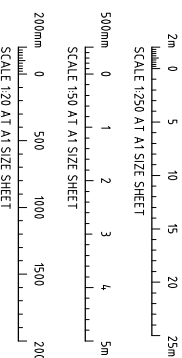
TYPICAL SEDIMENT CONTROL POND PLAN
SCALE 1:250

SEDIMENT CONTROL POND NOTES:

1. TYPE D BASIN IS REQUIRED.
2. VOLUME OF TYPE D POND SHALL BE AS NOMINATED ON DRAWING DAZ0. NOMINAL POND LOCATIONS AND NOMINAL DIMENSIONS.
3. SEDIMENT BUILD UP TO NOT EXCEED 33% TOTAL CAPACITY OF POND.
4. WATER LEVEL TO BE MAINTAINED AT 20% CAPACITY DURING SETTLING PERIOD.
5. LENGTH TO WIDTH RATIO TO BE 3:1 MIN. TYPICAL DEPTH TO BE 1.5m.
6. PROVIDE SECURITY FENCE TO POND FOR SAFETY.
7. DEWATERING OF POND TO BE PERFORMED TO THE BOTTOM OF THE SEDIMENT SETTLING ZONE.
8. WATER TO BE DOSED WITH GYPSUM MANAGEMENT OF DOSAGE AND DISCHARGE TO BE ACHIEVED IN A TIMELY MANNER BEFORE THE NEXT RAIN EVENT AND WITHIN 5 DAYS OF THE INITIAL RAINFALL EVENT.
9. GYPSUM DOSAGE RATE TO BE APPLIED AT APPROX. 32kg PER 100 CUBIC METRE OF COLLECTED RUNOFF.
10. THE USE OF ALUM AS A FLOCCULANT IS NOT RECOMMENDED AND IS TO BE USED ONLY FOLLOWING CONSULTATION WITH AND ACCEPTANCE FROM GOLD COAST CITY COUNCIL ESC OFFICERS.
11. DISCHARGE FROM POND IS PERMISSIBLE WHEN THE WATER PH IS 6.5-8.5 AND IS CLARIFIED IN 36-72 HOURS BELOW A TSS OF 50mg/L (75 NTU). CLARIFICATION WOULD GENERALLY BE ACHIEVED IN 36-72 HOURS WITH THE USE OF GYPSUM.
12. DEWATERING SHALL BE DONE IN SUCH A MANNER AS TO REMOVE THE RELATIVELY CLEAN WATER WITHOUT REMOVING OR DISTURBING THE SEDIMENT THAT HAS SETTLED. THE PUMP INTAKE PIPE IS NOT TO REST ON THE SETTLED SEDIMENT LAYER.
13. IF WATER EXCEEDS 155 OF 50mg/L (75 NTU) DURING DEWATERING, PUMPING IS TO CEASE.
14. RECORDS ARE TO BE KEPT (ON-SITE AT ALL TIMES) OF ALL MEASUREMENT PRIOR TO, DURING AND AFTER DISCHARGE. RECORDS TO BE MADE AVAILABLE TO COUNCIL OFFICERS UPON REQUEST.

SPILLWAY DETAIL & SCHEDULE

CATCHMENT (ha)	FLOW (m³/s)	WIDTH (mm)	FLOW DEPTH (mm)	ROCK SIZE (mm)	BUND HEIGHT ABOVE SPILLWAY (mm)
0.20	0.14	1000	200	-	600
0.5	0.2	2000	200	-	600
1	0.3	2000	200	-	700
2	0.6	4000	200	-	700
5	1.4	5000	300	200	800



FOR DEVELOPMENT APPLICATION

BOARD OF PROFESSIONAL ENGINEERS QLD
XAVIER CLURE (PENG 23822)
Wesley Cheng (PENG 04)
Date: 05/07/24

ISSUED FOR DEVELOPMENT APPLICATION
ISSUED FOR INFORMATION
AMENDMENTS

17/04/24	B
30/1/23	A
DATE	ISSUE

ARCHITECT
watson young

CLIENT
Charter Hall

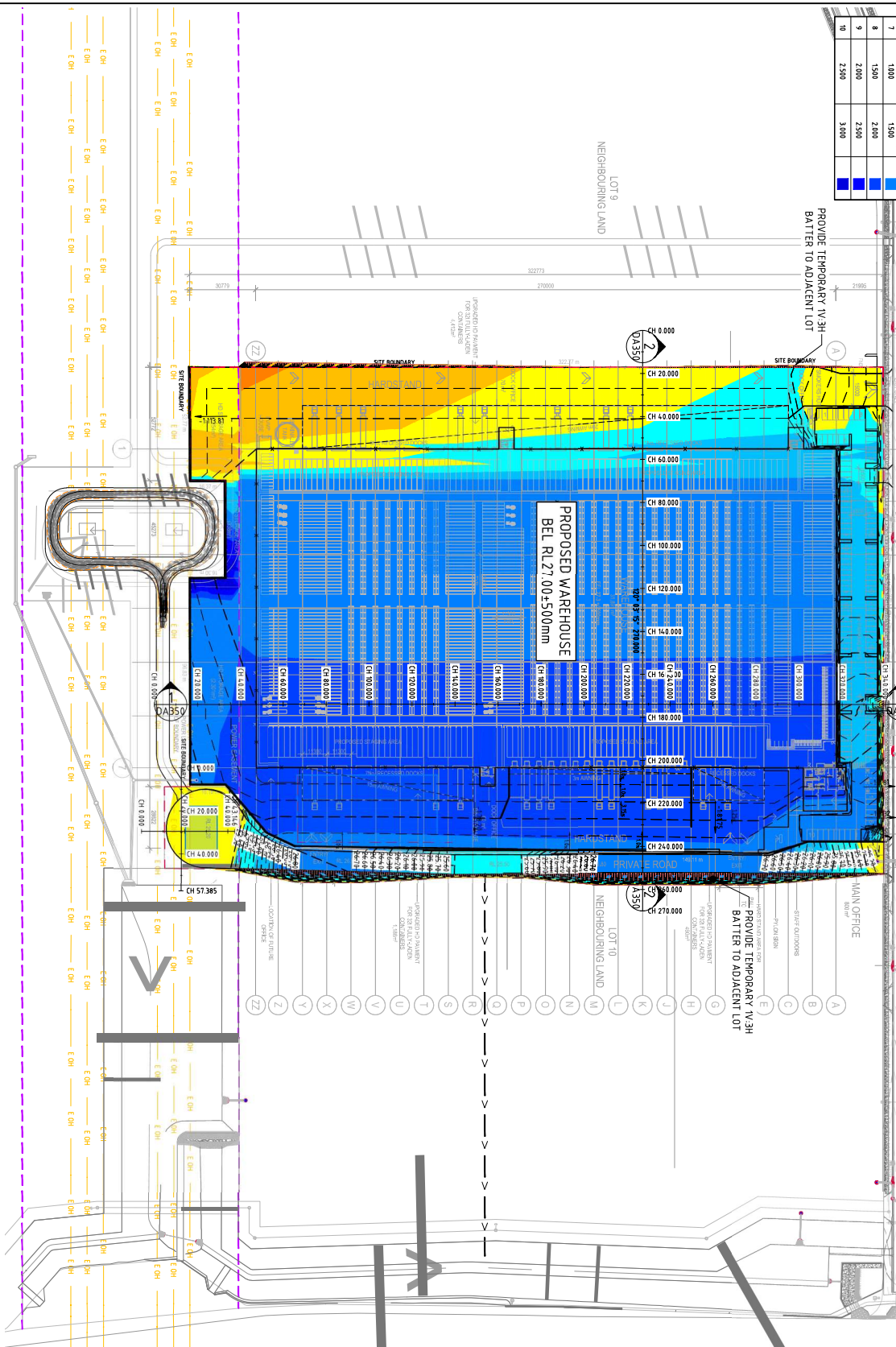
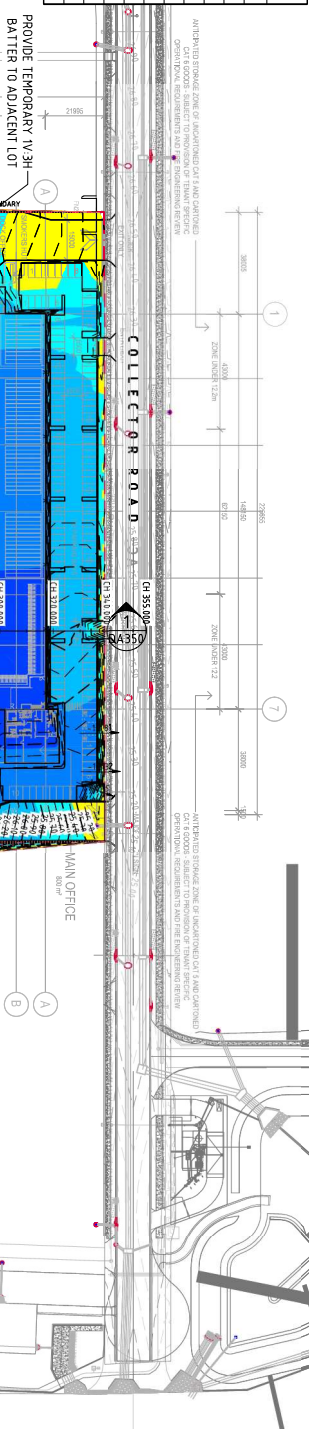
PROJECT
FLAGSTONE LOGISTICS ESTATE
NORTH MACLEAN, QLD, 4280
PROPOSED LOT 102

DESIGNED DRAWN DATE
AH RN XC
OCT 23

CHECKED AT SCALE
AS SHOWN
OCT 23

CONSULTANT
COSTIN ROE CONSULTING
Level 4 & 5, 228-230, 232-234, 236-238, 240-242, 244-246, 248-250, 252-254, 256-258, 260-262, 264-266, 268-270, 272-274, 276-278, 280-282, 284-286, 288-290, 292-294, 296-298, 300-302, 304-306, 308-310, 312-314, 316-318, 320-322, 324-326, 328-330, 332-334, 336-338, 340-342, 344-346, 348-350, 352-354, 356-358, 360-362, 364-366, 368-370, 372-374, 376-378, 380-382, 384-386, 388-390, 392-394, 396-398, 400-402, 404-406, 408-410, 412-414, 416-418, 420-422, 424-426, 428-430, 432-434, 436-438, 440-442, 444-446, 448-450, 452-454, 456-458, 460-462, 464-466, 468-470, 472-474, 476-478, 480-482, 484-486, 488-490, 492-494, 496-498, 500-502, 504-506, 508-510, 512-514, 516-518, 520-522, 524-526, 528-530, 532-534, 536-538, 540-542, 544-546, 548-550, 552-554, 556-558, 560-562, 564-566, 568-570, 572-574, 576-578, 580-582, 584-586, 588-590, 592-594, 596-598, 600-602, 604-606, 608-610, 612-614, 616-618, 620-622, 624-626, 628-630, 632-634, 636-638, 640-642, 644-646, 648-650, 652-654, 656-658, 660-662, 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DEPTH RANGE		
NO	FROM DEPTH	TO DEPTH
1	-2000	-1500
2	-1500	-1000
3	-1000	-500
4	-500	0000
5	0000	0500
6	0500	1000
7	1000	1500
8	1500	2000
9	2000	2500
10	2500	3000



SITE PREPARATION NOTES:

- [illegible]

EARTHWORK ESTIMATES

SITE AREA	= 7.56 Ha
CUT	= 4,950m ³
FILL	= 82,000m ³
ALLOWANCES	
DETAILED EXCAVATION	= -14,200m ³
[2000m ³ /Ha]	
EXTERNAL PAVEMENT	= -18,000m ³
OSO EXCAVATION	= -10,620m ³
RECESSED DOCK	= -2,000m ³

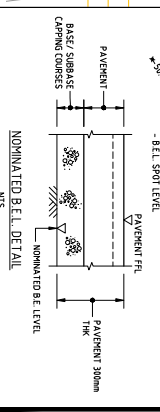
= +32,330m³ (i.e. FILL OVER CUT)

NOTE: EXCAVATION VOLUMES ARE APPROXIMATE ONLY. VOLUMES BASED ON 5:1 SLOPE RATIO. EXCAVATION VOLUMES FOR PREEXISTING MATERIAL, EROSION AND SEDIMENT CONTROL, BULKING OR COMPLETION OF FIELDED SLOES, THE REMOVAL OF UNCONTROLLED OR CONTAMINATED MATERIAL OR ANY OTHER UNSPECIFIED EXCAVATION RELATED TO CONSTRUCTION ACTIVITIES, DETAILLED EXCAVATION (ALL DRAINAGE IS APPROXIMATE ONLY) AND ACCOUNTS FOR STORMWATER/SERVICES TRUNKINGS AND FOUNDATIONS. THE DETAILED EXCAVATION VOLUMES ARE TO BE CONFIRMED BY THE CONTRACTOR. REFER ANY CONCERNS TO ENGINEER.

LEGEND

LEVELS DATUM IS AHD.
EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY
ARCADIS DATED 12/09/23.

- 50.00 — - EXISTING CONTOUR (0.2m INTER)
— 50.00 — - B.E.L. (CONTOUR MAJOR 1.0m)
— 50.10 — - B.E.L. (CONTOUR MINOR 0.25m)



5m 0 10 20 30 40

SCALE 1:500 AT A1 SIZE SHEET

FOR DEVELOPMENT APPLICATION

BULK EARTHWORKS PLAN
SCALE 1:1000

BOARD OF PROFESSIONAL ENGINEERS QLD

XAVIER CURE (RPEQ 23822)
MIEAUST CPENG METER (CWA)

Signature: [Signature] Date: 05/07/24

ISSUED FOR DEVELOPMENT APPLICATION	05.01.24	G
REFUSED FOR IMPAVED ESTATE ROADS AND DRAINAGE	03.01.24	F
REVISED AS CLOUDED	18.05.24	E
ISSUED FOR DEVELOPMENT APPLICATION	17.05.24	D
ISSUED FOR DEVELOPMENT APPLICATION	13.05.24	C
ISSUED FOR DEVELOPMENT APPLICATION	23.04.24	B
AMENDMENTS	DATE	ISSUE

Watson Young

NT
Charter Hall

PROJECT	DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	DATE
FLAG STONE LOGISTICS ESTATE	XX	XX	OCT '23	XC	A1	AS SHOWN	
NORTH MACLEAN, QLD, 4280							
PROPOSED LOT 102							



CONSULT AUSTRALIA

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Level 4, 8 Windmill Street, Millers Point NSW 2000
t: +61 2 9251 7699
e: mail@costinroe.com.au
w: costinroe.com.au

CRC
COSTIN ROE
CONSULTING

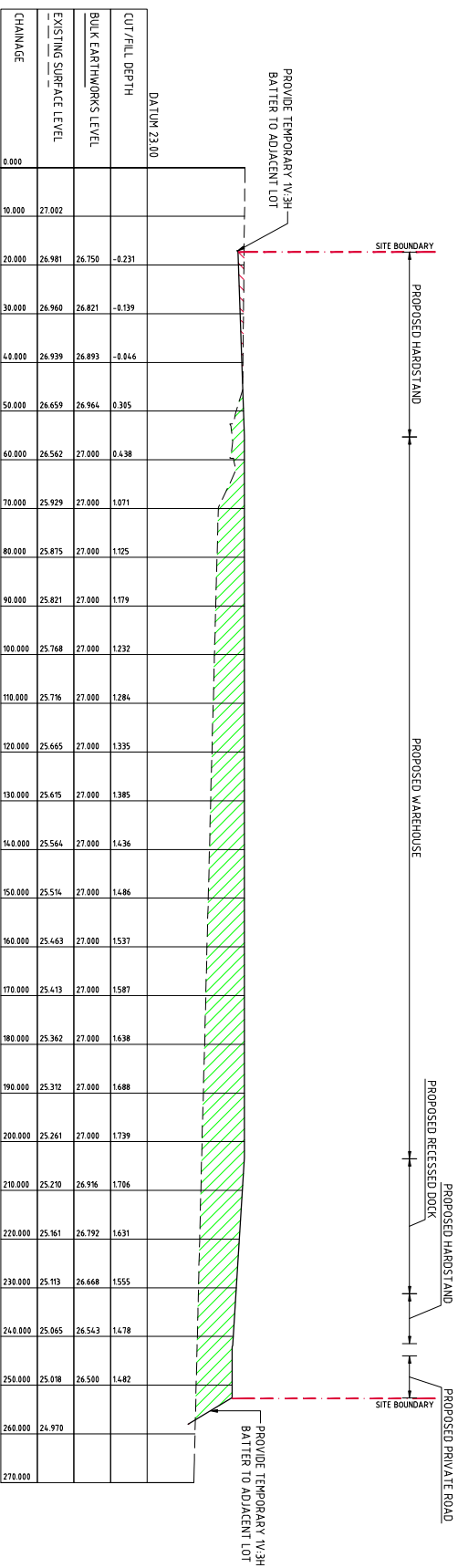
**CIVIL &
STRUCTURAL
ENGINEERS**

DRAWING TITLE
BULK EARTHWORKS PLAN
DRAWING No
C014547.03-DA300

|

CHANGING	EXISTING SURFACE LEVEL	BULK EARTHWORKS LEVEL	CUT/FILL DEPTH	DATUM 24.00
0.000	25.52			
10.000	25.490			
20.000	25.457	26.769	1.312	
30.000	25.423	26.854	1.431	
40.000	25.393	26.939	1.546	
50.000	25.395	27.000	1.605	
60.000	25.397	27.000	1.603	
70.000	25.399	27.000	1.601	
80.000	25.401	27.000	1.599	
90.000	25.402	27.000	1.598	
100.000	25.401	27.000	1.599	
110.000	25.400	27.000	1.600	
120.000	25.400	27.000	1.600	
130.000	25.399	27.000	1.601	
140.000	25.399	27.000	1.601	
150.000	25.398	27.000	1.602	
160.000	25.397	27.000	1.603	
170.000	25.397	27.000	1.603	
180.000	25.396	27.000	1.604	
190.000	25.396	27.000	1.604	
200.000	25.395	27.000	1.605	
210.000	25.394	27.000	1.606	
220.000	25.394	27.000	1.606	
230.000	25.393	27.000	1.607	
240.000	25.393	27.000	1.607	
250.000	25.392	27.000	1.608	
260.000	25.391	27.000	1.609	
270.000	25.391	27.000	1.609	
280.000	25.390	27.000	1.610	
290.000	25.389	27.000	1.611	
300.000	25.388	27.000	1.612	
310.000	25.386	27.000	1.614	
320.000	25.382	26.019	0.637	
330.000	25.378	26.018	0.640	
340.000	25.586	25.352	-0.235	
350.000	25.580			
355.000	25.47			

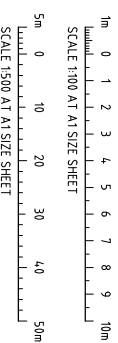
SECTION 1
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



SECTION 2
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

LEGEND:

- DENOTES BULK EARTHWORKS PROFILE
- DENOTES EXISTING PROFILE
- DENOTES AREA IN CUT
- DENOTES AREA IN FILL



FOR DEVELOPMENT APPLICATION

BOARD OF PROFESSIONAL ENGINEERS QLD
XAVIER CURE (RPEQ 23822)
MIEAust CPENG NFER (Cov)

Signature [Signature] Date 05/07/24

ISSUED FOR DEVELOPMENT APPLICATION AMENDMENTS	ISSUED FOR DEVELOPMENT APPLICATION	DATE	ISSUE
	05.07.24	B	
	18.06.24	A	

ARCHITECT
**watson
young**

CLIENT

Charter Hall 

PROJECT	DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD
FLAG STONE LOGISTICS ESTATE	AH	RN	OCT '73	XC	A1	AS SHOWN	C010

REF:
54703-DA350

CONSULT AUSTRALIA

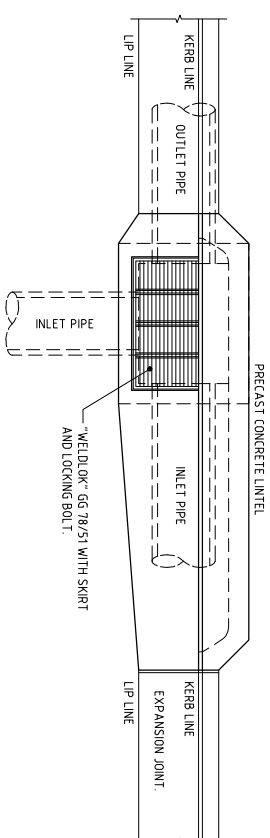
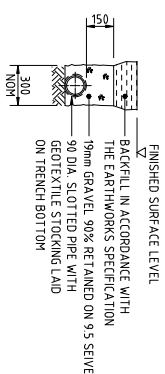
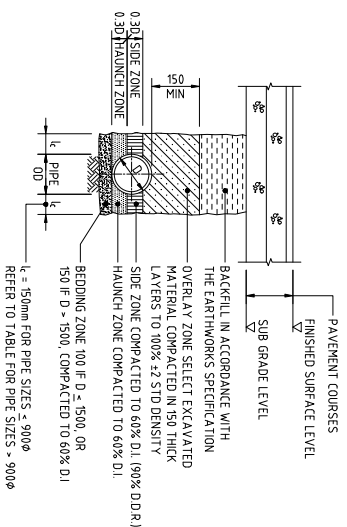
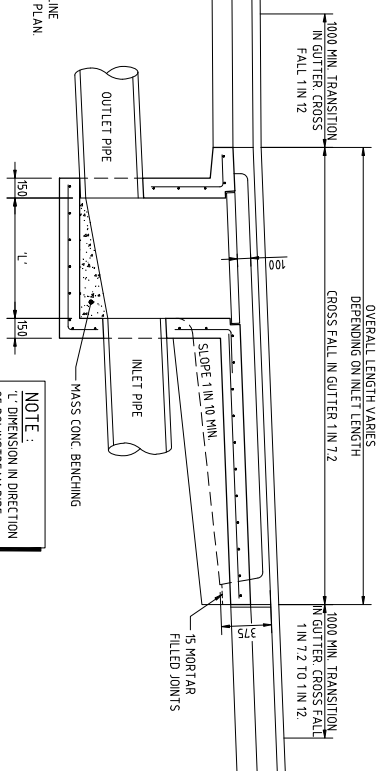
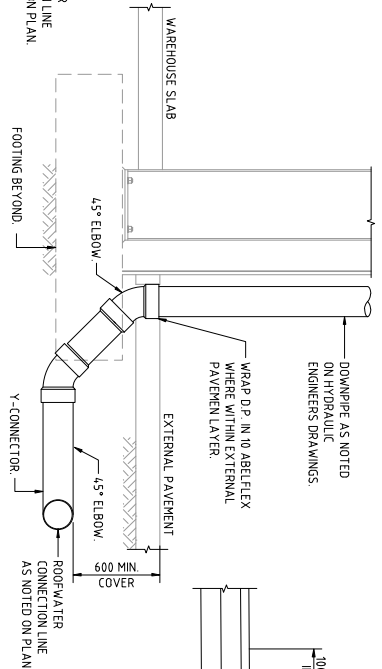
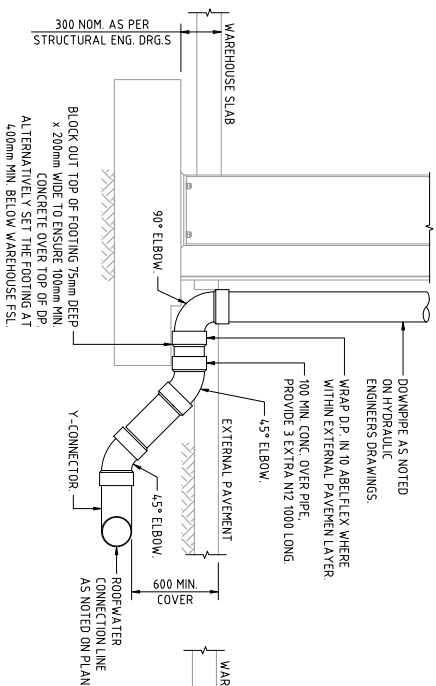
Costin Roe Consulting Pty Ltd
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CONSULTING

**CIVIL &
STRUCTURAL
ENGINEERS**

DRAWING TITLE	BULK EARTHWORKS SECTIONS
DRAWING No	C014547.03-DA350

12



CONCRETE QUALITY				
ELEMENT	SLUMP	AGGREGATE (MAX. SIZE)	CEMENT TYPE	AD MIXTURE
PIT	80	20	GP	NIL
				F _c (MPa)
				32

1. WHERE DULLY PIT IS LOCATED ON KEYS RETURN TO BUILD CUL-DE-SACS PROVIDE CURVED PRECAST CONCRETE LINTEL THE GRATE.
2. SAG PITS SHALL HAVE LINTEL PLACED CENTRALLY ABOUT THE GRATE.
3. ALL REINFORCING TO HAVE 30 MIN. CLEAR CONCRETE COVER.
4. FOR PITS DEEPER THAN 1000mm CLIMB RAILS SHALL BE PROVIDED.

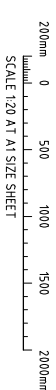
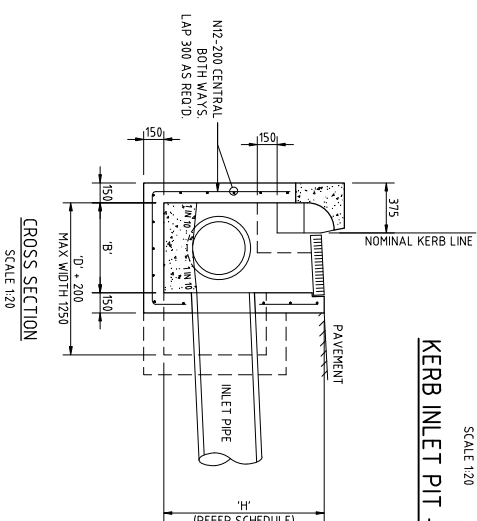
BEDDING & HAUNCH MATERIAL GRADING	
SEIVE SIZE (mm)	WEIGHT PASSING (%)
19.0	100
2.36	100 TO 50
0.60	99 TO 20
0.30	60 TO 10
0.15	25 TO 0
0.075	10 TO 0

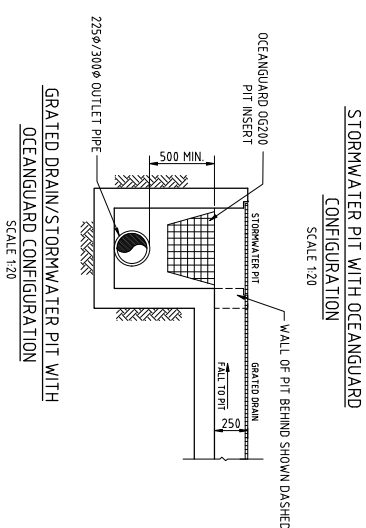
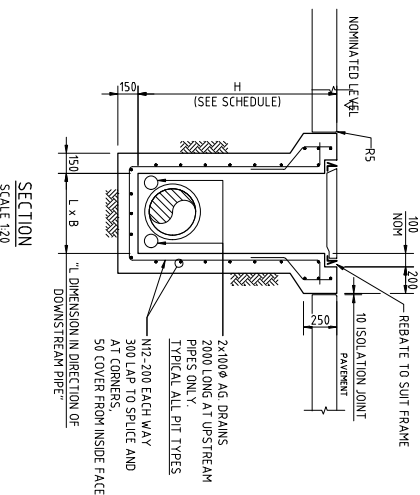
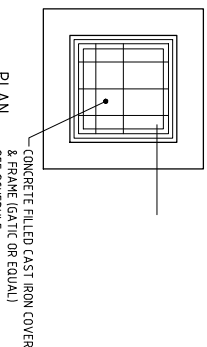
PIPE SIZE (mm)	t (mm)
≤ 900ø	150
1050ø	175
1200ø	200
1350ø	225
1500ø	250
1650ø	275
1800ø	300

ENGINEER TO SPECIFY TRENCH WIDTHS FOR PIPE SIZES GREATER THAN 1800ø

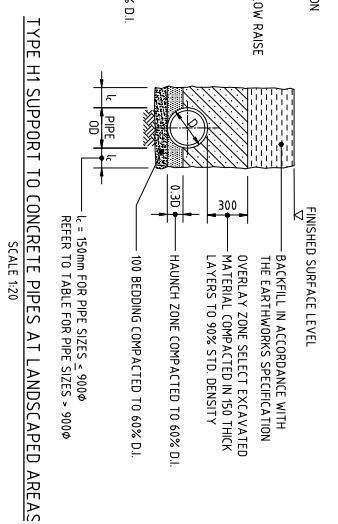
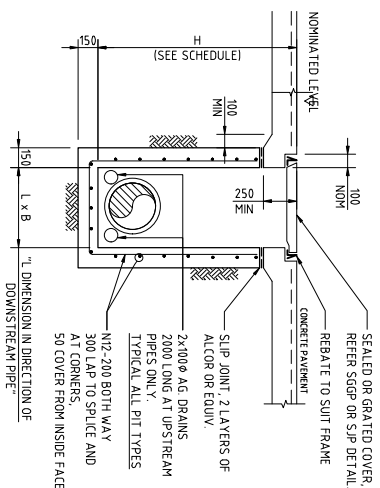
SIDE ZONE MATERIAL GRAING	
SIEVE SIZE (mm)	WEIGHT PASSING (%)
19.0	100
9.5	100 TO 50
2.6	100 TO 30
0.60	50 TO 15
0.075	25 TO 0

SELECT FILL MATERIAL IN ACCORDANCE WITH
TABLE 1 AS 3175





SEALED JUNCTION PIT - SJP



BEDDING & HAUNCH MATERIAL GRADING	
SLVE SIZE (mm)	WEIGHT PASSING (%)
19.0	100
2.36	100 TO 50
0.60	90 TO 20
0.30	60 TO 10
0.15	20 TO 0

SJP/CIS & SGGP/CIS (CAST IN SLAB) PIT DETAIL

GRATE/COVER SUPPORT FAST-INTO PAVEMENT SLAB

(ADOPT IN CONCRETE PAVEMENTS FOR SGGP'S & SJP'S, WHERE JOINTS ARE NOT LOCATED WITHIN PROXIMITY OF THE GRATE)

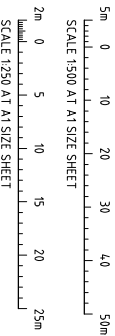
FOR DEVELOPMENT APPLICATION

[illegible]



POWERLINK OVERHEAD POWERLINE SECTION

SCALE 1:50



FOR INFORMATION

BOARD OF PROFESSIONAL ENGINEERS QLD

XAVIER CLURE (BPEQ 23822)

Wesley Craig WES (CAE)

Signature

Date 05 / 07 / 24

ISSUED FOR INFORMATION		
DATE	ISSUE	
10.05.24	A	
AMENDMENTS		

ARCHITECT

watson young

CLIENT

Charter Hall

PROJECT		
FLAG STONE LOGISTICS ESTATE		
NORTH MACLEAN, QLD, 4280		
PROPOSED LOT 102		
DESIGNED (DRAWN)	DATE	
AH	RN	OCT 23
CHECKED	SIZE	SCALE
XC	A1	A3 SHOWN
CNO REF		
C014547/03-DAS51		



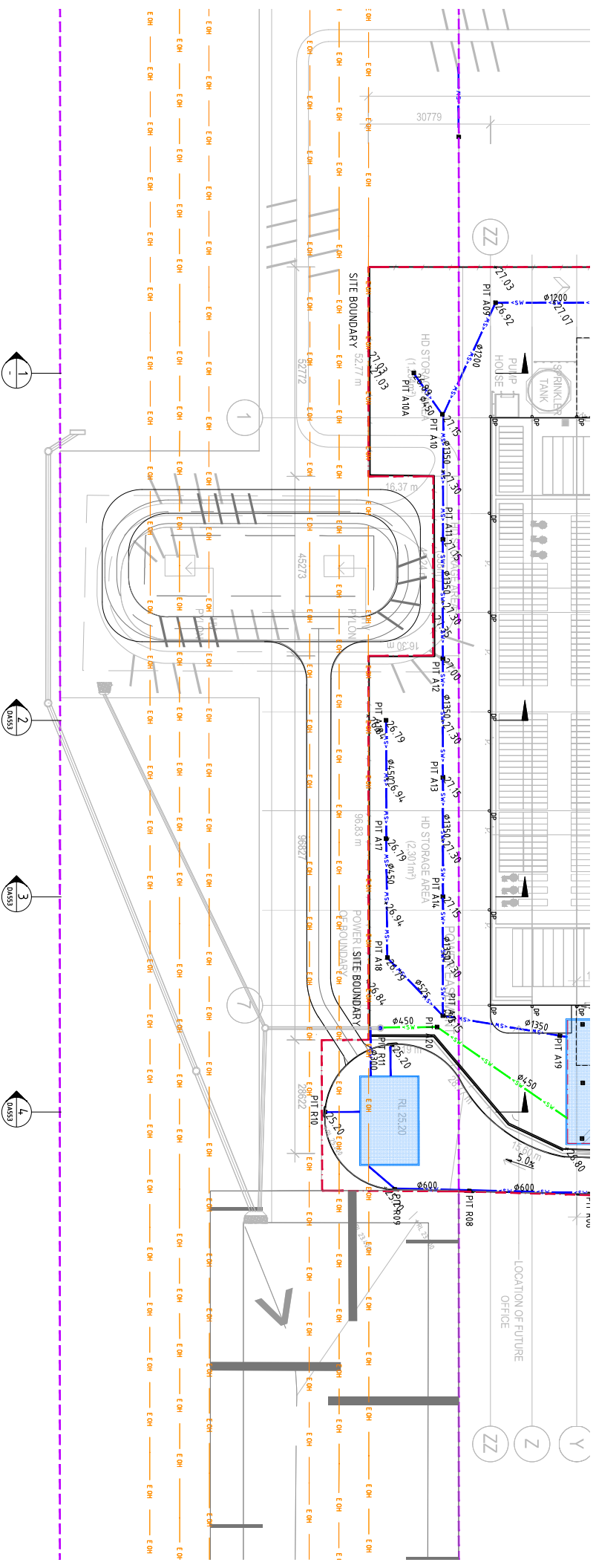
Coslin Roe Consulting Pty Ltd.
ABN 69 000 690 446
PO Box 1419, Brisbane, QLD 4000
Level 4, 8 Windmill Street, Millers Point NSW 2000
P: +61 2 9281 1769
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e: info@coslinroe.com.au

CRC

COSLIN ROE CONSULTING

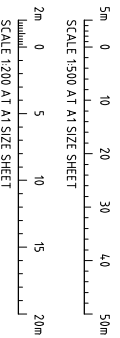
CIVIL & STRUCTURAL ENGINEERS

DRAWING TITLE	
POWERLINK OVERHEAD POWERLINE SECTION	
DRAWING NO	
C014547/03-DAS51	
ISSUE	
A	



POWERLINE EASEMENT CLEARANCE PLAN
SCALE 1:500

SECTION 1:200



FOR DEVELOPMENT APPLICATION

ARCHITECT		CLIENT		PROJECT		CONSULTANT		DRAWING TITLE	
watson young		Charter Hall		FLAG STONE LOGISTICS ESTATE NORTH MACLEAN, QLD, 4280 PROPOSED LOT 102		Costin Roe Consulting Pty Ltd. PO Box 1409, Brisbane, QLD 4000 Level 4, 8 Vindal Street, Millers Point NSW 2000 E: +61 2 9241 3751 W: www.costinroe.com.au		POWERLINE EASEMENT CLEARANCE PLAN & SECTIONS	
RESUBMITTED FOR UPDATED ESTATE ROADS AND DRAINAGE ISSUED FOR DEVELOPMENT APPLICATION		03/1/24, 8 17/6/24, A		DESIGNED (NAME) DATE AH RN OCT 23		CHECKED (NAME) DATE XC AT 16/5/2024		DRAWING NO C014/547.03-DA552	
BOARD OF PROFESSIONAL ENGINEERS QLD XAVIER CLURE (BPFO 23822) MICHAEL CHENG (BPES 064)		DATE 05/07/24		SIGNATURE		SIGNATURE		ISSUED BY B	

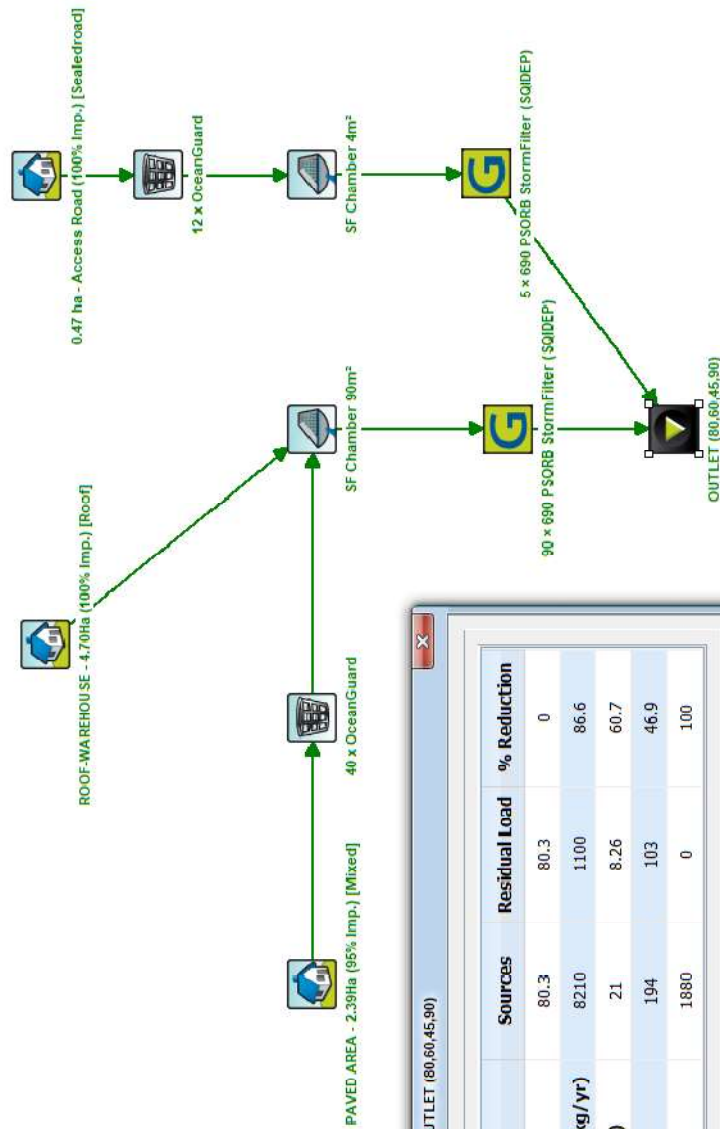
FOR DEVELOPMENT APPLICATION

BOARD OF PROFESSIONAL ENGINEERS QLD
XAVIER CLURE (BPFO 23822)
MICHAEL CHONG (BPES 064)
Signed: _____ Date: 05/07/24

PROJECT		CLIENT		PROJECT		DRAWING TITLE	
watson young		Charter Hall		FLAGSTONE LOGISTICS ESTATE NORTH MACLEAN QLD 4280 PROPOSED LOT 102		POWERLINE EASEMENT CLEARANCE SECTIONS	
ISSUED FOR DEVELOPMENT APPLICATION		03/07/24		DESIGNED DRAWN DATE		DRAWING NO	
ISSUED FOR DEVELOPMENT APPLICATION		17/06/24		AH RN XC		C014/547/03-DA553	
AMENDMENTS		DATE ISSUE		BY		BY	

APPENDIX B

MUSIC MODEL CONFIGURATION



Treatment Train Effectiveness - OUTLET (80,60,45,90)

	Sources	Residual Load	% Reduction
Flow (ML / yr)	80.3	80.3	0
Total Suspended Solids (kg / yr)	8210	1100	86.6
Total Phosphorus (kg / yr)	21	8.26	60.7
Total Nitrogen (kg / yr)	194	103	46.9
Gross Pollutants (kg / yr)	1880	0	100

APPENDIX C

STORMWATER TREATMENT MEASURE MAINTENANCE SCHEDULE

Proposed Lot 102, Proposed Warehouse

Stormwater Treatment Measure Maintenance Schedule

Date of Inspection: Next Inspection:

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE	CHECKED (Y/N)	MAINTENANCE NEEDED (Y/N)
LANDSCAPED AREAS					
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications		
Inspect landscape area for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.		
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained		
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.		

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE	CHECKED (Y/N)	MAINTENANCE NEEDED (Y/N)
Inspect surface for erosion	Six Monthly	Maintenance Contractor	Replace topsoil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.		
INLET & JUNCTION PITS					
Inside of Pit	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.		
Outside of Pit	Four Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.		
OCEANPROTECT "OCEANGUARD" OG200 PIT INSERTS & "STORMFILTERS" FILTRATION CARTRIDGES					
Refer to manufacturer's O&M manual attached in Appendix of this report	Monthly/ After Major Storm Refer to manufacturer's O&M manual attached in Appendix of this report	Maintenance Contractor Refer to manufacturer's O&M manual attached in Appendix of this report	Refer to manufacturer's O&M manual attached in Appendix of this report		

APPENDIX D

ARCADIS SBSMPQ AND SBSMP

4499 – 4651 MOUNT LINDESAY HIGHWAY, NORTH MACLEAN

Site Based Stormwater Quality Management Plan

16 FEBRUARY 2024

Incorporating



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CHARTER HALL PRIME INDUSTRIAL FUND 4499-4651 MOUNT LINDESAY HIGHWAY, NORTH MACLEAN

Site Based Stormwater Quality Management Plan

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Report No

EAG003-30109334-AAR

Date

16/02/2024

Revision Text

5

This report has been prepared for Charter Hall Prime Industrial Fund in accordance with the terms and conditions of appointment for 4499-4651 Mount Lindesay Highway – North Maclean – Civil Engineering dated 18/10/2021. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
01	31/01/2023	DRAFT Issue	TF	DC
02	13/02/2023	For Approval	EP	DC
03	22/06/2023	Response to RFI	TF	DC
04	15/08/2023	ROL Update	TF	DC
05	16/02/2024	Catchment Detailing	HQ	DC

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APPENDIX E

Water by Design “Maintaining Vegetated Assets”

APPENDIX F

Water by Design – Inspection and Maintenance Checklist for Bioretention Systems

1 EXECUTIVE SUMMARY

Arcadis has been engaged by Charter Hall Prime Industrial Fund to prepare a Site Based Stormwater Quality Management Plan (SBSQMP) for the proposed industrial development, situated at 4499-4651 Mount Lindesay Highway, North Maclean. The site is located in the Greater Flagstone Priority Development Area located within the Logan City Council local government area. On 21 September 2021, the Minister for Economic Development Queensland (EDQ) granted approval for a PDA development application over the site for a Development Permit for Reconfiguring a Lot – 1 into 4 lots, plus roads and open space. On 27 September EDQ granted approval for an amendment to the previous Reconfiguration of Lot application. The new approval was for the reconfiguring a lot - one (1) lot into eleven (11) lots and new roads, consisting of five super lots and six auxiliary lots, comprising drainage, open space and a sewer pump station.

This report demonstrates the proposed development will be constructed and operated in accordance with the Water Sensitive Urban Design (WSUD), requirements of Council, the South-East Queensland State Planning Policy (SPP), the Queensland Development Code, the Queensland Urban Drainage Manual (QUDM) Economic Development Queensland (EDQ) PDA guidelines and the Environmental Protection (Water) Policy (2009). This report also demonstrates the proposed amendment will not result in substantially different development to the existing approval.

The primary objective of this SBSQMP is to ensure that:

1. Details of a proposed stormwater quality treatment train are provided to ensure the discharge of stormwater from the site is of adequate quality standards to comply with the requirements of Economic Development Queensland (EDQ), Logan City Council (LCC) and the State Planning Policy 2017 (SPP 2017).

A stormwater quality assessment is provided which demonstrates that a specially tailored treatment system will be required to satisfy the pollutant removal targets of LCC and the South-East Queensland Healthy Waterways Partnership during the operational phase of the proposed development.

A regional bio-retention system has been proposed to treat stormwater runoff from Lot 1 and a portion of the circulation roadway (INTNL-1). Bio-retention pods are to be incorporated into the road reserves to treat stormwater runoff from the new roads. Individual water quality treatment plans are to be provided and implemented for Lots 2 – 5 (Catchments INTNL-2A - INTNL-4C) upon development. Additional filter media has been added to the northern regional bio-retention system to allow for the compensatory offset treatment of the flows from Crowson Lane and external properties to the north in place of treating runoff from the eastern portion of the Powerlink easement (Catchment INTNL-3C). This compensatory offset approach is necessary as Powerlink will not permit infrastructure such as water quality device to be located in the easement corridor and it is impractical to externally treat associated runoff elsewhere within the development footprint.

1.1 Revision 03

Revision 03 of this report has been prepared in response to Item E(d) of the Further Clarification email received from Mr Manjurul Alam of EDQ on Friday 31 March 2023, related to the Compliance Assessment for Conditions 21, 23 and 24 of the Decision Notice received for the PDA Development Permit for reconfiguring a lot – 1 lot into 4 lots, plus roads and open space. A review of the site grading has revealed that the western portion of the Powerlink Easement grades north-east as such has been included in Catchment INTNL-2B and will be treated accordingly.

Further discussion has been provided regarding the compensatory catchment treatment.

1.2 Revision 04

Revision 04 of this report has been prepared to support the amended ROL application, increasing the number of proposed allotments from four (4) to eleven (11) and new roads, consisting of five super lots and six auxiliary lots, comprising drainage, open space and a sewer pumpstation. The proposed amendments to the existing ROL development approval do not result in substantially different development from a stormwater management perspective. Minor changes were made to the MUSIC modelling as a result of this amendment.

1.3 Revision 05

Revision 5 of this report has been prepared in response to detailed design of the allotments, adjusting several stormwater catchments. With respect to water quality modelling, the only change of interest was to catchment INTNL-3C which changed in size and configuration. MUSIC modelling and reporting have been updated accordingly.

Furthermore, the 1.5m wide footpath width was increased to 1.8m to be consistent with detailed design.

2 INTRODUCTION

Arcadis has been engaged by Charter Hall Prime Industrial Fund to prepare a Site Based Stormwater Quality Management Plan (SBSQMP) for the proposed industrial development situated at 4499 - 4651 Mount Lindesay Highway, North Maclean. The site is situated within the Greater Flagstone Priority Development Area (PDA) located within the Logan City Council (LCC) local government area.

On 21 September 2021, the Minister for Economic Development Queensland (EDQ) granted approval for a PDA development application over the site for a Development Permit for Reconfiguring a Lot – 1 into 4 lots, plus roads and open space. On 27 September EDQ granted approval for an amendment to the previous Reconfiguration of Lot application. The new approval was for the reconfiguring a lot - one (1) lot into eleven (11) lots and new roads, consisting of five super lots and six auxiliary lots, comprising drainage, open space and a sewer pump station. The proposed amended ROL layout is shown in Figure 2-1, below.



Figure 2-1 –Approved ROL Layout (Source: Wolters, August 2023)

The following report demonstrates the proposed development will be constructed and operated in accordance with the Water Sensitive Urban Design (WSUD) requirements of Council, the Queensland State Planning Policy (SPP 2017), the Queensland Development Code, the Queensland Urban Drainage Manual (QUDM), Economic Development Queensland (EDQ) PDA guidelines and the Environmental Protection (Water) Policy (2009) with respect to the attenuation of stormwater runoff

from both quality and quantity perspectives. This report also demonstrates the proposed amendment will not result in substantially different development to the existing approval.

3 SITE CHARACTERISTICS

3.1 Site Description

The subject site is located within Logan, South-East Queensland, Australia on the following lot:

- Lot 39 on SP258739 (4499-4651 Mount Lindesay Highway, North Maclean)

The site is generally bounded by the following co-ordinates (GDA94 / MGA zone 56)

- South-West: 500708, 6928700
- North-East: 501974, 6929628

The proposed area for the development is approximately 117.9ha.

3.2 Existing Land Usage

The site is predominantly vegetated with cleared areas relating to the existing residential dwelling and associated land use and High Voltage Electrical Power transmission lines and towers.

The site currently has direct property frontage to Mount Lindesay Highway to the east, predominantly trees and vegetation to the south and rural residential developments to the north and west. A MEDQ Approved context plan published 10 September 2021 includes the subject site. The site is approved for specific land use "*Industry and Business Zone*" with overlay for indicative future bio-diversity corridor. An existing high voltage easement running through the site from the south into the existing rural residential dwelling to the north. A further high voltage (275kV) easement runs through the site within the cleared area.

A site locality plan is provided in Figure 3-1 below:



Figure 3-1- Development Locality Plan (Source: NearMap, June 2022)

3.3 Existing Topography and Site Drainage

In its current state, a ridge traverses the development site from the north-western corner to the southern site boundary, with further undulations dividing the site into three sub-catchments, as shown in Figure 3-2. The northern catchment slopes east at an average of 2% from RL44.0 to a culvert with a minimum invert level of RL20.90 which allows flows to pass beneath Mount Lindesay Highway to the opposite side. From here, water is ultimately discharged east of Mount Lindesay Highway towards the Logan River located approximately 1.1km east of the site.

The western portion of the site slopes south from RL44.0 to RL26.5 at an average grade of 1.6%. An overland flow path commences in this portion of the site, exiting the site across the southern boundary before re-entering the site in the east through the third catchment area. The overland flow path flows north-east to the abovementioned culverts. The third catchment area site also slopes to this culvert at an average grade of 1.2%.



Figure 3-2- Internal Catchment Plan (Source: NearMap, June 2022)

Stormwater runoff from upstream external catchments enter the site from the north, south and west. The extent of the external catchments are shown in Figure 3-3.



Figure 3-3: Existing Catchment Plan

3.3.1 Existing Approvals

It is understood that the existing EDQ approval (DEV 2018/961) over the site is for a reconfiguring a lot – 1 lot into 4 lots, plus roads and open space. As part of this approval Operational Works Approvals have been awarded, these works include:

- Construction of a service road along the western side of the Mount Lindesay Highway accessed via the existing Crowson Lane / Mount Lindesay Highway off ramp roundabout;

- Construction of a trunk rising sewer main running through the existing electrical main of the proposed development, ending at Greenbank Road.
- Connection to existing potable water mains along Crowson Lane and the Mount Lindsay Highway
- Proposed stormwater infrastructure;
- Construction of internal roads; and
- Proposed connection to existing underground electrical and telecommunication services along Crowson Lane and the Mount Lindsay Highway.

Further details on the works associated with the adjacent approval can be found within the relevant Decision Notice attached within Appendix C. The approved EDQ Context Plan is shown below in Figure 3-4 below.

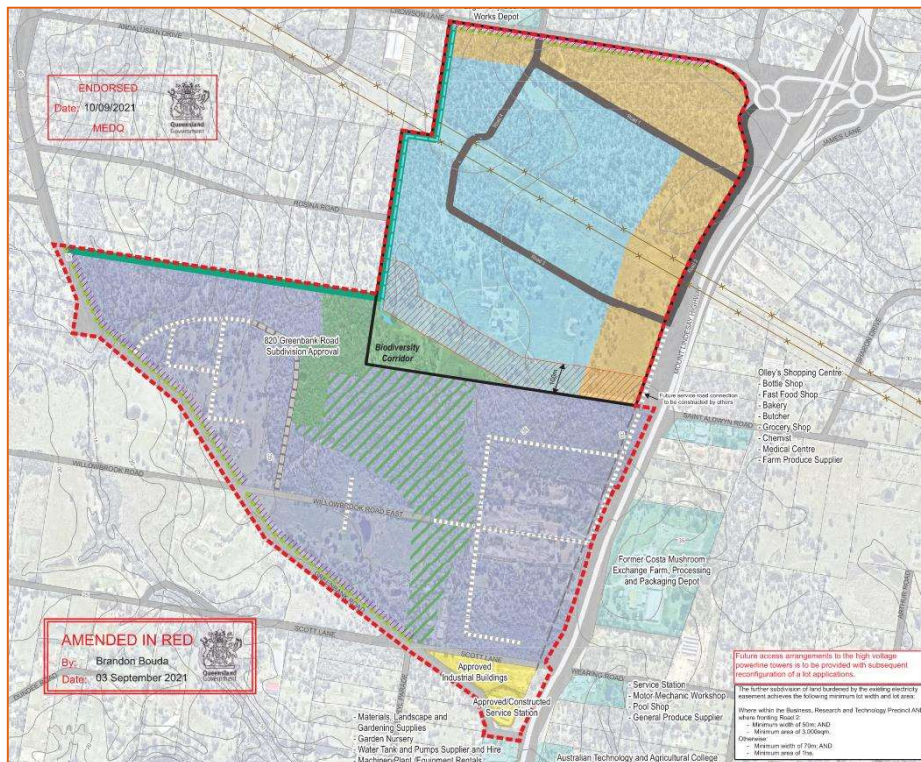


Figure 3-4- North Maclean Enterprise Context Plan (Source: Reel Planning, September 2021)

3.3.2 Geotechnical Investigation

A geotechnical investigation was completed separately by Protest Engineering in October 2021. Borehole testing revealed the ground profile generally comprises of silty sand (Emerson Class 6) up to 0.6m depth, overlaying silty/sandy clay up to 4m depth followed by low to high strength sandstone. Groundwater was not encountered during the investigation; however, Protest Engineering noted that groundwater levels can be seasonal and fluctuate during and after heavy rainfall events. Refer to Protest Engineering Report PTP/07651-0001-Rev3 for further details.

3.4 Existing Stormwater Infrastructure

Limited stormwater drainage infrastructure is present within the vicinity of the development site. A set of culverts is situated near the eastern property boundary discharging stormwater under the Mount Lindsay Highway and ultimately towards the Logan River located approximately 1.1km east of the site. The culverts comprise two 1.75m high, 2.1m wide reinforced concrete box culverts at RL21.09m AHD, between which sit two 1.75m high, 2.1m wide reinforced concrete box culverts at RL20.90m AHD

4499 – 4651 Mount Lindesay Highway, North Maclean

Smaller culverts are present within Crowson Lane, directing stormwater runoff from the northern upstream catchments beneath the road and discharging into the subject site. The pipes vary in size from approximately 375mm dia to 4 x 675mm dia.

4 DISCHARGE LOCATIONS

4.1 Pre-Developed Discharge Characteristics

As previously outlined in this report, the site in its pre-developed state consists of multiple catchments, discharging via concentrated flows into either local flood plain area to the south (Catchment EX_1Z) and/or ultimately to the highway infrastructure to the east (Catchments 2B and 3C).

4.2 Proposed Discharge Characteristics and Objectives

The proposed development will retain the existing discharge locations. To comply with the Water Sensitive Urban Design (WSUD) requirements of Council, the Queensland Development Code and the Environmental Protection (Water) Policy (2009), the following primary objective is to be achieved:

- suitable treatment train measures are determined and are either future infrastructure or incorporated in the development to achieve required water quality objectives.

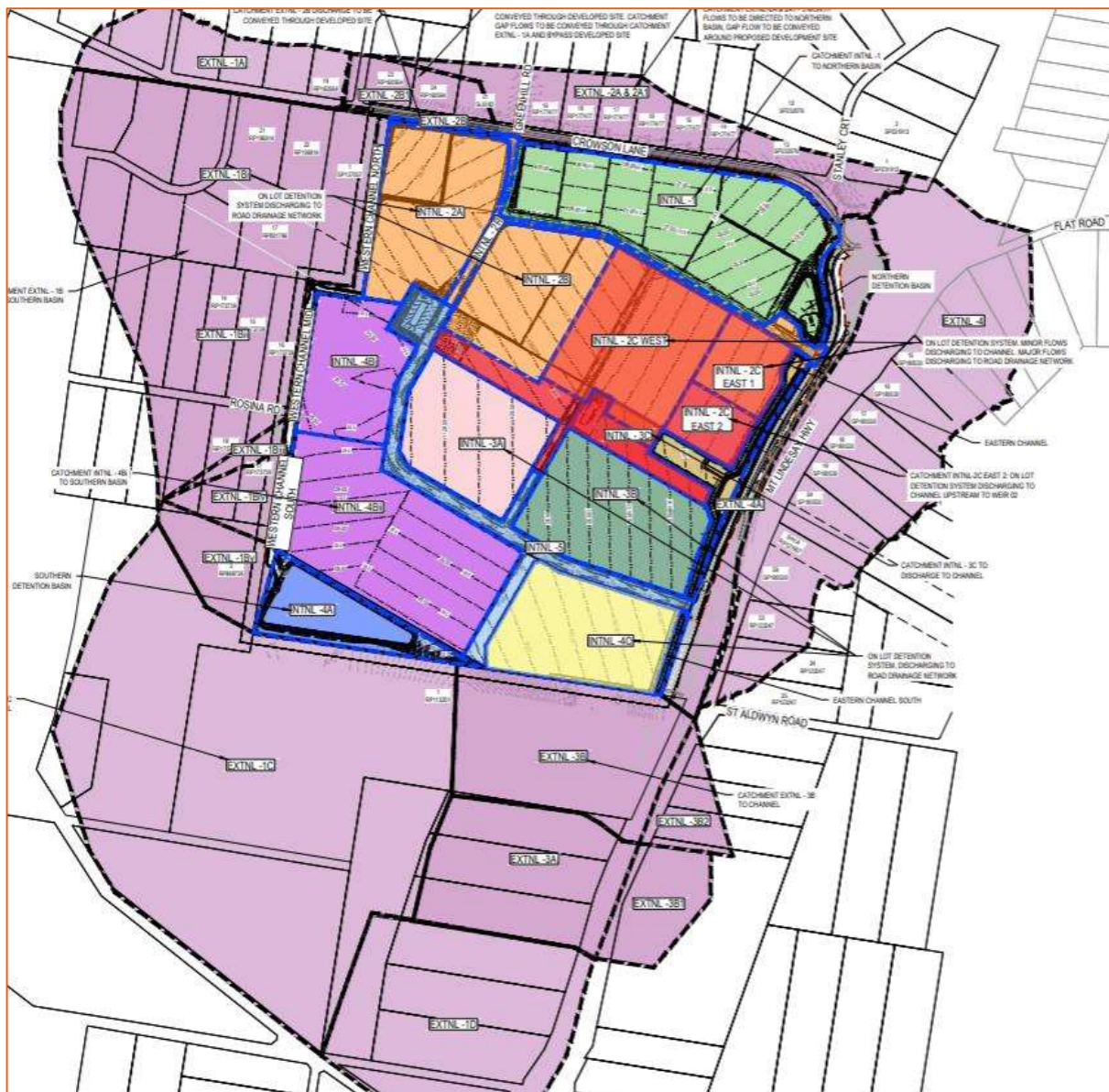


Figure 4-1: Stormwater Catchment Plan (refer to Appendix B)

5 ENVIRONMENTAL VALUES AND WATER QUALITY OBJECTIVES (WQO)

Water quality parameters and the proposed limits applicable for this site have been selected in accordance with South-East Queensland Healthy Waterways Partnership's Water by Design MUSIC Modelling Guidelines – Consultation Draft (Version 3, 2018). The Water Quality reduction targets stipulated by the State Planning Policy are presented in Table 5-1.

Table 5-1 Water Quality Operational Phase Performance Criteria

Pollutant	Criteria
Total Suspended Solids	80%
Total Phosphorus	60%
Total Nitrogen	45%
Gross Pollutants	90%

5.1 Stormwater Quality Treatment Approach

Bioretention systems are proposed for inclusion within the development layout to treat stormwater runoff from the internal road reserve and Catchment INTNL-1 as well as EXTNL-1A and EXTNL-1B in place of the eastern portion of the Powerlink Easement (INTNL-3C). Site specific SBSMPs will be required to accompany MCU applications for INTNL-2A - INTNL-4C to formulate an appropriate allotment specific stormwater treatment train and will not be addressed in this report. Please note that onus for treating the western portion of the Powerlink Easement has been delegated to INTNL-2B.

Stormwater runoff from Lot 1 (INTNL-1) and external catchments 1A and 1B (EXTNL-1A and EXTNL-1B) will be treated by the Northern Bio-retention Basin. Rainwater tanks are to be included in each allotment for the harvesting of roof water runoff which is to be reused across each lot through irrigation and toilet flushing. It has been assumed that half of each roof catchment is directed to the tanks.

Bio Pods are to be included in the internal road layout at a maximum of 100m intervals to treat stormwater runoff from the road reserve. The internal road is an Industrial Connector with an asymmetrical cross-section. The carriage way is crowned with two 4.0m wide traffic lanes centred either side of the crown, each with an adjacent 2.5m wide parking lane. The verge on the narrow side of the cross-section has a 4.5m wide verge with a 1.8m wide footpath. The wider side of the cross-section has a 5.5m wide verge with a 2.5m wide combined footpath and cycle way.

As the road is crowned, the catchment to each bio pod will consist of a half road catchment. Two half road catchments have been modelled in MUSIC to reflect the different footpath widths and corresponding fraction impervious.

Table 5-2 provides stormwater sub-catchment pervious/impervious area information modelled in MUSIC.

Table 5-2 Stormwater Catchments Areas

Catchment Name	Roof Area to Bio		Roof Area to Tank		Road Area		Ground Area	
	[Ha]	% impervious	[Ha]	% impervious	[Ha]	% impervious	[Ha]	% impervious
INTNL-1	3.358	100%	3.359	100%	4.505	100%	2.361	10%
Industrial Half Road – 2.5m Wide Footpath, 100m Road Length	-	-	-	-	0.120	76%	-	-
Industrial Half Road – 1.8m Wide Footpath, 100m Road Length	-	-	-	-	0.110	77%	-	-
INTNL-3C (Industrial)	-	-	-	-	-	-	4.1744	90%
EXTNL-1A&B (Crowson Lane)	-	-	-	-	2.789	80%	-	-
EXTNL-1A&1B (Rural Residential)	-	-	-	-	-	-	8.286	7%

5.2 Proposed Stormwater Quality Improvement Devices

Water Sensitive Urban Design (WSUD) aims to minimise the impact of a development on the natural water cycle by reducing the export of pollutants, sediments and nutrients from the site into the natural watercourse. To treat the stormwater runoff from the site, various treatment devices can be used throughout the development area and these concepts can be integrated into the overall design of the road layouts, road cross sections, stormwater layouts and water supply reticulation systems. Stormwater from the development will follow a specially designed stormwater quality treatment train prior to discharge from the site, which will ensure compliance with the water quality objectives.

5.2.1 Bio-retention Systems

A bio-retention area is a vegetated region where runoff is filtered through a filter media layer (e.g. sandy loam) as it percolates downwards to receiving underlying reticulation. Specific vegetation is to be incorporated into the landscaping of bio-retention areas which effectively reduce nutrient loads. Tables 19 and 20 of the Water by Design Bioretention Technical Design Guidelines provide guidance on selecting appropriate plant species for systems where the plants have a functional role in stormwater treatment, such as the aforementioned bio-retention basins.

Bio-retention areas are incorporated into the proposed development with planted bio-retention filter areas. The northern Bio-retention Basin is to be incorporated into the base of the stormwater detention structure; the lower 300mm of the basin has been excluded from the stormwater detention analysis of the basin and is to be dedicated to extended detention, ensuring that sufficient volume from frequent storm events will pond in the basin and percolate through the filter media receiving treatment.

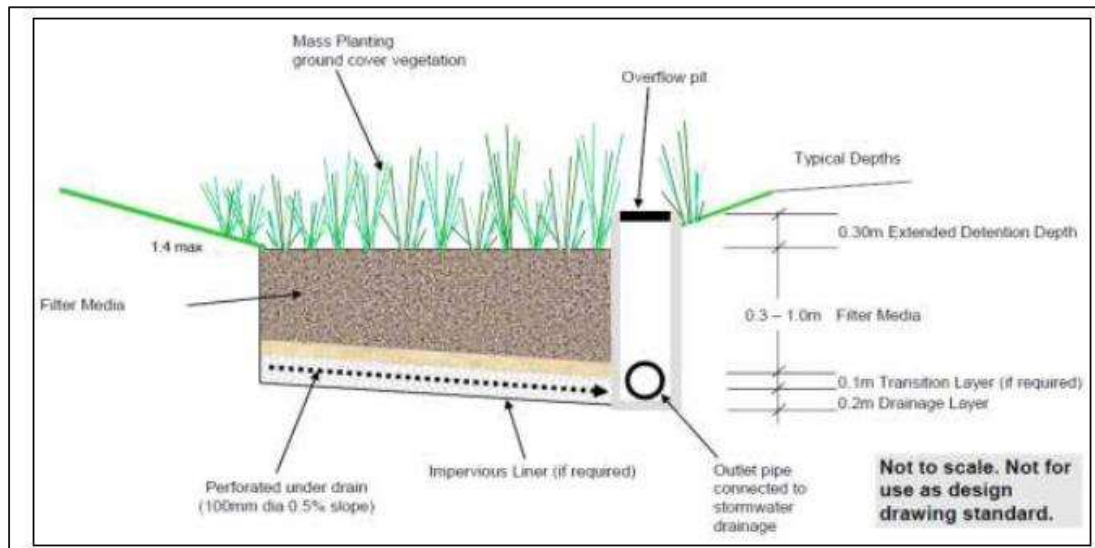


Figure 5-1 Bio-retention basin typical cross-section (courtesy of Healthy Waterways)

5.2.2 Essential Stormwater Harvesting Tanks

Essential rainwater harvesting tanks behave as stormwater quality improvement devices by removing stormwater from the treatment train. Rainwater harvesting tanks are proposed to be incorporated into each lot layout and are to be used for toilet flushing and landscape irrigation.

5.3 Modelling of the Development Site

In developing the modelling parameters for the site, the Water Sensitive Design concepts for the developed site were produced with the proposed method of improvement as follows:

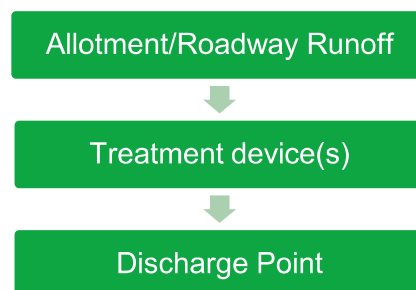


Figure 5-2 Modelling Strategy

This treatment train will be adopted to control stormwater quality from the development area. Modelling of the site was undertaken using the 'Model for Urban Stormwater Improvement Conceptualisation (MUSIC)' as promoted by the South-East Queensland Healthy Waterways Partnership. An appropriate type of land use was applied to all developed sub-catchments based on the proposed development's characteristics for either a residential or commercial land use. Each individual treatment system was assigned the relevant modelling treatment module. Consequently, a treatment train was established for each sub-catchment and ultimately combined to control the total discharge from the development area.

Meteorological data for input to MUSIC was obtained from the Bureau of Meteorology for the Thompson Road Greenbank station (40659), which is located approximately 9km north-west of the site. Six minute time step rainfall data was obtained from the years 1980 to 1989.

The catchment parameters of the MUSIC modelling were amended in accordance with the South-East Queensland Healthy Waterways Partnerships' Water by Design MUSIC Modelling Guidelines – Consultation Draft (2018).

5.3.1 Pollutant Source Node Details

The following tables show the pollutant source node parameters that were input to the MUSIC model, as determined using the South-East Queensland Healthy Waterways Partnership's *Water by Design MUSIC Modelling Guidelines for South-East Queensland*.

Table 5-3 Commercial and Industrial Rainfall-Runoff Parameters

Parameter	Industrial	Rural Residential
Soil Storage Capacity (mm)	18	98
Initial Storage (%)	10	10
Field Capacity (mm)	80	80
Infiltration Capacity Coefficient A	243	84
Infiltration Capacity Coefficient B	0.6	3.30
Initial Depth (mm)	50	50
Daily Recharge Rate (%)	0	100
Daily Baseflow Rate (%)	31	22

Table 5-4 Pollutant Export Parameters (Log Values)

Flow Type	Pollutant Source	TSS Log Values		TP Log Values		TN log values	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Industrial							
Baseflow	Roof	N/A	N/A	N/A	N/A	N/A	N/A
	Ground	0.78	0.45	-1.11	0.48	0.14	0.20
	Roads	0.78	0.45	-1.11	0.48	0.14	0.20
Stormflow	Roof	1.30	0.44	-0.89	0.36	0.25	0.32
	Ground	1.92	0.44	-0.59	0.36	0.25	0.32
	Roads	2.43	0.44	-0.30	0.36	0.25	0.32
Rural Residential							
Baseflow	Lumped	0.53	0.24	-1.54	0.38	-0.52	0.39
Stormflow		2.26	0.51	-0.56	0.28	0.32	0.30

5.3.2 Treatment Device Details

Stormwater run-off from the developed site will be collected via a series of drainage systems flowing into the various treatment devices prior to being discharged to the corresponding reporting point. The following section provides details of how each treatment device was modelled.

5.3.2.1 Rainwater Tanks

The rainwater tanks and reuse have been modelled specifically in accordance with the Water By Design MUSIC Modelling Guidelines (2018) and the Blacktown City Council WSUD Developer Handbook – MUSIC Modelling and Design Guide 2020. The reuse has been calculated based on an annual irrigation application of 548mm/m²/yr across the landscaped areas and a toilet/urinal demand of 0.1kL/toilet/day. Internal building layouts are not available at this stage, so a conservative estimate of the number of toilets has been made.

Table 5-5 below, summarises the parameters used to model the rainwater tanks.

Table 5-5 Rainwater Tank Modelling Parameters and Assumptions

Parameter	INTNL-1
Assumed irrigated landscape area (m ²)	14,866
Assumed number of toilets/urinals	23
Number of Tanks	8
Volume below overflow pipe (kL) (per tank)	20
Depth above overflow pipe (kL)	0.2
Surface Area (m ²) (per tank)	10
Initial Volume (kL)	0
Overflow Pipe Diameter (mm) (per tank)	90
Max Drawdown Height (m)	2
Demand (kL/yr)	8,745

5.3.2.2 Bio-Retention Areas

The bio-retention systems have been designed specifically in accordance with the Water by Design Bioretention Technical Design Guidelines Consultation Draft (2018). The bio-filtration areas have been modelled with a filter media depth of 450mm with median particle diameter of 0.45mm, a design saturated hydraulic conductivity of 200mm/hr (sandy loam), a maximum total nitrogen content for filter media of 400mg/kg; and a maximum orthophosphate content for filter media of 30mg/kg. An extended detention depth of 300mm has been adopted for the basins and 200mm for the bio pods. Table 5-6 summarises the spatial requirements of the bio-retention basins. Details of the exact location and design of the proposed treatment device are also presented in the Engineering Drawings in Appendix B.

Table 5-6 Bio-Retention Area Requirements

Catchment	Type	Basin Filter Area (m ²)
INTNL-1	Bio-retention (North)	1200
Industrial Half Road – 2.5m Wide Footpath, 100m Road Length	Bio pod	12
Industrial Half Road – 1.8m Wide Footpath, 100m Road Length	Bio pod	11

5.3.3 MUSIC Model Layout

The development site has been modelled in MUSIC based on the assumptions outlined in section 7.1. Appropriate percentage impervious factors have been applied to all nodes as per Table 5-2.

A diagrammatic view of the MUSIC model layout is presented in Figure 5-3 below.

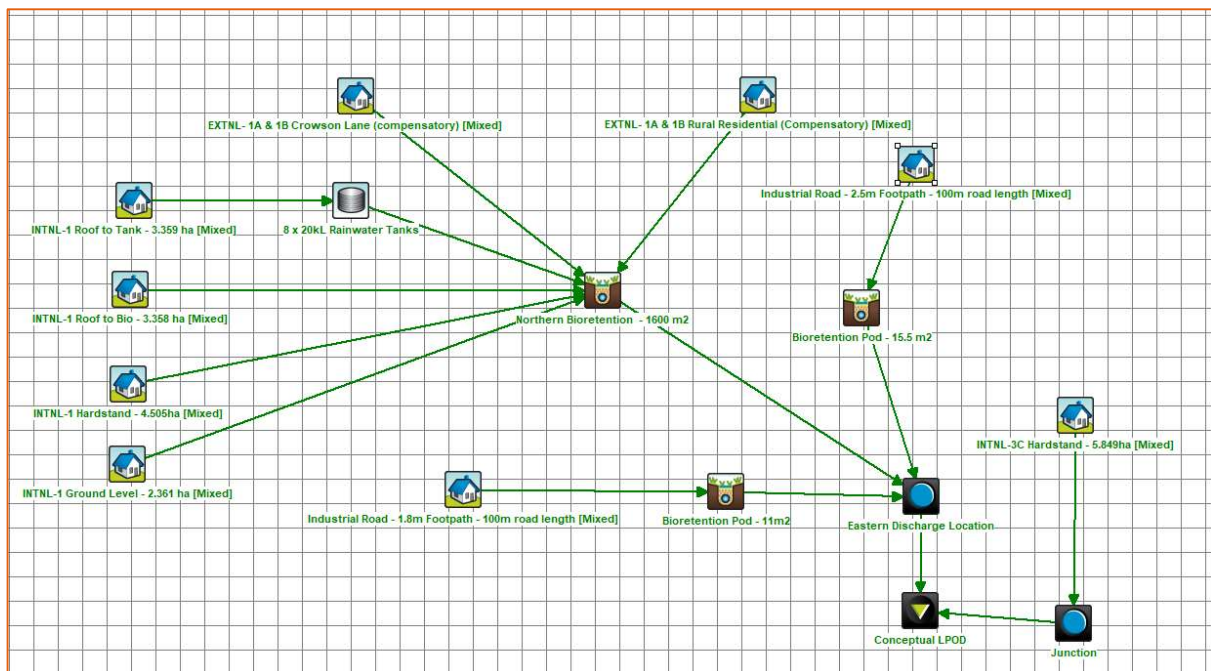


Figure 5-3 MUSIC Model Layout

5.3.4 MUSIC Results

The reduction in pollutant loadings at the discharge locations are presented in Tables 5-7 and 5-8, below.

Table 5-7 MUSIC Treatment Train Effectiveness – Road Bio Pods

Reporting Location	Total Suspended Solids	Total Phosphorus	Total Nitrogen	Gross Pollutants
Industrial Half Road Bio Pod – 2.5m Footpath	82.0%	74.6%	45.6%	100%
Industrial Half Road Bio Pod – 1.8m Footpath	80.4%	74.6%	46.4%	100%
WQO	80.0%	60.0%	45.0%	90.0%

Careful consideration was given to the way in which the compensatory catchments and treatment measures were modelled and analysed to ensure the Northern Bioretention Basin is sufficiently sized to capture an adequate volume of pollutants, meeting the WQOs. As the compensatory catchment (EXTNL1A & 1B) has a different landuse, fraction impervious and size to the by-pass catchment (INTNL-3C), a like-for-like approach was deemed unsuitable. Further to this, the Northern Bioretention Basin also treats Catchment INTNL-1, further complicating the matter. As such, mean annual loads produced by each catchment (pre-treatment) were extracted from MUSIC and the minimum volume of pollutants to be retained by the Northern Bioretention System was calculated based on the application of the WQO's to the sum of the mean annual loads produced by Catchments INTNL-3C and INTNL-1. These values were subtracted from the combined mean annual loads applied to the Northern Bioretention Basin from Catchments INTNL-1 and EXTNL 1A & 1B to determine the maximum volume of pollutants allowable to be discharge from the Northern Bioretention Basin.

The Northern Bioretention Basin filter media area was adjusted until the mean annual load discharged from the basin was less than or equal to the maximum volume, as described above.

Table 5-8 provides details of the analysis.

Table 5-8 MUSIC Treatment Train Effectiveness – Northern Bioretention Basin

Reporting Location	Total Suspended Solids	Total Phosphorus	Total Nitrogen	Gross Pollutants
INTNL-3C Mean Annual Load (kg/yr) [1]	12,100	18.6	62.9	679
INTNL-1 Mean Annual Load (kg/yr) [2]	16,200	32.9	192.0	1,430
Combined INTNL-3C and INTNL-1 Mean Annual Load (kg/yr) [1+2]	28,300	51.5	254.9	2,109
WQO Pollutant Reduction (%)	80.0%	60.0%	45.0%	90.0%
Mean Annual Load Pollutant Retention Target (kg/yr) [3]	22,640	30.9	114.7	1,898.1
Combined INTNL-1 and EXTNL 1A & 1B Mean Annual Load (kg/yr) [4]	28,900	49.4	274.0	2,060
Maximum Combined INTNL-1 and EXTNL- 1A & 1B Mean Annual Load Post Treatment (kg/yr) [4-3]	6,260	18.5	159.3	162
Actual Combined INTNL-1 and EXTNL- 1A & 1B Mean Annual Load Post Treatment (kg/yr) [5]	2,940	9.75	130	0
Reduction (%) Achieved $[(4-5)/4*100]$	89.8%	80.2%	52.6%	100%

Table 5-8 demonstrates that the Northern Bioretention Basin has been adequately sized to treat the flows from both INTNL-1 and EXTNL-1A & 1B to compensate for allowing INTNL-3C to bypass treatment, achieving the WQO's for Total Suspended Solids, Total Phosphorus, Total Nitrogen and Gross Pollutants.

6 CONSTRUCTION PHASE WATER QUALITY

During the construction phase of the development, an Erosion and Sediment Control Program will be implemented to minimise water quality impacts. A detailed Erosion and Sediment Control Program will be employed throughout the site; the sediment control measures shall include silt fences, cut-off drains for polluted stormwater and diversion channels for clean stormwater run-off, gully pit sediment barriers, field inlet sediment traps and temporary bio-retention filter protection.

Details of the sediment and erosion control measures shall be provided on the engineering drawings for the clearing, site earthworks and civil engineering works. The contractor shall be responsible for the provision of the construction phase water quality objectives which shall be enforced by the preparation and implementation of an Erosion and Sediment Control Program.

The following information is provided to identify controls and procedures, and who is responsible for them, which will be incorporated into the Erosion and Sediment Control Program.

6.1 Pre-construction

- Establish a single stabilised entry/exit point (rumble pad) for each stage of construction. This point should also include a vehicle shakedown device to mitigate the transportation of dust and dirt.
- Sediment fences are to be placed along the low side of the site to slow flows, reduce scour and capture some sediment runoff.
- Sediment fences are to be constructed at the base of fill embankments.
- Divert up-slope water around the work site and appropriately stabilise any drainage channels.
- Areas for plant and construction material storage are to be designated along with associated diversion drains and spillage holding ponds.
- Diversion banks are to be created at the upstream boundary of construction activities to ensure upstream runoff is diverted around any areas to be exposed. Catch drains are to be created at the downstream boundary of construction activities.
- Construction of temporary sediment basins.
- Site personnel are to be educated to the sediment and erosion control measures implemented on site.

6.2 During Construction

- Progressive re-vegetation of filled areas and fill batters.
- Construction activities are to be confined to the necessary construction areas.
- The provision of a construction exit to prevent the tracking of debris from tyres of vehicles onto public roads.
- The topsoil stockpile location will be nominated to coincide with areas previously disturbed. A sediment fence is to be constructed around the bottom of the stockpile to trap sediment. A diversion drain is to be installed upstream of the stockpile if required.
- Transport loads that are subject to loss through wind or spillage shall be covered or sealed to prevent entry of pollutants to the stormwater system.
- Regular inspection and maintenance of silt fences, sediment basins and other erosion control measures. Following rainfall events greater than 50mm inspection of erosion control measures and removal of collected material should be undertaken. Replacement of any damaged equipment should be performed immediately.

8.2.1 Bio-retention Basin Construction Requirements

The construction of the bio-retention basins for the development must be in accordance with “Option 1: Surface Protection” from the Water by Design “*Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands*”. A copy of the step-by-step construction sequence and sign-off forms are included in Appendix D.

6.3 Operational Management and Maintenance Plan

6.3.1 Aims and Objectives

Long term management and maintenance of the bio-retention basins on site is required after construction has finished. The objective of the bio-retention basins is to allow stormwater from the development to be treated through the vegetation and filter media before discharging into the downstream catchment. By having an Operational Management and Maintenance Plan (OMMP) in place, the bio-retention basins can be maintained to ensure that it is operating to optimal functionality.

6.3.2 Maintenance Requirements and Locations

Maintenance requirements for the bio-retention basin consists of:

- Regular and storm event inspection to ensure:
 - Sufficient vegetation within bio-retention areas; and
 - Ensuring no erosion has occurred.
- Regular mowing/harvesting to ensure vegetation is maintained at acceptable levels.
- Removal of litter within bio-retention areas.
- Regular trash removal.

The Sediment and Erosion Control Management Plans should be provided to all people involved with the site, including sub-contractors, private certifiers, home owners and regulators. These guidelines have been formed in accordance with the Healthy Waterways Fact Sheet 'Erosion and Sediment Control Management Plans' and the 'Best Practice Erosion and Sediment Control'.

6.3.3 Personnel Responsible

The Contractor/Developer will be responsible for the maintenance of erosion and sediment control and stormwater devices from the possession of the site until the site is accepted 'Off Maintenance' or until stabilisation has occurred to the satisfaction of the superintendent and Council.

After "Off Maintenance", all devices remain the property of the developer and their responsibility for maintenance.

6.3.4 Scheduling of Inspections and Monitoring

Regular Maintenance is used for activities that require a small number of resources. These activities include weeding and removing litter and debris. Table 8.1 below sets out recommended frequency for inspections and regular maintenance of stormwater quality treatment devices.

Table 6-1 Inspection and Maintenance Frequency

Asset Type	Wet Season	Dry Season
Bio-Retention Systems	2 Months	3 Months

Responsive Maintenance is used to check for erosion, the condition of structures and the cover and health of vegetation. This should be carried out at least once a year during or immediately after a significant rainfall event. A check that the system is free-draining should also be carried out at this time.

Renewal Period The eWater MUSIC model states that, on average, bio-retention systems may need their filtration media replaced every 25 years. Therefore, as the proposed redevelopment is being designed with a 25-year design horizon.

6.3.5 Maintenance Techniques and Rectification Procedures

As outlined in the Water by Design "Maintaining Vegetated Assets" document, maintenance activities for bio-retention systems include the following:

- Repairing erosion;
- Unblocking inlets and outlets;
- Removing sediment;
- Removing litter and debris;
- Replanting and Controlling weeds; and
- Managing algal or moss growth on the bio-retention system.

Identification and rectification procedures for all of the above are included in Appendix E (taken from the Water by Design “*Maintaining Vegetated Assets*” document).

6.3.6 Record Keeping and Reporting Requirements

The Water by Design “*Inspection and Maintenance Checklist for Bioretention Systems*” included in Appendix F should be used whenever an inspection is conducted and kept as a record on the asset condition and quantity of removed pollutants over time.

7 CONCLUSION

This SBSQMP has been prepared to provide a design proposal and guide to the stormwater quality management techniques for the site.

The primary objective of this SBSQMP has been to ensure that:

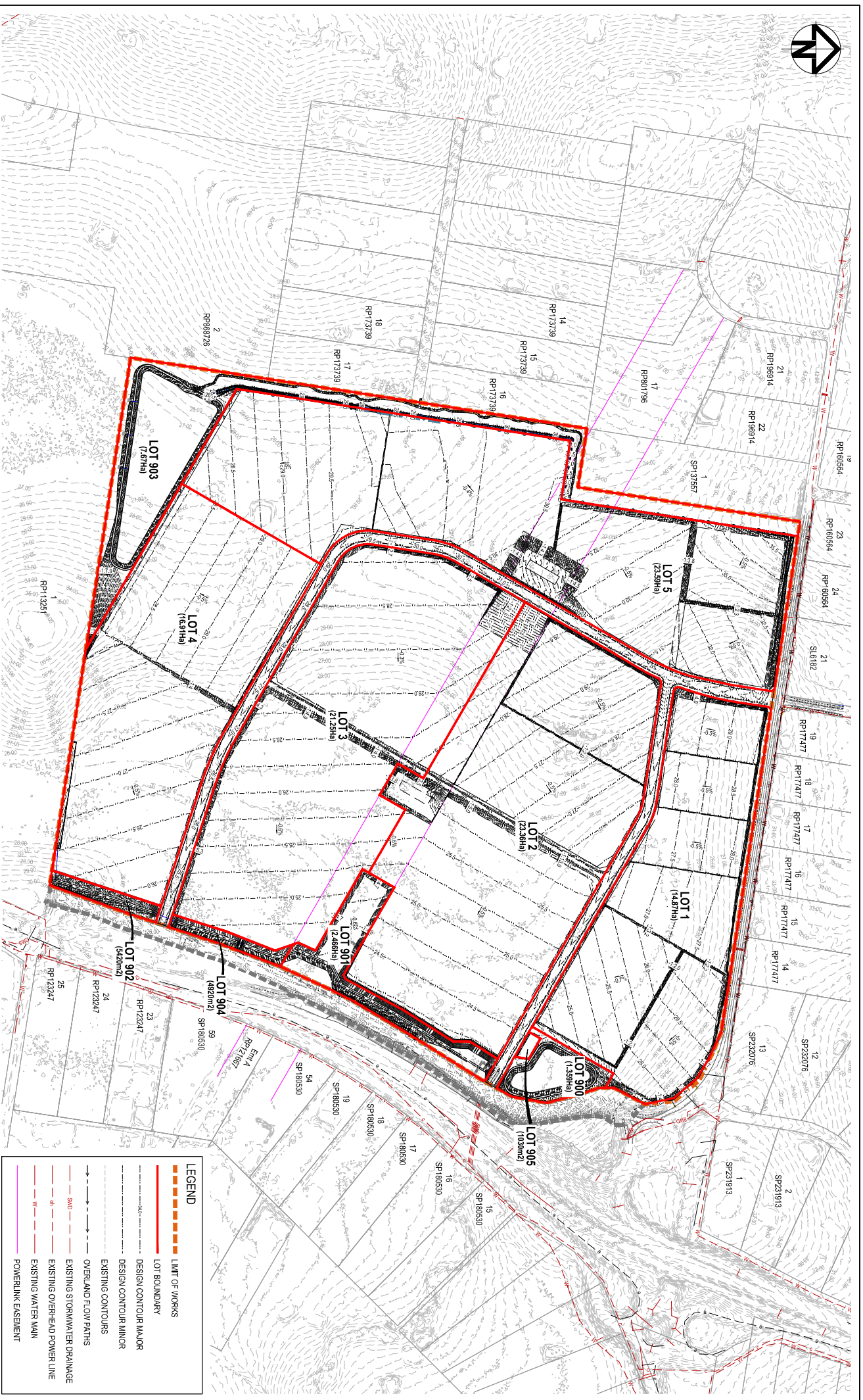
- 1. Details of a proposed stormwater quality treatment train are provided to ensure the discharge of stormwater from the site is of adequate quality standards to comply with the requirements of Economic Development Queensland (EDQ), Logan City Council (LCC) and the South-East Queensland Healthy Waterways Partnership.**

A stormwater quality assessment is provided which demonstrates that a specially tailored treatment system will be required to meet the pollutant removal targets of LCC during the operational phase of the proposed development. The proposed treatment system includes routing of stormwater through discharge locations. Site specific SBSMPs will be required to accompany the MCU applications for catchments INTNL-2A - INTNL-4C to formulate an appropriate stormwater treatment train and has not been addressed in this report.

Construction phase sediment control devices are to be implemented during construction works in accordance with requirements associated with Type 1 sediment discharge zones, comprising of a vehicle shakedown, sediment fences, gully inlet protection, sediment basin and check dams.

APPENDIX A

Site Layout Plan



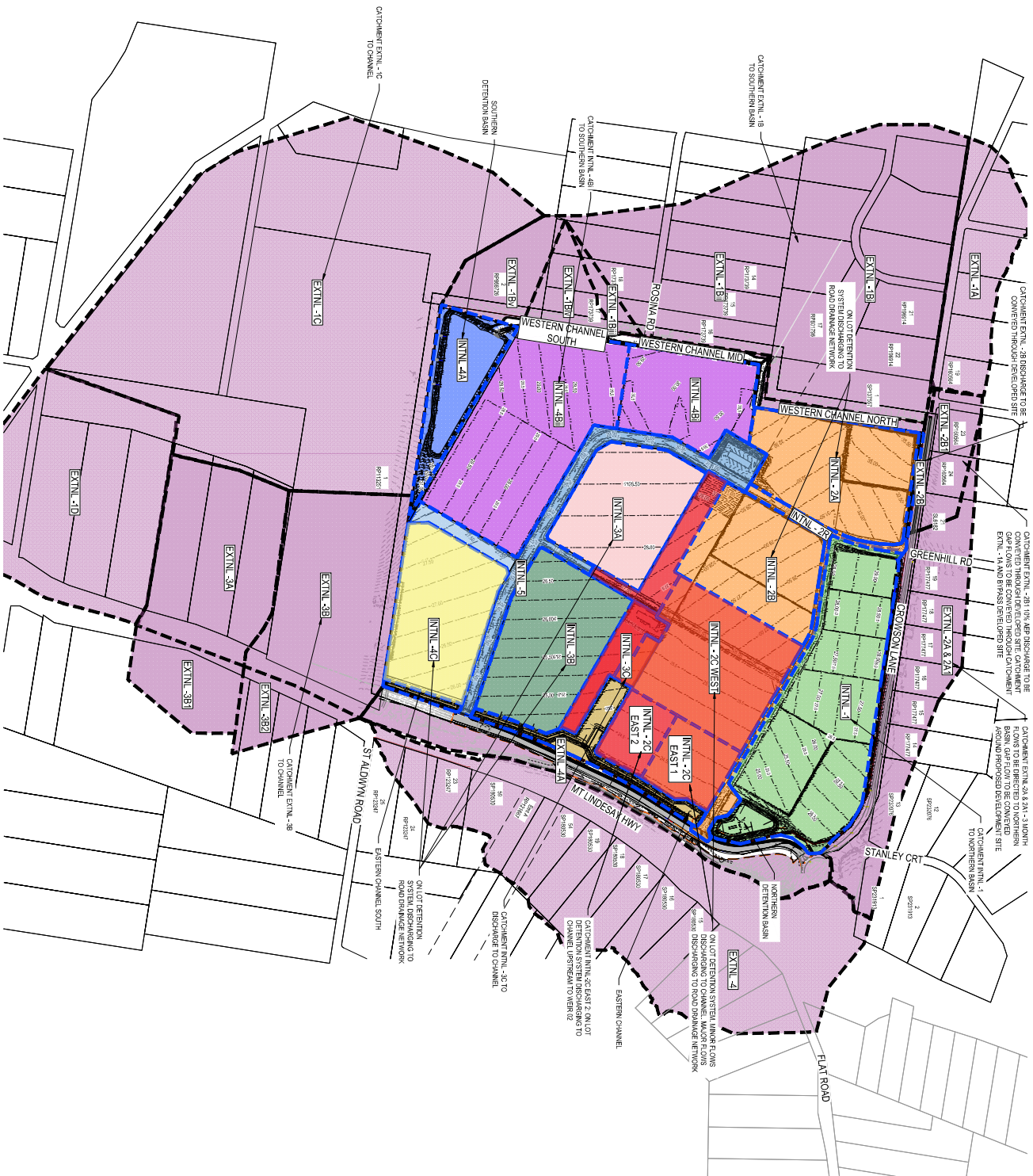
 ARCADIS	
Arcadis Australia Pacific Pty Limited Level 35, 111 Eagle Street BRISBANE QLD 4000 AUST 78 104 465 589 Tel No: +61 7 2337 0000 www.arcadis.com/au	
Telephone:	Fax:
Email:	Website:
30109334 - AAP - W500P - CV - SKT - 018 - 06	

APPENDIX B

Engineering Drawings and Site Topography

LEGEND	
	EXISTING SURFACE CONTOURS
	PROPOSED MAJOR CONTROLS
	PROPOSED MINOR CONTROLS
	EXTERNAL STORMWATER CATCHMENT
	POST DEVELOPMENT
	STORMWATER CATCHMENT

CATCHMENT AREAS	
LABEL	AREA (Ha)
EXTNL - 1A	7.224
EXTNL - 1B	23.636
EXTNL - 1BI	16.674
EXTNL - 1BII	0.903
EXTNL - 1BV	3.966
EXTNL - 1B	4.203
WESTERN CHANNEL NORTH	1.244
WESTERN CHANNEL MID	0.960
WESTERN CHANNEL SOUTH	0.517
EXTNL - 1C	64.974
EXTNL - 1D	19.78
EXTNL - 2A & 2A1	12.662
EXTNL - 2B1	2.070
EXTNL - 3A	12.180
EXTNL - 3B	14.090
EXTNL - 3B1	4.830
EXTNL - 3B2	2.810
EXTNL - 4	34.632
EXTNL - 4A	8.764
INTNL - 1	17.062
INTNL - 2A	8.918
INTNL - 2B	7.7892
INTNL - 2C WEST	9.5941
INTNL - 2C EAST 1	2.9479
INTNL - 2C EAST 2	2.1556
INTNL - 2B	2.0607
INTNL - 3A	7.740
INTNL - 3B	9.165
INTNL - 3C	4.1522
INTNL - 4A	5.529
INTNL - 4B1	6.553
INTNL - 4B1	13.967
INTNL - 4C	7.916
INTNL - 5	5.968
EASTERN CHANNEL	2.904
EASTERN CHANNEL SOUTH	0.546



Scale

0 50 100 200 300 400 500m

1 : 5000

North Arrow

N

Surveyor

WOLTER
consulting group

Client

Charter Hall

STATUS

CONCEPT DESIGN ONLY
NOT TO BE USED FOR CONSTRUCTION

DESIGNED BY

L. STANTON

PROJECT MANAGER

G. ELIS

ORIGINAL ISSUE SIGNATURES

DESIGNED BY

PROJECT MANAGER

DATE

DATE

DATE

APPROVED BY

DATE

DATE

PROJECT

4499-4651 MOUNT LINDESAY
HIGHWAY, NORTH MACLEAN

POST-DEVELOPMENT
QUALITY CATCHMENT PLAN

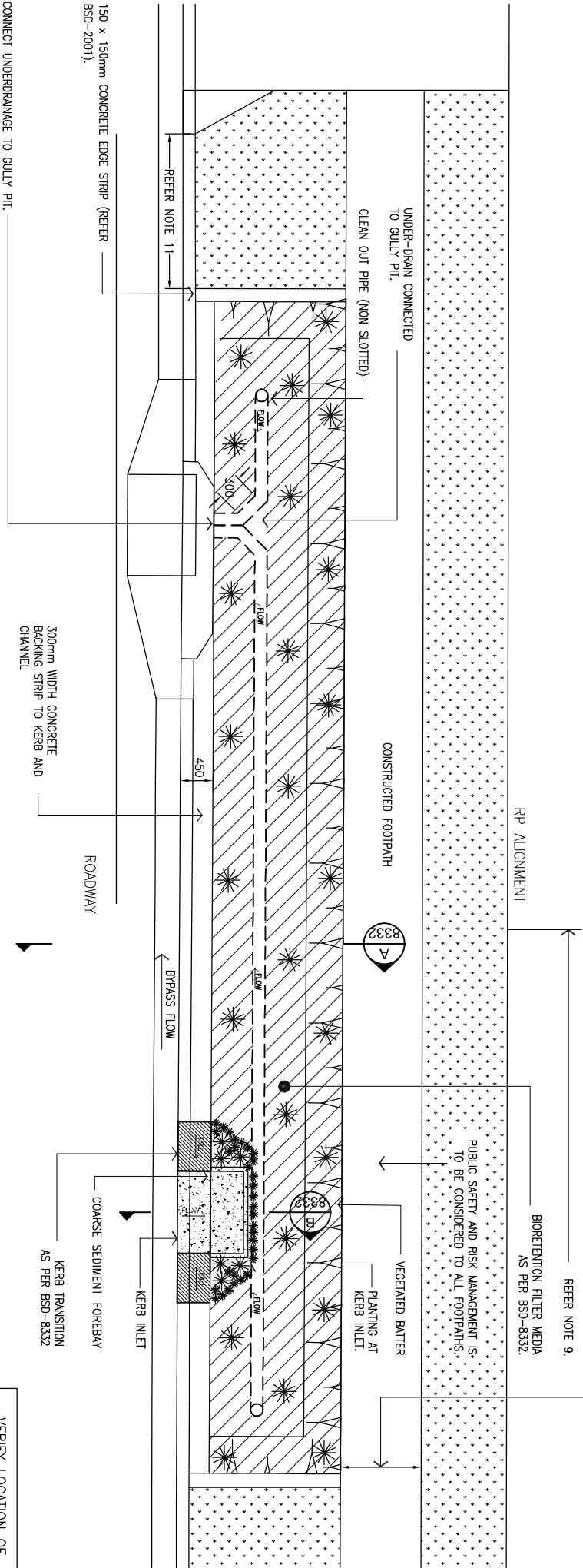
ARCADIS

ARCADIS Australia Pacific Pty Limited
BRISSBANE QLD 4000
ABN 78 104 485 289
TEL No: +61 7 3337 0000
WWW.ARCADIS.COM.AU

30/10/2024 - AAP - WS000P - CV - SKT - 0248 - 03

NOTES

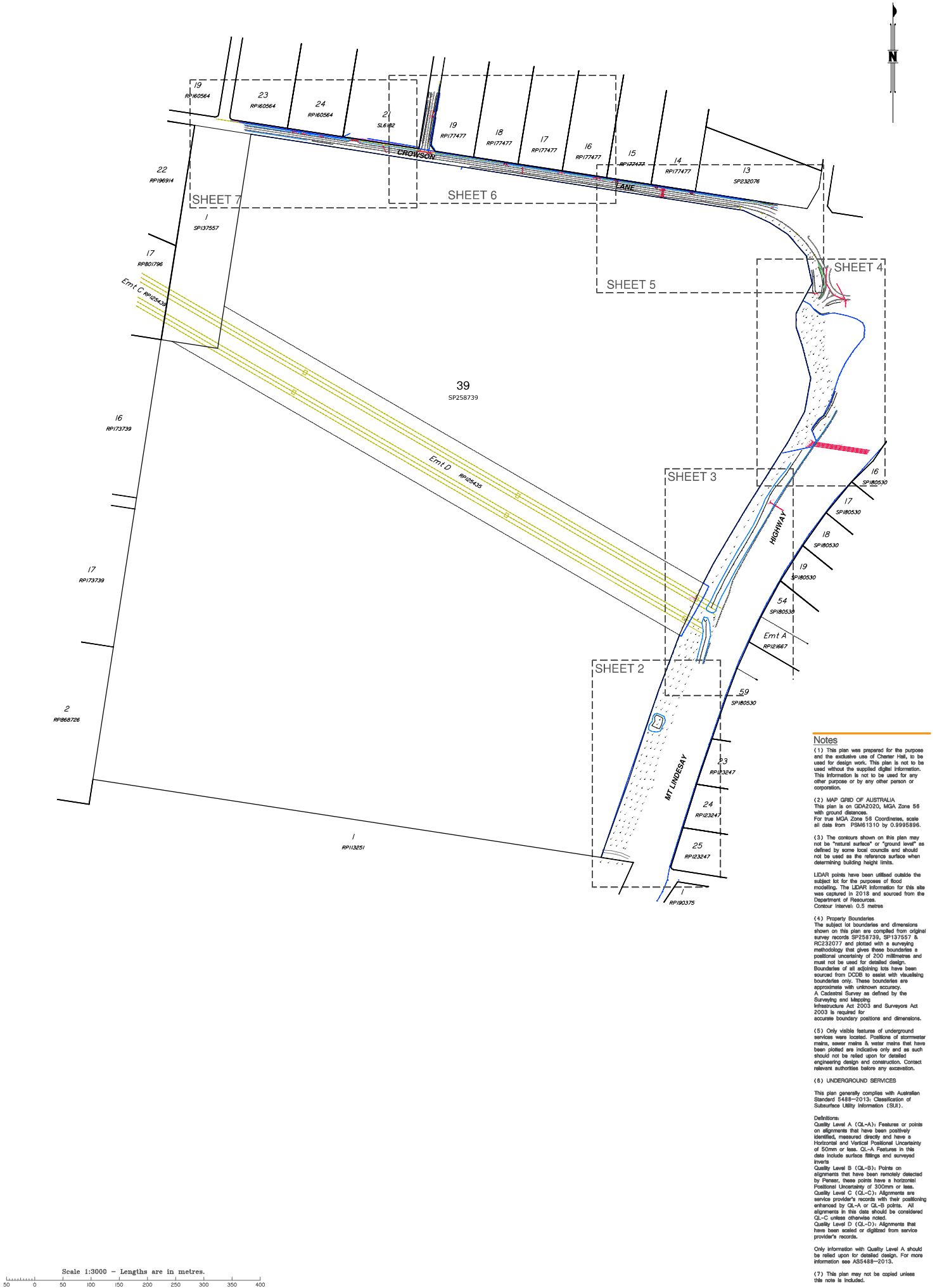
- 1. THIS PLAN IS TO BE READ IN CONJUNCTION WITH BSD-8331.
- 2. FOR BIORETENTION SYSTEM NOTES AND DIMENSIONS REFER TO BSD-8332.
- 3. DETAIL TO BE INCORPORATED IN DEVELOPMENTS WHERE SERVICES/ GRADES ENABLE THE CONSTRUCTION OF THE BIORETENTION SYSTEM AND WHERE THE UNDER-DRAIN CAN BE DRAINED TO A STORMWATER GULLY PIT.
- 4. SELECTION OF APPROPRIATE PLAN LAYOUT IS BASED ON SITE SPECIFIC DETAILS INCLUDING SPACE, SERVICES, DRAINAGE, TOPOGRAPHY, TRAFFIC CONDITIONS ETC.
- 5. APPROVAL FOR VARIATIONS TO EXISTING ROADS/VERGES SHALL BE OBTAINED FROM BCC.
- 6. STEEP VERGE OR ROAD GRADES MAY LIMIT THE FEASIBILITY OF STREETSCAPE BIORETENTION.
- 7. WHEN LOCATED NEXT TO STREET PARKING CONSIDER ACCESS TO AND FROM VEHICLES.
- 8. MULTIPLE KERB INLETS MAY BE REQUIRED DEPENDING ON CONTRIBUTING CATCHMENT, GRADE, LENGTH, AND INFLOWS.
- 9. CONSIDER PLACEMENT OF BIORETENTION POD AT DIVIDING BOUNDARY TO PREVENT IMPINGING ON AVAILABLE PROPERTY ACCESS.
- 10. CONCRETE EDGE STRIP (150 X 150mm) REQUIRED AT BACK EDGE OF DEVICE WHERE NO FOOTPATH IS PROPOSED.
- 11. MAXIMUM LENGTH OF DEVICE IS TO BE SIZED TO ALLOW ADEQUATE SPACE FOR DRIVEWAY CROSsoVERS AND WASTE PICKUP. TYPICAL MAXIMUM LENGTH IS 8 METERS.
- 12. IN SAG LOCATIONS A TYPE 1 FIELD INLET WITHIN THE BASIN MAY BE SUBSTITUTED FOR A GULLY PIT.



STREETSCAPE BIORETENTION POD (VERGE TYPE) – TYPICAL LAYOUT

DESIGN REVIEWED & CERTIFIED FOR ISSUE			
NAME:	MARK GIBSON	PREP:	6722
SIGNATURE:	SIGNATURE ON ORIGINAL	DATE:	09/04/16

BRISBANE CITY COUNCIL STANDARD DRAWING WATERSMART BIORETENTION POD (VERGE TYPE) — LAYOUT BSD-8331 SCALE: NOT TO SCALE ORIGINAL SIZE: A3 REVISION: D								 BRISBANE CITY			
D	CLARIFICATION & IMPROVEMENT TO NOTES & DESIGN	Nov '16	Nov '16	Dec '16	DESIGN	CPD - P&D	DATE	Apr '16			
C	Drawing Title Amended	FEB '16	JUL '16	JUL '16	DRAWN	CPD - P&D	DATE	Apr '16			
B	NOTES UPDATED	Feb '15	Feb '15	Feb '15	CHECKED	M. GIBSON	DATE	Apr '16			
A	ORIGINAL ISSUE	Apr '14	Apr '14	Apr '14	DRAWING	BSD-8331dmg					
ISSUE	AMENDMENT	DRAWN DATE	CHK'D DATE	APPRO'D DATE	ASSOCIATED PLANS						
					NATURAL ENVIRONMENT WATER & SUSTAINABILITY						
					DESIGN REVIEWED & CERTIFIED FOR ISSUE						
					NAME: MARK GIBSON PREP: 6722						
					SIGNATURE: SIGNATURE ON ORIGINAL						
					DATED APRIL '16						
					PRINCIPAL PROGRAM MANAGER						
					ASSOCIATED PLANS						
					BRISBANE CITY						
					BRISBANE CITY COUNCIL STANDARD DRAWING						
					WATERSMART BIORETENTION						
					POD (VERGE TYPE)						
					— LAYOUT						
					SCALE: NOT TO SCALE						
					DRAWN: BSD-8331						
					ORIGINAL SIZE: A3						
					REVISION: D						



Notes

(1) This plan was prepared for the purpose and the exclusive use of Charter Hall, to be used for design work. This plan is not to be used without the supplied digital information. This information is not to be used for any other purpose or by any other person or corporation.

(2) MAP GRID OF AUSTRALIA
This plan is on GDA2020, MGA Zone 56 with ground distances.
For true MGA Zone 56 Coordinates, scale all data from PSM61310 by 0.9995896.

(3) The contours shown on this plan may not be "natural surface" or "ground level" as defined by some local councils and should not be used as the reference surface when determining building height limits.
LIDAR points have been utilized outside the subject lot for the purposes of flood modelling. The LIDAR information for this site was captured in 2018 and sourced from the Department of Resources.
Contour Interval: 0.5 metres

(4) Property Boundaries
The subject lot boundaries and dimensions shown on this plan are compiled from original survey records SP258739, SP137557 & RC232077 and plotted with a surveying methodology that gives these boundaries a positional uncertainty of 200 millimetres and must not be used for detailed design. Boundaries of all adjoining lots have been sourced from DCDs to assist with visualising boundaries only. These boundaries are approximate with unknown accuracy. A Cadastral Survey as defined by the Surveying and Mapping Infrastructure Act 2003 and Surveyors Act 2003 is required for accurate boundary positions and dimensions.

(5) Only visible features of underground services were located. Positions of stormwater mains, sewer mains & water mains that have been plotted are indicative only and as such should not be relied upon for detailed engineering design and construction. Contact relevant authorities before any excavation.

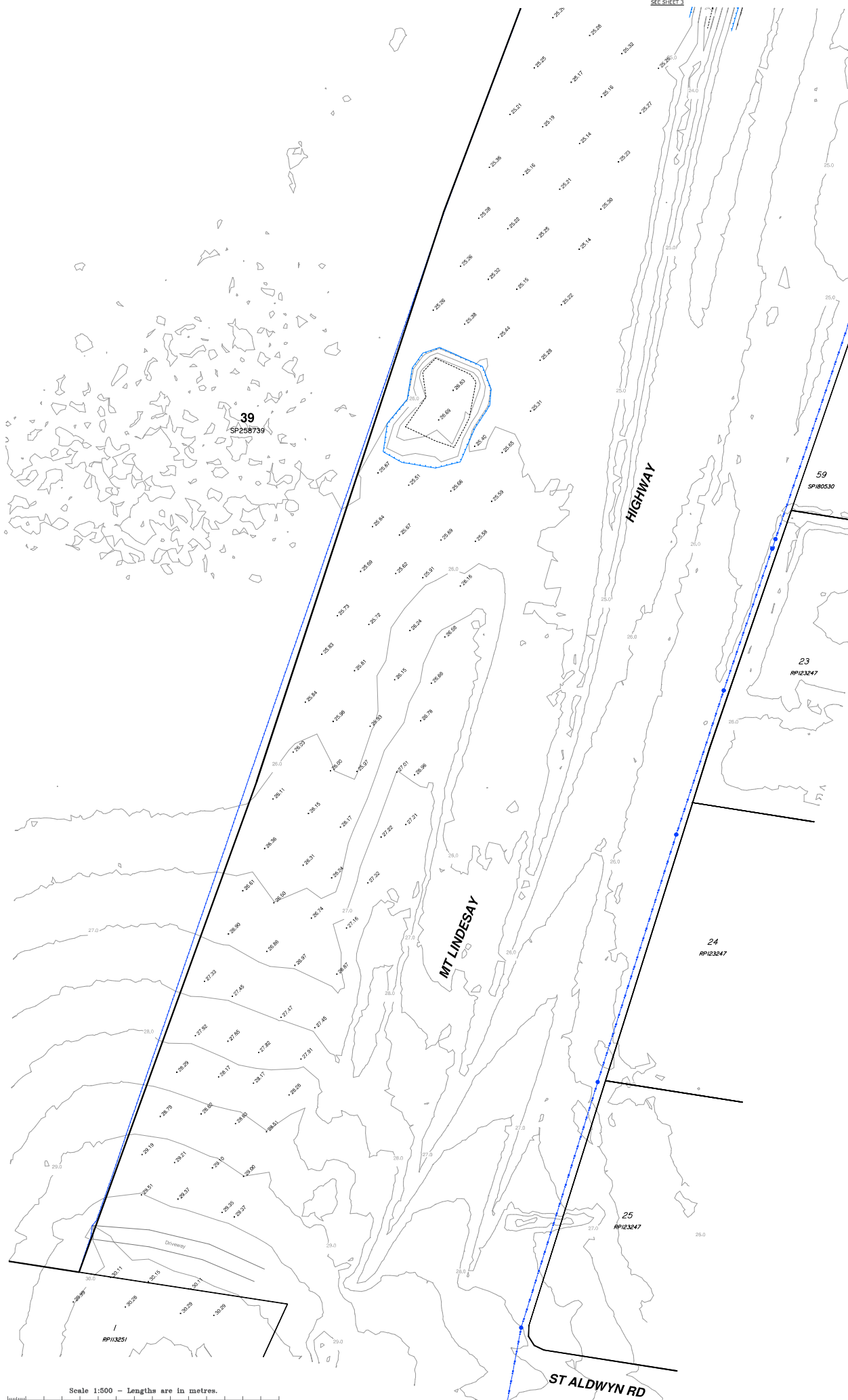
(6) UNDERGROUND SERVICES
This plan generally complies with Australian Standard 5488-2013: Classification of Subsurface Utility Information (SU1).

Definitions:
Quality Level A (QL-A): Features or points on alignments that have been positively identified, measured directly and have a Horizontal and Vertical Positional Uncertainty of 50mm or less. QL-A Features in this data include surface fittings and surveyed inverts.
Quality Level B (QL-B): Points on alignments that have been remotely detected by Finesse, these points have a horizontal Positional Uncertainty of 300mm or less.
Quality Level C (QL-C): Alignments are service provider's records with their positioning enhanced by QL-A or QL-B points. All alignments in this data should be considered QL-C unless otherwise noted.
Quality Level D (QL-D): Alignments that have been scaled or digitized from service provider's records.

Only information with Quality Level A should be relied upon for detailed design. For more information see AS5488-2013.

(7) This plan may not be copied unless this note is included.

Scale 1:3000 - Lengths are in metres.
0 50 100 150 200 250 300 350 400



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- Linework**
- Electrical Overhead
 - Fence Line
 - Road Crown
 - Road Driveway
 - Road Blumner Edge
 - Road Kerb Back
 - Road Kerb Invert
 - Road Kerb Lip
 - Storm Located - Quality Level 'A'
 - Storm Located - Quality Level 'D'
 - Telecomms Located - Quality Level 'C'
 - Topo Bank Bottom
 - Topo Bank Top
 - Topo Change of Grade
 - Topo Concrete
 - Traffic Barrier
 - Water Located - Quality Level 'C'
 - Water Located - Quality Level 'D'

- Symbols**
- Electrical Light Pole
 - Electrical Pit
 - Electrical Pole
 - Storm Headwall
 - Storm Invert
 - Storm Manhole
 - Storm Gully Trap
 - Survey Benchmark
 - Telecomms Piller
 - Telecomms Pit
 - Topo Surface Level
 - Water Booster Cabinet
 - Water Valve
 - Water Fire Hydrant

Scale 1:500 - Lengths are in metres.
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70

WOLTER
consulting group

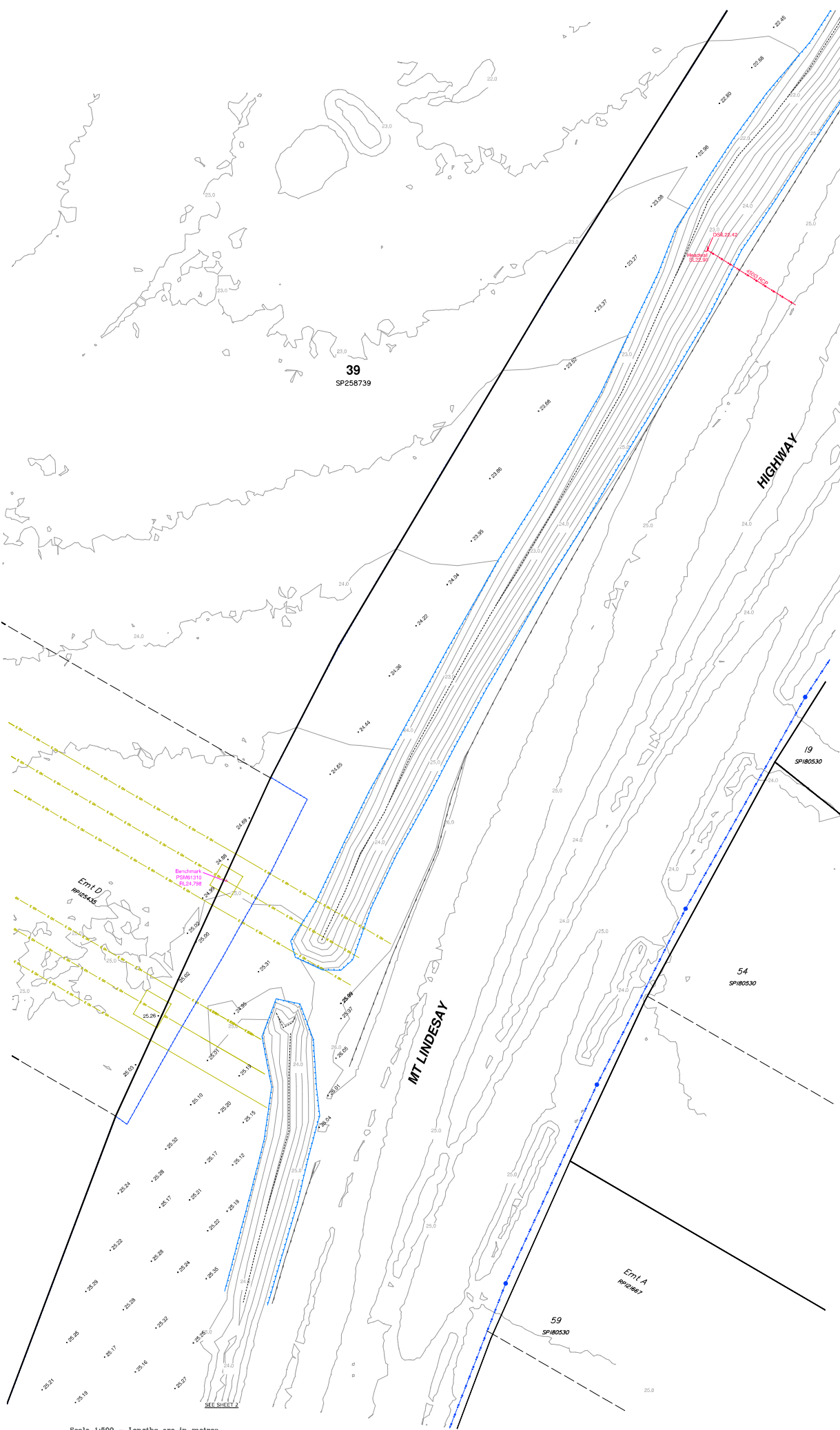
Planning Urban Design Landscape Environment Surveying

Contour and Detail Survey
2-140 Crowson Lane, North Maclean
Local Authority: North Maclean Description: Lot 39 on SP258739
Level Datum: PM61310 - RL24.798 Origin: AHD
Co-ord System: GDA2020, MGA Zone 56

A	Original Issue	02-03-2022	J.Townend	J.Cowell	G.Hanton
Rev.	Reason for Issue or Amendment	Date	Surveyed	Drawn	Approved

DRAWING NO.
21-0432S-01

SHEET NO. 2 of 7 **VERSION** A



Notes

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Quality Level D (QL-D): Alignments that have been scaled or digitized from service provider's records.
- Only information with Quality Level A should be relied upon for detailed design. For more information see AS4488-2013.
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Linework

- Electrical Overhead
- Fence Line
- Road Crown
- Road Driveway
- Road Blumner Edge
- Road Kerb Back
- Road Kerb Invert
- Road Kerb Lip
- Storm Located - Quality Level 'A'
- Storm Located - Quality Level 'D'
- Telecomms Located - Quality Level 'C'
- Topo Bank Bottom
- Topo Bank Top
- Topo Change of Grade
- Topo Concrete
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- Water Located - Quality Level 'D'

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- Electrical Pit
- Electrical Pole
- Storm Headwall
- Storm Invert
- Storm Manhole
- Storm Gully Trap
- Survey Benchmark
- Telecomms Piller
- Telecomms Pit
- Topo Surface Level
- Water Booster Cabinet
- Water Valve
- Water Pits Hydrant

Scale 1:500 - Lengths are in metres.
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70

A	Original Issue	02-03-2022	J.Townend	J.Cowell	G.Hanton
Rev.	Reason for Issue or Amendment	Date	Surveyed	Drawn	Approved

APPENDIX C

Existing Approval Decision Notice



Our ref: DEV2018/961/8

27 September 2023

Department of
**State Development, Infrastructure,
Local Government and Planning**

CH Hydrangea Pty Ltd
C/- Wolter Consulting Group Pty Ltd
Att: Ms Jen Taylor
PO Box 436
NEW FARM QLD 4005

Email: jtaylor@wolterconsulting.com.au

Dear Ms Taylor

Section 99 Approval - Application to Change PDA Development Approval
PDA Development Permit for Reconfiguring a Lot – 1 Lot into 11 Lots, New Roads and Open Space and Context Plan at 4499-4651 Mount Lindesay Highway, North Maclean described as Lot 39 on RP253739

On 27 September 2023 the Minister for Economic Development Queensland (MEDQ) decided to grant **all** of the amendment application applied for, subject to PDA development conditions set out in this PDA decision notice.

The PDA decision notice and approved plans/documents can be viewed in the MEDQ Development Approvals Register via the Department website www.dsdilgp.qld.gov.au/pda-da-applications.

If you require any further information, please contact Mrs Jennifer Davison, Principal Planner Development Assessment, in Economic Development Queensland, by telephone on (07) 3452 7127 or at jennifer.davison@dsdilgp.qld.gov.au, who will assist.

Yours sincerely

Brandon Bouda
A/Director
Development Assessment
Economic Development Queensland

PDA Decision Notice – Approval

Site information		
Name of priority development area (PDA)	Greater Flagstone PDA	
Site address	4499-4651 Mount Lindesay Highway, North Maclean	
Lot on plan description	Lot number	Plan description
	39	SP258739
PDA development application details		
DEV reference number	DEV2018/961	
'Properly made' date	29 August 2023	
Type of application	☐ PDA development application for: ☐ Material change of use ☐ Preliminary approval ☐ Development permit ☐ Reconfiguring a lot ☐ Preliminary approval ☐ Development permit ☐ Operational work ☐ Preliminary approval ☐ Development permit ☒ Application to change PDA development approval ☐ Application to extend currency period	
Description of proposal applied for	Reconfiguring a Lot - 1 into 11 Lots, New Road, and Open Space; and Context Plan	
PDA development approval details		
Decision of the MEDQ	The MEDQ has decided to grant all of the PDA development approval applied for, subject to PDA development conditions forming part of this decision notice. The changes relate to the inclusion of new drainage lots, pump station lot, additional industrial lot, temporary access easements and amended lot sizes.	
Original Decision date	10 September 2021	
Change to approval date	27 September 2023	
Currency period	6 years from the original decision date	

Approved Plans and Documents

The plans and documents approved by the MEDQ and referred to in the PDA development conditions for the PDA development approval are detailed below.

Approved plans and documents		Number	Date
1.	Plan of Reconfiguration, prepared by Wolter Consulting	22-0007P/01-02 Version E	14/08/2023
2.	Staging Sketch Plan, prepared by Wolter Consulting	22-0007P/01-03 Version E	14/08/2023
3.	Traffic Impact Assessment, prepared by Bitzos Consulting	P5708.001R North Maclean Industrial Estate TIA	15 August 2023
4.	Site Based Stormwater Management Plan (Quantity), prepared by Arcadis	EAG001-30109334-AAR Revision 9	15 August 2023
5.	Site Based Stormwater Quality Management Plan, prepared by Arcadis	EAG003-30109334-AAR Revision 4	15 August 2023
6.	Overall Bulk Earthworks Sketch Layout Plan, prepared by Arcadis	30109334-AAP-WS00OP-CV-SKT-030 Issue 1	15 August 2023
7.	Overall Water Main Sketch Layout Plan, prepared by Arcadis	30109334-AAP-WS00OP-CV-SKT-031 Issue 1	8/08/2023
8.	Overall Sewer Sketch Layout Plan, prepared by Arcadis	3010933-AAP WS00OP-CV-SKT-032 Issue 1	22/08/2023
9.	Swale and Channel Typical Details, prepared by Arcadis	30109334-AAP-WS00OP-CV-DRG-0164 Issue 5	31/07/2023
10.	Swale and Channel Longitudinal Section Sheet 2, prepared by Arcadis	30109334-AAP-WS00OP-CV-DRG-0162 Issue 5	31/07/2023
Plans and documents previously approved on 10 September 2021		Number	Date
11.	Bushfire Management Plan	Report 16014, Final V3	13 July 2018
12.	Addendum to the Bushfire Management Plan for the proposed development at 4499-4651 Mount Lindsay Highway, North Maclean	N/A	18 February 2019
13.	North Maclean Enterprise Precinct (4499-4651 Mount Lindesay Highway, North Maclean) – Progression of Ecological Issues	N/A	31 March 2017

Supporting Plans and Documents

To remove any doubt, the following documents are not approved documents for the purposes of this PDA development approval, but rather are supporting documents.

Supporting Plans, Reports and Specifications		Number	Date
Endorsed Context Plan			
1.	North Maclean Enterprise Context Plan Land Use and Road Network	N/A	12/07/2021 (as amended in red dated 03/09/2021)
2.	North Maclean Enterprise Context Plan Land Use and Road Network (Wider Locality)	N/A	12/07/2021
3.	North Maclean Enterprise Context Plan Ultimate Water and Sewer Network	N/A	12/07/2021
4.	North Maclean Enterprise Context Plan Ultimate Stormwater Network	N/A	12/07/2021 (as amended in red dated 03/09/2021)

Supporting Plans, Reports and Specifications

5.	Site Based Stormwater Management Plan	TEL202159, Issue A	08 July 2021
6.	Engineering Services Report	TEL202159, Issue A	06/07/21.

PDA Development Conditions

PREAMBLE AND ABBREVIATIONS

PREAMBLE

For the purpose of interpreting this PDA Development Approval, including the PDA Development Conditions, the following applies:

COMPLIANCE ASSESSMENT

Where a condition of this approval requires Compliance Assessment, Compliance Assessment is required in accordance with the following:

- a) The applicant must:
 - i) pay to MEDQ at the time of submission the relevant fee for Compliance Assessment, including any third party peer review costs which will be charged on a 100% cost recovery basis. The Compliance Assessment fees are set out in EDQ Development Assessment Fees and Charges Schedule¹ (as amended from time to time).
 - ii) submit to EDQ DA a duly completed Compliance Assessment form².
 - iii) submit to EDQ DA the documentation as required under the relevant condition.
- b) Where EDQ is satisfied the documentation submitted for Compliance Assessment meets the requirements of the relevant condition (or element of the condition), EDQ will endorse the documentation and advise by written notice.
- c) Compliance Assessment and endorsement can be repeated where a different design or solution, to that already endorsed, is sought.

¹ The EDQ Development Assessment Fees and Charges Schedule is available at EDQ's website.

² The Compliance Assessment form is available at EDQ's website. It sets out how to submit documentation for Compliance Assessment and how to pay Compliance Assessment fees.

- d) The process and timeframes that apply to Compliance Assessment are as follows:
- i) applicant submits items required under a) above to EDQ DA for Compliance Assessment.
 - ii) **within 30 business days** – EDQ assesses the documentation and:
 - 1. if satisfied, endorses the documentation; or
 - 2. if not satisfied, notifies the applicant accordingly.
 - iii) if the applicant is notified under ii.2. above, revised documentation must be submitted **within 30 business days** from the date of notification.
 - iv) **within 30 business days** – EDQ assesses the revised documentation and:
 - 1. if satisfied, endorses the revised documentation; or
 - 2. if not satisfied, notifies the applicant accordingly.
 - v) where EDQ notifies the applicant as stated under iv.2. above, repeat steps iii. and iv. above. If either party is not satisfied by the outcome of this process, that party can elect to enter into a mediation process with an independent mediator agreed to by both parties.

Despite note v. above, the condition (or element of the condition) is determined to have been met only when EDQ endorses relevant documentation.

SUBMITTING DOCUMENTATION TO EDQ:

Where a condition of this approval requires documentation to be submitted to either EDQ DA or EDQ IS, submit the documentation to:

- a) EDQ DA at: pdadevelopmentassessment@dsmip.qld.gov.au.
- b) EDQ IS at: EDQ_PrePostConstruction@dsmip.qld.gov.au.

ABBREVIATIONS

For the purposes of interpreting the PDA Development Conditions, the following is a list of abbreviations utilised:

- 1. **AILA** means a Landscape Architect registered Australian Institute Landscape Architect.
- 2. **Certification Procedures Manual** means the document titled *Certification Procedures Manual*, prepared by the Department of Infrastructure, Local Government and Planning, dated 16 October 2017 (as amended from time to time).
- 3. **Contributed Asset** means an asset constructed under a PDA development approval or Infrastructure Agreement that will become the responsibility of an External Authority. For the purposes of operational works for a Contributed Asset, the following definitions apply:
 - a. **External Authority** means a public-sector entity other than the MEDQ;
 - b. **Parkland** means carrying out operational work related to the provision of parkland infrastructure;
 - c. **Roadworks** means carrying out any operational work within existing or proposed road(s), to a depth of 1.5m measured from the top of kerb, and includes Streetscape Works;
 - d. **Sewer Works** means carrying out any operational work related to the provision of wastewater infrastructure;
 - e. **Streetscape Works** means carrying out any operational work within the verge of a road, including footpath surface treatments, street furniture, street lighting and landscaping;
 - f. **Stormwater Works** means carrying out any operational work related to the provision of stormwater infrastructure; and
 - g. **Water Works** means carrying out any operational work related to the provision of water infrastructure.
- 4. **Council** means Logan City Council.

5.	DSDILGP means The Department of State Development, Infrastructure, Local Government and Planning.	
6.	EDQ means Economic Development Queensland.	
7.	EDQ DA means Economic Development Queensland's – Development Assessment team.	
8.	EDQ IS means Economic Development Queensland's – Infrastructure Services team.	
9.	IFF means Infrastructure Funding Framework.	
10.	MEDQ means The Minister of Economic Development Queensland.	
11.	PDA means Priority Development Area.	
12.	RPEQ means Registered Professional Engineer of Queensland.	
No.	Condition	Timing
General		
1.	Carry out the Approved Development Carry out the approved development generally in accordance with the approved plans and documents; and any other documentation endorsed via Compliance Assessment as required by these conditions.	Prior to survey plan endorsement for the relevant stage
2.	Street Naming Submit to EDQ DA a schedule of street names approved by Council.	Prior to survey plan endorsement for the relevant stage
Construction		
3.	Hours of Work – Construction Unless otherwise endorsed, via Compliance Assessment for out of hours work, construction hours for the approved development are limited to Monday to Saturday between 6:30am to 6:30pm, excluding public holidays.	During construction unless otherwise endorsed
4.	Out of Hours Work – Compliance Assessment Where out of hours work is proposed, submit to EDQ DA, for Compliance Assessment, an out of hours work request. The out of hours work request must include a duly completed out of hours work request form ³ .	Minimum of 10 business days prior to proposed out of hours work commencement date
5.	Certification of Operational Work Carry out all Operational Work under this approval in accordance with the <i>Certification Procedures Manual</i> .	At all times

³ The out of hours work request form is available at EDQ's website.

6.	Construction Management Plan a) Submit to EDQ IS a site-based Construction Management Plan (CMP), prepared by the principal site contractor and reviewed by a suitably qualified and experienced person responsible for overseeing the site works, to manage construction impacts, including: i) noise and dust in accordance with the EP Act; ii) stormwater flows around and through the site without increasing the concentration of total suspended solids or Prescribed Water Contaminants (as defined in the EP Act), causing erosion, creating any ponding and causing any actionable nuisance to upstream and downstream properties; iii) contaminated land, where required under a site suitability statement prepared in accordance with section 389 of the EP Act; iv) complaints procedures; v) site management: 1. for the provision of safe and functional alternative pedestrian routes, past, through or around the site; 2. to mitigate impacts to public sector entity assets, including street trees, on or external to the site; 3. for safe and functional temporary vehicular access points and frequency of use; 4. for the safe and functional loading and unloading of materials including the location of any remote loading sites; 5. for the location of materials, structures, plant and equipment; 6. of waste generated by construction activities; 7. detailing how materials are to be loaded/unloaded; 8. of proposed external hoardings and gantries (with clearances to street furniture and other public sector entity assets); 9. of employee and visitor parking areas; 10. of anticipated staging and programming; 11. for the provision of safe and functional emergency exit routes; and 12. any out of hours work as endorsed via Compliance Assessment. b) A copy of the CMP submitted under part a) of this condition must be current and available on site. c) Carry out all construction work generally in accordance with the CMP submitted under part a) of this condition.	a) Prior to commencing work for the relevant stage b) During construction c) During construction
7.	Erosion and Sediment Management a) Submit to EDQ IS an Erosion and Sediment Control Plan (ESCP), certified by a RPEQ or an accredited professional in erosion and sediment control, and prepared generally in accordance with the following: i) construction phase stormwater management design objectives of the <i>State Planning Policy 2017</i> (Appendix 2 Table A);	a) Prior to commencing work for the relevant stage

	ii) <i>Healthy Land and Water Technical Note: Complying with the SPP – Sediment Management on Construction Sites.</i> b) Implement the certified ESCP submitted under part a) of this condition.	b) During construction
8.	Dispersive Soil Management a) Submit to EDQ IS a Dispersive Soil Management Plan, prepared by a soil science/soil chemistry specialist that details for the design, construction, and operational phases of the development including: i) the suite of methods required to identify and address potential issues associated with the exposure and re-use of dispersive soils, ii) details of the areas where dispersive soils will be disturbed and treated/rehabilitated. b) Implement and monitor the actions identified in the Dispersive Soil Management Plan as required under part a) of this condition.	a) Prior to commencing site works b) At all times during construction
9.	Traffic Management Plan a) Submit to EDQ IS a Traffic Management Plan (TMP), certified by a person holding a current Traffic Management Design qualification. The TMP must include the following: i) provision for the safe and functional management of traffic around and through the site during and outside of construction work hours; ii) provision for the safe and functional management of pedestrian traffic, including alternative pedestrian routes past, through or around the site; iii) provision of parking for workers and materials delivery; iv) risk identification, assessment and identification of mitigation measures; v) ongoing monitoring, management review and certified updates (as required); and vi) traffic control plans and/or traffic control diagrams, prepared in accordance with <i>Austroads Guide to Temporary Traffic Management</i>, for any temporary part or full road closures. b) Carry out all construction work generally in accordance with the certified TMP submitted under part a) of this condition, which is to be current and available on site. Advice Note: <i>Operational traffic changes, such as temporary and permanent lane modifications, relaxation of clearway zone hours or footpath closures may require authorisation from Council or DTMR as road manager. It is recommended that applicants engage directly with the applicable road manager.</i>	a) Prior to commencing work for the relevant stage b) During construction
10.	Public Infrastructure (Damage, Repairs and Relocation) a) Repair any damage to existing public infrastructure caused by works carried out in association with the approved development.	a) Prior to survey plan endorsement for the relevant stage

	b) Where existing public infrastructure require repair or relocation, due to the approved development and/or works associated with the approved development, repair and/or relocate the public infrastructure at no cost to others and in accordance with statutory requirements and adopted design standards. Advice Note: <i>It is recommended applicants record their own dated photographic evidence of the condition of relevant existing public infrastructure both before and after works carried out in association with the approved development.</i>	b) Prior to survey plan endorsement for the relevant stage
Earthworks and retaining walls		
11.	Compliance Assessment – Earthworks a) Submit to EDQ DA for Compliance Assessment detailed earthworks plans, certified by a RPEQ, and designed generally in accordance with: i) Australian Standard AS3798 – 2007 Guidelines on Earthworks for Commercial and Residential Developments and ii) the approved Overall Bulk Earthworks Sketch Layout Plan, 30109334-AAP-WS00OP-CV-SKT-030 Issue 1, prepared by Wolter Consulting. The certified earthworks plans are to: i) include a geotechnical soils assessment of the site; ii) accord with the Erosion and Sediment Control Plan, as required by condition 7 – Erosion and sediment management; iii) accord with the Dispersive Soil Management Plan, as required by condition 8 – Dispersive soil management; iv) include the location and finished surface levels of any cut and/or fill; v) provide details of any areas where surplus soils are to be stockpiled; vi) detail protection measures to: 1. ensure adjoining properties and roads are not impacted by ponding or nuisance stormwater resulting from earthworks associated with the approved development; 2. preserve all drainage structures from structural loading impacts resulting from earthworks associated with the approved development. b) Carry out earthworks generally in accordance with the certified plans endorsed by EDQ through part a) of this condition. c) Submit to EDQ IS RPEQ certification that: i) all earthworks have been carried out generally in accordance with the certified plans submitted under part a) of this condition; and ii) any unsuitable material encountered has been treated or replaced with suitable material.	a) Prior to commencing earthworks for the relevant stage b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage

12.	Retaining Walls (Excluding the Western Boundary Retaining Wall) a) Submit to EDQ IS detailed engineering plans, certified by a RPEQ, of all retaining walls 1m or greater in height. Retaining walls must be: i) certified to achieve a minimum 50 year design life; ii) designed generally in accordance with <i>AS4678 – Earth Retaining Structures</i> and relevant material standards (e.g., <i>AS3600 – Concrete Structures</i>); b) Construct retaining walls generally in accordance with the certified plans required under part a) of this condition. c) Submit to EDQ IS certification from an RPEQ that all retaining wall works 1.0m or greater in height have been constructed generally in accordance with the certified plans submitted under part a) of this condition.	a) Prior to commencing earthworks for the relevant stage b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage
13.	Compliance Assessment – Western Boundary Retaining Wall a) Submit to EDQ DA for Compliance Assessment preliminary engineering plans, certified by a RPEQ, of the proposed western boundary retaining wall adjoining the swale. The retaining wall must be: i) fully contained, including footings, within the private lots; ii) designed based on a professional geotechnical advice; iii) take into consideration scour and flood impacts from the adjoining swale; and iv) appropriately fenced (fauna exclusion). b) Submit to EDQ IS detailed engineering plans, certified by a RPEQ, of the proposed retaining wall along the western swale, generally in accordance with the endorsed plans required under part a) of this condition. The retaining wall must be: i) certified to achieve a minimum 100 year design life; ii) designed generally in accordance with <i>AS4678 – Earth Retaining Structures</i> and relevant material standards (e.g., <i>AS3600 – Concrete Structures</i>); c) Construct retaining walls generally in accordance with the certified plans required under part b) of this condition. d) Submit to EDQ IS: i) 'as-constructed' plans, certified by a RPEQ, demonstrating that the retaining wall has been constructed generally in accordance with the certified plans submitted under part a) of this condition. ii) A survey plan identifying the location of wall and footings to the property boundary.	a) Prior to commencing earthworks for Stage 2 b) Prior to survey plan endorsement for Stage 2 c) Prior to survey plan endorsement for Stage 2 d) Prior to survey plan endorsement for Stage 2

Roadworks, Urban Servicing and Stormwater Management

14.	Compliance Assessment – Internal Roads a) Submit to EDQ DA for Compliance Assessment functional layout plans, certified by a RPEQ, for the internal roads generally in accordance with: i) PDA Guideline No. 13 Engineering standards; and ii) Plan of Reconfiguration, Ref No. 22-0007P/01-02 Version E prepared by Wolter Consulting and dated 14/08/2023; and iii) Industrial Connector Street Cross-Section as identified in the Engineering Services Report prepared by Telford Civil and dated 06/07/21. The roads are to be designed to allow for the use of heavy vehicles (B-doubles). b) Submit to EDQ IS detailed engineering plans, certified by a RPEQ, for roadworks for the internal roads, including parking bays, traffic devices and footpaths generally in accordance with: i) PDA Guideline No. 13 Engineering standards; and ii) functional layout plans endorsed under part a) of this condition. c) Construct roadworks generally in accordance with the certified plans submitted under part b) of this condition. d) Submit to EDQ IS: i) certification from a RPEQ that all roadworks have been constructed generally in accordance with the certified plans submitted under part a) of this condition; and ii) all documentation as required by the <i>Certification Procedures Manual</i>. iii) as-constructed drawings, asset register and test results, certified by a RPEQ, in a format acceptable to the end asset owners for all roadworks constructed under this condition.	a) Prior to commencing site works b) Prior to commencing roadworks for the relevant stage c) Prior to survey plan endorsement for the relevant stage d) Prior to survey plan endorsement for the relevant stage
15.	Compliance Assessment – Crowson Lane and Greenhill Road Intersection Interim Layout Unless ultimate intersection works are already delivered by Council as part of the Crowson Lane augmentation project: a) Submit to EDQ DA for Compliance Assessment engineering design and construction drawings, certified by a RPEQ, for the auxiliary left-turn treatment and channelised right turn lane treatment at the Crowson Lane/Greenhill Road intersection, generally in accordance with the following plans/documents: i) PDA Guideline No. 13 Engineering standards; and ii) Traffic Impact Assessment, document reference P5708.001R North Maclean Industrial Estate TIA prepared Bitzos Consulting and dated 15 August 2023 b) Construct the works generally in accordance with the endorsed plans submitted under part a) of this condition.	a) Prior to commencing intersection works b) Prior to survey plan endorsement for the first stage

	c) Submit to EDQ IS: i) certification from a RPEQ that the intersection works have been constructed generally in accordance with the certified plans submitted under part b) of this condition; and ii) all documentation as required by the Certification Procedures Manual. iii) as-constructed drawings, asset register and test results, certified by a RPEQ, in a format acceptable to the end asset owners for all roadworks constructed under this condition.	c) Prior to survey plan endorsement for the first stage
16.	Mount Lindesay Highway Service Road a) Submit to EDQ IS, approval from the Department of Transport and Main Roads for the entirety of the Mount Lindesay Highway service lane as shown on Staging Sketch Plan, document reference 22-0007P/01-03 Version E, prepared by Wolter Consulting and dated 14/08/2023. The service lane is to be designed to allow for the use of heavy vehicles (B-doubles). b) Construct the extent of the service road as shown on Staging Sketch Plan, document reference 22-0007P/01-03 Version E, prepared by Wolter Consulting and dated 14/08/2023 from the intersection with the new internal road in Stage 1 to the Crowson Lane Interchange with the first stage of development in accordance with the approval from DTMR as required under part a). c) Construct the remainder of the service road as shown on staging Sketch Plan, document reference 22-0007P/01-03 Version E, prepared by Wolter Consulting and dated 14/08/2023 with the second stage of development in accordance with the approval from DTMR as required under part a). d) Submit to EDQ IS, certification from a RPEQ that all roadworks have been constructed generally in accordance part a) of this condition. Advice Note: Construction of this service lane in accordance with the Industrial Connector cross-section or as alternatively agreed to by EDQ and meets EDQ's minimum requirements for offsetable infrastructure, can be considered offsetable.	a) Prior to commencing works for Stage 1 b) As indicated c) As indicated d) Prior to survey plan endorsement for the relevant stage
17.	Street lighting Comply with either parts a) and c) or parts b) and c) of this condition. a) Design and install a <u>Rate 2</u> street lighting system, certified by a RPEQ, to all roads, including footpaths/bikeways within road reserves. The design of the street lighting system must: i) meet the relevant standards of Energex; ii) be endorsed by Energex as 'Rate 2 Public Lighting'; iii) be endorsed by Council as the Energex 'billable customer'; iv) be generally in accordance with <i>Australian Standards AS1158 – 'Lighting for Roads and Public Spaces</i>.	a) Prior to survey plan endorsement for the relevant stage

	b) Design and install a <u>Rate 3</u> street lighting system, certified by a suitably qualified and experienced RPEQ, to all roads, including footpaths/bikeways within road reserves. The design of the street lighting system must: i) be in accordance with <i>Australian Standards AS1158 – ‘Lighting for Roads and Public Spaces’</i> ii) meet the requirements of AS3000 – ‘SAA Wiring Rules’. iii) meet the requirements of Energex for unmetered supply iv) be endorsed by the relevant ownership authority. c) Submit to EDQ IS ‘as-constructed’ plans and test documentation, certified by a RPEQ, in a format acceptable to Council.	b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage
18.	Compliance Assessment - Water reticulation a) Submit to EDQ DA for Compliance Assessment a detailed water network plan, supported by hydraulic analysis, certified by RPEQ. The water network plan shall be prepared in accordance with: i) <i>SEQ Water Supply and Sewerage Design and Construction Code</i>; and ii) Overall Water Main Sketch Layout Plan, Plan no. 30109334-AAP-WS00OP-CV-SKT-031, Issue 1, prepared by Arcadis and dated 08/08/2023. b) Submit to EDQ IS detailed water reticulation design plans, certified by a RPEQ. The certified water reticulation design plans must be designed generally in accordance with: i) <i>SEQ Water Supply and Sewerage Design and Construction Code</i>; and ii) the endorsed water network analysis required under part a) of this condition. c) Construct water reticulation works generally in accordance with the certified plans submitted under part a) of this condition. d) Submit to EDQ IS ‘as constructed’ plans, certified by a RPEQ, of all water reticulation infrastructure constructed in accordance with this condition, including an asset register, pressure and bacterial test results in accordance with <i>SEQ Water Supply and Sewerage Design and Construction Code – Asset Information</i>.	a) Prior to commencing works for Stage 1 b) Prior commencing water reticulation work for the relevant stage c) Prior to survey plan endorsement for the relevant stage d) Prior to survey plan endorsement for the relevant stage
19.	Compliance Assessment – Internal Sewer Reticulation a) Submit to EDQ DA for Compliance Assessment a detailed internal sewerage network plan, supported by hydraulic analysis, certified by RPEQ. The internal sewer network plan shall be prepared in accordance with: i) <i>SEQ Water Supply and Sewerage Design and Construction Code</i>; and ii) Overall Sewer Sketch Layout Plan, Plan No. 3010933-AAP-WS00OP-CV-SKT-032, Issue 1, prepared by Arcadis and dated 22/08/23. The sewerage network plan shall include the extension of the internal sewer reticulation to the southern boundary to service the external catchment falling to the site.	a) Prior to commencing works for the relevant stage

	b) Submit to EDQ IS detailed sewer reticulation design plans, certified by a RPEQ. The certified sewer reticulation design plans must be designed generally in accordance with: i) <i>SEQ Water Supply and Sewerage Design and Construction Code</i>; and ii) the endorsed sewer network plan required under part a) of this condition c) Construct the internal sewer reticulation works generally in accordance with the certified plans submitted under part b) of this condition. d) Submit to EDQ IS 'as constructed' plans, certified by an RPEQ, of all internal sewer reticulation infrastructure constructed in accordance with this condition, including an asset register, pressure and CCTV results in accordance with <i>SEQ Water Supply and Sewerage Design and Construction Code - Asset Information</i>. Advice Note: <i>The Sub-Regional sewerage pump station NM1 and external sewer rising main will be constructed and put in operation by Council.</i>	b) Prior to commencing works for the relevant stage c) Prior to survey plan endorsement for the relevant stage d) Prior to survey plan endorsement for the relevant stage
20.	Temporary Sewage Tankering of Wastewater Unless the Sub-Regional sewerage pump station NM1 and external rising main is completed and in operation by Council: a) Enter into a tankering agreement with Council for the collection and disposal of wastewater for any lots created; and b) Maintain the tankering agreement required by part a) of this condition until Sub-Regional sewerage pump station NM1 is commissioned.	a) Prior to survey plan endorsement for the first stage b) As indicated
21.	Compliance Assessment – Updated Site Based Stormwater Management Plan Submit to EDQ DA for Compliance Assessment an updated Site Base Stormwater Management Plan (SBSMP), certified by a RPEQ, for the management of stormwater within the site to ensure non-worsening to downstream properties, including Mt Lindesay Highway, generally in accordance with <i>PDA Guideline No. 13 Engineering standards, Stormwater Quantity and Stormwater Quality</i>. The updated SBSMP shall include the following: i) Confirmation that the subject site is not impacted by flooding. This confirmation is to be provided through the undertaking of a site based flood model. If impacted by flood, provide further details on the Q100 line and the type of inundation – conveyance and/or storage; OR Demonstrate that the updated current solution identified in the SBSMP ensures that there is no worsening at lawful point of discharge based on Council's nominated 1% AEP flood level at Mt Lindesay Highway. ii) the on-site detention/bio-retention basins form part of the overall solution. Provide an engineering and legal	Prior to commencing works

	strategy/mechanism (e.g., Easement) to ensure that these devices can continue to perform as designed into the future. iii) Demonstrate that the design of the road stormwater system will convey runoff from the road reserve and the pre-developed lots to the proposed detention / bio-retention basin. iv) Demonstrate that the configuration, sizing and operation of the proposed detention / bio-retention basin system will accommodate runoff from the road stormwater system as per part (iii) above and result in no net worsening downstream of the site. v) Conveyance of existing external flows to the existing lawful point of discharge, ensuring no-net worsening downstream of the site.	
22.	Stormwater Conveyance System a) Submit to EDQ IS detailed engineering drawings and hydraulic calculations, certified by a RPEQ, for the stormwater conveyance system designed generally in accordance with: i) <i>PDA Guideline No. 13 Engineering standards – Stormwater quantity</i>; and ii) Updated Site Based Stormwater Management Plan, required by Condition 21 of this approval. b) Construct stormwater network generally in accordance with the certified plans submitted under part a) of this condition. c) Submit to EDQ IS "as constructed" plans, certified by a RPEQ including an asset register in a format acceptable to Council.	a) Prior to commencing works for the relevant stage b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage
23.	Compliance Assessment - Stormwater detention/bio-retention basin a) Submit to EDQ DA for Compliance Assessment detailed engineering drawings and hydraulic calculations, certified by a RPEQ, for the proposed detention/bio-retention basin designed generally in accordance with: i) <i>PDA Guideline No. 13 Engineering standards – Stormwater Quantity and Stormwater Quality</i>; and ii) Updated Site Based Stormwater Management Plan, required by Condition 21 of this approval. b) Construct the basin generally in accordance with the endorsed plans required under part a) of this condition. c) Submit to EDQ IS "as constructed" plans, certified by a RPEQ including an asset register in a format acceptable to Council. Advice Note: <i>The proposed industrial allotments will have lot-based on-site stormwater detention and water quality treatment measures in the post-development phase. These treatment devices will be installed by the future lot owner with their size and location being allocated to suit the end use. Maintenance of these devices will be the responsibility of the future lot owners.</i>	a) Prior to commencing works b) Prior to survey plan endorsement for the first stage c) Prior to survey plan endorsement for the first stage

24.	Compliance Assessment – Swale a) Submit to EDQ DA for Compliance Assessment detailed engineering drawings and hydraulic calculations, certified by a RPEQ, for the stormwater swale on the western boundary of the land designed generally in accordance with: i) PDA Guideline No. 13 Engineering standards – Stormwater quantity and: ii) Swale and Channel Longitudinal Section, Plan No. 30109334-AAP-WS00OP-CV-DRG-0162, Issue 5, Prepared by Arcadis and dated 31/07/2023 iii) Swale and Channel Typical Sections, Plan No. 30109334-AAP-WS00OP-CV-DRG-0164, Issue 5, Prepared by Arcadis and dated 31/07/2023 The detailed design shall ensure that the swale: iv) has adequate capacity to convey overland flow up to including the 1 in 100 year event with appropriate freeboard v) is free flowing with no ponding vi) is provided with an adjacent track to allow future maintenance vii) maintain a depth*velocity product not exceeding 0.6 up to including 1 in 100 year event unless agreed in writing by Council viii) is appropriately fenced (fauna exclusion) along the eastern side of the swale. b) Construct the swale generally in accordance with the endorsed plans required under part a) of this condition. c) Submit to EDQ IS swale "as constructed" plans, certified by a RPEQ including an asset register in a format acceptable to Council.	a) Prior to commencing works b) Prior to survey plan endorsement for Stage 2 c) Prior to survey plan endorsement for Stage 2
25.	Electricity a) Submit to EDQ IS a Certificate of Electricity Supply from ENERGEX for the provision of electricity supply to the approved development. b) Connect the approved development in accordance with the Certificate of Electricity Supply submitted under part a) of this condition.	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage
26.	Telecommunications a) Submit to EDQ IS documentation from an authorised telecommunication service provider confirming that an agreement has been entered into for the provision of underground telecommunication services to the approved development. b) Connect the approved development in accordance with the documentation submitted under part a) of this condition.	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage

27.	Broadband a) Submit to EDQ IS written agreement, from an authorised telecommunications service provider, confirming that fibre-ready pit and pipe infrastructure designed to service the approved development can accommodate services compliant with <i>Industry Guideline G645:2017 Fibre-Ready Pit and Pipe Specification for Real Estate Development Projects</i> . b) Construct the fibre-ready pit and pipe infrastructure specified in the agreement submitted under part a) of this condition.	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage
28.	Gas a) Submit to EDQ IS, documentation from an authorised gas service provider, confirming that an agreement has been entered into for the provision of underground gas services to the proposed development. b) Connect the development to underground gas services in accordance with the agreement mentioned in part a) of this condition.	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage
Landscape and Environment		
29.	Streetscape Works – Compliance Assessment a) Submit to EDQ DA, for Compliance Assessment, detailed streetscape works drawings, certified by an AILA, for proposed streetscape works for all internal roads, including a schedule of proposed standard and non-standard Contributed Assets to be transferred to Council. The certified drawings are to include, where relevant: i) location and type of street lighting in accordance with AS1158 – ‘ <i>Lighting for Roads and Public Spaces</i> ’; ii) footpath treatments; iii) location and specifications of streetscape furniture; iv) location and size of stormwater treatment devices; and v) street trees and plants, including species, size and location generally in accordance with Council’s adopted planting schedules and guidelines. b) Construct streetscape works generally in accordance with the streetscape plans endorsed under part a) of this condition. c) Submit to EDQ IS ‘as constructed’ plans, certified by an AILA, and asset register in a format acceptable to Council.	a) Prior to commencing streetscape work for the relevant stage b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage
30.	Vegetation Clearing a) Submit to EDQ IS a vegetation clearing plan prepared by an ecologist for each stage that excludes the 25m buffer corridor and lot identified for open space.	a) Prior to commencement of clearing for relevant stage

	b) Undertake vegetation clearing generally in accordance with the plan submitted under part a) of this condition. The clearing is to be undertaken with the stage to be developed. c) Vegetation clearing is to be supervised by an Ecologist. d) Submit to EDQ IS written certification from an Ecologist that vegetation clearing has been carried out generally in accordance with part b) of this condition.	b) At all times c) At all times d) Within 3 months of completion of clearing of the relevant stage
31.	Fauna Spotter a) A licensed Wildlife Spotter/Catcher under the <i>Nature Conservation Act 1992</i> is to undertake a survey of the site to identify any fauna or habitat features (e.g., nests, tree hollows) and certify that any necessary fauna protection measures or relocation procedures have been implemented. b) A licensed Wildlife Spotter/Catcher must be present during the vegetation clearing. c) Submit to EDQ IS certification from the licensed Wildlife Spotter/Catcher that vegetation clearing, and fauna protection measures was carried out generally in accordance with the conditions of approval. Advice Note: <i>Where an Environmental Protection and Biodiversity Conservation Act 1999 (EPBC) approval has been granted and includes fauna spotter requirements, the fauna spotter requirements under this condition will not be applicable for the same matters under the EPBC approval.</i>	a) Prior to commencement of vegetation clearing for the relevant stage b) At all times during vegetation clearing c) Within 3 months of the completion of vegetation clearing of the relevant stage
32.	Vegetation – Compensatory Planting a) Submit to EDQ IS a planting plan certified by an ecologist showing the extent of compensatory planting to be undertaken in lot identified as 'Open Space' on Proposed Development Layout Plan, Plan No. TIEL2020159.CIV.DA, Dwg 10, Issue H dated 07/07/2021, excluding the minimum 25m buffer on the western boundary, including, type and extent of planting, as set out in the EDQ Guideline 17: Remnant Vegetation and Koala Habitat Obligations in Greater Flagstone and Yarrabilba PDAs dated May 2015. b) Undertake compensatory planting in accordance with a) of this condition. c) Once compensatory planting has been undertaken, submit to EDQ IS confirmation from a qualified arborist (AQF Level 5) or ecologist that the compensatory planting has been undertaken in accordance with b) of this condition.	a) Prior to commencement of vegetation clearing for the relevant stage b) Within 3 months of commencement of vegetation clearing c) Within 12 months of commencement of vegetation clearing of the relevant stage

33.	Bushfire Management a) Carry out Bushfire Management Works in accordance with: - Section 6 of the approved Bushfire Management Plan, Report 16014, Final V3, dated 13 July 2018; and - Addendum to the Bushfire Management Plan for the proposed development at 4499-4651 Mount Lindsay Highway, North Maclean dated 18 February 2021. b) Submit to EDQ IS verification from a suitably qualified professional that the works required for bushfire management and mitigation within the relevant stages have been carried out generally in accordance with the relevant approved plans and documents. Advice Note: <i>If the adjoining landowner obtains approval for vegetation clearing that reduces bushfire impact, then this can be articulated though an updated context plan supported by a new bushfire advice.</i>	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage
Surveying, Land Transfers and Easements		
34.	Land Transfers – Contaminated Land Submit to EDQ IS a copy of a site suitability statement, as required under the EP Act, confirming that all land conditioned to be transferred to a trustee is suitable for the intended purpose(s). The site suitability statement must be prepared by a suitably qualified person and be certified by an approved auditor in accordance with the EP Act. NOTES: <i>For the purpose of this condition a suitably qualified person is defined in the EP Act. A list of approved auditors can be found at the following website:</i> https://www.qld.gov.au/environment/pollution/management/contaminated-land/auditor-engagement.	Prior to survey plan endorsement for the relevant stage
35.	Land Transfers – Drainage and Offset Area Transfer, in fee simple, to Council as trustee, the Lot identified as Open Space as shown on the approved plans for drainage and offset open space purposes.	At registration of survey plan for Stage 2
36.	Land transfers – Sewerage pump station Transfer in fee simple, to Council as trustee, Lot 905 as shown on Plan of Subdivision, Plan No. 22-0007P/01-02, Version E prepared by Wolter Consulting and dated 14/08/23. The land metes and bounds must be to the satisfaction of the Chief Executive Officer of the authority. Advice Note: <i>This land forms part of the sub-regional sewer infrastructure to be delivered by Council. Offsets for the land may be available.</i>	At registration of survey plan for the first stage

37.	Rising Main Easement Provide a 6m wide easement, in favour of and at no cost to the Council, along the southern boundary for the proposed sub-regional sewerage rising main generally in accordance as shown on Overall Sewer Sketch Layout Plan, Plan No. 3010933-AAP-WS00OP-CV-SKT-032, Issue 1, prepared by Arcadis and dated 22/08/23. The terms of public utility easements are to be to the satisfaction of the Chief Executive Officer of the authority which is to accept and maintain the Contributed Assets. Advice Note: <i>If an alternative route for the rising main is pursued, the easement can be cancelled at the agreement of Council.</i>	At registration of survey plan for the first stage
38.	Easements over Infrastructure Provide public utility easements, in favour of and at no cost to the grantee, over infrastructure located in land (other than road) for Contributed Assets. The terms of public utility easements are to be to the satisfaction of the Chief Executive Officer of the authority which is to accept and maintain the Contributed Assets.	At registration of survey plan for the relevant stage

STANDARD ADVICE

Please note that to lawfully undertake development, it may be necessary to obtain approvals other than this PDA development approval. For advice on other approvals that may be necessary in relation to your proposal, it is recommended that you seek professional advice.

**** End of Package ****

APPENDIX D

Construction and Establishment Guidelines – Swales, Bioretention Systems and Wetlands.

Table 3.6: Summary of Staged Construction and Establishment Methods

	OPTION 1: SURFACE PROTECTION	OPTION 2: BYPASS AND EARLY ESTABLISHMENT	OPTION 3: SEDIMENT BASIN AND BIORETENTION FUNCTION	OPTION 4: LEAVE AS SEDIMENT BASIN
Description	Construct the civil infrastructure, including under-drainage and media, for the bioretention system. Install protective layers on the surface of the filter media, allowing it to operate as a shallow sediment basin during the building phase. Surface protection options are: - filter cloth, topsoil and turf - coarse sand, topsoil and turf When 80–90% of building in the catchment is complete, remove the protective layers and establish vegetation in the bioretention system.	Construct the civil infrastructure for the bioretention system. Bypass stormwater around the bioretention system or isolate it from stormwater using a temporary bund. This allows the surface of the bioretention system to be planted out and established immediately. Vegetation is fully established by the end of the building phase. When 80–90% of building in the catchment is complete, the bypass systems can be removed and the bioretention system allowed to function.	The approach combines Option 1 (surface protection) with a sediment basin upstream of the bioretention system. Outflow from the sediment basin is discharged to the bioretention system for further treatment before discharging to the receiving environment. The sediment basin should be designed to capture either coarse sediment only (125µm) or as a Type C, D or F sediment basin. Refer to a suitable erosion and sediment control guide, for example the <i>Best Practice Erosion and Sediment Control</i> (IECA, 2008) for design requirements of sediment basin. When building in the catchment is 80–90% complete, the sediment basin is cleaned or removed and the protective layers on the bioretention system are removed and vegetation is established.	Install the hydraulic structures and bulk out the system. Allow it to operate as a sediment basin (Type C, D or F) during the building phase. Refer to a suitable erosion and sediment control guide, for example the <i>Best Practice Erosion and Sediment Control</i> (IECA, 2008) for design requirements of sediment basin.
Order of construction	Follow the procedures in Section 3.9 from Step 1 to Step 40.	Follow the procedures in Section 3.9 from Step 1 to Step 40.	Follow the procedures in Section 3.9 from Step 1 to Step 40.	Follow the procedures in Section 3.10.
Environmental benefit — the level of water quality management during the building phase	Moderate	Low	High	High

OPTION 1: SURFACE PROTECTION					OPTION 2: BYPASS AND EARLY ESTABLISHMENT		OPTION 3: SEDIMENT BASIN AND BIORETENTION FUNCTION		OPTION 4: LEAVE AS SEDIMENT BASIN		
Landscape amenity	Moderate to high	High	Moderate	Low							
Timeframe*	24-36 mo.	12-24 mo.	24-36 mo.	24-36 mo.							
Advantages	Protects filter media.	Protects filter media.	Protects filter media.	Bioretention system not constructed until after building, therefore no sediment issues.							
	Very little maintenance during building phase.	Early establishment of vegetation.	High level of protection to receiving environment.	High level of protection to receiving environment.							
	Moderate amenity.	High amenity.	Amenity should be moderate to high, provided construction and establishment is successful.	High level of protection to receiving environment.							
Disadvantages	Moderate protection to receiving environment (only manages coarse sediment down to 125um).	Low protection to the receiving environment during the building phase. If Option 2 is adopted, it should be combined with strict erosion and sediment control on the building sites or sediment basins at the discharge point of the drainage system (i.e. downstream of the bioretention systems).	Additional space is required for the sediment basin.	Poor landscape amenity.							
	Vegetation established after completion of building phase.		A high level of management of sediment basin required, particularly if it is a Type F sediment basin.	Delay of construction results in a long period before asset handover.							
	Delayed handover of asset.	Establishment of plants requires water or novel irrigation methods		A high level of management of sediment basin required, particularly if it is a Type F sediment basin.							
Preferred construction and establishment method based on scale:											
Streetscape	✓	✓	X	X							
Parkland in high profile location	✓	✓	✓	X							
Parkland in low profile location	✓	✓	✓	✓							

*Timing dictated by the Building Phase period (this timing assumes 18-24 moth Building Phase)

3.8.1 Option 1: Surface protection

To minimise the risk of damage and the cost of any re-establishment, the civil works for bioretention systems can be undertaken and temporary protective measures installed to prevent clogging of the filter media during the building phase (see Figure 3.9).

Option 1 involves:

- Stage 1 Civil Works — Civil construction and installation of the functional elements of the bioretention system should be undertaken in accordance with Section 3.9.1.
- Stage 2 Building Phase Protection
 - Sediment fences should be installed around the perimeter of the filter media and the top of the batter to prevent sediment from being carried into the system by overland flow. The fences clearly show that construction traffic should not enter the system.
 - Covering the surface of the filtration media with a temporary filter cloth or coarse sand (25 mm) and laying 25 mm of topsoil and turf over it will protect the bioretention system during the construction and building phases.
 - During the building phase, the extended detention acts as a shallow sediment basin.

- Stage 3 Landscape Establishment — When the building phase is 80–90% complete, the temporary measures protecting the bioretention systems and the accumulated sediment can be removed. The bioretention system can be planted and established according to Section 3.9.3.

As illustrated in Figure 3.10, for Option 1, the system will be in the Building Phase Protection mode for up to 24 months, followed by a 12-month period of landscape establishment. Advantages of Option 1 are:

- the bioretention system is comprehensively protected during the building phase
- very little maintenance or irrigation is required during building phase.

Disadvantages of Option 1 include:

- the landscape is not established until after the building is complete and plants will not be fully established until 6–12 months after the building phase
- the filter cloth used to protect the surface of the filter media has blocked in some situations, therefore, the use of coarse sand is also supported.

Figure 3.9: Illustration of Option 1: Protect the bioretention system during the building phase

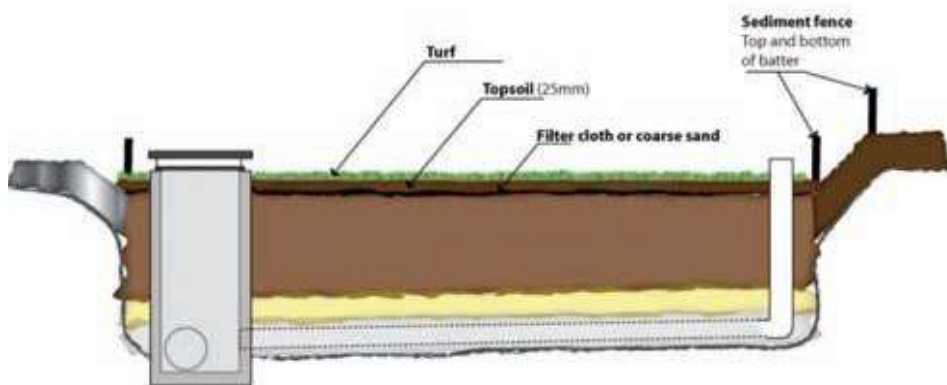
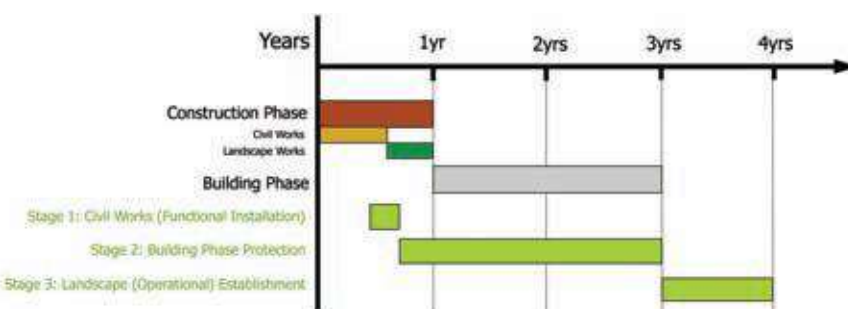


Figure 3.10: Stages of construction associated with Option 1: Surface protection (amended from Leinster, 2006)



3.9 Step-by-step sequence — Options 1, 2 and 3

The following sections provide a step-by-step sequence for civil construction, building phase protection and landscape establishment for the Staged Construction and Establishment Options 1, 2 and 3. Detailed descriptions and, where available, photos are provided for each step in tabular format. It is envisaged the tables will be laminated and used as an on-site reference during construction and establishment.

3.9.1 Stage 1 – Civil construction

The recommended civil construction sequence for bioretention systems is summarised in Table 3.7. The construction sequence should be read in combination with the Bioretention Construction and Establishment Sign-Off Forms.

Table 3.7: Civil construction (Stage 1) step-by-step sequence — Options 1, 2 and 3

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 1: Pre-start meeting	Hold a pre-start meeting with the bioretention designer, civil engineer, landscape architect, site superintendent, civil contractor, landscape contractor and, where required, the Council compliance officer to: - explain the function of the bioretention system - highlight issues and risks associated with construction and establishment - talk through a preferred construction and establishment approach for the site - explain the as-constructed survey or drawing, inspection and sign-off requirements - confirm sources of bioretention media and certification requirements.		

STEP 2: Preparation

Prepare for construction at least 10 days before starting on site. Preparation includes organising the correct equipment to achieve required tolerances (Section 3.4.2), sourcing the bioretention media, ensuring the supplier of the filter media is completing the correct testing (Section 3.5), ordering materials and identifying construction timing and rain contingency plans (Section 3.3).

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 3: Install overflow pit and outlet pipe	Install the overflow pit and ensure the crest of the pit is at design level. The crest of the pit can be used as a datum from which other levels within the system are measured. The pit requires holes for under-drainage pipe connections. These holes should be drilled at this stage or plastic stubs should be installed at the time of casting the pit. Construct outflow headwalls and install sections of stormwater outlet pipe. If the outlet pipe is below the receiving environment levels (Section 3.3.4) consult the superintendent and designers to resolve a change in the design. Design levels and tolerances (+25 mm) must be achieved (Section 3.4.2).		
STEP 4: Bulking out	Undertake bulk earthworks, including construction of bunds surrounding system. The bunds and batters surrounding the system should have 200 mm of topsoil applied following earthworks. Design levels for the top of the bund are inclusive of this 200 mm layer of topsoil, so that bulk earthworks should leave the top of bund 200 mm below the design level. Excavate the surrounding landform to design subsoil levels. This will reduce the need for earthworks adjacent to the systems after they have been constructed. If adopting Construction and Establishment Method Option 3, the upstream sediment basin should be constructed and commissioned prior to bulking out the bio-retention system.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 5: Trimming and profiling	Undertake detailed excavation, trimming and profiling of bunds, embankments, batters, sides and base of system, ensuring the base has a minimum 0.5% grade towards pit, unless the design specifies a flat base and design levels achieve (+ 50 mm). If the design has a flat base and does not contain the 0.5% grade, confirm with the designer and refer to these guidelines or the <i>WSUD Technical Design Guidelines for SEQ</i> (SEQHWP, 2006). Ensure base of system is free from debris and meets the tolerances (Section 3.4.2).	 A photograph showing the construction of a small bioretention system. It features a dirt area with some vegetation, a concrete curb, and a small pit. A small number '2' is in the bottom right corner.	 A photograph showing the construction of a large bioretention system. It features a large, flat, brown dirt area with a concrete curb and a small pit. A small number '2' is in the bottom right corner.
STEP 6: Construct overflow weir if required	Where an overflow weir is part of the system design, it should be constructed at this stage and appropriately 'keyed' into the bunds to avoid potential scour at the edges of the weir. Design levels and tolerances must be achieved (+25 mm).	 A photograph showing the construction of an overflow weir. It features a concrete weir structure with a small pit. A small number '1' is in the bottom right corner.	
STEP 7: As-constructed survey	Undertake an as-constructed survey of the system at this stage to confirm design and tolerances (Section 3.4.2) are achieved, including: - overflow pit crest level, invert level and under-drainage connections invert and diameter - outlet pipe upstream and downstream invert levels - overflow weir - base of bioretention system to illustrate the level and the 0.5% grade.	 A photograph showing an as-constructed survey. It features a person in a yellow safety vest standing next to a concrete curb and a small pit. A small number '2' is in the bottom right corner.	

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 8: HOLD POINT Inspection and sign-off (Form A)	Following collection of the as-constructed survey, the site superintendent and bioretention designer will inspect the system with the contractor, review the as-constructed survey and take photos. If the construction meets the tolerances outlined Section 3.4.2 and conforms with the design, complete Sign-Off Form A attaching the as-constructed survey and photos.		
STEP 9: Filter cloth Lining	Line system with filter cloth, ensuring the filter cloth extends a minimum of 500 mm beyond the top of the bioretention system side walls.		
STEP 10: Install under-drainage	Install slotted rigid under-drainage pipes and ag-pipes and rigid collector pipes in the specified layout outlined in Section 3.3.6. Ensure all pipes are laid at a minimum 0.5% slope with no localised depressions verified using levels or string lines. Ensure levels are achieved (+25 mm). Seal junctions and connections using sufficient sealant to prevent sand, gravel or soil passing into drainage network. The same drainage layer material (aggregate) may be required to raise pipe in section to adhere to design grade (0.5%).		
STEP 11: Install cleanouts	Connect clean-out points ensuring top of clean-out points will ultimately sit at least 50 mm (preferably 150 mm) above the bioretention surface. The caps on the clean-out points should be screwed in place to secure against vandalism.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 12: HOLD POINT Inspection and sign-off (Form B)	Following installation of the liner and under-drainage, either the site superintendent or bioretention designer will inspect the system with the contractor and take photos. If the lining and under-drainage meets the design and construction requirements, they will complete Sign-Off Form B and attach photos.	 2	 4
STEP 13: Source drainage layer, transition layer and filter media material	Testing and sourcing the drainage, transition and filter media layers should have commenced as part of Step 2. By Step 13, the material can be delivered and stockpiled on site ready for installation.		
STEP 14: Install drainage layer	Install 200–250 mm deep gravel drainage layer to cover the slotted under-drainage pipe network. The preferred approach is to use an excavator (long-arm if required) or conveyor belt (see Section 3.4.7) positioned on the edge of the system to place gravel into the system. Contractors can then spread and flatten the gravel to the specified depth using spreader bars. The exact procedure for constructing the drainage layer is determined through consultation with the contractor. It may differ from the procedure described in Section 3.4.7. The site superintendent or bioretention designer should inspect the drainage layer to ensure the correct depth (200–250 mm) and tolerances (+25 mm) have been achieved and that the surface is flat.		
STEP 15: HOLD POINT Inspection of drainage layer	The site superintendent or bioretention designer should inspect the drainage layer to ensure the correct depths (200–250 mm) and grades (typically 0.5%) have been achieved and the surface is flat. The relevant sections of Sign-Off Form C must be completed and photos taken. There is no need to stop construction for this inspection unless specifically required. The site superintendent or designer should undertake the inspection as construction occurs.		

CONSTRUCTION STEP		ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 16: Install transition layer		Install a 100 mm deep coarse sand transition layer on top of the gravel drainage layer using the same approach outlined in Step 14 to achieve the correct tolerances (+25 mm) and to ensure the surface is flat.		
STEP 17: Inspection of transition layer		The site superintendent or bioretention designer should inspect the transition layer to ensure the correct depths (100 mm) and grade (typically 0.5%) have been achieved and that the surface is flat. The relevant sections of Sign-Off Form C should be completed and photos taken. The site superintendent or designer can undertake the inspection as construction occurs.		
STEP 18: Install filter media		Place the bioretention filter media to the designed the surface level of the bioretention system in two separate lifts, where required, with each lift lightly compacted as outlined in Section 3.4.6. At the completion of the section lift and compaction, use a spreader bar to flatten the surface of the filter media. Ultimately, the surface of the filter media must be at the design level (+25 mm) and free from local depressions.		
STEP 19: Install sediment fences		Immediately after installing the filter media, install sediment fences around the filter media and at the top of the batter to prevent sediment from entering the batters and to keep construction vehicles off the system.		
STEP 20: Lay protective filter cloth, where required		If there is a delay between Step 18 and Steps 25 and 29, the surface and batters of the bioretention system should be covered with a temporary layer of filter cloth to protect against sediment-laden runoff. Some or all of this filter cloth will be left in place as part of Steps 25 to 28.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 21: As constructed survey	Undertake an as-constructed survey of the system surface and surrounding bunds, picking at least four spots on the surface of the small bio retention systems (<100 m ²), one spot level per 100 m ² on the surface of large bio retention systems and at least one spot level every 10 m along the top of the bunds as well as any low points.		
STEP 22: HOLD POINT Inspection and sign-off (Forms C and D)	Following collection of the as-constructed survey, the site superintendent and bio retention designer will inspect the system, review the as-constructed survey and take photos. If the construction meets the tolerances outlined in Section 3.4.2 and conforms to the design, Sign-Off Forms C and D will be completed and signed and the as-constructed survey and photos attached.		
STEP 23: Install coarse sediment forebay	Construct the coarse sediment forebay in accordance with the design and advice provided in Section 3.4.9. Concrete is preferred with surface treatment as directed by the design.		
STEP 24: Inspection and sign-off (Form E) PRACTICAL COMPLETION	The site superintendent or bio retention designer should inspect the coarse sediment forebay to ensure consistency with design. The relevant sections of Sign-Off Form E should be completed and photos are taken before either Building Phase Protection works or Landscape Works start.		
CONTINUE TO STEP 25 (Building Phase Protection) if there is building or works in the catchment that will cause damage to the bio retention system or the accumulation of sediment in the system. CONTINUE TO STEP 29 (Landscape Works) if there is no building or works proposed in the catchment that are likely to cause damage to the bio retention system or the accumulation of sediment in the system.			

3.9.2 Stage 2 — Building phase protection

Steps 25–28 provide the construction and establishment sequence for the Building Phase Protection (Stage 2) for Option 1, 2 and 3.

Table 3.8: Building phase protection (Stage 2) step-by-step sequence — Options 1 and 3

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 25: Install sediment fences	If not installed as part of Step 19, sediment fences should be installed around the filter media and at the top of the batter to prevent sediment entering from the batters and to keep construction vehicles off the system.		
STEP 26: Install protective layers on surface of filter media (filter cloth and turf)	Cover the surface of filter media with filter cloth or 25–50 mm of coarse sand and place 25 mm topsoil and turf over the filter cloth or coarse sand. Filter cloth has been known to block in some situations. Coarse sand (25–50 mm) can be used if there is concern with the filter cloth.		
STEP 27: HOLD POINT Inspection and sign-off (Form F)	Following installation of protective layers, the site superintendent and bioretention designer will inspect the system with the contractor. If approved, Sign-Off Form F can be completed and signed and photos attached.		
STEP 28: Building phase operation	During the building phase, which may be as long as 2–4 years, the bioretention system will operate as a shallow sediment basin, and protect the filter media from sediment and clogging. When 80–90% of the building in the catchment is complete, Stage 3: Landscape Works can start (Step 29).		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 25: Install sediment fences	If not already installed as part of STEP 19, sediment fences should be installed around the filter media and at the top of the batter to prevent sediment entering from the batters and to keep construction vehicles off the system.		
STEP 26A: Install bypass system (temporary protective bunds)	The majority of the bioretention system should be isolated from sediment-laden inflows. This can be achieved by: - completely bypassing pipe flows during the building phase and connecting the pipe system to the bioretention system following the building phase - partitioning (bunding) the majority of the bioretention system to isolate flows to the outlet and inlet of the system. Where partitioning (bunding) is used: - it should be designed so that flows are directed into either the overflow pit or overflow weir rather than entering the bioretention system preventing sediment-laden runoff from spreading across the bioretention surface - in small bioretention systems, the protective bund can be created using form ply with all joints overlaid and sealed - in larger bioretention system, the protective bunds can be created using the filter media wrapped in filter cloth - the crest of the bund should be higher than both the overflow pit and the surrounding embankments to ensure no sediment-laden flow enters the bioretention system and the bund should be keyed into the batters to avoid scouring around the edges causing water to enter the system.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 26B: Install protective layers on surface of filter media (filter cloth and turf)	Install temporary protective covering over the bioretention surface located within banded area adjacent to the coarse sediment forebay. Cover the surface of filtration media with filter cloth (or coarse sand) and place 25 mm topsoil and turf over the filter cloth.		
STEP 27: HOLD POINT Inspection and sign-off (Form F)	Following collection of the as-constructed survey, the site superintendent and bioretention designer will inspect the system, review the as-constructed survey and take photos. If the construction meets the tolerances outlined in Section 3.4.2 and conforms to the design, Sign-Off Forms C and D will be completed and signed and the as-constructed survey and photos attached.		
STEP 28: Building phase operation	During the building phase, which may be up to 2–4 years, landscape can be established on the majority of the bioretention system surfaces in accordance with Stage 3: Landscape Works (Step 29 onwards). The small, protected part of the bioretention system will operate as a sediment basin, while protecting the filter media from sediment and clogging. When 80–90% of the building in the catchment is complete, the bund and protective layers can be removed and appropriate landscaping applied.		

3.9.3 Stage 3 — Landscape establishment

Once the building phase is finished, the protected portions of the bioretention system are cleaned and any accumulated is removed in readiness for establishing the landscape. The recommended landscape establishment sequence for the bioretention systems is shown in Table 3.10. The construction sequence should be read in combination with the Bioretention Construction and Establishment Sign-Off Forms.

Table 3.9: Landscape establishment (Stage 3) step-by-step sequence — Options 1, 2 and 3

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 29: Pre-start and plant set-out meeting	Before starting landscape preparation, hold a pre-start and plant set-out meeting with the bioretention designers, including an ecologist, site superintendent and landscape contractors. The meeting should confirm design and planting establishment and set out the planting to ensure the correct plants are installed in the correct locations.		
STEP 30: Preparation	Prepare for the landscape establishment up to six months before starting, including ordering and inspecting plants at the nursery, ordering and receiving organic mulch and matting and organising a source of irrigation water.		
STEP 31: Remove building phase protection and flushing of under-drainage (where required)	Remove the building phase protective measures such as bunds, filter cloth, coarse sand, turf and accumulated sediment. Care should be taken to avoid damaging the clean-out points for the under-drainage. The under-drainage should be flushed out with potable water to remove any accumulated sediment. If adopting Option 1, the protective measures will remain in place while landscape is being establishment. Protective measures are removed when building is 80–90% complete.		

CONSTRUCTION STEP		ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)		PHOTOS (LARGE BIORETENTION SYSTEM)	
STEP 32: Flatten surface		After the protective layers are removed, flatten the surface of the filter media using a spreader bar. Additional filter media may be required to fill in any over-excavated zones. Care should be taken to not over-compact the filter media (refer Sections 3.4.6 and 3.4.7).				
STEP 33: Mulching		Mulch the filter media surface in accordance with Section 3.6.4. Create holes in the mulch for planting. Ensure the holes have 50 mm separation from stem of the plant to the mulch.				
STEP 34: Soil preparation		Dig planting holes by hand and apply the prescribed amount of slow-release native fertiliser detailed in Section 3.6.3. Pre-soaked wetting agents are recommended in this step.				
STEP 35: Planting		Plant tubestock ensuring the root ball is covered with filter media and the stem is sitting above the filter media. Clear away any mulch from the step to 50 mm (refer Section 3.6.5).				

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 36: Inspection and sign-off (Form G) PRACTICAL COMPLETION	After installing the mulch and plants, the site superintendent and bioretention designer will inspect the system and Sign-Off Form G is completed and photos attached.		

STEP 37: Watering	Water the plants according to Section 3.6.6: Week 1-6 5 waterings per week Week 6-103 waterings per week Week 11-152 waterings per week If there is no rain, each plant should receive 2.5-5.0 litres of water per week during establishment in the first six weeks (40 mm per week).	 2	 1
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STEP 38: Weeding	Inspect bioretention plants fortnightly during establishment, removing any weeds by hand.		
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CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 39: On-going inspections and final landscape establishment	Monitor the establishment of plants until they are robust and self-sustaining. An established bioretention is measured by (Section 3.6.7): 1. survival of more than 90% of plants 2. 80% coverage of bioretention surface 3. more than one species per macrophyte zone 4. at least 5 plants per m² and preferably 6–10 plants/m² 5. an increase in plant height of at least 50% measured through markers or stakes 6. propagation of more than 2–3 stems and there is seeding 7. no weeds. Record growth and maturity through three-monthly photo logs every 500m².	 2	 2
STEP 40: Inspection and sign-off (Form H)	After plants are established, the site superintendent and bioretention designer will inspect the system and complete Sign-Off Form H with attached photos.	 1	

3.10.3 Stage 3 — Civil construction and landscape establishment

Once the building phase is complete, the bioretention system is cleaned out of accumulated sediment, civil works are finalised and landscape established in accordance with the sequence provided in Table 3.12. The construction and establishment sequence should be read in combination with the Bioretention System Construction and Establishment Sign-Off Forms.

Table 3.11: Civil construction and landscape establishment step-by-step sequence — Option 3

CONSTRUCTION STEP	ACTIVITY	PHOTOS (LARGE BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 7: Pre-start meeting	Hold a pre-start meeting with the bioretention designer, civil engineer, landscape architect, site superintendent, civil contractor, landscape contractor and, where required, the Council compliance officer to: - explain the function of the bioretention system - highlight issues and risks associated with construction and establishment - talk through a preferred construction and establishment approach for the site - explain the as-constructed survey or drawing, inspection and sign-off requirements - confirm sources of bioretention media and certification requirements.		
STEP 8: Preparation	Prepare for construction at least 10 days before starting on site. Preparation includes organising the correct equipment to achieve required tolerances (Section 3.4.2), sourcing the bioretention media ensuring the supplier of the filter media is completing the correct testing (Section 3.5), ordering materials and identifying construction timing and rain contingency plans (Section 3.3).		
STEP 9: Clean out the bioretention system	Drain the bioretention system and remove accumulated sediment, gross litter and any lining installed for sediment basin operation.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 10: Check the hydraulic structures	The hydraulic structures should be inspected for damage or movement.		
STEP 11: Trimming and profiling	Undertake detailed excavation, trimming and profiling of bunds, embankments, batters, sides and base of system, ensuring base has minimum 0.5% grade towards pit, unless the design specifies a flat base and design levels achieve (+ 50 mm). If the design has a flat base, confirm with the designer and refer to these guidelines or the <i>WSUD Technical Guidelines for South East Queensland</i> (SEQHWP, 2006) if the designer does not understand the purposes of the 0.5% grade. Ensure base of system is free from debris and meets the tolerances (Section 3.4.2).		
STEP 12: Construct overflow weir if required	Where an overflow weir is part of the system design, it should be constructed at this stage and appropriately 'keyed' into the bunds to avoid potential scour at the edges of the weir. Design levels and tolerances must be achieved (+25 mm).		
STEP 13: As-constructed survey	An as-constructed survey of the system is required at this stage to confirm design and tolerances (Section 3.4.2) are achieved, including: - overflow pit crest level, invert level and under-drainage connections invert and diameter - outlet pipe upstream and downstream invert levels - overflow weir - base of bioretention system to illustrate the level and the 0.5% grade.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 14: HOLD POINT Inspection and sign-off (Form A)	Following collection of the as-constructed survey, the site superintendent and bioretention designer will inspect the system with the contractor, review the as-constructed survey and take photos. If the construction meets the tolerances outlined Section 3.4.2 and conforms with the design, complete Sign-Off Form A attaching the as-constructed survey and photos.		
STEP 15: Filter cloth lining	Line system with filter cloth, ensuring filter cloth extends a minimum of 500 mm beyond the top of the bioretention system's side walls.		
STEP 16: Install under-drainage	Install slotted rigid under-drainage pipes or ag-pipe and rigid collector pipes in the specified layout outlined in Section 3.4.5. Ensure all pipes are laid at a minimum 0.5% slope with no localised depressions verified using levels or string lines. Ensure levels are achieved (+25 mm). Seal junctions and connections using sufficient sealant to prevent sand, gravel or soil passing into drainage network. The same drainage layer material (aggregate) can be used to adjust the under drainage grade of the pipe to 0.5%.		
STEP 17: Install cleanouts	Connect clean out points ensuring the top of clean out points will ultimately sit at least 50 mm (preferably 150 mm) above the bioretention surface. Clean out caps should be screwed in place to secure against vandalism.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 18: HOLD POINT Inspection and sign-off (Form B)	Following collection of the as-constructed survey, the site superintendent and bioretention designer will inspect the system with the contractor, review the as-constructed survey and take photos. If the construction meets the tolerances outlined Section 3.4.2 and conforms with the design, complete Sign-Off Form A attaching the as-constructed survey and photos.		
STEP 19: Source drainage layer, transition layer and filter media material	Testing and sourcing of the drainage, transition and filter media layers should have commenced as part of Step 2. By Step 19, the material can be delivered and stockpiled on site ready for installation.		
STEP 20: Install drainage layer	Install 200–250 mm deep gravel drainage layer to cover the slotted under-drainage pipe network. The preferred approach is to use an excavator (long-arm if required) or conveyor belt (see Section 3.4.7) positioned on the edge of the system to place gravel into the system. Contractors can then spread and flatten the gravel to the specified depth using spreader bars. The exact procedure for constructing the drainage layer is determined through consultation with the contractor. It may differ from the procedure described in Section 3.4.7. The site superintendent or bioretention designer should inspect the drainage layer to ensure the correct depth (200–250 mm) and tolerances (+25 mm) have been achieved and that the surface is flat.	 2	 4
STEP 21: HOLD POINT Inspection of drainage layer	The site superintendent or bioretention designer should inspect the drainage layer to ensure the correct depths (200–250 mm) and grade (typically 0.5%) have been achieved and the surface is flat. The relevant sections of Sign-Off Form C must be completed and photos taken. There is no need to stop construction for this inspection unless specifically required. The site superintendent or designer should undertake the inspection as construction occurs.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 22: Install transition layer	Install a 100 mm deep coarse sand transition layer on top of the gravel drainage layer using the same approach outlined in Step 14 to achieve the correct tolerances (+25 mm) and to ensure the surface is flat.		
STEP 23: Inspection of transition layer	The site superintendent or bioretention designer should inspect the transition layer to ensure the correct depths (100 mm) and grade (typically 0.5%) have been achieved and that the surface is flat. The relevant sections of Sign-Off Form C should be completed and photos taken. There is no need to stop construction for this inspection, unless specifically required. The site superintendent or designer should undertake the inspection as construction occurs.		
STEP 24: Install filter media	Place the bioretention filter media to the designed the surface level of the bioretention system, in two separate lifts where required, with each lift lightly compacted as outlined in Section 3.4.6. At the completion of the section lift and compaction, use a spreader bar to flatten the surface of the filter media. Ultimately, the surface of the filter media must be level at the design level (+25 mm) and free from local depressions.		
STEP 25: Install sediment fences	Immediately after installing the filter media, install sediment fences around filter media and at the top of the batter to prevent sediment from entering the batters and to keep construction vehicles off the system.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 26: Lay protective filter cloth, where required	If there will be delay between Step 34 and Step 35 (handover from civil contractor to landscape contractor), the surface and batters of the bioretention system should be covered with a temporary layer of filter cloth to protect against sediment-laden runoff. The filter cloth will be removed prior to installation and establishment of the landscape.		
STEP 27: As constructed survey	Undertake an as-constructed survey of the system surface and surrounding bunds, choosing at least four spots on the surface of the small bioretention systems (<100 m²), one spot level per 100 m² on the surface of large bioretention systems and at least one spot level every 10 m along the top of the bunds as well as any low points.		
STEP 28: HOLD POINT Inspection and sign-off (Forms C and D)	Following collection of the as-constructed survey, the site superintendent and bioretention designer will inspect the system, review the as-constructed survey and take photos. If the construction meets the tolerances outlined Section 3.4.2 and conforms with the design, Sign-Off Forms C and D will be completed and signed and the as-constructed survey and photos attached.		
STEP 29: Install coarse sediment forebay	Construct coarse sediment forebay in accordance with the design and advice provided in Section 3.4.9. Concrete is preferred with surface treatment as directed by the design.		
STEP 30: Inspection and sign-off (Form E) PRACTICAL COMPLETION	The site superintendent or bioretention designer should inspect the coarse sediment forebay to ensure consistency with design. The relevant sections of Sign-Off Form E should be completed and photos taken before either Building Phase Protection works or Landscape Works start.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
CONTINUE TO STEP 31 (Landscape Works) immediately. This will involve a rapid handover from the civil contractor to the landscape contractor.			
Landscape works	Before starting landscape preparation, hold a pre-start and plant set-out meeting with the bioretention designers, including an ecologist, site superintendent and landscape contractors. The meeting should confirm design and planting establishment and set out the planting to ensure the correct plants are installed in the correct locations.		
STEP 31: Pre-start and plant set-out meeting			
STEP 32: Preparation	Prepare for the landscape establishment up to six months before starting, including ordering and inspecting plants at the nursery, ordering and receiving organic mulch and matting and organising a source of irrigation water. For bioretention systems, recycled water for irrigation is generally not recommended.		
STEP 33: Remove temporary protection	If temporary protective filter cloth was installed at STEP 26, this should be removed at this stage. Care should be taken to avoid damaging the clean-out points for the under-drainage.		
STEP 34: Flatten surface	After the protective layers are removed, flatten the surface of the filter media using a spreader bar. Additional filter media may be required to fill in any over-excavated zones. Care should be taken to not over-compact the filter media (refer Sections 3.4.6 and 3.4.7).		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 35: Mulching	Mulch the filter media surface in accordance with Section 3.6.4. Create holes in the mulch for planting. Ensure the holes have 50 mm separation from stem of the plant to the mulch.	 2	 4
STEP 36: Soil preparation	Dig planting holes by hand and apply the prescribed amount of slow-release native fertiliser detailed in Section 3.6.3. Pre-soaked wetting agents are recommended in this step.		
STEP 37: Planting	Plant tubestock ensuring the root ball is covered with filter media and the stem is sitting above the filter media. Clear away any mulch from the step to 50 mm (refer Section 3.6.5).	 3	 4
STEP 38: Inspection and sign-off (Form G) PRACTICAL COMPLETION	After installing the mulch and plants, the site superintendent and bioretention designer will inspect the system and Sign-Off Form G is completed and photos attached.	 2	 4

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 39: Watering	Water the plants according to Section 3.6.6: Week 1–6 5 waterings per week Week 6–10 3 waterings per week Week 11–15 2 waterings per week If there is no rain, each plant should receive 2.5–5.0 litres of water per week during establishment in the first six weeks (40 mm per week).	 2	 1
STEP 40: Weeding	Inspect bioretention plants fortnightly during establishment, removing any weeds by hand.	 2	 1
STEP 41: On-going inspections and final landscape establishment	Monitor the establishment of plants until they are robust and self-sustaining. An established bioretention is measured by (Section 3.6.7): 1. survival of more than 90% of plants 2. 80% coverage of bioretention surface 3. more than one species per macrophyte zone 4. at least 5 plants per m² and preferably 6–10 plants/m² 5. an increase in plant height of at least 50% measured through markers or stakes 6. propagation of more than 2–3 stems and there is seeding 7. no weeds. Record growth and maturity through three-monthly photo logs every 500m².	 1	 1

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 42: Inspection and sign-off (Form H)	After plants are established, the site superintendent and bioretention designer will inspect the system and complete Sign-Off Form H with photos attached.		

3.11 Potential failure and rectification

Constructing and establishing any civil or landscape asset requires refinement and repair of defects to ensure compliance with the design. Table 3.13 outlines potential construction and establishment failures or defects for bioretention systems and suggests ways to rectify the problems. The table focuses on construction and establishment defects and on functional failures that can occur following the completion of construction and provides rectification actions. The table is not exhaustive and will be updated in future revisions of this guideline. The bioretention designer or external expert should be consulted when the following failures occur to confirm rectification actions.

Table 3.12: Potential failure scenarios for bioretention systems and rectification actions

DEFECT OR FAILURE	CAUSES	RECTIFICATION
Ponding water on surface or reduce filtration rate	Blinding or blockage of filter media surface with sediment.	Confirm surface blinding or blockage by scraping back the surface sediment to reach the bioretention filter media filling the void with water to see if the water drains. In-situ hydraulic conductivity testing should be undertaken at the surface, middle and bottom of the filter media profile in accordance with <i>Practice Note 1: In-Situ Measurement of Hydraulic Conductivity</i> (Hatt and Le Coustumer, 2008). More detailed assessment may be required by: - collecting samples at the surface and at depth at a number of locations in the system - testing samples for particle size distribution and saturated hydraulic conductivity in accordance with the <i>Guideline Specifications for Soil Media in Bioretention Systems</i> (FAWB, 2008). Rectification of the system is required if: - the in-situ hydraulic conductivity testing confirms low conductivity at the surface and high conductivity at depth - the particle distribution size analysis finds finer material at the surface.



DEFECT OR FAILURE	CAUSES	RECTIFICATION
Ponding water on surface or reduce filtration rate (cont).		Rectification options include: - identifying the source of the sediment and rectifying - removing the surface layer of sediment and re-installing the filter media to achieve the design surface level, then mulching and replanting - planting with rushes, grasses and trees to increase plant and root density to break up the surface. The bioretention system must drain according to design requirements within 12 months. If it does not drain, remove the surface sediment and re-mulch and replant the system.
	Structural collapse as a result of using incorrect media or poor installation. Structural collapse means the soil's structure is unable to hold fine soil in place so the fines move to a certain location in the profile of the filter media, therefore blocking the movement of water.	Confirm structural collapse by: - collecting samples at the surface, middle and bottom of the filter media at a number of locations in the system - testing the samples for particle size distribution and saturated hydraulic conductivity in accordance with the <i>Guideline Specifications for Soil Media in Bioretention Systems</i> (FAWB, 2008) - completing in-situ hydraulic conductivity testing at the surface, middle and bottom of the filter media profile in accordance with <i>Practice Note 1: In-Situ Measurement of Hydraulic Conductivity</i> (Hatt and Le Coustumer, 2008). If the testing finds the filter media has structurally collapsed, rectification is required. Rectification options include: - removing the filter media and installing new media that meets the specifications, mulch and replant (preferred) - planting with rushes, grasses and trees to break-up the surface (alternative). The bioretention system must drain according to the design requirements within 12 months. If it does not drain, remove the surface sediment and re-mulch and replant the system.



DEFECT OR FAILURE	CAUSES	RECTIFICATION
Ponding water on surface or reduce filtration rate (cont).	Blockage of transition or drainage layer with sediment.	To confirm if the transition layer or drainage layer is blocked with sediment, a geotech specialist can create boreholes at a number of locations in the bioretention system to allow the collection of samples for particle size distribution analysis. Permeability testing should also be undertaken at the transition layer and drainage layer to confirm hydraulic conductivity. If the transition layer or drainage layer is blocked with sediment (i.e. contains significant fine soils), remove the bioretention media and refill the system with filter media and plant out in accordance with these guidelines.
	Filter cloth around under-drainage or between the filter media and transition layer/ drainage layer is clogged with fine sediment.	Filter cloth should not be installed around the under-drain or between any of the bioretention media layers. The Sign-Off Forms and photos will confirm that filter cloth has not be used. If filter cloth has been used and is clogged with fine sediment, remove the filter cloth and the bioretention media. Refill the bioretention system with filter media and plant out in accordance with these guidelines.
	Blockage of under-drains.	Clean out under-drains with standard plumbing equipment. The bioretention system should drain after cleaning. If system does not drain, then investigate blockage of the transition or drainage layers, blinding of filter media, or structural collapse of the filter media.
Scour and short-circuiting of flows at outlet pit	Under-drains that are not sealed into outlet pit can result in flow short-circuiting down the side of pit and scouring the filter media, the transition layer and the drainage layer.	To rectify (Figure 3.16): - seal the under-drainage pipes into the pit - dig out the eroded sections of the bioretention profile including the filter media, transition layer and drainage layer well beyond the bounds of the scour - replace the drainage layer, transition layer and filter media and compact the layers - install a layer of filter cloth to the pit and extend it down the side of the pit into the filter media to a depth of 300 mm, extending the filter cloth horizontally out into the filter media by 300–500 mm as shown in the sketch to minimises the risk of scour down the side of the pit.



DEFECT OR FAILURE	CAUSES	RECTIFICATION
	Scour will eventually occur around any apron or concrete spill on the outlet pit as it impossible to compact filter media up under the apron or spill.	To rectify: - dig out the eroded sections of the bioretention profile including the filter media, transition layer and drainage layer well beyond the bounds the scour - remove the concrete apron or spill - install a layer of filter cloth to the pit and extend it down the side of the pit into the filter media to a depth of 300 mm, extending the filter cloth horizontally out into the filter media by 300–500 mm as shown in the sketch to minimises the risk of scour down the side of the pit - replace the drainage layer, transition layer and filter media and compact the layers.
Scour and short-circuiting at the edge of bioretention system	Erosion of the bioretention batters. Filter cloth is not extended up to the batters of the bioretention system resulting in scour down the outside edge of the filter cloth.	To rectify: - dig out the eroded sections of the bioretention profile including the filter media, transition layer and drainage layer well beyond the bounds the scour - install new filter cloth from the base of the bioretention up the edge to extend at least 500 mm up the batters and pin in place - replace the drainage layer, transition layer and filter media and compact the layers - place topsoil over the filter cloth on the batters.
Scour and short-circuiting at bioretention walls	In many situations, the conceptual design of bioretention systems does not allow space for batters and designers are forced to use vertical walls. Where the walls extend down the side of the filter media there is a risk of flow scouring the filter media at the interface with the wall. This is a particular concern with rock walls or walls without a flat vertical surface.	To rectify: Option 1 (Figure 3.17) - place filter fabric on the wall and extend at least 1 m onto filter media - install filter media or top soil over the filter cloth to create a batter against the wall, extending the top of the batter well above the likely flood level - wrap the filter cloth back over the top of the batter and place more topsoil on the surface - compact, mulch and plant.



2

DEFECT OR FAILURE	CAUSES	RECTIFICATION
Scour around short-circuiting at bioretention walls (cont).		Option 2 (Figure 3.18) - dig out the eroded sections of the bioretention profile including the filter media, transition layer and drainage layer to at least 0.5 m away from the wall - install clay within the 0.5 m space, from the edge of the filter media to the wall - compact the clay to ensure there is no potential flow connection from the wall to the drainage layers of the bioretention system - install filter fabric up the vertical edge of clay and across flat surface - install the drainage layer, transition layer and filter media and compact the layers - mulch and plant out.
Scour around the high-flow weir	If the weir crest and grouted rock protection is not extended up the batters of the bioretention system, scour may occur around the edge of the weir as flows will skirt the weir.	Extend the concrete weir crest and grouted rock batters up the batters to at least 500 mm above the weir invert.
Scour of bioretention batters	Lateral surface flows enter the bioretention system from a small catchment directly adjacent to the bioretention.	Direct the lateral flows to small rock-lined channels that feed down the batters to the bioretention system. Plant out scoured zones. Where required, organic mesh or netting may be required to avoid erosion of the batters.
Failure of the bioretention bunds	Failure of bioretention bunds can occur through scours and overflows. The bunds can also fail if they are constructed too low.	Rectify scour and ensure geotech certification of the bund for stability and capacity. If necessary, raise the bund well above the top of the potential flood levels in the bioretention system and provide rock protection in high velocity locations.
Damaged to clean-out or missing inspection caps	The systems may be vandalised, for example, inspection caps may be removed.	Replace inspection caps and ensure they are secured with screws to reduce the risk of vandalism.

DEFECT OR FAILURE	CAUSES	RECTIFICATION
Failure of plants	Plants may fail to thrive if the filter media does not meet specifications, particularly for water-hold capacity and organic content.	Review Bioretention Construction and Establishment Sign-Off Form C to confirm the media meets the specifications outlined in Section 3.5. Collect samples within the bioretention system at the surface, middle and base of the filter media approximately every 250 m². Complete the FAWB tests on the samples in accordance with Section 3.5 and compare the results with the specification. If the installed media does not meet the specifications, seek advice from laboratory on how to ensure the specifications are met. In-situ amelioration may be possible; however, if not the filter media will need to be removed and replaced.
	Inappropriate watering during establishment of plants.	If plants are alive, irrigate according to the recommendations in Section 3.6.6 or install a riser at the outlet pit to raise water levels in the bioretention system to just below the root of the plants. If the plants have died, mulch, replant and irrigate according to Section 3.6.6 or install a riser to raise water levels in the bioretention system.
	Lack of mulch or fertiliser during establishment of plants.	If plants are alive, apply small quantity of liquid fertiliser and apply much. If plants have died, mix compost or organics into the top 50–100 mm of the filter media, mulch and replant.
	Poor plant cover of less than five to six plants per m ² .	Review species selection in consultation with the bioretention designer and select an alternative species that is better suited to the subject site.
	Excessive weed cover.	Remove weeds manually to protect native plants. Avoid weed seed set by pro-actively maintaining and reducing weeds from the edge of the bioretention system.

BIORETENTION SYSTEM CONSTRUCTION & ESTABLISHMENT SIGN-OFF FORMS

Asset I.D.		DA No.	
System location:			
Area:	Catchment Area (ha):	Bioretention Area (ha):	
Civil drawing no.			
Landscape drawing no.			
ROLE/STAKEHOLDER	COMPANY	CONTACT NAME	CONTACT DETAILS
Developer			
Site superintendent (civil)			
Site superintendent (landscape)			
Bioretention designer			
Civil engineer			
Landscape architect			
Civil contractor			
Landscape contractor			
Council compliance officer			

CHECKLIST OF SIGN-OFF FORMS

SIGN-OFF FORM	DATE COMPLETED	NAME OF SIGNATORY & ROLE (E.G. SUPERINTENDENT)	SIGNATURE
Pre-Start Meeting			
Form A — Earthworks & Functional Structures			
Form B — Under-Drainage			
Form C — Bioretention Media			
Form D — Finished Levels			
Form E — Coarse Sediment Forebay			
Form F — Protective Measures			
Form G — Landscape Installation			
Form H — Landscape Establishment			

PRE-START MEETING

List pre-start meeting attendees who are to sign indicating they have attended the meeting and understand the design intent, construction and establishment process.

Location			
Date			
ROLE/STAKEHOLDER	COMPANY	CONTACT NAME	CONTACT DETAILS
Developer			
Site superintendent (civil)			
Site superintendent(landscape)			
Bioretention designer			
Civil engineer			
Landscape architect			
Civil contractor			
Landscape contractor			
Other			
Other			
Other			
Comments (attach and refer to additional pages if necessary)			

Actions (attach and refer to additional pages if necessary)

FORM A — EARTHWORKS AND FUNCTIONAL (HYDRAULIC) STRUCTURES

Purpose: To ensure earthworks bulking out, trimming and profiling and the key levels of functional (hydraulic) structures are in accordance with design drawings and specifications. The earthworks and structures dictate the movement of stormwater through the bioretention system and are a critical element in the function of the system.

ITEMS	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
As constructed survey completed and attached to this form				
Photos taken and attached to this form				
Set-out of system is correct				
Base levels are at correct elevation (± 50 mm)				
Base at correct grading (0.5%)				
Punch out holes in overflow pit are correct size, correct level and above invert level of outlet pipe ($+25$ mm)				
Overflow pit is correct size and crest and invert is at correct level (± 25 mm)				
Outlet pipe invert levels are correct (upstream and downstream) (± 25 mm)				
Outlet pipe is free draining				
Overflow weir (if required) is correct length and at correct level ± 25 mm)				
Overflow weir (if required) is keyed into bund				
Bunds/embankments surrounding the system are at correct levels or above				

HOLD POINT: Superintendent and bioretention designer inspection and sign-off before proceeding.

Comments (attach and refer to additional pages if necessary)

NB: As constructed survey and drawings and photos attached.

Signed by superintendent:

Print name:

Date:

Signed by bioretention designer:

Print name:

Date:

FORM B — UNDER-DRAINAGE

Purpose: To ensure under-drainage is installed correctly before the bioretention media is installed.

ITEMS	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
Base of system free from debris				
Liner (typically filter cloth) correctly installed				
There is no fabric 'sock' around the under-drainage				
Correct under-drainage has been supplied and slotted at 2 mm or smaller				
Under-drainage pipes are laid at the correct spacing (small bioretention system 1.5 m, large system 2 m)				
Required grade (verified using level or string line)				
Under-drainage pipes laid at required grade (verified using level or string line to achieve design level ± 25 mm and 0.5% grade)				
All junctions and connections have been appropriately sealed				
Top of clean out points at design level (i.e. approximately 50–150 mm above filter media surface)				

HOLD POINT: Superintendent and bioretention designer inspection and sign-off before proceeding.

Comments (attach and refer to additional pages if necessary)

NB: As constructed survey and drawings and photos attached.

Signed by superintendent:

Print name:

Date:

Signed by bioretention designer:

Print name:

Date:

FORM C — BIORETENTION MEDIA

Purpose: To ensure that the media placed in the system meets the required specifications and that there is a record of the media being delivered to site.

To ensure media layers are installed correctly and meet the design and specification requirements.

SOURCING, TESTING AND SUPPLYING BIORETENTION MEDIA

DRAINAGE LAYER	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
Meets the specifications				
Meets the required hydraulic conductivity (4,000 mm/hr)				
Delivery supply docket certifies that the material delivered is the material tested (delivery docket attached)				
TRANSITION LAYER SUPPLY				
Meets the specifications				
Supplier certification provided (certification attached)				
Delivery supply docket certifies that the material delivered is the material tested (delivery docket attached)				
FILTER MEDIA SUPPLY				
Meets the FAWB's <i>Guideline Specifications for Soil Media in Bioretention Systems</i> (2008)				
Meets the required hydraulic conductivity (100–500 mm/hr, 750 mm/hr maximum)				
Frequency of laboratory testing completed in accordance with Section 3.5 (results of testing attached)				
Supplier certification provided (certification attached)				
Delivery supply docket certifies that the material delivered is the material tested (delivery docket attached)				

HOLD POINT: Superintendent or bioretention designer inspection and review of test results and certifications before proceeding.

Comments (attach and refer to additional pages if necessary)

FORM C — BIORETENTION MEDIA (CONT.)

INSTALLATION OF BIORETENTION MEDIA

	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
Base of system free from debris				
Drainage layer (fine gravel) installed to correct depth (± 25 mm)				
Transition layer (coarse sand) installed to correct depth (± 25 mm)				
Placement of filter media completed to avoid compaction of media and using at least two lifts				
Filter media installed to correct depth				
Light, even compaction applied to remove air gaps (e.g. light roller or single pass with a 'pozitrack' bobcat)				
Spreader bar used to flatten surface of filter media				
Sediment fences in place				

INSPECTION: Superintendent and bioretention designer inspection and sign-off to occur while installation of media is occurring. Photos must be taken by the superintendent, the bioretention designer or the contractor.

Comments (attach and refer to additional pages if necessary)

NB: Laboratory test results, certification, delivery dockets and photos attached.

Signed by superintendent:

Print name:

Date:

Signed by bioretention designer:

Print name:

Date:

FORM D — FINISHED LEVELS

Purpose: To ensure finished levels of system surface and bunds are correct and meet the design.

ITEMS	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
Landscaping topsoil applied to surrounding bunds to achieve design levels				
As-constructed survey of system surface and surrounding bunds completed				
Final constructed levels are consistent with design levels				
Under-drainage clean-outs extended 50–150 mm above filter media				
Under-drainage pipes flushed to remove initial ingress of material				

HOLD POINT: Superintendent and bioretention designer inspection and sign-off before proceeding.

Comments (attach and refer to additional pages if necessary)

NB: As constructed survey and drawings and photos attached.

Signed by superintendent:

Print name:

Date:

Signed by bioretention designer:

Print name:

Date:

FORM E — COARSE SEDIMENT FOREBAY

Purpose: To ensure the coarse sediment forebay is constructed correctly.

ITEMS	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
Extent of coarse sediment forebay correctly set out				
Rocks to be used to line base of forebay are correct size and shape				
Base of constructed forebay is flat and set at the correct level below the surface of the filter media				
Rocks placed for energy dissipation are of appropriate size and are in correct location				
Interface between forebay and filter media is structurally sound and not prone to collapse				
HOLD POINT: Superintendent or bioretention designer inspection and sign-off before proceeding.				
Comments (attach and refer to additional pages if necessary)				

NB: As constructed survey and drawings and photos attached.

Signed by superintendent:

Print name:

Date:

Signed by bioretention designer:

Print name:

Date:

FORM F — PROTECTIVE MEASURES

Purpose: To ensure protective measures are correctly installed to protect the bioretention system while building is occurring in the catchment.

Protection option adopted (Option 1, 2 or 3)

OPTION 1 — SURFACE PROTECTION DURING BUILDING PHASE	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
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Continuous sediment fences installed around perimeter of filter media and top of batter.				
Where landscape works are not to commence immediately then cover batters with filter cloth.				
Protective covering (filter cloth + 25 mm topsoil + turf) installed across entire filter media area of system.				

OPTION 2 — BYPASS AND EARLY ESTABLISHMENT	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
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Continuous sediment fences installed around perimeter of filter media and top of batter.				
Where landscape works are not to commence immediately then cover batters with filter cloth.				
Temporary bund installed (where required) to prevent stormwater runoff from entering bulk of system. Bund keyed into batters of bioretention and crest level higher than pits and weirs.				
Temporary protective covering (filter cloth + 25 mm topsoil + turf) installed within banded area.				

OPTION 3 — SEDIMENT BASIN AND BIORETENTION FUNCTION	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
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Continuous sediment fences installed around perimeter of filter media and top of batter				
Sediment basin installed upstream of bioretention in accordance with either (including hydraulic structures): • WSUD Technical Design Guidelines for SEQ (SEQHWP) • Local erosion and sediment control guidelines or Best Practice Erosion and Sediment Control (IECA, 2008)				
Suitable access provided to sediment basin for clean out				
Bioretention system installed downstream of sediment basin				
Protective covering (filter cloth + 25mm topsoil + turf) installed across entire filter media area of basin.				

HOLD POINT: Superintendent and bioretention designer inspection and sign-off before proceeding.

Comments (attach and refer to additional pages if necessary)

NB: Photos attached.

Signed by superintendent:

Print name:

Date:

Signed by bioretention designer:

Print name:

Date:

FORM G — LANDSCAPE INSTALLATION

Purpose: To ensure the correct plants are supplied, installed and established.

ITEMS	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
Correct mulch has been supplied				
Mulch applied to correct depth and secured				
Supplied plants are correct species				
Supplied plants are in correct pot sizes and maturity (300 mm min)				
Plants have been installed at correct planting density (min 6 plants/m ²)				
As constructed drawings marked up with final plant species and densities				
Mulch is clear of plant stems by approximately 50 mm				
HOLD POINT: Superintendent AND bioretention designer inspection and sign-off before proceeding.				
Comments (attach and refer to additional pages if necessary)				

NB: As constructed drawings and photos attached.

Signed by superintendent:

Print name:

Date:

Signed by bioretention designer:

Print name:

Date:

FORM H — LANDSCAPE ESTABLISHMENT

Purpose: To ensure the correct plants are supplied, installed and established.

ITEMS	CHECKED	SATISFACTORY	ACTION (IF UNSATISFACTORY)	INITIAL
PLANT ESTABLISHMENT				
Weeds being removed as required				
Watering occurring as required				
Replanting occurred as required to replace failed plants				
Plants successfully established plants propagation is occurring. Measure of successful establishment 1. Survivorship greater than 90% 2. 80% coverage of system 3. Preferably more than one species per macrophyte zone 4. At least 5 plants/m ² (preferably 6–10 plants/m ²) 5. Plant height of at least 50%. This can be measures through the use of marker or stakes through the bioretention 6. Propagation is occurring (more than 2–3 stems, seeding) 7. No weeds. Growth and maturity should be recorded through three-monthly photo logs every 500 m ² .				

HOLD POINT: Superintendent AND bioretention designer inspection and sign-off.

Comments (attach and refer to additional pages if necessary)

NB: As constructed drawings and photos attached.

Signed by superintendent:

Print name:

Date:

Signed by bioretention designer:

Print name:

Date:

APPENDIX E

Water by Design “Maintaining Vegetated Assets”

Maintenance activities for swales, bioretention systems, constructed wetlands, and sediment basins include:

- repairing erosion (Section 3.1)
- unblocking inlets and outlets (Section 3.2)
- removing sediment (Section 3.3)
- removing litter and debris (Section 3.4)
- managing mosquitoes (Section 3.5)
- managing birds (Section 3.6)
- managing high or low water levels in a wetland (Section 3.7)
- responding to a paint or fuel-spill (Section 3.8)
- replanting (Section 3.9)
- controlling weeds (Section 3.10)
- managing excessive algae in sediment basins and constructed wetlands (Section 3.11)
- managing algal or moss growth on bioretention systems (Section 3.12)

The need for maintenance can be identified by comparing the state of the asset against the performance indicators in the checklists in Section 4.

3.1 Repairing erosion

ISSUE

Erosion in and around vegetated stormwater assets is generally because of fast flows, poor soil placement or compaction, inadequate vegetation cover, or dispersive soils. The most common areas for erosion are:

- at the base of a swale or on the surface of a bioretention system
- on the batter slopes, usually due to lateral inflows to the asset or where there is poor vegetation
- around inlet structures, due to high velocities
- at the interface of concrete and soil surfaces, due to water preferentially flowing along the concrete surface

Figure 14 and Figure 15 show examples of erosion in vegetated stormwater assets.

Minor erosion can extend and turn into a larger problem, including undermining structures, channelling of flows, and affecting vegetation health.

Figure 14 Erosion at the transition between a swale and bioretention system causing ripping of the jute mat



Photo: Paul Dubowski, Healthy Waterways

Figure 15 Erosion at the transition between wetland cells



Photos: Jason Sonneman, DesignFlow

ACTIONS

If the erosion poses a risk to public safety or the structural integrity of the asset, or is likely to worsen if left unattended, undertake repairs immediately.

If the erosion is minor, re-profile using hand tools or light machinery to limit damage to adjacent vegetation. Re-plant using replacements from other parts of the asset or bring in new stock.

Larger washouts may require large machinery and new fill material and plant stock to be imported. When using large machinery, take care not to compact the filter media of a bioretention system. If imported fill is used, it must meet the design specifications (particularly for bioretention systems). If the design specifications are not known, consult the *Technical Design Guidelines*. Re-plant once the earthworks are finished.

If an investigation into the source of the erosion is needed (e.g. the erosion is severe or recurring), refer to *Rectifying Vegetated Stormwater Assets*.

3.2 Unblocking inlets and outlets

ISSUE

The inlets and outlets are the main hydraulic controls. If they are blocked or not flowing freely:

- the asset may pose a risk to flooding, particularly if there is no alternative high-flow path
- the vegetation will be at risk (the plants may drown eventually)
- the volume of water that can be treated will be restricted as inflow will not enter the asset when it is full, causing flows to overflow or to pass downstream untreated

Figure 16 Litter blocking outlet pits



Photos: Paul Dubowski, Healthy Waterways and Robin Allison, DesignFlow

Figure 16 shows examples of blocked outlet pits that are restricting flows.

ACTIONS

Remove litter and debris by hand or with hand tools, such as shovels, forks, and tongs. Special opening tools (e.g. grate/gatic openers) are required for some outlets.

For sediment basins and wetlands, waders or a boat may be required to access the water body.

In extreme cases, machinery may be required.

If blocking persists, refer to *Rectifying Vegetated Stormwater Assets*. An alternative grate may be required or upstream measures may need to be investigated e.g. checking or installing gross pollutant traps.

3.3 Removing sediment

ISSUE

Sediment build-up in swales, bioretention systems (Figure 17), constructed wetlands, and sediment basins can:

- smother vegetation
- change the surface profile of the asset, which influences flow patterns
- form an impermeable layer on the surface of bioretention systems and prevent infiltration

If infiltration in a bioretention system is reduced or not occurring (see Figure 18), stormwater will bypass untreated into the overflow and the media may become boggy. A lack of water will affect the health of the vegetation and boggy conditions can attract mosquitoes, as well as generate unpleasant odours.

Figure 17 Sediment accumulated at an inlet



Photo: Paul Dubowski, Healthy Waterways

Figure 18 Examples of a bioretention surface that has been blinded with clay-like sediment deposition



Photos: Alan Hoban, Healthy Waterways and Andrew O'Neill, DesignFlow

ACTIONS

If an asset requires cleaning out at an unacceptable or unsustainable frequency, refer to *Rectifying Vegetated Stormwater Assets*.

Bioretention systems – coarse sediment forebay

Coarse sediment forebays are placed at the inflow location to bioretention systems to capture very coarse sediment (>1 mm). The forebays will typically be constructed of rock or concrete and should be designed to be cleaned out once a year¹. When the sediment forebay is 75% full or greater, remove the sediment.

Removing sediment should be a straightforward task that can be done by hand or mechanically. Because the forebay captures coarse sediment only, it should not be contaminated, and because the forebay is shallow and mostly dry, dewatering should not be needed.

Bioretention systems – surface

Remove sediment in dry weather and ideally at the end of the dry season.

To maintain the integrity of the vegetation and prevent compaction of the filter media, remove sediment by hand (if possible) using flat shovels.

If machinery is used, remove sediment via an excavator located on the edge of the bioretention system or via a pozitrack bobcat to avoid compaction of the filter media. Minimise the number of times the bobcat passes over the bioretention surface. Reprofile and replant the area as required.

The equipment required for cleaning the coarse sediment forebay and the surface of the bioretention system includes:

- shovel and wheelbarrow for small assets
- bobcat or small excavator for large assets
- tipper truck if sediment disposal cannot occur locally

Sediment basins

Sediment basins are normally designed to be cleaned out at least once every five years¹. Clean out a sediment basin when there is less than 1 m of water above the accumulated sediment. Complete the works in dry weather, ideally at the end of the dry season.

When removing sediment:

- Complete a sediment contamination and disposal assessment as outlined in Appendix A. In most cases, sediment contamination should not be a concern. If the sediment is contaminated, engage a licensed waste removal contractor as transporting and disposing of the sediment is subject to local and state regulations.
- Get necessary approvals for the works, including permission to de-water if necessary. Approval to drain the asset may be required for sediment basins and wetlands.
- Lower the water level with a maintenance valve or de-water the asset with a pump in accordance with the procedures of the relevant authority. Divert inflows away from the asset. In some cases, install a plug in the inlet pipe, pump the water, and clean the asset while holding the water upstream. Dewatering can take 1–2 days depending on the size of the asset and the capacity of the drain or pump. Ensure the dewatering has no adverse environmental affects.
- Remove and store plants that will be disturbed, in order to replant them after removing the sediment.
- Remove the sediment using appropriate machinery (see below).
- Remove sediment from the bottom of the asset. Sediment basins may have a hard base (such as concrete, rocks, or gravel), which indicates the bottom. The design drawings should identify this.
- If a drying (de-watering) area is available, place the sediment in this area to dry, ensuring it has silt control, and leave it until it is dry enough to remove. Clean sediment (no pollutants, needles etc.) may be re-used in earthworks or landscaping activities subject to relevant testing. Otherwise, place the sediment in a

truck and transport to an approved recycling or disposal facility.

- If a drying area is not available, place the sediment in a sealed truck for transport to an approved waste disposal facility. It is worth investigating if a drying area can be created nearby to reduce transport and disposal costs.
- Clean the sediment basin and reinstate the dewatering area and sediment pond edges as required, including replanting.

The equipment required to maintain sediment basins includes:

- pump to dewater the basin if maintenance valves do not completely drain it
- method of stopping inflows to the basin e.g. sand bags for small inflows
- if sediment needs to be collected from the edge of the basin, an excavator (possibly with a long-reach) or a heavy vacuum loader unit with a 6 inch hose
- if there are reinforced access tracks, a backhoe or excavator can enter the asset
- drying pad or a sealed truck to transport the saturated sediment
- if the dry sediment if it cannot be reused on site, a truck
- hand tools or small machinery to reinstate the disturbed area

Constructed wetlands

Removing sediment from wetlands is similar to removing it from sediment basins, with the following additional tasks:

- Ensure the wetland is off-line, diverting flows around the wetland if possible. Always have sediment controls in place in case of flows into the wetland.
- Access the wetland from the edge to avoid damaging vegetation.
- Replant all disturbed areas after removing the sediment.

¹ This clean out frequency is after construction activity in the catchment has finished.

3.4 Removing litter and debris

ISSUE

While litter and debris are mainly an aesthetic issue, they can smother vegetation, provide habitat for mosquito breeding, be a source of pollutants, block inlet and outlet structures, and pose a risk to public safety. If litter is able to enter downstream waterways it can cause environmental harm.

ACTIONS

Remove litter and excessive debris, by hand or with hand tools such as shovels, forks, and tongs.

For sediment basins and wetlands, waders or a boat may be required to access the water body.

In extreme cases, small machinery such as bobcats may be required.

3.5 Managing mosquitoes

ISSUE

Shallow, isolated pools of water that exist for several days in constructed wetlands, sediment basins, or water-logged areas of swales and bioretention systems can provide habitat for mosquitoes. Permanent water bodies are less likely to cause mosquito issues because they support predator species that can keep mosquito populations under control.

ACTIONS

Fill and reprofile isolated pools of water and re-plant if necessary.

If there are excessive numbers of mosquitoes or the problem is recurring, refer to *Rectifying Vegetated Stormwater Assets*.

3.6 Managing birds

ISSUE

While fauna is generally welcomed in vegetated stormwater assets, large populations of some fauna can be a nuisance and can affect how an asset functions. In particular, birds can be a problem in and around constructed wetlands because they can eat or trample vegetation. For example, plant death can result from swamp hens trampling vegetation (see Figure 20). Faeces of other birds that gather in high numbers can affect water quality. Common problem species are ibises and ducks.

ACTIONS

Manage the preferred habitat. For example, remove islands or provide a predator bridge. Wetlands should not have islands as these encourage birds to nest and roost safe from predators. Other options are using signs to encourage visitors not to feed the birds or dropping the water level before and during breeding time to encourage the birds to leave the area, particularly for swamp hens. If the wetland does not have an outlet control pit (refer to *Technical Design Guidelines*), it is recommended that one is installed. If the wetland cannot be drained under gravity, pumping will be required.

If excessive numbers of birds are causing significant or repeated damage to an asset, refer to *Rectifying Vegetated Stormwater Assets*.

Figure 19 Swamp hen and associated damage



Photos: Andrew O'Neill, DesignFlow

3.7 Managing high or low water levels in a wetland

ISSUE

The water level in a constructed wetland will vary according to climatic conditions. During rainfall it will rise up to 0.5 m above the normal water level and during drought conditions it may lower by up to 0.3 m. The wetland plants will tolerate this variation and most will thrive. However, persistently high or low water levels (Figure 20) will have a negative impact on the plants and will need to be fixed.

Figure 20 Example of a wetland with persistently low water levels



Photo: Robin Allison, DesignFlow

ACTIONS

If it has not rained for three days and water levels remain high, the outlet may be blocked or there may be high water downstream that is preventing the wetland from drawing down. If an outlet or riser orifice is blocked, see Section 3.2. If there are no blockages, consult *Rectifying Vegetated Stormwater Assets*.

If the water level is much lower than the normal water level, inflows may have reduced or there may be a leak in the wetland. Consult *Rectifying Vegetated Stormwater Assets*.

3.8 Responding to paint or fuel spills

ISSUE

Pollutants from paint or fuel spills can get into stormwater and into a vegetated stormwater asset. Action is required to reduce the impacts, particularly on wetlands.

ACTIONS

Ensure designated staff and equipment are available in the case of a pollution-related incident.

Stop polluted material from moving through a wetland and reaching downstream environments using floating booms and by shutting off the outlet area (if possible).

Record all incidents on the inspection and maintenance checklist.

3.9 Replanting

ISSUE

Vegetated stormwater assets should have dense, evenly distributed vegetation across all planted areas. Maintaining vegetation is crucial to the performance of vegetated stormwater assets because it:

- assists to spread and slow water, which maximises the amount of vegetation in contact with the stormwater
- helps to reduce erosion
- minimises the establishment of weeds by shading and competing for nutrients
- preserves hydraulic conductivity in bioretention systems
- traps coarse litter
- acts as a deterrent to public access

Some water plant species will dieback (senesce) each winter: this does not equate to dead vegetation.

Figure 21 shows an example of uneven vegetation in a wetland. It is important to quickly re-establish vegetation in bare areas before weeds establish.

Figure 21 Uneven vegetation cover in a wetland and after transplanting



Photos: Robin Allison, DesignFlow

ACTIONS

If the asset does not meet the performance indicators for vegetation, re-establish the vegetation using new stock or (for constructed wetlands) using stock transplanted from elsewhere within the asset.

If replanting with new stock, use the plant species that are growing well in other parts of the asset. (For wetlands, look for plants growing in similar depths of water.) Otherwise, refer to the *Technical Design Guidelines* or a person with a good understanding of aquatic vegetation. Plant at a density of between 6–10 plants per m² and use a minimum of two species.

In constructed wetlands, dividing and relocating existing vegetation is a simple and cost-effective way of replacing vegetation. Mature water plants from a similar depth zone can be removed and the plant divided by splitting it through the base. Directly plant the new sections into the re-establishment area, taking care of the root system. Water plants with rhizomatous root systems (underground stems with multiple shoots off them) are ideal candidates for division and relocation, as each rhizome can be cut into multiple sections.

In wetlands with grazing waterbirds (particularly Purple Swamp Hens) or where the water level cannot be maintained at a constant low level (10 cm), replant using larger seedlings or plants. This is because swamp hens tend to pull seedlings out and high water levels often drown the seedlings. In areas with few birds and good water level control, use seedlings to revegetate as they are usually more cost-effective.

Use specialist aquatic plant contractors when large areas need replanting. A small boat may be required.

Refer to the *Construction and Establishment Guidelines* for detailed advice on planting procedures for vegetated stormwater assets.

If the lack of vegetation cover is severe or recurring or the replanted vegetation fails to establish, consult *Rectifying Vegetated Stormwater Assets*.

3.10 Controlling weeds

A weed is a plant that is growing where it is not wanted. Plants are considered weeds because they: compete with or displace native plant species; reduce biodiversity; impact ecosystem function; alter natural habitats; restrict natural processes; reduce amenity; and cause blockages to hydraulic structures. While this definition is generally applied to introduced plant species, some native plant species are also classified as weeds when they grow out of their natural range. Appendix B contains detailed information on common weeds encountered in vegetated stormwater assets.

ISSUE

Identifying and controlling weeds is important to preserve the function of a vegetated stormwater asset.

Assets are particularly vulnerable to weed invasions when the desirable plants are stressed, such as during the dry season or at the end of the wet season.

Swales and bioretention systems

Common terrestrial weeds readily grow within bioretention systems and swales (Table B-1). The growth of weeds within bioretention systems can reduce vegetation health, cover, and diversity, and result in an excessive organic layer accumulating on the surface of the filter material. Dense weeds within swales can reduce the flow capacity of the asset and increase the risk of flooding.

Sediment basins and wetlands

Enriched nutrient conditions and open water provides ideal habitat for aquatic weeds within sediment basins and constructed wetlands. Emergent aquatic plants (i.e. Cumbungi) and semi-aquatic weeds (i.e. para grass) colonise and grow well within the planted marsh zones and ephemeral margins (Table B-1). Common terrestrial weeds readily grow on the batters (Table B-1).

ACTIONS

Ideally, remove or control all weed species within an asset as part of a regular maintenance program. This is mandatory for declared weeds. A low level of undeclared weed cover may be okay if it does not hinder the functioning of an asset. However, early detection and action should cost less and result in higher success rates for managing weeds.

The main aspects of controlling weeds in vegetated stormwater assets are:

- recognise that some weed growth is inevitable because stormwater conveys weed seeds from the catchment
- know which weeds cause problems
- regularly inspect for weeds

Persistent weed ingress or excessive weed cover may mean that maintenance activities are not sufficient to manage the weeds. In this case, increase the maintenance frequency for a growing season (6–12 months). If this does not satisfactorily manage weeds, refer to *Rectifying Vegetated Stormwater Assets*.

When managing weeds, consider the following factors:

- the cause of the weed infestation
- the biology and ecology of the weed species
- methods to remove weeds, including their costs and benefits

Determining the source or cause of weeds will help to determine the most appropriate weed control strategy.

Understanding a weed's biology or ecology may influence the timing of the control method. For example, it may be beneficial to control a particular weed before it seeds to prevent further spread of the infestation.

There is a range of methods commonly used to control weeds within vegetated stormwater assets (see below). An integrated approach, where a number of control methods are used in a co-ordinated manner, is often the most effective long-term strategy. For example, a weed may initially be removed by hand, with any remaining weeds controlled using chemicals.

Many aquatic weed species are able to re-grow from small plant fragments and seeds. Take extreme care when physically removing and disposing of the plant material. Thoroughly clean all equipment used with or near aquatic weeds before moving the equipment to another waterway. This includes hand equipment, boats, booms, excavators, harvesters, and transport vehicles.

Control methods

PHYSICAL REMOVAL OF WEEDS

Hand pulling: A labour-intensive method that is extremely effective for controlling isolated weed infestations. This method is particularly useful for removing shallow-rooted weed species. Take care to remove all root material, particularly when removing deep-rooted perennial weed species.

Hand raking: A labour-intensive method used to remove small aquatic weed infestations. This method involves using a long-handled rake to remove floating or submerged aquatic weeds from sediment basins and constructed wetlands.

Grubbing: This method uses tools such as shovels and mattocks to remove weeds. Grubbing is a useful method for removing deep-rooted, woody weed species.

Mechanical removal: Use this method to remove large infestations of floating or submerged aquatic weeds from sediment basins and constructed wetlands.

Specialised floating harvesters can remove floating aquatic weeds or cut and remove weed biomass at a fixed depth below the water surface. Floating harvesters can manage weed biomass. Weed harvesting needs to be regularly repeated.

An excavator can remove floating and submerged aquatic weeds from open water areas. This normally involves scooping plants from the water with a bucket. If using excavators, use floating booms to concentrate floating aquatic weeds.

Long-reach draglines, such as chains or nets, can remove floating or submerged aquatic weeds. This involves pulling the chain or net through the water using a tractor. Only use this method when other methods of weed control are unfeasible as draglines can damage desirable macrophytes.

While using floating harvesters, excavators, or draglines to remove aquatic weeds is unlikely to eradicate them, this may provide an effective strategy for short-term control.

Floating booms: Floating booms are an effective method to control the spread of free-floating aquatic weeds within sediment basins and constructed wetlands. Floating booms are particularly useful for confining small, isolated weed infestations to particular areas of the asset, at which point plants may be physically removed or other control methods used, such as herbicides.

SLASHING

Slashing is an effective strategy to prevent weeds from flowering and seeding. Slashing is particularly useful for controlling isolated weed infestations but is not an effective method for eradicating weeds. Slashing can be undertaken using either a hand-held brush-cutting machine or a tractor equipped with a slashing implement.

BIOLOGICAL

Biological control uses insects and disease to control the spread of particular weed species. Biological control does not eradicate weeds. Biological control is a long-term strategy that reduces the health of a weed population, in order to control it easily with other methods. Biological control can be a cost-effective and environmentally sensitive method of weed control. A number of aquatic weed species within Australia have been successfully targeted using this method.

WATER LEVEL MANAGEMENT

Lowering the water level in sediment basins and wetlands can help to control floating and submerged aquatic weeds. The draw-down of water levels will dry out the vegetative material. Drying out sediment basins and wetlands is most effective during the dry season, when there is little or no stormwater runoff.

HERBICIDES

Herbicides are a common method used to control weeds growing in vegetated stormwater assets. Chemical weed control is often more cost-effective than mechanical methods and is particularly effective at controlling large weed infestations.

Major risks associated with using herbicides include the potential impacts on desirable plants and the environmental effects due to chemical residues accumulating within sediments and soils.

When treating aquatic weeds within sediment basins and constructed wetlands, take care to ensure that herbicides are registered or permitted for use around aquatic areas. Use herbicides in accordance with the registered labels and the relevant legislation (e.g. *Chemical Usage (Agricultural and Veterinary) Control*

Act 1988 in Queensland). Seek advice from the relevant government department if considering uses other than prescribed on labels. Note that all staff using herbicides should have completed Chemcert Training or its equivalent. Special licences may be required to use herbicides within a water body.

Herbicides are commonly applied to weeds using either foliar spray or rope-wick applicator methods. Cut stump and stem injection (drill and fill) are suitable methods for applying herbicides to woody weeds.

Foliar spray: Apply foliar herbicides using spot spraying techniques with hand-held sprayers. Spot spraying reduces the amount of herbicide used, which minimises the cost of application and damage to non-target plants. Take care to minimise the amount of herbicide that makes contact with the water. Using booms to confine isolated aquatic weeds may help to minimise non-target application of the herbicide.

Rope-wick applicators: Consists of a handle with a wick or rope attached to the end that is soaked with herbicide. Use the wetted wick or rope to brush herbicide over the surface of the weed. Rope-wick applicators are suitable for herbaceous weeds and young regrowth. This method ensures minimal damage to non-target plants.

Cut stump: This method involves cutting the stump of the weed approximately 15 cm from the ground using a cane knife or secateurs and applying herbicide immediately to the cut surface of the stump using a paintbrush or spray bottle.

Stem injection: This method involves making a 45-degree incision in the bark of the weed's stem using a small axe or machete and filling the pocket with a herbicide mixture. The incision must penetrate through the sapwood. Incisions are required every 7.5 cm around the circumference of the trunk.

All herbicides are potentially hazardous to humans. Protective clothing is essential when handling or spraying most herbicides. The minimum personal protection required is: rubber boots; long pants or overalls; rubber or plastic apron or coat covering the tops of the boots; rubber or plastic gloves; face shield; and waterproof hat or hood.

STEAMING

The direct application of heated steam can control weeds. Applying steam removes the plant's outer, waxy coating and breaks cellular structures, resulting in discoloration and death within a few days. While

steaming is an effective method for controlling annual weeds, regrowth of perennial weeds often occurs unless repeated treatments are undertaken.

3.11 Managing excessive algae in sediment basins and constructed wetlands

ISSUE

Algae occurs naturally in sediment basins and constructed wetlands due to the nutrient concentrations in stormwater inflows and the nutrients released from sediment and decomposing organic matter.

Generally, algal growth is either planktonic or filamentous.

Planktonic algae comprise individual, free floating cells that often turn the water green, which is also known as an 'algal bloom'. Planktonic algae include many blue-green algal species that produce toxins and pose a potential public health risk.

Planktonic algae typically grow in open water areas, particularly in sediment basins characterised by highly enriched conditions. Algal blooms will not affect the functional performance of either sediment basins or constructed wetlands.

Filamentous algae comprise single algal cells that form visible chains and often appear as floating or submerged algal mats that are bright green. Filamentous algae feel slimy when handled and individual filaments can often be recognised.

Filamentous algae grow in shallow vegetated zones and open water areas. A combination of high nutrient concentrations, light, and warm shallow water often results in excessive filamentous algal biomass.

Excessive filamentous algal biomass may severely affect the functional performance of sediment basins and constructed wetlands. Filamentous algae can block hydraulic structures, resulting in altered water regimes, and can potentially damage vegetation health, cover, and diversity. Filamentous algal biomass in constructed wetlands can smother the vegetation and be displaced by stormwater inflow. This can severely reduce plant health and the overall vegetation cover within the wetland. The death and decay of filamentous algal biomass can lead to oxygen depletion and result in poor water quality and fish kills.

ACTIONS

Planktonic algae

If access to sediment basins and constructed wetlands is restricted and there are minimal public health risks, it is not necessary to take any further action regarding planktonic algae.

Where sediment basins or constructed wetlands are accessible to the public or located within prominent public locations, the presence of blue-green algae requires further investigation. Refer to *Rectifying Vegetated Stormwater Assets*.

Filamentous algae

If filamentous algal biomass is observed within a sediment basin or wetland, it is generally not necessary to take any further action. However, in high amenity areas it may be desirable to remove filamentous algal biomass from areas of open water. Filamentous algal biomass can be physically removed using rakes, or through mechanical removal with specialist machinery (e.g. that used for removing wet sediment).

If the filamentous algal mat covers more than 10% of the sediment basin or constructed wetland area on two consecutive inspections, refer to *Rectifying Vegetated Stormwater Assets*.

3.12 Managing algal or moss growth on bioretention systems

ISSUE

Constant wetting of the filter surface of a bioretention system may result in the growth of algal or moss. Algae can be identified as a green/brown coloured coating or biofilm on the surface of the filter media, as shown in Figure 22. Filamentous algae may also appear on the surface of the filter media and often appears as a dense mat of fine green filaments (see Section 3.11). Moss is easy to identify because it looks like a thick green carpet as shown in Figure 23.

In most circumstances, minor algal and moss growth on the surface of a bioretention system will not be detrimental to infiltration rates. However, excessive algal growth or moss can clog the filter surface and prevent infiltration, and indicate that either base flows are entering the asset or there are problems with the infiltration rate. If infiltration in a bioretention system is reduced or not occurring (see Figure 18), stormwater will bypass untreated into the overflow and the media may become boggy. A lack of water will affect the health of

the vegetation and boggy conditions can attract mosquitoes, as well as generate unpleasant odours.

ACTIONS

If the cover of algal and moss growth is more than 10% of the filter media surface, refer to *Rectifying Vegetated Stormwater Assets*.

Figure 22 Algae growing on the filter media surface



Photo: Leon Rowlands, Sunshine Coast Council

Figure 23 Moss growing on the filter bed surface



Photo: Paul Dubowski, Healthy Waterways

APPENDIX F

Water by Design – Inspection and Maintenance Checklist for Bioretention Systems

4.3 Inspection and maintenance checklist for bioretention systems

ASSET TYPE	Bioretention	ASSET ID
Location		
Date		
Date of last rainfall		Weather
Officer's name		

Bioretention plan

Insert diagram or plan of the asset showing key features e.g. locations of inlet, outlet, and overflow

Additional information

Time taken to complete inspection or maintenance

Photos of site (explanatory notes)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

General comments and sketches

Officer's signature

What to look for	Performance Indicator (PI)	Condition rating*	Maintenance undertaken**	Additional work needed
SURROUNDS				
Damaged or removed structures e.g. traffic bollards	No damage that poses a risk to public safety or structural integrity			
INLET				
Erosion	Inlet is structurally sound and there is no evidence of erosion or subsidence/settlement			
Damaged or removed structures e.g. pit lids or grates	No damage that poses a risk to public safety or structural integrity			
Sediment, litter, or debris	No blockage			
COARSE SEDIMENT FOREBAY (IF PRESENT)				
Erosion	Minor erosion only that does not pose a risk to public safety or structural integrity and would not worsen if left unattended			
Sediment	Coarse sediment forebay <75% full and no litter			

* 1 – PI met; 2 – PI met after maintenance activity undertaken; 3 – Additional maintenance needed; 4 – Rectification may be needed; NI – not inspected; NA – not applicable
** Quantify where possible e.g. amount of sediment or litter removed

What to look for	Performance Indicator (PI)	Condition rating*	Maintenance undertaken**	Additional work needed
BATTER SLOPES AND BASE INVERT				
Erosion	Minor erosion only that does not pose a risk to public safety or structural integrity and would not worsen if left unattended			
Crust of fine sediment	No surface crusting			
Depressions or mounds	No surface depressions or mounds > 100 mm			
Hydraulic conductivity or permeability	Filter media is draining freely, whereby water is not ponded on the surface for more than 12 hours after rainfall and there is no obvious impermeable or clay-like surface on the filter media**			
Underdrains/clean out points	Clean out points not damaged and end caps securely in place			
Litter	Maximum 1 piece litter per 4 m ²			
Unusual odours, colours, or substances (e.g. oil and grease)	None detected			
Vegetation	Minimum 95% vegetation cover (minimal bare batches)			
	Plants healthy and free from disease			
	Average plant height > 500 mm			

* 1 – PI met; 2–PI met after maintenance activity undertaken; 3 – Additional maintenance needed; 4 – Rectification may be needed; NI – not inspected; NA – not applicable

** Quantify where possible e.g. amount of sediment or litter removed

What to look for	Performance Indicator (PI)	Condition rating*	Maintenance undertaken**	Additional work needed
Algal or moss growth	Maximum 10% of surface covered in algae			
	No moss growth			
OUTLET (OVERFLOW WEIR, PIPE, OR OUTFALL)				
Erosion	Outlet is structurally sound and there is no evidence of erosion or subsidence/settlement, including around edges of rock protection or toe of weir for large systems			
Damaged or removed structures e.g. pit lids or grates	No damage that poses a risk to public safety or structural integrity			
Sediment, litter or debris	No blockage			
Outlet freely draining to receiving drainage or waterway	No downstream impediments to the release of water, no erosion or damage to the outfall structure, and no evidence of malfunction (e.g. excessive sediment accumulated)			

* 1 – PI met; 2–PI met after maintenance activity undertaken; 3 – Additional maintenance needed; 4 – Rectification may be needed; NI – not inspected; NA – not applicable

** Quantify where possible e.g. amount of sediment or litter removed

*** Presence of Typha is an indicator of poorly draining filter media

4499 – 4651 MOUNT LINDESAY HIGHWAY, NORTH MACLEAN

Site Based Stormwater Management Plan (Quantity)

19 JUNE 2024

Incorporating



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CHARTER HALL PRIME INDUSTRIAL FUND 4499-4651 MOUNT LINDESAY HIGHWAY, NORTH MACLEAN

Site Based Stormwater Management Plan (Quantity)

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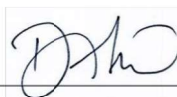


Checker

Brook Kitson

Approver

Darlan Castro
RPEQ 19918



Report No

EAG001-30109334-AAR

Date

19/06/2024

Revision Text

12

This report has been prepared for Charter Hall Prime Industrial Fund in accordance with the terms and conditions of appointment for 4499-4651 Mount Lindesay Highway – North Maclean – Civil Engineering dated 18/10/2021. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
01	30/09/2022	DRAFT Issue	TF	DC
02	14/10/2022	Issue for Approval	TF	DC
03	06/02/2023	Response to RFI	TF	DC
04	22/02/2023	Amended Southern Basin Outlet	EP	DC
05	23/06/2023	Response to Peer Review Comments	TF/DC	DC
06	04/07/2023	Table 5-9 Updated	TF	DC
07	06/07/2023	Weir Width Updated and Inundation Curve Added	TF	DC
08	03/08/2023	Overall Site Layout Updated	TF	DC
09	15/08/2023	ROL Update	TF	DC
10	16/02/2024	ROL Update	TF	DC
11	27/02/2024	Fixed Appendix D Missing Flood Maps	TF	DC
12	19/06/2024	Updated Eastern Channel Drainage Strategy	TF	DC

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Stormwater Drainage Safety Audit

1 EXECUTIVE SUMMARY

Arcadis has been engaged by Charter Hall Prime Industrial Fund to prepare a Site Based Stormwater Management Plan (Quantity) (SBSMPQ) for the proposed industrial development, situated at 4499-4651 Mount Lindesay Highway, North Maclean. The site is located in the Greater Flagstone Priority Development Area located within the Logan City Council local government area. On 21 September 2021, the Minister for Economic Development Queensland (EDQ) granted approval for a PDA development application over the site for a Development Permit for Reconfiguring a Lot – 1 into 4 lots, plus roads and open space. On 27 September EDQ granted approval for an amendment to the previous Reconfiguring a Lot application (DEV2018/961/8). The new approval was for reconfiguring a lot - one (1) lot into eleven (11) lots and new roads and open space.

This report demonstrates the proposed development will be constructed and operated in accordance with the requirements of Council, the South-East Queensland State Planning Policy (SPP), the Queensland Development Code, the Queensland Urban Drainage Manual (QUDM) Economic Development Queensland (EDQ) PDA guidelines and the Environmental Protection (Water) Policy (2009). This report also demonstrates the proposed amendment will not result in substantially different development to the existing approval.

The primary objective of this SBSMPQ is to ensure that:

1. Suitable measures are incorporated into the development to ensure that there are no adverse impacts to downstream receiving waterways, property or infrastructure resulting from any increase to stormwater runoff peak flow rates.

This report therefore includes hydraulic and hydrological modelling which demonstrate, that due to change in stormwater catchment parameters, there is an increase in peak flow rate during the post development scenario. Subsequently, three regional detention structures have been proposed and designed in conjunction with numerous on-site detention systems for Lots 2 - 5 such that flow rates discharged from the development site are no greater than the corresponding catchment existing peak flow rates at the proposed points of interest, from 50% to 1% Average Exceedance Probability (AEP) storm events.

The impact of the proposed development against the existing condition at the areas immediately downstream and upstream of the site have been assessed using TUFLOW. The assessment considers the changes and if they would cause corresponding changes to the existing flood behaviour and thereby would cause any actionable nuisance.

In assessing the area constraints and the flood characteristics surrounding the site, Arcadis assigned a 2m grid size to the TUFLOW model, with resulting increased accuracy of the results in flood sensitive areas compared to larger grid sizes. Results from the model were assessed for peak water surface level afflux between the existing and developed scenarios.

This report presents the methodology and results of a flood modelling assessment which has included the analysis of the impacts of the proposed development in comparison to the existing scenario. In particular, this assessment has focused on the impact immediately upstream and downstream of the site where complex flood behaviour, with flows currently draining through private properties, is present.

Results indicate that the proposed development will generally improve flood conditions downstream of the site by applying the reduction of site stormwater discharge via the proposed detention systems and augmenting the proposed earthworks to allow adequate flood storage and conveyance through the site.

Note: The proposed operational stormwater quality treatment train is detailed in the Site Based Stormwater Quality Management Plan (SBSQMP) (EAG003-30109334-AAR-01).

1.1 Revision 03

Revision 03 of this report was prepared in response to the Information Request received from EDQ via email on 22 November 2022, related to the Compliance Assessment for Condition 21 of the Decision Notice received for the PDA Development Permit for reconfiguring a lot – 1 lot into 4 lots, plus roads and open space. Specifically includes changes to the Western Swale configuration to reduce clearing impacts within the 25m buffer.

1.2 Revision 05

Revision 05 of this report has been prepared in response to the comments received from Water Tech following their peer review of this report, as well as the Further Clarification Request received from EDQ on 31 March 2023 related to the Compliance Assessment for Condition 21 of the Decision Notice received for the PDA Development Permit for reconfiguring a lot – 1 lot into 4 lots, plus roads and open space.

1.3 Revision 08

The Overall Site Layout in Appendix A has been updated for Revision 08 of this report. The Overall Site Layout has been updated to reflect the adjustment to the northern site boundary which has been realigned to reflect the minimum 11m clear zone required by Council for safety purposes pertaining to the proposed upgrade of Crowson Lane. This has adjusted the size of Lots 1 and 4.

The above change results in a minor reallocation of land from the allotment catchments to the Crowson Lane catchments. No changes have been made to the modelling undertaken as part of this report as the change is considered negligible in relation to the catchment as a whole and the modelling undertaken is more conservative.

Revision 08 of this report was submitted to EDQ as part of the Compliance Assessment for Condition 21 of the Decision Notice received for the PDA Development Permit for reconfiguring a lot – 1 lot into 4 lots, plus roads and open space.

1.4 Revision 09

Revision 09 of this report has been prepared to support the amended ROL application, increasing the number of proposed allotments from four (4) to eleven (11) and new roads, consisting of five super lots and six auxiliary lots, comprising drainage, open space and a sewer pumpstation. The proposed amendments to the existing ROL development approval do not result in substantially different development from either a stormwater management or a flooding perspective. No changes were made to the DRAINS or TUFLOW models as a result of this amendment.

1.5 Revision 10

Revision 10 of this report has been prepared in response to detailed design of the allotments, adjusting the stormwater catchments referred to as INTNL-2R, INTNL-2B, INTNL-2C and INTNL-3C with respect to size and direction of flow. INTNL-2B and INTNL-2R was reduced in size. INTNL-3C changed configuration. INTNL-2C increased in size and was divided into three sub-catchments with minor flows directed to the channel. The major and minor flows were divided for these three catchments to direct the minor flows through a longer travel path (passes through two weir structures within the channel), in order to create a non-worsening effect on the downstream properties, east of Mount Lindesay Highway during the 0.5EY storm event. DRAINS and TUFLOW modelling and reporting have been updated accordingly.

4499 – 4651 Mount Lindesay Highway, North Maclean

1.6 Revision 11

Revision 11 of this report has been prepared to include the missing Flood Maps from Appendix D.

1.7 Revision 12

Revision 12 of this report reflects the changes to the Eastern Channel drainage strategy. The weirs (Weir 01 and 02) and bund previously proposed for the Eastern Channel have been removed to allow the channel to drain in a timely manner. This results in a minor increase in flows downstream of the development site during the 0.5EY storm event; however, it has been demonstrated that such afflux is minor and corresponds to an inundation reduction where viewed in the context of historical earthworks which were undertaken south of the development site.

Minor changes have been made to the internal sub-catchments and allotment detention as details of the final land use and topography have emerged.

2 INTRODUCTION

Arcadis has been engaged by Charter Hall Prime Industrial Fund to prepare a Site Based Stormwater Management Plan (Quantity) (SBSMPQ) for the proposed industrial development, situated at 4499 - 4651 Mount Lindesay Highway, North Maclean. The site is situated within the Greater Flagstone Priority Development Area (PDA) located within the Logan City Council (LCC) local government area.

On 21 September 2021, the Minister for Economic Development Queensland (EDQ) granted approval for a PDA development application over the site for a Development Permit for Reconfiguring a Lot – 1 into 4 lots, plus roads and open space. On 27 September EDQ granted approval for an amendment to the previous Reconfiguring a Lot application (DEV2018/961/8). The new approval was for reconfiguring a lot - one (1) lot into eleven (11) lots and new roads and open space. The proposed amended ROL layout is shown in Figure 2-1, below.

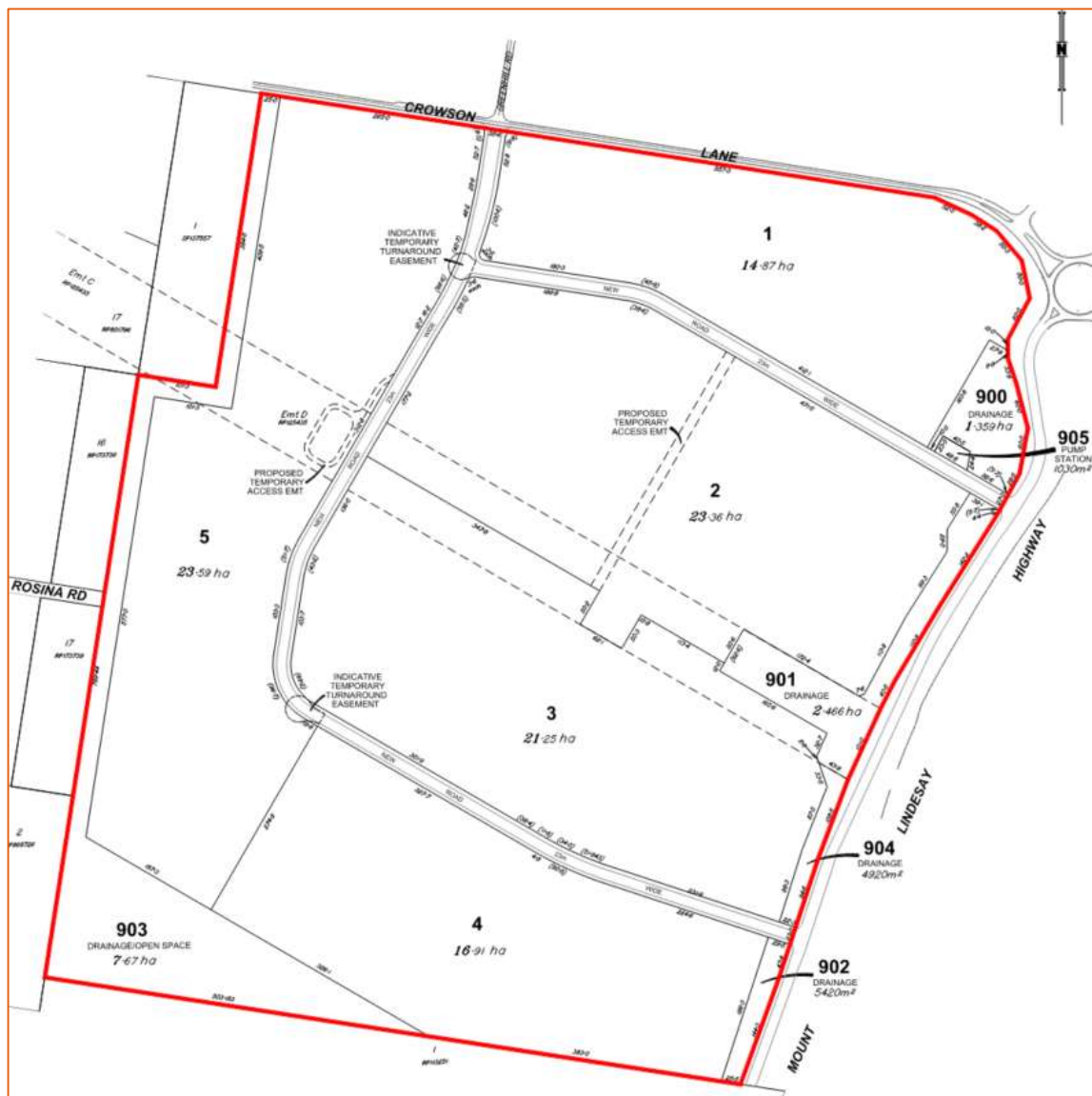


Figure 2-1 – Approved Amended ROL Layout (Source: Wolters, August 2023)

The following report demonstrates the proposed development will be constructed and operated in accordance with the Queensland State Planning Policy (SPP 2017), the Queensland Development Code, the Queensland Urban Drainage Manual (QUDM), Economic Development Queensland (EDQ) PDA guidelines and the Environmental Protection (Water) Policy (2009) with respect to the attenuation of stormwater runoff. This report also demonstrates the proposed amendment will not result in substantially different development to the existing approval.

4499 – 4651 Mount Lindesay Highway, North Maclean

3 SITE CHARACTERISTICS

3.1 Site Description

The subject site is located within Logan, South-East Queensland, Australia on the following lot:

- Lot 39 on SP258739 (4499-4651 Mount Lindesay Highway, North Maclean)

The site is generally bounded by the following co-ordinates (GDA94 / MGA zone 56)

- South-West: 500708, 6928700
- North-East: 501974, 6929628

The proposed area for the development is approximately 117.9ha.

3.2 Existing Land Usage

The site is predominantly vegetated with cleared areas relating to the existing residential dwelling and associated land use and High Voltage Electrical Power transmission lines and towers.

The site currently has direct property frontage to Mount Lindesay Highway to the east, predominantly trees and vegetation to the south and rural residential developments to the north and west. A MEDQ Approved context plan published 10 September 2021 includes the subject site. The site is approved for specific land use "*Industry and Business Zone*" with overlay for indicative future bio-diversity corridor. An existing high voltage easement running through the site from the south into the existing rural residential dwelling to the north. A further high voltage (275kV) easement runs through the site within the cleared area.

A site locality plan is provided in Figure 3-1 below:



Figure 3-1- Development Locality Plan (Source: NearMap, June 2022)

3.3 Existing Topography and Site Drainage

In its current state, a ridge traverses the development site from the north-western corner to the southern site boundary, with further undulations dividing the site into three sub-catchments, as shown in Figure 3-2. The northern catchment slopes east at an average of 2% from RL44.0 to a culvert with a minimum invert level of RL20.90 which allows flows to pass beneath Mount Lindesay Highway to the opposite side. From here, water is ultimately discharged east of Mount Lindesay Highway towards the Logan River located approximately 1.1km east of the site.

The western portion of the site slopes south from RL44.0 to RL26.5 at an average grade of 1.6%. An overland flow path commences in this portion of the site, exiting the site across the southern boundary before re-entering the site in the east through the third catchment area. The overland flow path flows north-east to the abovementioned culverts. The third catchment area site also slopes to this culvert at an average grade of 1.2%.



Figure 3-2- Internal Catchment Plan (Source: NearMap, June 2022)

Stormwater runoff from upstream external catchments enter the site from the north, south and west. The extent of the external catchments is shown in Figure 3-3.



Figure 3-3: Existing Catchment Plan

3.4 Existing Approval

It is understood that the existing EDQ approval (DEV 2018/961/8) over the site is for a reconfiguring a lot – 1 lot into eleven (11) lots, plus roads and open space. As part of this approval key services to support the development were identified with associated works including:

- Construction of a service road along the western side of the Mount Lindesay Highway accessed via the existing Crowson Lane / Mount Lindesay Highway off ramp roundabout;

4499 – 4651 Mount Lindesay Highway, North Maclean

- Construction of a trunk rising sewer main running through the existing electrical main of the proposed development, ending at Greenbank Road.
- Connection to existing potable water mains along Crowson Lane and the Mount Lindesay Highway
- Proposed stormwater infrastructure;
- Construction of internal roads; and
- Proposed connection to existing underground electrical and telecommunication services along Crowson Lane and the Mount Lindesay Highway.

Further details on the works associated with the adjacent property approval can be found within the relevant Decision Notice attached within Appendix C. The approved EDQ Structure Plan is shown below in Figure 3-4 below.

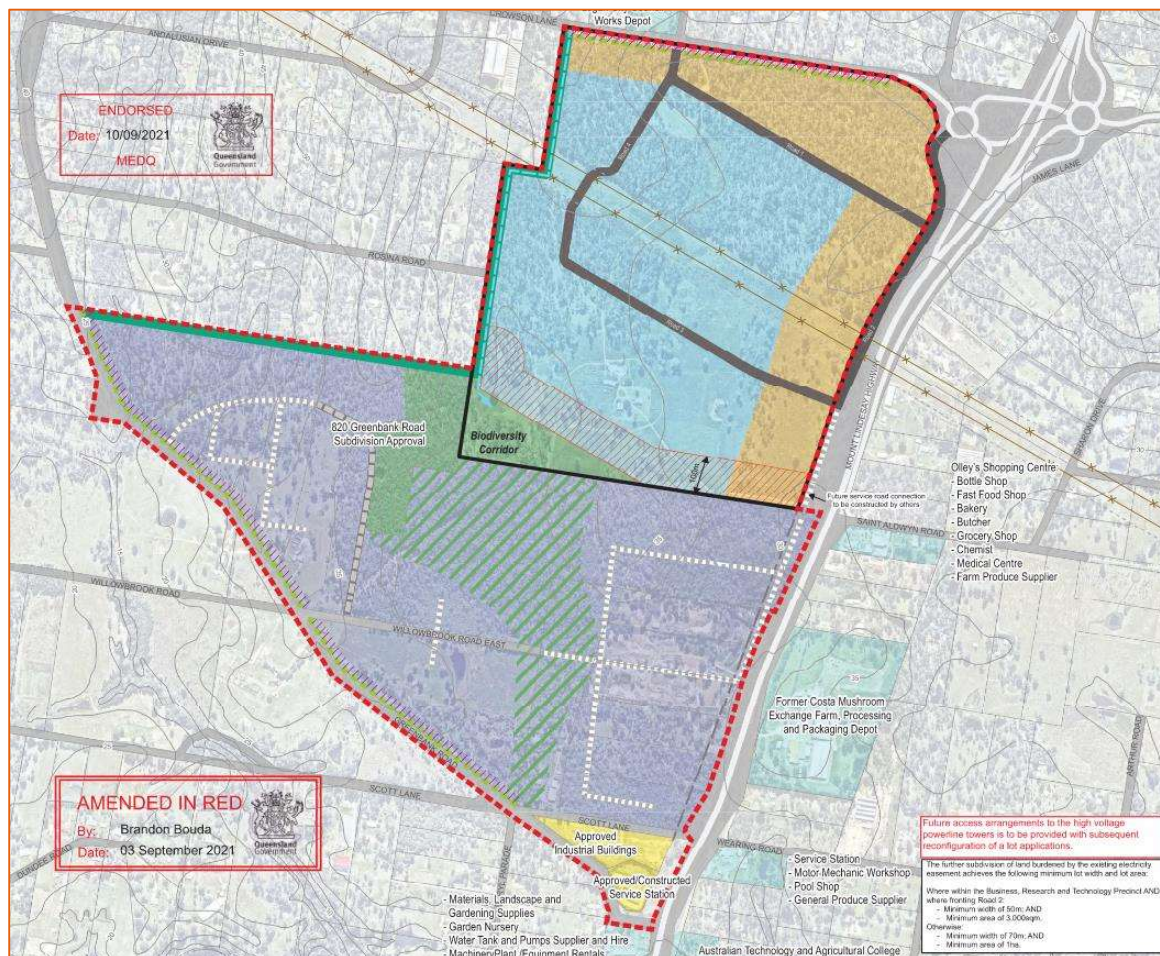


Figure 3-4- North Maclean Enterprise Context Plan (Source: Reel Planning, September 2021)

3.5 Geotechnical Investigation

A geotechnical investigation was completed separately by Protest Engineering in October 2021. Borehole testing revealed the ground profile generally comprises of silty sand (Emerson Class 6) up to 0.6m depth, overlaying silty/sandy clay up to 4m depth followed by low to high strength sandstone. Groundwater was not encountered during the investigation; however, Protest Engineering noted that groundwater levels can be seasonal and fluctuate during and after heavy rainfall events. Refer to Protest Engineering Report PTP/07651-0001-Rev3 for further details.

3.6 Flooding

A review of LCC's Flood Hazard Tigger Overlay Map (OM-05) revealed that the site is identified as a Flooding and inundation area with a large portion of the site being prone to flooding. Figure 3-5 below shows LCC's Flood Hazard Overlay for the site. Detailed flood modelling has been undertaken to ensure modifications to the overland flow path does not have adverse impacts on properties upstream or downstream of the development site. The overland flow path has also been modified to include adequate storage of flows from the eastern developed catchment to ensure flows discharged from the development site do not exceed pre-development flows.

It is noted that the Logan City Council riverine flood modelling and flood overlay mapping is reflective of the previous natural ground levels and not the current approved finish surface levels (bulk earthworks) across the subject land. Arcadis have prepared a supplementary memo titled *Flagstone Estate: LCC TLPI No 1/2023 Response – Flood Overlay Code* dated 1 March 2024, which includes updated flood risk mapping in accordance with the Logan City Council Planning Scheme Policy. Reference should be made to this document for details of the revised flood mapping applicable to the development.

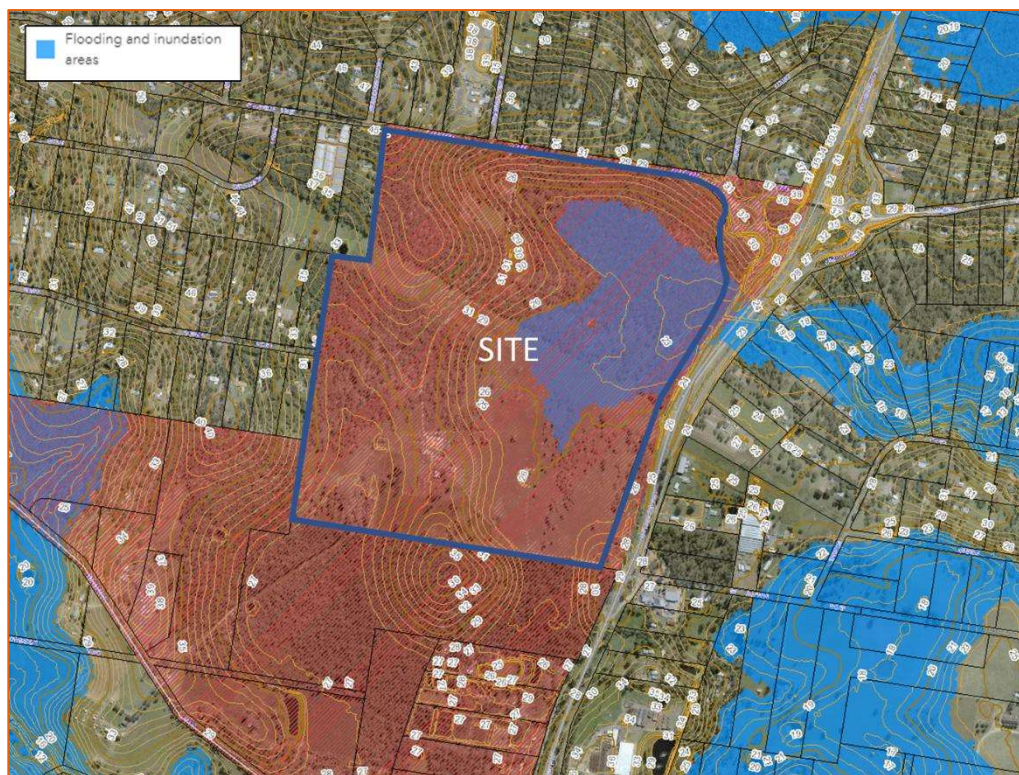


Figure 3-5- Flood Hazard Overlay (Source: Logan City Council, June 2022)

3.7 Existing and Planned Stormwater Infrastructure

Limited stormwater drainage infrastructure is present within the vicinity of the development site. A set of culverts is situated near the eastern property boundary discharging stormwater under the Mount Lindsay Highway and ultimately towards the Logan River located approximately 1.1km east of the site. The culverts comprise two 1.75m high, 2.1m wide reinforced concrete box culverts at RL21.09m AHD, between which sit two 1.75m high, 2.1m wide reinforced concrete box culverts at RL20.90m AHD

Smaller culverts are present within Crowson Lane, directing stormwater runoff from the northern upstream catchments beneath the road and discharging into the subject site. The pipes vary in size from approximately 375mm dia to 4 x 675mm dia.

Crowson Lane and the adjacent streets are to be upgraded by Logan City Council in the near future. The proposed stormwater drainage upgrades are shown in Figure 3-6 below and in Appendix B.

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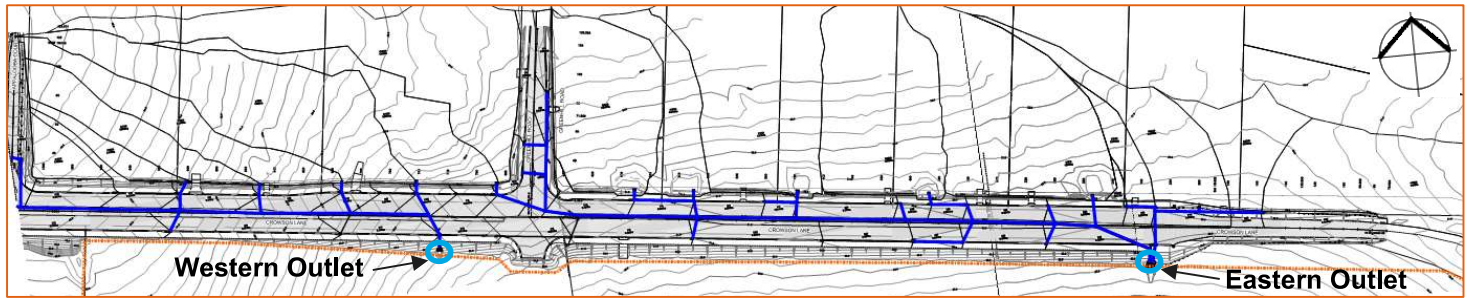


Figure 3-6- Proposed Crowson Lane Stormwater Drainage Upgrade (Source: Logan City Council, August 2022)

Following the proposed stormwater drainage upgrades, the Crowson Lane piped network will discharge flows into the development site at two locations, circled in the figure above. The western discharge pipe is 1050mm dia. The eastern outlet consists of two pipes – a 1350mm dia pipe and a 900mm dia pipe.

The proposed internal drainage network has been designed to convey the developed flows associated with Crowson Lane upgrade through the site to the legal point of discharge.

4 DISCHARGE LOCATIONS

4.1 Pre-Developed Discharge Characteristics

As previously outlined in this report, the site in its pre-developed state consists of multiple catchments, discharging via concentrated flows into either local flood plain area to the south (Catchment EX_1Z) (referred to as “Southern Discharge Location” in Figure 3-3) and/or ultimately to the highway infrastructure to the east (Catchments 2B and 3C) (referred to as “Eastern Discharge Location” in Figure 3-3).

4.2 Proposed Discharge Characteristics and Objectives

The proposed development will retain the existing discharge locations, as marked on Figure 3-3 and Figure 5-1. To comply with the requirements of Council, the Queensland State Planning Policy (SPP 2017), the Queensland Development Code, the Queensland Urban Drainage Manual (QUDM) and the Environmental Protection (Water) Policy (2009), the following primary objectives are to be achieved:

- Suitable measures are incorporated into the development to ensure that there are no adverse impacts to downstream receiving waterways, property or infrastructure resulting from any increase to stormwater runoff peak flow rates; and
- waterway flow management measures are implemented to ensure no adverse stability impacts to downstream receiving unlined waterways;

For all standard Average Exceedance Probability (AEP) design events attenuation is proposed for the 4499 - 4651 Mount Lindesay Highway, North Maclean development. The site assessment will demonstrate compliance with LCC Policy by discharging pre-detained 50%, 20%, 10%, 2% and 1% AEP flows to the points of interest.

5 HYDROLOGICAL ASSESSMENT

The hydrological assessment presented in this report has been undertaken in accordance with the methodology documented in the Australian Rainfall & Runoff 2019. This methodology replaces the Average Variability Method (AVM) temporal patterns of ARR1987 with a fundamentally changed ensemble approach (i.e. 10 temporal distributions per storm duration). This methodology also uses the updated design rainfall inputs sourced from the AR&R (2019) data hub.

5.1 Temporal Patterns

Rainfall Intensities Frequency Duration data were obtained from The Bureau of Meteorology (<http://www.bom.gov.au/water/designRainfalls/revise-ifd/?year=2016>). The Latitude and Longitude of used for the site is summarised in Table 5-1 below.

Table 5-1 Site Latitude & Longitude

Parameter	Value
Latitude	-27.761
Longitude	153.013

5.2 Preburst Data

Preburst depths and ratios were obtained from the Australian Rainfall and Runoff Data Hub for the coordinates shown in the table above. The preburst depths are listed in Table 5-2.

Table 5-2 Preburst Depths (mm)

Duration (hour)	% AEP					
	50	20	10	5	2	1
1	0.4	2.9	4.6	6.2	7.6	8.7
1.5	0.1	1.3	2.1	2.8	11.4	17.7
2	0.1	2.5	4.1	5.6	12.5	17.7
3	0.3	2.2	3.4	4.6	16.7	25.8
6	0	2.6	4.4	6	16.1	23.6
12	2.5	8.9	13.2	17.3	24	29.1
18	0.6	8.2	13.3	18.1	23.4	27.4
24	0	5.2	8.6	11.9	16.2	19.4
36	0	2.3	3.9	5.4	12.1	17.1
48	0	0.9	1.5	2.1	6.9	10.4
72	0	0	0	0	2	3.4

5.3 Catchment Analysis

As previously discussed, the development site drains to two points of interest (Western Discharge Location and Eastern Discharge Location). The development site has been assessed under the following two scenarios:

- **Pre-development Scenario** – Site and external catchment in their current state. The pre development scenario also includes the proposed upgrades to Crowson Lane and Eastern Trunk service road. As all the catchments modelled in this scenario have a rural/rural residential land use, the RAFTS method has been adopted as the most appropriate method to model the catchments.
- **Mitigated Scenario** – The proposed industrial development (divided into the catchments shown in Figure 5-1) with the calculated detention infrastructure in place and no changes to the external catchment areas. The RAFTS method has continued to be used to model the external catchments in the mitigated scenario. The ILSAX method has been used to model the industrialised internal catchments.

The scenarios listed above have been modelled in TUFLOW to assess the impact on the properties upstream and downstream of the site boundaries beyond identified points of interest. The catchments were first modelled in DRAINS with the hydrographs exported and imported into TUFLOW. This methodology ensures that peak flow concentrations from the catchments are assessed and mitigated appropriately.

Table 5-3 and Table 5-4, below, list the loss parameters adopted in DRAINS for the RAFTS and ILSAX models. The pervious initial and continuing losses were sourced from the AR&R Data Hub.

Table 5-3 RAFTS Initial and Continuing Losses

Parameter	Initial Loss (mm)	Continuing Loss (mm/h)
Impervious Area	1	0
Pervious Area	26	1.9

Table 5-4 ILSAX Depression Storage

Parameter	Depression Storage (mm)
Impervious Area	1
Pervious Area	5

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Table 5-5 – Pre-development Catchment Parameters

Catchment	Area (ha)	Impervious (%)	Slope (%)	Mannings 'n'
EXTNL-1A	7.224	1	2.65	0.050
EXTNL-1Bi	23.636	10	2.49	0.050
EXTNL-1Bii	16.974	5	4.19	0.050
EXTNL-1Biii	0.9034	5	4.22	0.050
EXTNL-1Biv	3.3656	5	4.44	0.050
EXTNL-1C	74.256	0.5	1.26	0.100
EXTNL-1D	19.78	10	0.26	0.055
EX_1Z	25.142	0.5	0.98	0.055
EXTNL-2A	5.218	2	2.01	0.045
EXTNL-2A1	7.434	2	2.01	0.055
EXTNL-2B	32.26	0	2.05	0.060
EXTNL-2B1	4.077	2	3.71	0.045
EXTNL-2C	8.764	10	3.55	0.050
EXTNL-3A	12.15	0	1.64	0.055
EXTNL-3B	14.09	0	2.91	0.100
EXTNL-3B1	4.83	25	2.17	0.035
EXTNL-3B2	2.81	5	1.56	0.040
3C	55.53	1	1.62	0.050
EXTNL-4	34.632	25	3.76	0.040

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Table 5-6 – Post-development Catchment Parameters

Catchment	Area (ha)	Impervious (%)	Slope (%)	Mannings 'n'
EXTNL-1A	7.224	1	2.65	0.050
EXTNL-1Bi	23.636	10	2.48	0.050
EXTNL-1Bii	16.974	5	4.19	0.050
EXTNL-1Biii	0.9034	5	4.22	0.050
EXTNL-1Biv	3.3656	5	4.44	0.050
EXTNL-1Bv	4.2025	5	4.02	0.050
EXTNL-1C	64.974	0.5	1.26	0.100
EXTNL-1D	19.780	10	0.26	0.055
EXTNL-2A	5.218	2	2.01	0.045
EXTNL-2A1	7.434	2	2.01	0.055
EXTNL-2B1	3.6801	2	3.71	0.045
EXTNL-2B (Crowson Lane)	0.3972	90	3.14	0.015
EXTNL-3A	12.15	0	1.64	0.055
EXTNL-3B	14.09	0.001	2.91	0.100
EXTNL-3B1	4.83	25	2.17	0.035
EXTNL-3B2	2.81	5	1.56	0.040
EXTNL-4A	8.764	10	3.55	0.050
EXTNL-4	34.632	25	3.76	0.040
Western Channel North	1.244	7.4	2.16	0.05
Western Channel Mid	0.960	36	0.66	0.037
Western Channel South	0.517	36	0.5	0.037
Catchment	Area (ha)	Impervious (%)	Impervious Time of Concentration (minutes)	Pervious Time of Concentration (minutes)
INTNL-1	17.052	85	15	15
INTNL-2A	8.918	90	10	10
INTNL-2B	8.8808	90	10	10

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Catchment	Area (ha)	Impervious (%)	Slope (%)	Mannings 'n'
INTNL-2CW	7.5559	90	10	10
INTNL-2CE1	2.9479	90	10	10
INTNL-2CE2	2.1702	90	10	10
INTNL-2R	2.3818	75	20	20
INTNL-3A	7.740	90	10	10
INTNL-3B	9.165	90	10	10
INTNL-3C	5.1039	90	17	17
INTNL-4A	5.529	0	1	0.035
INTNL-4Bi	6.5529	75	15	24
INTNL-4Bii	13.9671	75	15	24
INTNL-4C	7.916	90	10	10
INTNL-5	5.958	75	20	20
Channel South	0.5458	0	0.5	0.035
Channel North	2.9041	0	0.5	0.035

5.4 Model Verification

Catchment EXTNL-1B was selected for a comparative exercise to validate the adoption of the RAFTS hydrological models for the rural/rural residential catchments. Catchment EXTNL-1B has been adopted as it does not contain large depression/storage areas which would distort the results. In addition to the RAFTS method, Catchment EXTNL-1B has been modelled using the Rational Method, ILSAX, Initial and Continuing Loss hydrological models.

A time of concentration of 31.7 minutes was applied to pervious and impervious portions of the catchment, alike, as the impervious areas traverse large tracks of pervious area before reaching the edge of the catchment boundary.

A 15mm grass depression storage was adopted for the ILSAX model. This is larger than the value listed in Table 5-4 as Catchment EXTNL-1B has a rural residential land use and is predominantly pervious with an uneven surface.

Refer to Table 5-7, below for the results.

Table 5-7 Catchment EXTNL-1B 1% AEP Hydrological Model Verification

Hydrological Model	1% AEP Flow (m ³ /s)
RAFTS	9.95
ILSAX	11.8
Initial and Continuing Loss	13.7
Rational Method	11.2

As can be seen in Table 5-7, the RAFTS model produced the lowest 1% AEP flow and as such is considered the most conservative hydrological model with respect to detention volume calculations and is therefore appropriate for modelling the rural/rural residential catchments.

5.5 Drainage Strategy

As discussed in Section 4 of this report, the development site drains to two discharge locations (refer to Figure 3-3 and Figure 5-1). The proposed development will result in the redefinition of the catchment boundaries and characteristics draining to each discharge location, and as such, detention structures are required to attenuate flows to pre-development flow rates.

A regional detention basin is proposed to be constructed in the south-west corner of the development site to attenuate flows from Catchment INTNL-4B for all storm events, up to and including the 1% AEP storm event. Flows from external catchments EXTNL-1A, EXTNL-2B and EXTNL-1B are also conveyed through this detention basin. This detention basin was previously documented in Arcadis report '4499-4651 Mount Lindesay Highway, North Maclean SBSMP (Southern Catchment Discharge Area)' (11-0001-30101970-AAR-04); however, owing to changes to the contributing catchment, and proposed preservation measures to the southern wetland areas this basin has been remodelled. The proposed southern catchment management strategy and mitigation measures still comply with the general outcomes of the previous report (11-0001-30101970-AAR-04).

A second regional detention basin is proposed to be constructed in the north-eastern corner of the site to attenuate flows from Catchment INTNL-1. As such, the minor flows from the road network will bypass the Northern Detention Basin.

A third regional detention system is proposed in the form of the conveyance channel situated along the eastern site boundary. The channel conveys flows from Catchments INTNL-2C WEST (minor flows only), INTNL-2C EAST 1 (minor flows only), INTNL-2C EAST 2, INTNL-3A, INTNL-3B, INTNL-3C, INTNL-4C, INTNL-5 and external catchments EXTNL-1C (including flows discharged from the southern detention basin), EXTNL-1D, EXTNL-3A, EXTNL-3B, EXTNL-3B1 and EXTNL-3B2. The proposed outlet configuration controls the flows discharging immediately upstream of the existing culverts situated beneath the Mount Lindesay Highway (eastern discharge location).

Catchments INTNL-2A – INTNL3B and INTNL-4C are to provide on-site allotment detention. For the purpose of sizing the three regional detention systems, an estimate of the detention volumes for the INTNL-2A – INTNL3B and INTNL-4C on-site detention systems has been calculated using the DRAINS software and is documented as part of this report; however, this is to be confirmed through a site specific SBSMP created for each individual lot. An allowance has been made for a portion of Lots 2, 3 and 4 to bypass the on-site allotment detention, discharging undetained to the drainage infrastructure in the road corridor. As such Catchments INTNL-2R and INTNL-5 extend slightly beyond the road corridor, and catchments INTNL-2B, INTNL-3A, INTNL-3B and INTNL-4C do not encompass the full allotment extents.

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Catchment 2C has split into three catchments: INTNL_2C WEST, INTNL_2C EAST 1 and INTNL_2C EAST 2. Catchments INTNL_2C WEST and INTNL_2C EAST 1 discharge major and minor flow to separate points of discharge where minor flows discharge to the eastern conveyance channel on Lot 901 and major flows discharge to the proposed internal road drainage network. Catchment INTNL_2C EAST 2 discharges both major and minor flows to the eastern conveyance channel.

Note that internal catchment INTNL-3C does not require lot scale detention and is included in the regional mitigation system.

The proposed detention systems work in union to ensure the flows discharged from the development site do not cause adverse impacts upstream or downstream of the development site, for all storm events, up to and including the 1% AEP storm event.

Owing to the extensive external catchments conveyed through the regional detention systems, the complexity of the outlet structures, obstructions and drowned orifices, DRAINS was not considered the most appropriate software to model the regional detention systems. As such, the regional detention systems have been modelled in TUFLOW with input from DRAINS for the discharge flows from the allotment detention systems proposed for Catchments INTNL-2A – INTNL3B and INTNL-4C.

5.6 Detention Sizing

5.6.1 Allotment Detention

5.6.1.1 Methodology

The allotment detention systems proposed for Catchments INTNL-2A – INTNL3B and INTNL-4C were sized using DRAINS. The DRAINS models utilise a combination of the RAFTS and ILSAX methods to more accurately represent the different land use types. ILSAX was used to model the developed catchments with RAFTS used to model the relatively undeveloped existing and external catchments. The rainfall hydrographs generated for each catchment were exported from DRAINS and imported into the TUFLOW model.

The critical storm events were determined via an investigation of storm durations ranging from 10mins to 1080mins. The models were then used to route post-developed runoff from the eastern catchment through the proposed detention structure to determine the most efficient onsite detention system to comply with aforementioned objective.

Each catchment was modelled using a split catchment approach, with the first sub-catchment representing impervious areas and the second pervious. This allows for an accurate representation of Manning's roughness coefficients and applicable loss parameters.

5.6.1.2 Allotment Detention System Design Sizing

As stated in section 5.3, Catchments INTNL-2A – INTNL-3B and INTNL-4C are to provide individual on-site detention. Site specific SBSMPs will be required for each individual lot to determine the detention volumes and configurations required; however, for the purposes of sizing the northern and southern detention basins and the detentions storage in the conveyance channel, the detention volumes has been estimated and modelled in DRAINS. The discharge from each allotment detention system was extracted from DRAINS and imported into TUFLOW.

Table 5-8 provides a summary of the design parameters adopted for each individual allotment detention system. The allotment detention system design parameters were determined by modelling the pre and post development areas specific to Catchments INTNL-2A – INTNL-3B and INTNL-4C in DRAINS and ensuring the detention systems are adequately sized such that the post development flows do not exceed the pre-development flows.

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Table 5-8 Allotment Detention System Design Parameters

Catchments	Internal Base Area	Maximum Water Depth	Detention Storage Volume	Control Outlets
INTNL-2A	2,400 m ²	1.99m (RL31.99m AHD)	4,151 m ³	375mm dia outlet @ RL30m AHD (base level); 3m wide weir @ RL31.5m AHD
INTNL-2B	3,250 m ²	1.80m (RL27.80m AHD)	5,854m ³	300mm dia outlet @ RL26m AHD (base level); 4.25m wide weir @RL27.4m AHD
INTNL-2CE1	2,600 m ²	0.8m (RL26.80m AHD)	2,074m ³	300mm dia outlet @ RL26m AHD (base level); 8.9m wide weir @RL26.7m AHD
INTNL-2CE2	2,100 m ²	0.73m (RL26.73mAHD)	1,533 m ³	280mm dia outlet @ RL26m AHD (base level); 7.5m wide weir @RL26.65m AHD
INTNL-2CW	3,350 m ²	1.71m (RL27.71mAHD)	4,883 m ³	2 x 225mm dia outlet @ RL26mAHD (base level) 4.75m wide weir @RL27.45m AHD
INTNL-3A	4,800 m ²	0.86m (RL28.86m AHD)	4,132m ³	2x525mm dia outlet @ RL28m AHD (base level); 4m wide weir @RL28.65m AHD
INTNL-3B	5,110 m ²	1.67m (RL25.67m AHD)	8,627m ³	375mm dia outlet @ RL24m AHD (base level); 4m wide weir @RL25.5m AHD
INTNL-4C	1,800 m ²	1.86m (RL26.36m AHD)	3,495m ³	2x375mm dia outlet @ RL24.5m AHD (base level); 4m wide weir @RL26m AHD

The peak water level estimated for each system is provided in Figure 5-2 below.

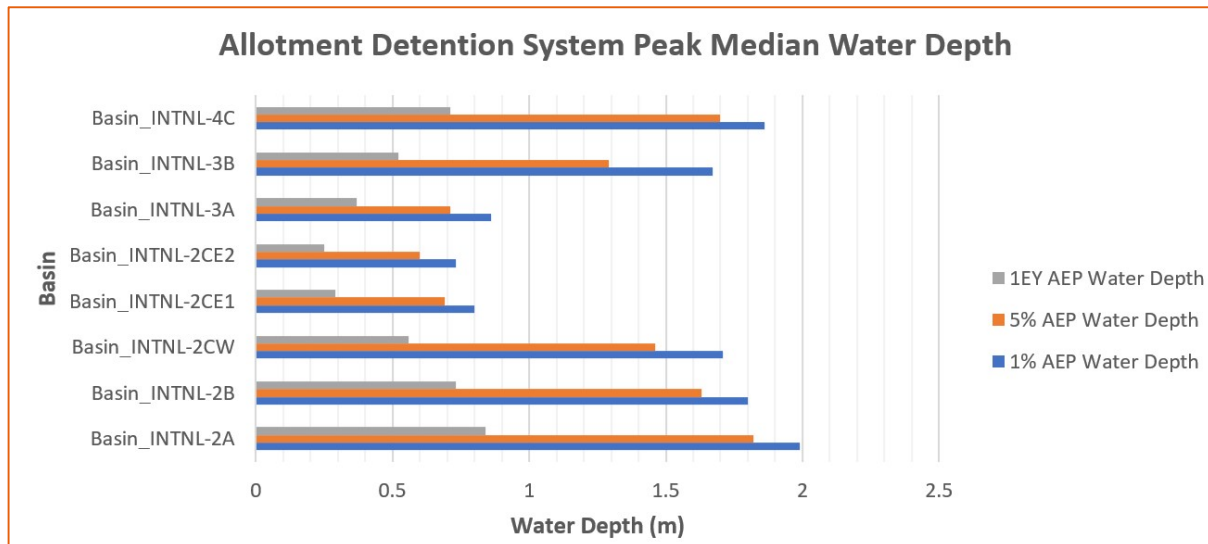


Figure 5-2: Allotment Detention System Peak Median Water Level

We note that should the individual lots adopt a different basin configuration other than what is specified in Table 5-8, the proposed basins shall be designed to ensure no increase in discharge rates up to the 540min duration for all the design events to ensure no impacts downstream.

5.6.2 Southern Detention Basin

Table 5-9 presents the parameters for the proposed southern on-site detention basin, as modelled in TUFLOW, which attenuates flows from Catchment INTNL-4B for all storm events, up to and including the 1% AEP storm event, prior to release to the southern discharge location. External catchments EXTNL-1A and EXTNL-1B are also conveyed through this basin.

This basin was previously documented in Arcadis report '4499-4651 Mount Lindesay Highway, North Maclean SBSMP (Southern Catchment Discharge Area)' (11-0001-30101970-AAR-04); however, owing to changes to the contributing catchment, this basin has been remodelled as part of this report, resulting in a larger and higher weir. This adjustment to the outlet configuration ensures that the flows discharged from the basin continue to be restricted to pre-development flows. The proposed southern catchment management strategy and mitigation measures still comply with the general outcomes of the previous report (11-0001-30101970-AAR-04).

Reference should be made to Engineering Drawings in Appendix B for a conceptual illustration of how the detention basin will operate.

Table 5-9 Southern Detention System Design Parameters

Contributing Catchments	Internal Base Area	Maximum Water Depth	Detention Storage Volume	Control Outlets
EXTNL-1A, EXTNL-1B & INTNL-4B	26,672 m ²	1.58 m (RL28.19m AHD)	32,706m ³	3 x 900mm dia pipe low flow outlets @ RL26.61m AHD (base level) with 800mm dia orifice fit to one of the 900mm dia low flow pipes 64m wide weir @ RL28.0m AHD

5.6.3 Northern Detention Basin

The northern on-site detention basin is situated in the north-east corner of the proposed development and attenuates flows from INTNL-1 and the major flows from the northern portion of the internal road network, prior to discharge to the northernmost portion of the eastern conveyance channel. Bio-retention filter media is proposed to be included in the base of this basin to achieve the water quality objectives for Lot 1. The detention volume modelled was above the extended detention required for water quality (0.3 m).

Reference should be made to Figure 5-1 for the catchment plan and the Engineering Drawings in Appendix B for a conceptual illustration of how the detention basin will operate. Table 5-10 provides a summary of the design parameters adopted for the northern detention basin in TUFLOW.

Table 5-10 Northern Detention System Design Parameters (Depths and Areas include extended detention for water quality)

Contributing Catchments	Internal Base Area	Maximum Water Depth (including extended detention depth)	Detention Storage Volume	Control Outlets
INTNL-1	5,200 m ²	1.94m (RL24.48m AHD)	7,402m ³	2 x 300mm dia low flow pipe outlets @ RL22.54m AHD; 2 x 900x450 RCBC @ RL23.40m AHD

5.6.4 Conveyance Channel

A conveyance channel (East) is proposed to be constructed along the eastern site boundary to convey flows from the following catchments to the eastern discharge location, being the four 1.75m high, 2.1m wide reinforced concrete box culverts which convey flows beneath Mount Lindesay Highway to the receiving waterway:

- INTNL-2C WEST (minor flow only)
- INTNL-2C EAST 1 (Minor Flow only)
- INTNL-2C EAST 2
- INTNL-3A
- INTNL-3B
- INTNL-3C
- INTNL-4C
- INTNL-5
- EXTNL-1D
- EXTNL-3A
- EXTNL-1C (including flows discharged from the Southern Detention Basin)
- EXTNL-3B
- EXTNL-3B1
- EXTNL-3B2

An outlet pit structure will be constructed upstream of the receiving stormwater drainage culverts, to control the flows released to the eastern discharge location, thus converting the conveyance channel into a combined conveyance and detention structure. This configuration was represented in the TUFLOW model to ensure flows are safely conveyed through the site and no adverse impacts occur upstream or downstream of the site.

Reference should be made to Figure 5-1 for the catchment plan and to the Engineering Drawings in Appendix B for catchment plans, channel dimensions, outlet details and a conceptual illustration of how the detention structure will operate.

6 HYDRAULIC ASSESSMENT

6.1 Methodology

The hydraulic assessment has been undertaken to evaluate how the proposed on-site detention basin and proposed development pad will manage flows being conveyed through the overland flow path.

The hydraulic assessment of the proposed overland flow path required a detailed understanding of the hydraulic and hydrological characteristics under a series of storm events.

To assess the complex flood behaviour around the site a TUFLOW two-dimensional flood model has been identified as the preferred method to accurately determine any impacts caused by the proposed development.

The hydraulic and hydrological impact assessment undertaken via a two-dimensional model presents more accurate results through utilising a grid to represent the catchment topography and complex existing flow distribution. The results are particularly relevant around the inflow and outflow locations of the site, determining peak flow rates, the extent of flood inundation as well as flow distribution.

6.2 Objectives

The primary objective of this assessment is to ensure the proposed stormwater management will not significantly change the flood behaviour against the existing condition at the areas immediately downstream and upstream of the site. The assessment considers the changes and if they would cause any actionable nuisance.

6.3 Model Set Up and Adopted Data

A TUFLOW 2D flood model has been created to assess any changes in flood behaviour caused by the proposed development as well as the conveyance of external flows through the site and flood impacts upstream and downstream of the site. The following sections provide discussion on the adopted inputs into the TUFLOW model.

6.3.1 Hydrology

Due to intrinsic complexity of 2D modelling and particularly modelling time, a DRAINS rainfall runoff model was used to determine the hydrograph for each Annual Exceedance Probability (AEP) event: 50%, 20%, 10%, 5%, 2% and 1% AEP. The results for this model were then used to give an indication of which duration would be critical at the assessment point (i.e. northern site boundary) however, the routing of flows through the catchment and determination of median temporal pattern has been undertaken in TUFLOW.

6.3.1.1 Determination of Critical Durations and Median Temporal Pattern

TUFLOW was run initially for the storm durations ranging from 60 minutes to 540 minutes using all 10 temporal patterns based on the results of the DRAINS modelling. Although the critical durations throughout the model were found to vary, at the downstream portion of the model, the critical durations would vary from 90min to 540min in the existing and developed case. As such, the model was then run for all these durations to determine potential impacts.

Once the critical durations were selected, the simulation output was processed as follows:

- For each storm duration, the median flood grid was extracted from the 10 temporal pattern flood grids using the TUFLOW utility `asc_to_asc.exe`, `-statMedian` switch.
- The median flood grids for each of the simulated durations were combined to form the maximum median flood grid for each AEP (max max).

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6.3.1.2 Modelling Results

Modelling results have been assessed to compare the peak flow rates downstream of Mount Lindesay Highway and at the outlet of the Southern Detention Basin in the Existing Model Scenario and Developed Model Scenario, shown in Table 6-1.

Table 6-1 Peak Flow Rates Downstream

Scenario	Peak Flow Rate for Annual Exceedance Probability (m ³ /s)					
	50%	20%	10%	5%	2%	1%
Downstream of Mount Lindesay Highway						
Existing	2.90	6.24	8.26	10.50	13.07	16.15 (16.16)
Developed	3.01	4.87	6.79	9.36	12.72	15.85 (14.99)
Difference	+0.11	-1.37	-1.47	-1.14	-0.35	-0.3
Outlet of Southern Detention Basin						
Existing	2.87	3.54	3.74	4.54	8.13	8.84 (9.41)
Developed	1.58	2.71	2.85	3.55	3.83	4.49 (6.68)
Difference	-1.29	-0.83	-0.89	-0.99	-4.3	-4.35

*Flow presented in this table are peak median values "Rank 6"
 1% AEP Mean flows provided in ()

Table 6-2 Critical Temporal Pattern

AEP	Scenario	Duration	Selected Temporal Pattern(s)
50%	Existing	540 min	TP06
	Developed	270 min	TP01
20%	Existing	540 min	TP05
	Developed	540 min	TP05
10%	Existing	180 min	TP08
	Developed	120 min	TP08
5%	Existing	180 min	TP08
	Developed	120 min	TP03
2%	Existing	270 min	TP09
	Developed	120 min	TP02
1%	Existing	90 min	TP03
	Developed	120 min	TP02

6.3.2 Boundary Conditions

The downstream boundary condition has been set approximately 1150m downstream of the Mount Lindesay Highway drainage crossing (west to east). This set up has allowed the system to be generally free discharging with the main hydraulic control being the culvert crossing beneath Mount Lindesay Highway. It is noted however that an existing access road adjacent to the site boundary acts like a 'weir' in the existing and developed case allowing additional ponding within the site.

4499 – 4651 Mount Lindesay Highway, North Maclean

Due to recent updates to the Logan River flood model, Arcadis has conducted a sensitivity assessment based on water level information extracted from this model and applied at the boundary. Further discussion is provided in section 6.5.5 below.

6.3.3 Grid Size

A 2m grid has been adopted in the model to accurately represent the hydraulic features of the existing and proposed overland flow path.

To accurately depict the proposed western channel, the QUADTREE option in TUFLOW has been employed. This function has reduced the grid to 0.5m around the channel, ensuring the accurate representation of channel dimensions. To maintain consistency in the final comparison, the same approach was applied to the modelling of the existing condition.

6.3.4 Manning's Values

The Manning's values adopted as part of this assessment are provided in Table 6-3.

Table 6-3 Manning's Values

Land use	Manning's n
Medium Scrub	0.055 – 0.06
Dense Vegetation	0.1
Scattered Scrub	0.05
Open Ground (sparse grass)	0.027
Road	0.018
Swales	0.06 / 0.02
Eastern Channel*	0.15

*Does not include Powerlink easement area

6.3.5 Existing Downstream Drainage Infrastructure

Mount Lindesay Highway drainage crossing (west to east)– 4 x 1.8 m high x 2.1m wide box culverts.

6.3.6 Planned Upstream Drainage Infrastructure

As discussed in section 3.5, Logan City Council will soon be upgrading the stormwater drainage infrastructure in Crowson Lane. As such the following planned and/or existing drainage infrastructure has been modelled in TUFLOW:

Mount Lindesay Highway drainage crossing (east to west)– 900mm dia RCP.

Crowson Lane West (north to south) – 1050mm dia RCP.

Crowson Lane East (north to south) – 1350mm dia RCP

Crowson Lane East (north to south) – 900mm dia RCP

4499 – 4651 Mount Lindesay Highway, North Maclean

6.3.7 Existing Model Scenario

The existing terrain has been represented based on LiDAR information for the area. Aerial photos as well as site visits have been used to determine the existing condition roughness.

6.3.8 Developed Model Scenario

The TUFLOW model has been modified to include the proposed industrial development including the proposed overland flow path.

6.4 Assumptions and Limitations

6.4.1 Key Limitations

6.4.1.1 LiDAR Ground Survey

The model topography has been based on LiDAR survey information (2018) provided in digital format with a 1m grid resolution. It is recommended this report be reviewed and amended as required in conjunction with the detailed design once detailed survey of the site and its boundaries is obtained.

6.4.1.2 Climate Change

Climate change has not been considered in this assessment.

6.4.1.3 Sensitivity

No sensitivity assessment for roughness has been considered in this assessment.

6.4.2 Key Assumptions

6.4.2.1 Proposed Development

This report has made assumptions on finished surface levels and roughness values of particular land use areas to show that a potential solution is available for the proposed development. In the event that the development proposal changes in any form or further applications are lodged with Council or EDQ, this report **must** be updated to reflect the changes made to the hydraulic conveyance capacity of the development site.

6.5 Model Results

The primary assessment of flood impacts has been undertaken using a comparison of the peak water surface levels resulting from the proposed development stormwater management and earthworks against the existing scenario terrain, under a variety of flood events. Appendix D of this report shows existing and developed scenario peak water depth ranges along with peak water surface level changes for a range of flood events (50%, 20%, 10%, 5%, 2% and 1% AEP). Additionally, the results section includes peak velocity maps for the existing and proposed scenarios.

6.5.1 Flood Depths

The project site hydraulic properties have been designed with the aim of minimising changes in flood behaviour both upstream and downstream of the site. Maximum depths in the existing case 1% AEP storm event are seen to reach approximately 1.1m adjacent to Mount Lindesay Highway.

4499 – 4651 Mount Lindesay Highway, North Maclean

Immediately downstream of the site flood depth in the 1% AEP reaches approximately 2.4m in both existing and developed cases. The proposed earthworks changes, creates an overland flow channel crossing the site from south to north. Depth within this channel is approximately 2.9m in the 1% AEP within the bounds of the site.

Figure 6-1 and Figure 6-2, below, provide the 1% AEP peak flood depths for both existing and developed cases respectively.



Figure 6-1 - Existing Peak Water Depth - 1% AEP

4499 – 4651 Mount Lindesay Highway, North Maclean

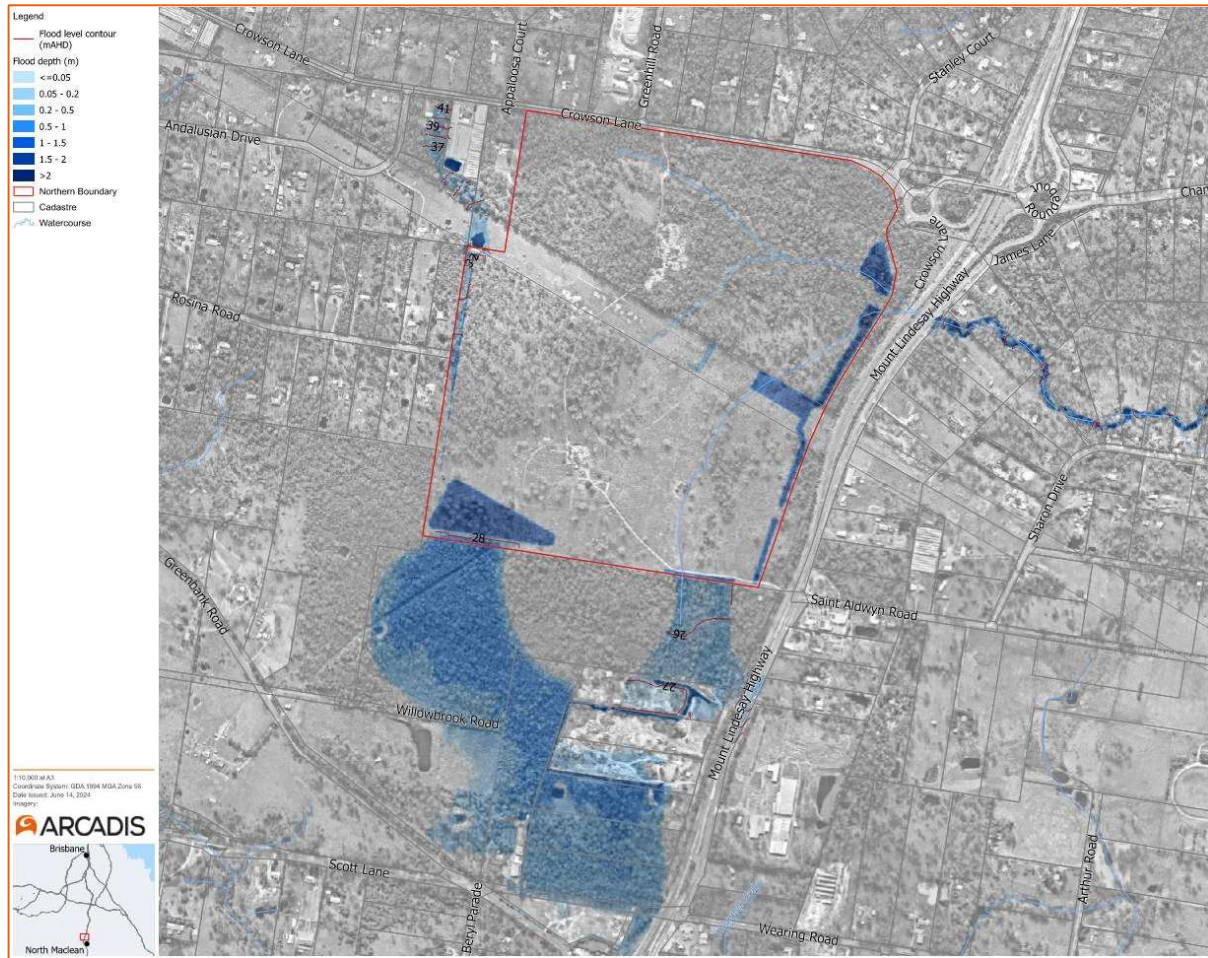


Figure 6-2 - Developed Peak Water Depth - 1% AEP

Table 6-4 1% AEP Channel Water Level

MD01		MD04	
Chainage	1% AEP Water Level	Chainage	1% AEP Water Level
0	25.10	0	25.64
100	24.84	40	25.50
200	24.63	80	25.43
300	24.57	120	25.37
400	24.51	180	25.33
500	24.47	-	-
600	24.46	-	-

Note: Refer to Appendix B DWG SKT011-06 for Chainage references concerning Channels MD01 and MD04. Refer to Arcadis supplementary memo titled Flagstone Estate: LCC TLPI No 1/2023 Response – Flood Overlay Code dated 1 March 2024 for details concerning 1% AEP at 2100 and larger events.

4499 – 4651 Mount Lindesay Highway, North Maclean

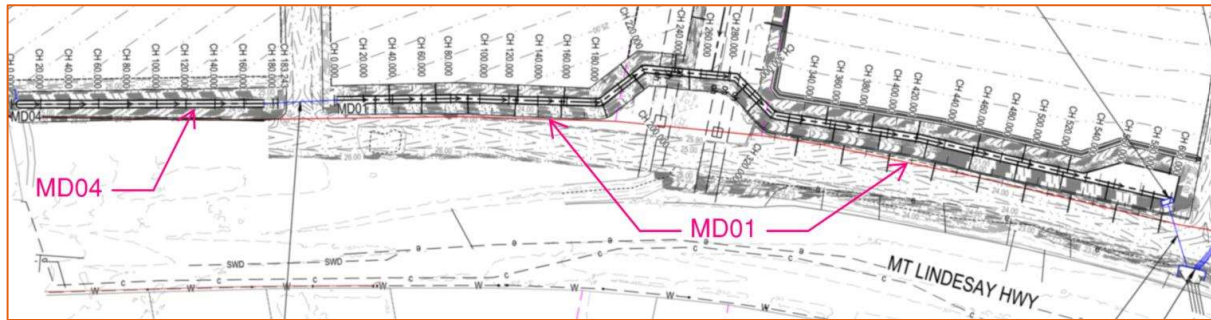


Figure 6-3 – Channels MD01 and MD04 Reference Chainages.

6.5.2 Peak Water Surface Level Change

Modelling results show that generally, the existing flood behaviour outside of the site is maintained as per the existing condition. Changes in the water surface levels are generally negative with a reduction in levels in the proposed case scenario. Increase in water surface levels are contained to the site boundary, where earthworks are proposed. A minor positive afflux is shown downstream of the site in the 50% AEP event however this is considered negligible (11mm) and localised. An additional sensitivity assessment is provided in Section 6.5.6 of this report showing that when compared to Historical events, no negative afflux is noticed.

Modelling results for all storm events up to the 1% AEP have been included in Appendix D.

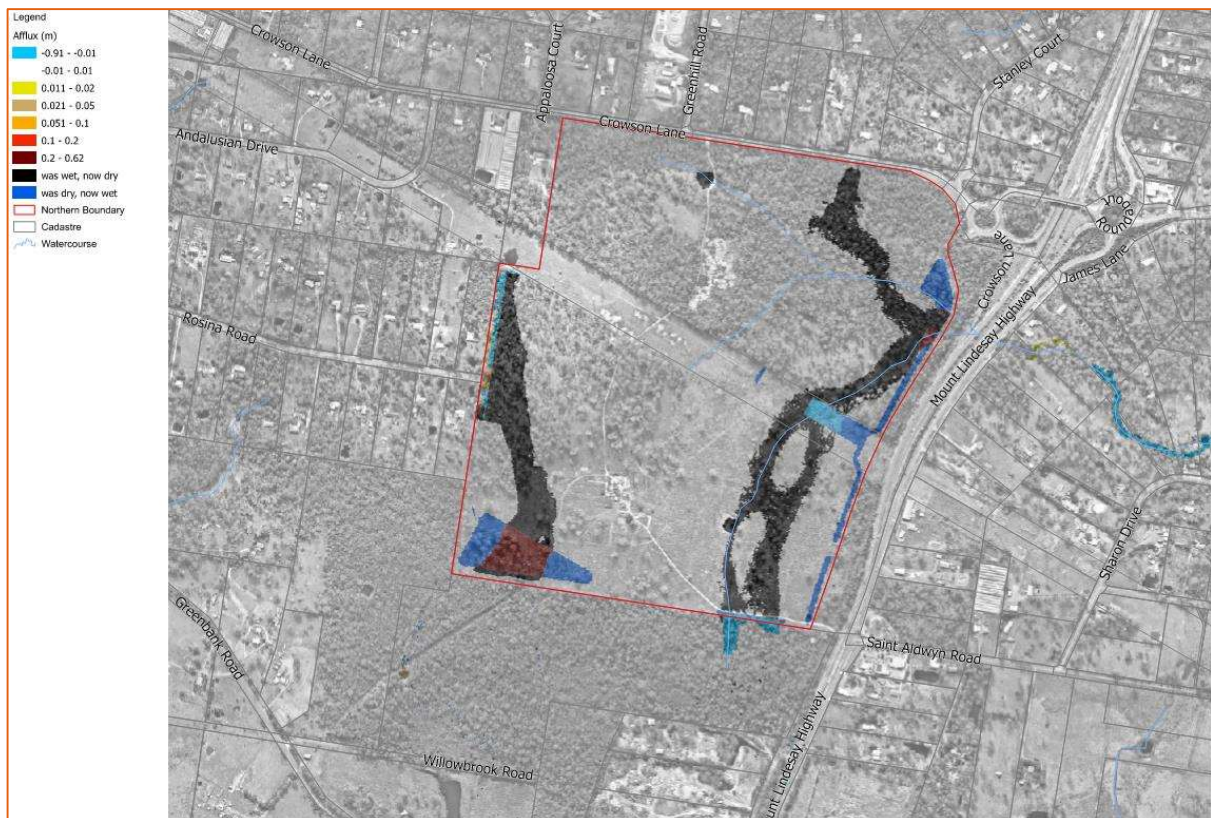


Figure 6-4 - Developed Peak Water Surface Level Change - 50% AEP

4499 – 4651 Mount Lindesay Highway, North Maclean



Figure 6-5 - Developed Peak Water Surface Level Change - 1% AEP

6.5.3 Peak Velocities

Modelling results are presented in Appendix D to show the peak velocities reached within the assessment area. Figure 6-6 and 6-7, show an extract of the 1% AEP flood event peak velocity, with the results indicating that velocities are generally below 1m/s and unchanged upstream and downstream of the site. Within the proposed overland flow channel created by the earthworks, velocities are higher than existing case reaching 1.5m/s.

4499 – 4651 Mount Lindesay Highway, North Maclean



Figure 6-6 - Existing Peak Water Velocity - 1% AEP



Figure 6-7 - Developed Peak Water Velocity - 1% AEP

No significant change in flow velocity is observed outside of the site. Modelling results are presented in Appendix D showing change in velocity for all events up to the 1% AEP.



Figure 6-8 – Change in Flow Velocity - 1% AEP

6.5.4 Blockage Sensitivity

A sensitivity assessment for pipe blockage has been conducted, modelling two scenarios: a 20% pipe blockage and a 50% pipe blockage. The results presented in Appendix D indicate that in the 20% blockage scenario, the flow is generally contained within the channel. In the 50% blockage scenario, minor spillage is observed at the downstream end of the eastern and western channels. However, it is worth noting that water levels are still below the finished floor level and the proposed sewer pump station.

Figure 6-9 demonstrates that the peak water level in the Southern Detention Basin increases slightly under the blocked scenario and the inundation time increases from approximately 6.5 hours to 9.5 hours during the 1% AEP event.

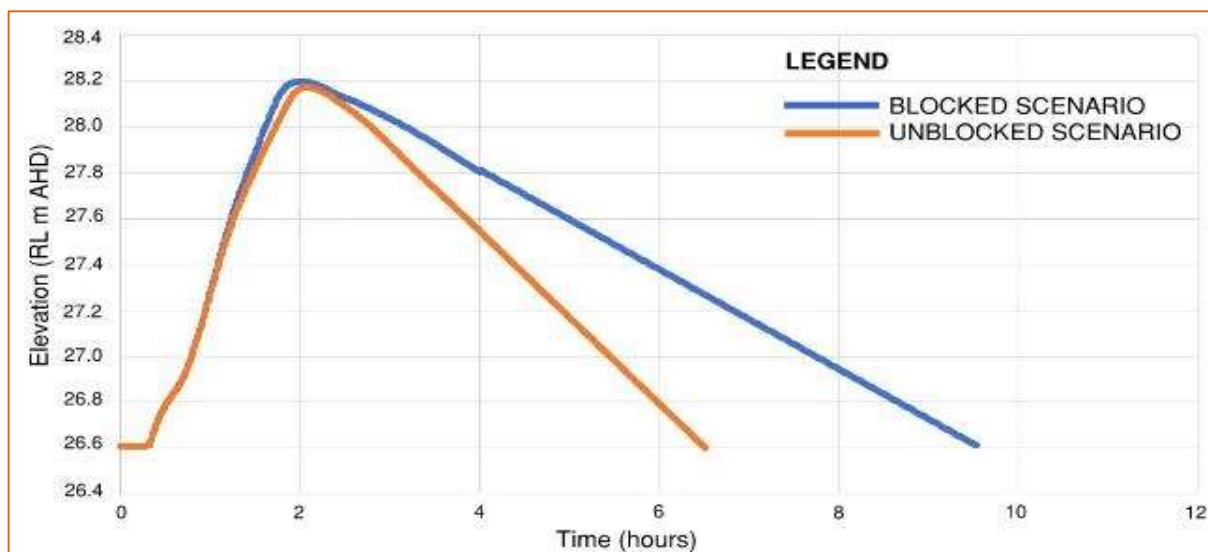


Figure 6-9 – Southern Basin Inundation Curves - 1% AEP

6.5.5 Regional Flood Sensitivity

A regional sensitivity has been undertaken based on the recently updated Logan River Flood Model. To undertake this assessment Arcadis has purchased the TUFLOW model and accompanying report. Based on this information Arcadis has determined that the peak water level for the site area occurs in the 72hr event.

Water levels for this event was then extracted and applied to the site-specific flood model as a boundary condition. Whilst the results indicated a higher water level downstream of the site, flood levels were generally below the peak water level for the site (540min). It is also noted that results indicated that the peak for the river occurs approximately 20hrs past the site peak which validates the assessment with a lower boundary.



Figure 6-10 - 1% AEP 72hr Regional Flood Depth and Extents

6.5.6 Historical Flood Sensitivity

A historical sensitivity has been undertaken based on the catchment configuration south of the site. Arcadis investigated the impact of existing earthworks to the south of the site as it currently causes some unintentional flow attenuation. This external catchment feature is not accounted for in Council's regional flood model. Two figures are provided to show catchment features.

Figure 6-.11 below shows the existing earthworks as represented in the site-specific assessment presented in this report. Figure 6-.12, from 1983, shows the catchment without the earthworks.

4499 – 4651 Mount Lindesay Highway, North Maclean

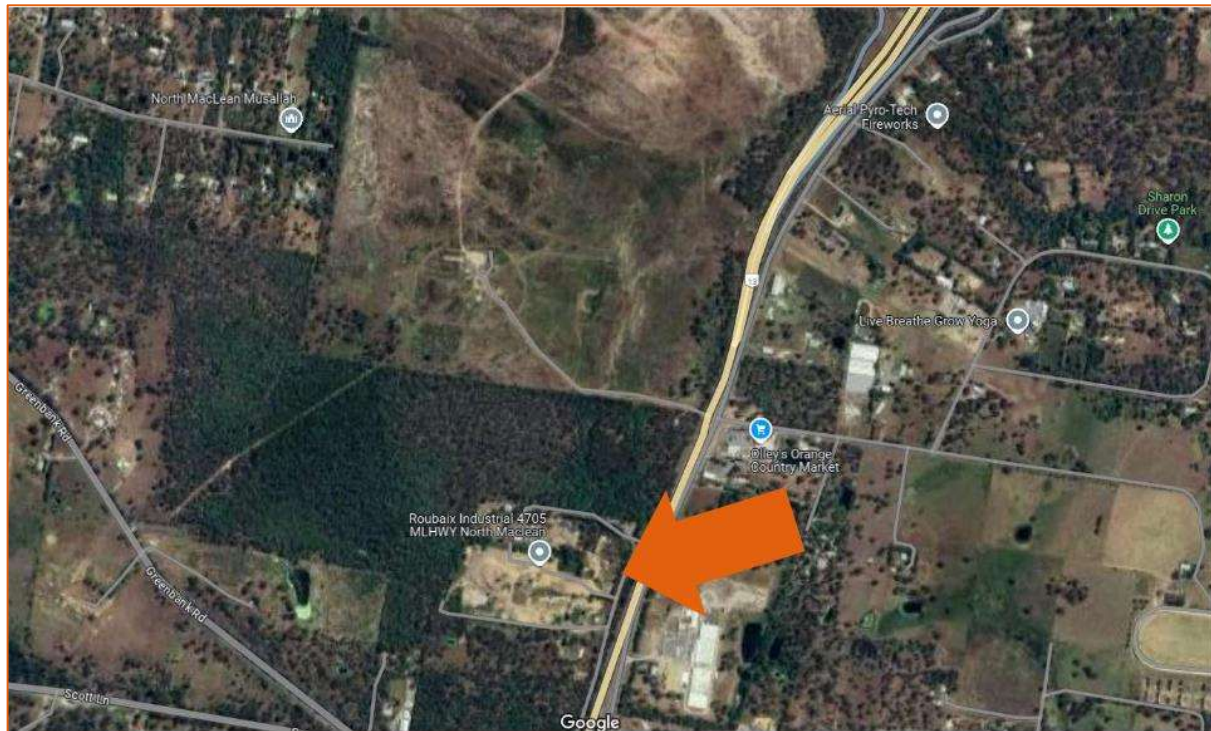


Figure 6-11 – Current Earthworks Extents South of the Site



Figure 6-12 – Catchment condition in 1983

Results indicate that compared to the historical results, the proposed development will significantly reduce flood levels. Afflux figures below show a reduction in water level of up to 200mm in the 1% AEP and 140mm in the 50% AEP for historical comparison.

4499 – 4651 Mount Lindesay Highway, North Maclean



Figure 6-13 - Developed Peak Water Surface Level Change - 50% AEP



Figure 6-14 - Developed Peak Water Surface Level Change - 1% AEP

Arcadis also investigated the area where, when compared to the current existing condition, a minor afflux is shown. The cross-section below shows the levels for all three scenarios, and while an 11mm increase in water level is shown when compared to existing conditions, a 44mm reduction is shown when compared to the historical event.

4499 – 4651 Mount Lindesay Highway, North Maclean

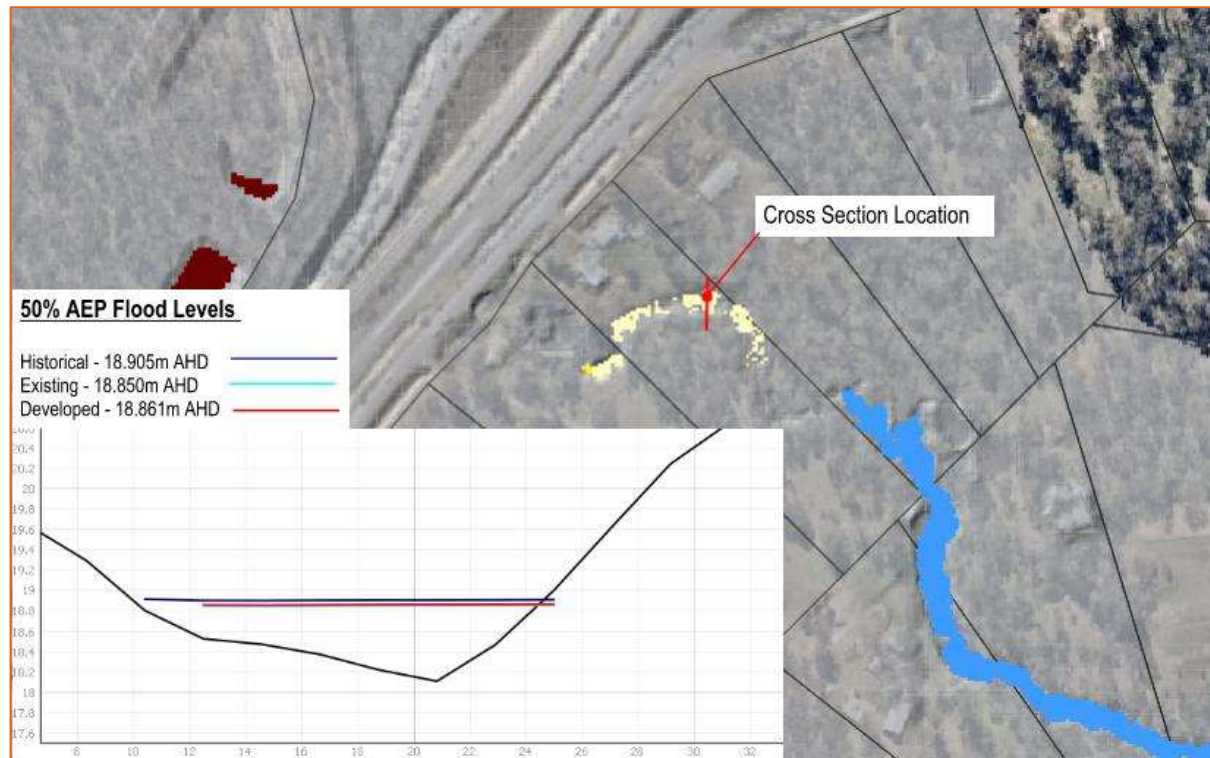


Figure 6-15 – 50 % AEP Flood Level Comparison

The subject minor 50% AEP afflux corresponds to no adverse or discernible velocity change for the associated 11mm WSL increase. Further, the maximum 50% AEP velocity is recorded along this reach as 1.4 m/s and is anticipated to cause no waterway instability issue. Figure 6-16 shows the velocity vector along the longitudinal section of this particular reach of the downstream waterway.

4499 – 4651 Mount Lindesay Highway, North Maclean

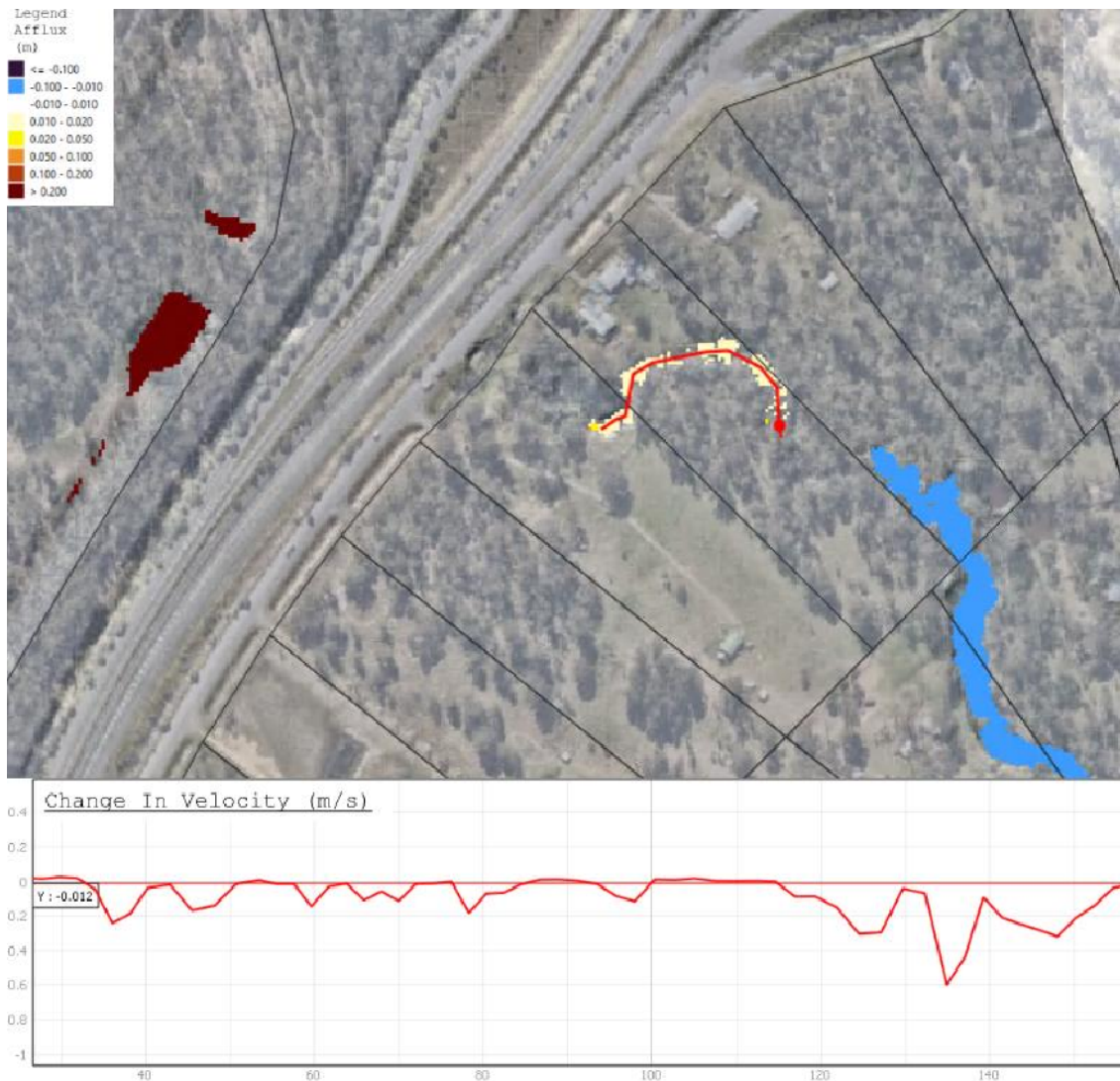


Figure 6-16 – 50 % AEP Velocity Change for afflux reach section.

6.6 Objective Discussion

The above hydraulic investigation has demonstrated that suitable measures can be included in the design of the proposed development, to ensure that there is no increase in peak 1% AEP discharge being directed off-site to existing downstream infrastructure and no actionable nuisance caused to neighbouring properties as a result of the development.

6.7 Drainage System Safety

Urban drainage systems can present a risk to community during storms and times of flood. The consequences of interaction with the proposed drainage system and treatment areas can lead to physical harm and trauma. Notwithstanding the safety risks associated with the proposed stormwater structures can be managed through design and management techniques. In this instance it is considered necessary to develop risk assessment profile and implement where required appropriate design and management techniques. Refer to supplied Bulk Earthworks Engineering Plans for associated risk analysis and proposed management actions.

7 CONCLUSION

This SBSMPQ has been prepared to provide a design proposal and guide to the stormwater quantity management techniques and strategies for the site.

The primary objective of this SBSMPQ has been to ensure that:

- 1. Suitable measures are incorporated in the development to ensure that there are no adverse impacts to downstream receiving waterways, property or infrastructure resulting from any increase to peak discharging stormwater flow rates.**

This report has presented the methodology and results of a flood modelling assessment which has included the analysis of the impacts of the proposed development in comparison to the existing scenario. In particular this assessment has concentrated to the impact immediately upstream and downstream of the site where complex flood behaviour exists.

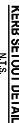
To undertake the assessment of the hydraulic conveyance changes as a result of the proposed development, Arcadis has created a TUFLOW model using results documented in the 4499 - 4651 Mount Lindesay Highway, North Maclean Site Based Stormwater Management Plan Report, EAG001-30139050-AAR-01. The assumptions and limitations associated with the modelling exercises undertaken are highlighted in this report and the subsequent results are summarised as follows.

Results indicate that the proposed development will generally improve flood conditions downstream of the site by applying the reduction of site stormwater discharge via the proposed detention systems.

Note: The proposed operational stormwater quality treatment train is detailed in the Site Based Stormwater Quality Management Plan (SBSQMP) (EAG003-30109334-AAR-05).

APPENDIX A

Site Layout Plan



CROSS DRAINAGE SETOUT TABLE									
ITEM I.D	INLET			OUTLET			PIPE TYPE	PI	P
	EASTING	NORTHING	IL	EASTING	NORTHING	IL			
CD09	494617.826	6929933.19	44.342	494953.809	6929848.666	43.33	RCP 43.3		
CD01	494942.366	6930355.955	52.293	494942.587	6930378.713	52.25	RCP 43.3		
CD04	494963.685	693006.889	44.771	494959.432	6930095.45	44.76	RCP 43.3		
CD05	494961.719	6930010.03	44.778		6930002.976	44.76	RCP 43.3		
CD06	494937.92	693040.81	52.815	494933.379	6930408.041	52.77	RCP 43.3		
CD07	494938.117	6930408.096	52.87	494938.009	693041.898	52.83	RCP 43.3		
CD08	494958.246	692992.866	41.835	494958.322	6929935.44	41.72	RCP 43.3		
CD09	494964.573	692956.611	27.647	494961.648	6929605.801	27.665	RCP 43.3		
CD10	494812.043	692953.899	27.647	494814.775	6929605.801	27.665	RCP 43.3		
CD11	500111.525	693013.905	46.075	500117.242	6930129.716	46.054	RCP 43.3		
CD12	494978.144	692954.568	23.298	494972.019	6929512.846	23.206	RCP 43.3		
CD13	494972.343	693028.084	30.832	494971.939	6930255.345	30.67	RCP 43.3		
CD14	494971.836	693029.605	30.268	494971.804	6930270.019	30.05	RCP 43.3		
CD15	494943.389	693004.065	28.808	494943.944	6930039.978	28.771	RCP 43.3		
CD16	494944.006	693002.793	51.669	494943.297	6930035.665	51.595	RCP 43.3		
CD17	501801.736	6929778.919	29.916	501603.644	6929778.022	29.885	RCP43		

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 CITY OF LOGAN 101 Waverley Road, Logan Centre, QLD 4114 Ph: (07) 3412 3444 FAX: (07) 3412 3444 Ph: (07) 3412 4279 Email: info@cityoflogan.qld.gov.au	QT ADVANCEMENT CENTRE 101 Waverley Road, Logan Centre, QLD 4114 Ph: (07) 3412 3444 FAX: (07) 3412 3444 Ph: (07) 3412 4279 Email: info@cityoflogan.qld.gov.au	PROJECT NO. B19175	COMP. REF. SMULV.dwg	T.A.K. 26.08.20	SUBMITTER	SURVEY REF. CD45	DESIGNED R.W.B 10.05.21	CHECKED S.T. 10.05.21	DRAWN M.P 02.09.22	CHECKED S.T. 02.09.22
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CROWSON LANE
MT LINDESAV HWAY TO TEVIOT RD
UPGRADE & EXTENSION
DRAINAGE NOTES AND LEGEND
CROSS DRAINAGE SETOUT TABLE
SHEET 1 OF 1

APPROVED		SHEET
DRAWN	NUMBER	
1	B19175-DROU	-

PRELIMINARY
NOT FOR CONSTRUCTION

ROCK SCOUR PROTECTION				
LOCATION	D ₅₀ ROCK SIZE (mm)	DEPTH (mm)	Approx. Vol. (m ³)	
Outlet 1/03	300	600	9.4	
Outlet 1/25	200	400	1.7	
Outlet 1/25	200	400	2.3	
Outlet 1/32	200	400	0.7	
Outlet 1/36	200	400	0.6	
Outlet 1/39	200	400	1.4	
CO01 Inlet	200	400	7.6	
CO01 Inlet	200	400	28.4	
CO03 Inlet	300	600	35.1	
CO03 Outlet	300	600	34.9	

ROCK SCOUR PROTECTION				
LOCATION	D ₅₀ ROCK SIZE (mm)	DEPTH (m)	Approx. COEFF. OF FRICTION (m ² /s ²)	Approx. COEFF. OF FRICTION (ft ² /s ²)
C004 outlet	400	800	403.3	1.0
C004 outlet	400	800	700.9	1.8
C005 inlet	200	400	55.2	1.4
C005 outlet	200	400	55.2	1.4
C006 inlet	200	400	55.2	1.4
C006 outlet	200	400	21.9	0.6
Outlet 1/212	300	600	53.0	1.4
C008 inlet	200	400	7.1	0.2
C008 outlet	200	400	7.1	0.2
all delivery outlets (17 outlets)	100	200	11.0 (each)	0.3

CHECKED AGAINST THIS DESIGN,
18. SHEET/BLANKS TO BE CONSTRUCTED
DWG. NO. 1-140, 1-142.

ACCOMPLISH WITH PWEA STD.

^Δ NOTE: Setout of box culvert structures is based on "ROCA" products. Adjustments to setout points to be made by contractor if selected product dimensions vary.

MAJOR CULVERT SETOUT TABLE

POINT NO.	EASTING	NORTHING	ELEVATION	COMMENT
481	498819.626	6929691.556	19.060	CC04 BASE
482	498818.218	6929677.564	19.029	CC04 BASE
483	498816.412	6929674.609	19.029	CC04 BASE
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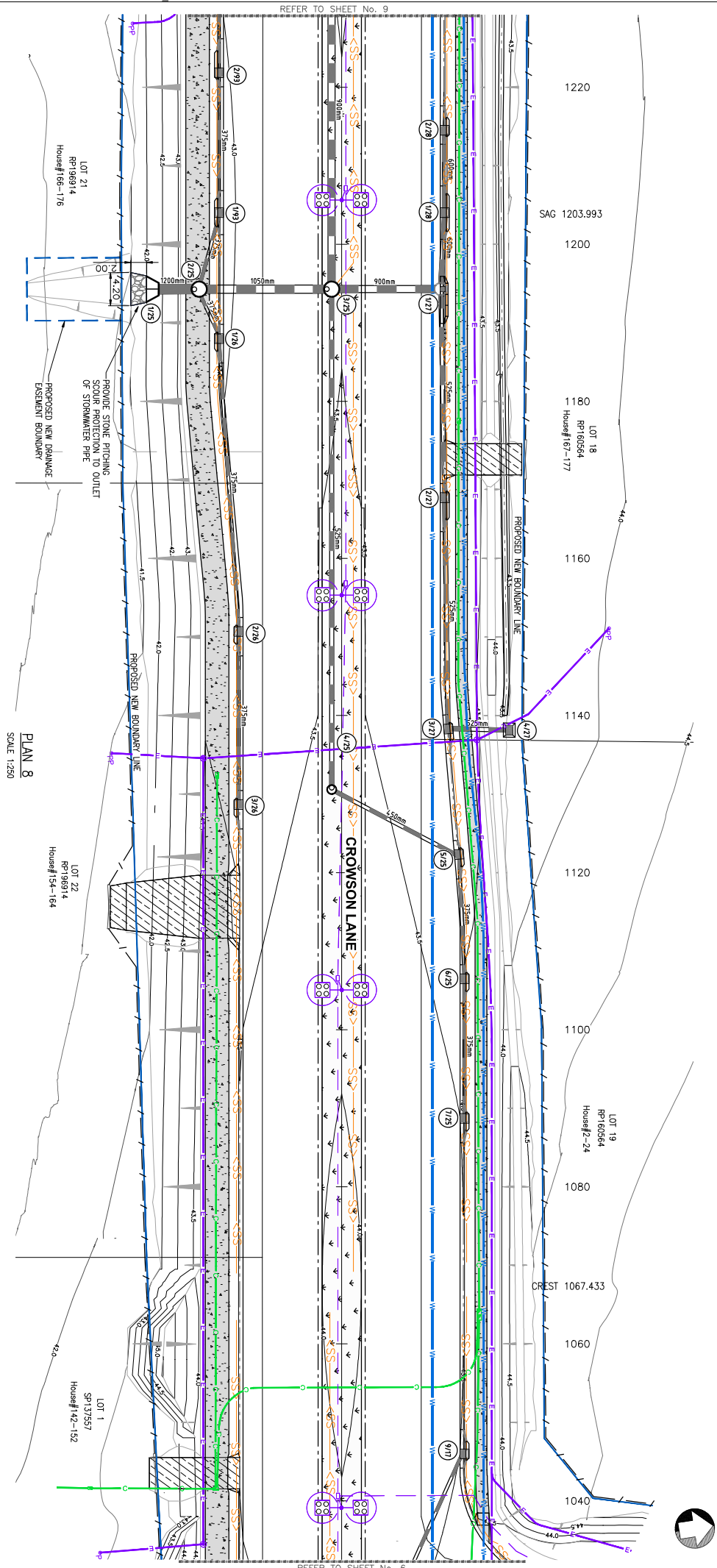
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NOTE:
REFER TO DRAWING B19175-DROO
FOR DETAILS, NOTES AND LEGENDS.

PRELIMINARY
NOT FOR CONSTRUCTION



AMENDMENTS		BY		CHKD	APP'D	DATE
 WESTERNA PARTNERS STRUCTURAL-CIVIL-ENVIRONMENTAL ENGINEERS www.westernpartners.com.au ABN 52 097 417 915		 CITY OF LOGAN 100 Victoria Road, Logan Central QLD 4114 Tel: (07) 3412 4278 Email: info@cityoflogan.qld.gov.au				
PT EXISTING NORTHING RL DESCRIPTION REFER TO DRAWING SET "C" FOR DETAILS BAR SCALES (A1 UNREduced)  SCALE IN METRES (1:250 BEFORE REDUCTION)		CITY ADMINISTRATION CENTRE PROJECT NO. 819/175 COMP. REF. SMD/AV.dwg SURVEYOR T.J.K. 26.08.20 SURVEY REF. Pto(0)3412 3412 SMD(0)3412 3412 SMD(0)3412 4278 DESIGNED R.vdw 10.05.21 CHECKED S.T. 10.05.21 DRAWN M.P. 02.09.22 CHECKED S.T. 02.09.22				
ROAD DRAINAGE LAYOUT SHEET 6 OF 31		MT CROWSON LANE LINDSEAY HWAY TO TEVIOT RD UPGRADE & EXTENSION DRAWING NUMBER 1 B/19175-DR06 -				



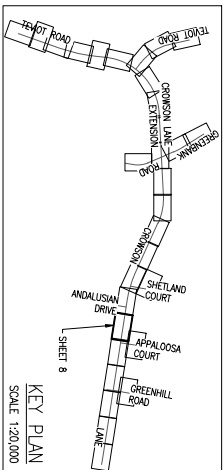
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REFER TO SHEET No.

LOGAN CITY COUNCIL DM FILE NUMBER: 1089382-1

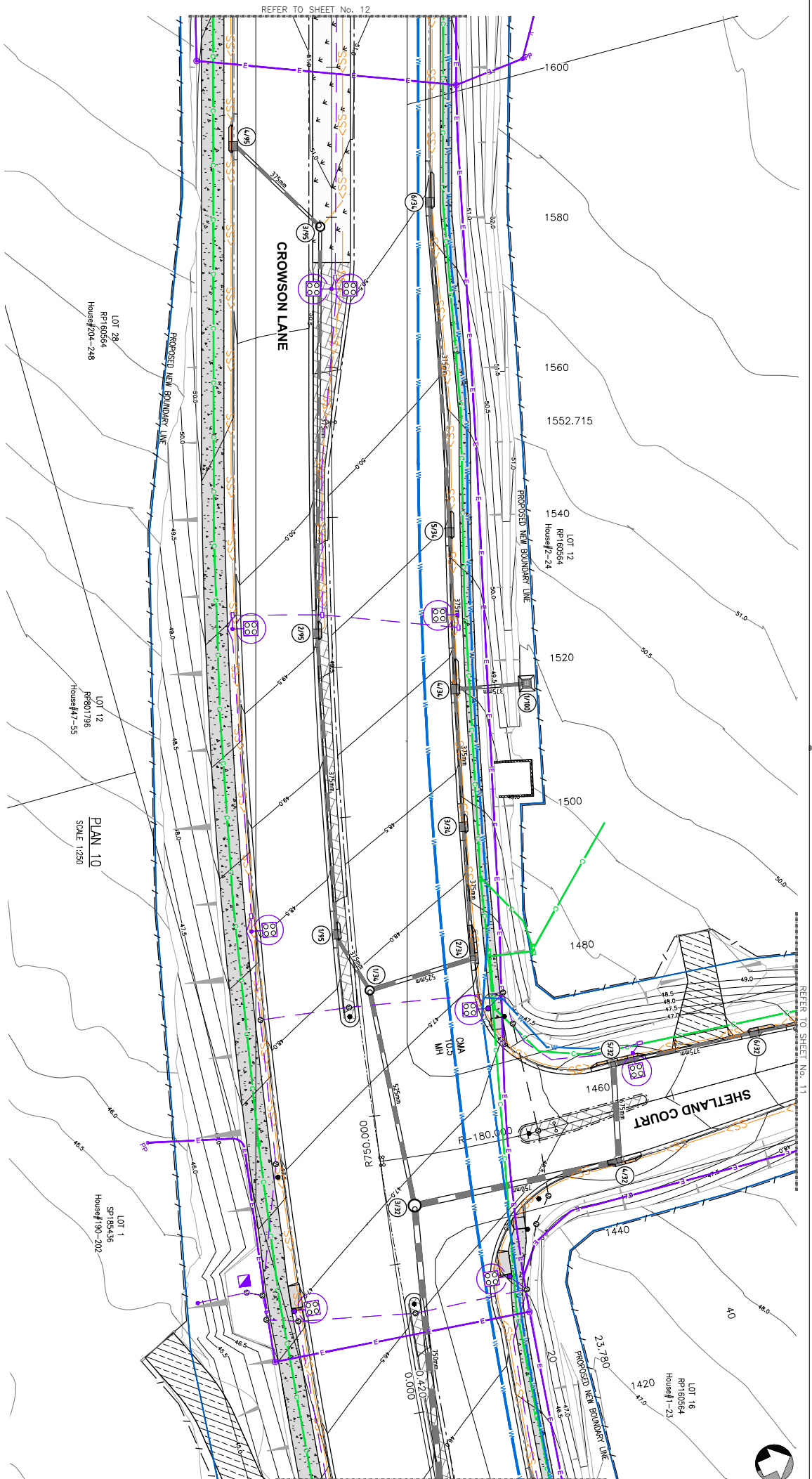
NOTE:
REFER TO DRAWING B19175-DROO
FOR DETAILS, NOTES AND LEGENDS.

PRELIMINARY
NOT FOR CONSTRUCTION



KEY PLAN
SCALE 1:20,000

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		CITY OF LOGAN CITY ADMINISTRATION CENTRE 550 WOODWARD RD LOGAN, QLD 4114 Ph: (07) 5412 3412 Fax: (07) 5412 3444 Email: info@cityoflogan.qld.gov.au			PROJECT NO. B19175		
COMP. REF.		SMD/AL/DMG			CROWSON LANE		
DATE		1 J.A.K. 26.08.20			LINDSEAY HWAY TO TEVIOT		
SURVEYOR		S/RENEOR			UPGRADE & EXTENSION		
SURVEY REF.		CD45			ROAD DRAINAGE LAYOUT		
R.A.M.B		10.05.21			SHEET 8 OF 33		
CHECKED		S.T.			DRAWING NUMBER		
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CHECKED		S.T. 02.09.22			1		

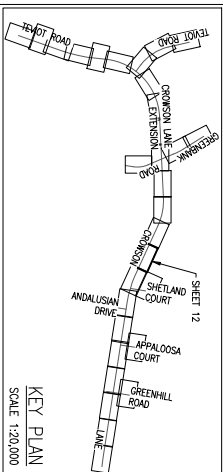
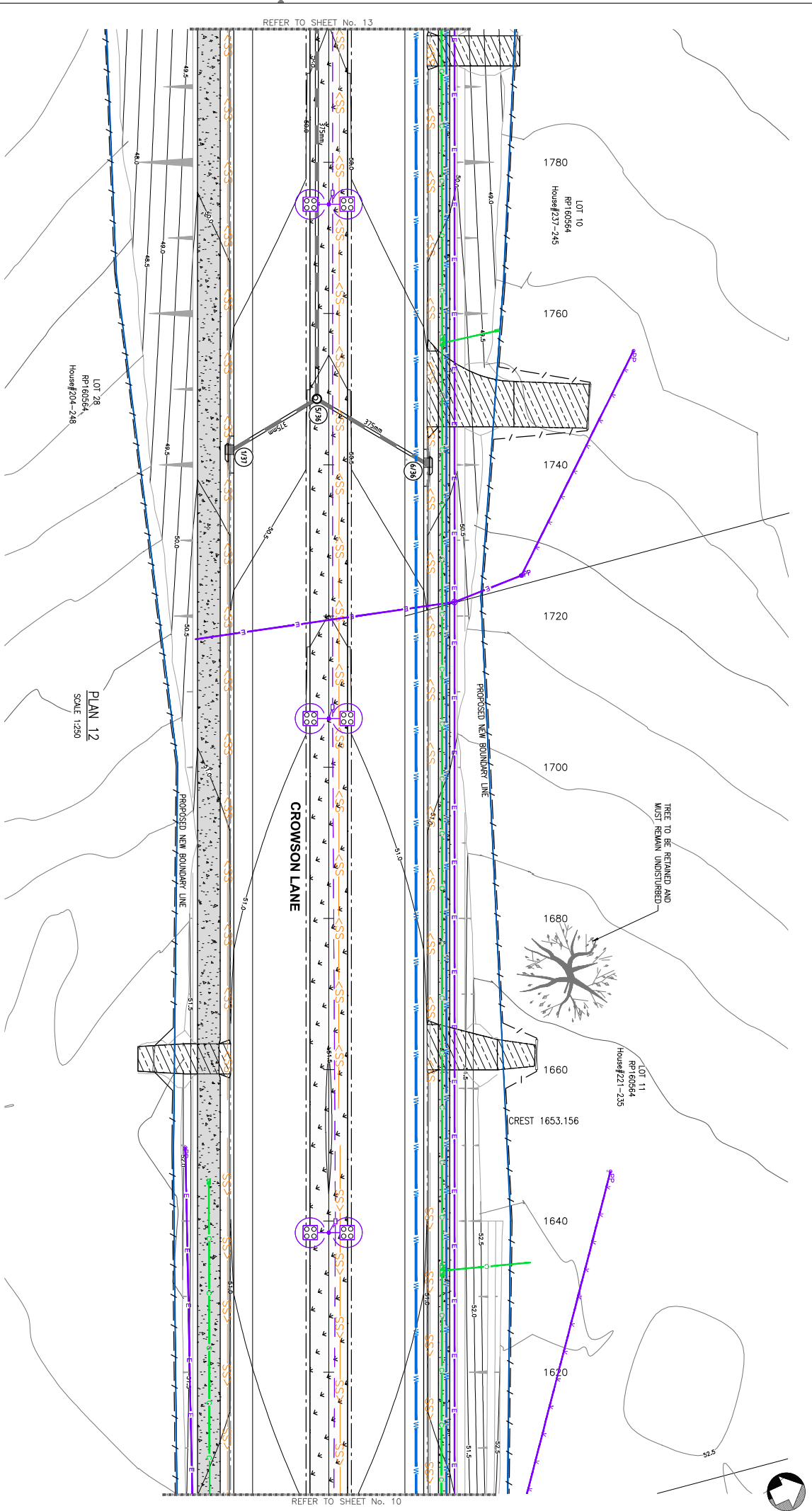


REFER TO SHEET No. 11

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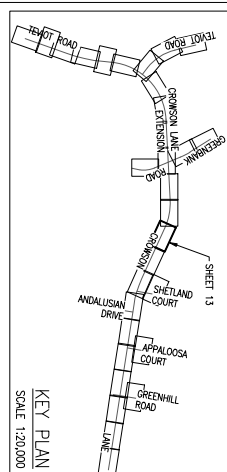
AMENDMENTS		BY	CHMD	APP'D	DATE
 WESTERN PARTNERS STRUCTURAL-COL+ENVIRONMENTAL ENGINEERS www.westernpartners.com.au AIN 52 097 417 975					
PT EASTING NORTHING RL DESCRIPTION REFER TO DRAWING SET VOL FOR DETAILS BAR SCALES (A1 UNREPROD)  SCALE IN METRES (1:250 BEFORE REDUCTION)		 city of LOGAN CITY ADMINISTRATION CENTRE 150 Macleay Road Logan City 4114 Ph(07)3412 3412 Fax(07)3412 3444 Ph(07)3412 4278 Email: info@cityoflogan.qld.gov.au			
PROJECT NO.		B19175		CROWSON LANE	
COMP. REF.		SMDVLA/4mg		MT LINDESADE HWAY TO TEVIOT RD	
SURVEYOR		T.J.K. 26.08.20		UPGRADE & EXTENSION	
SURVEY REF.		CD45			
R.A.M.D		10.05.21			
CHECKED		S.T.			
DRAWN		M.P.			
CHECKED		02.09.22			
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SHEET 10 OF 33		1		SHEET 10 OF 31	



KEY PLAN
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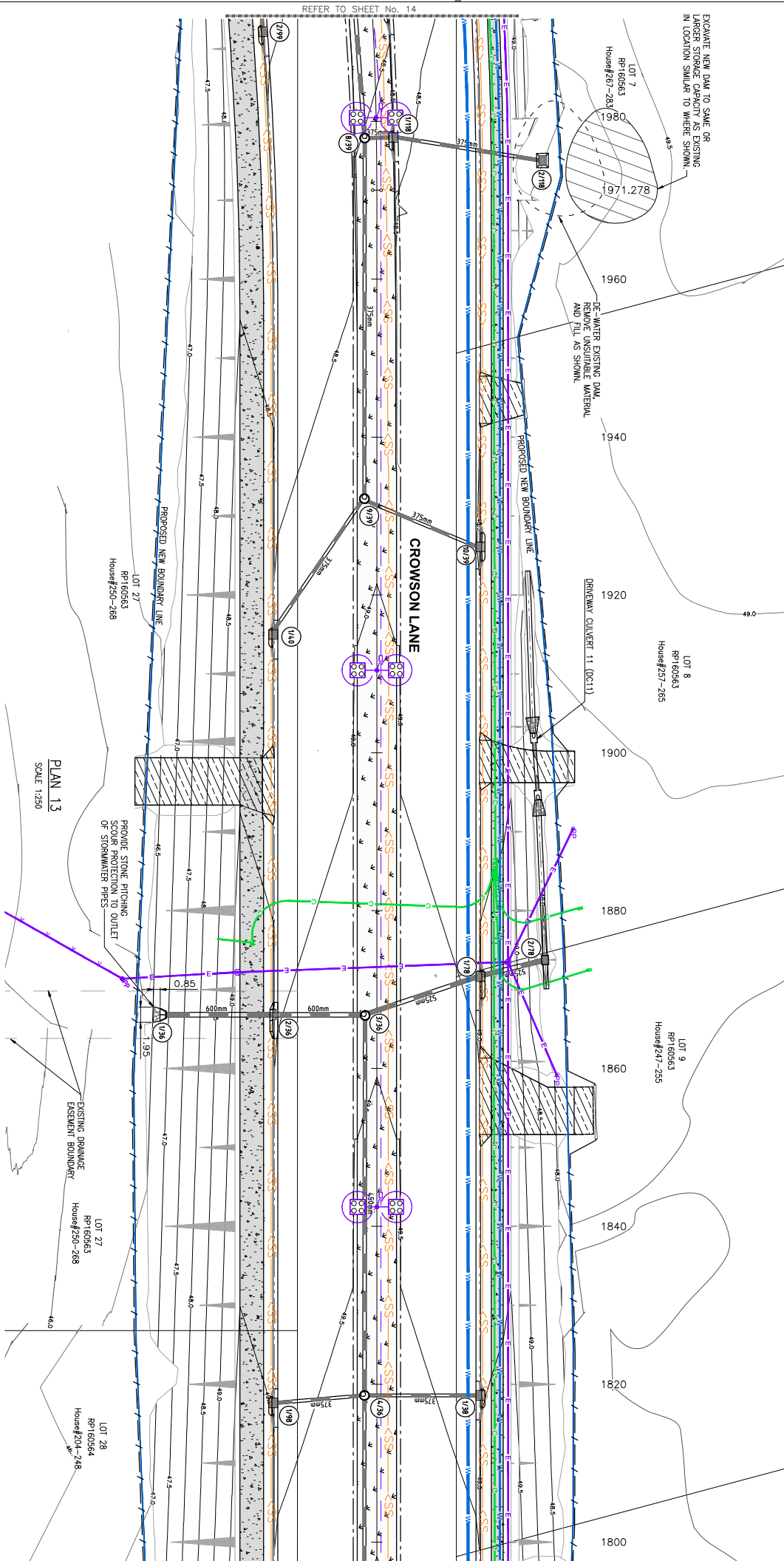
PRELIMINARY
NOT FOR CONSTRUCTION

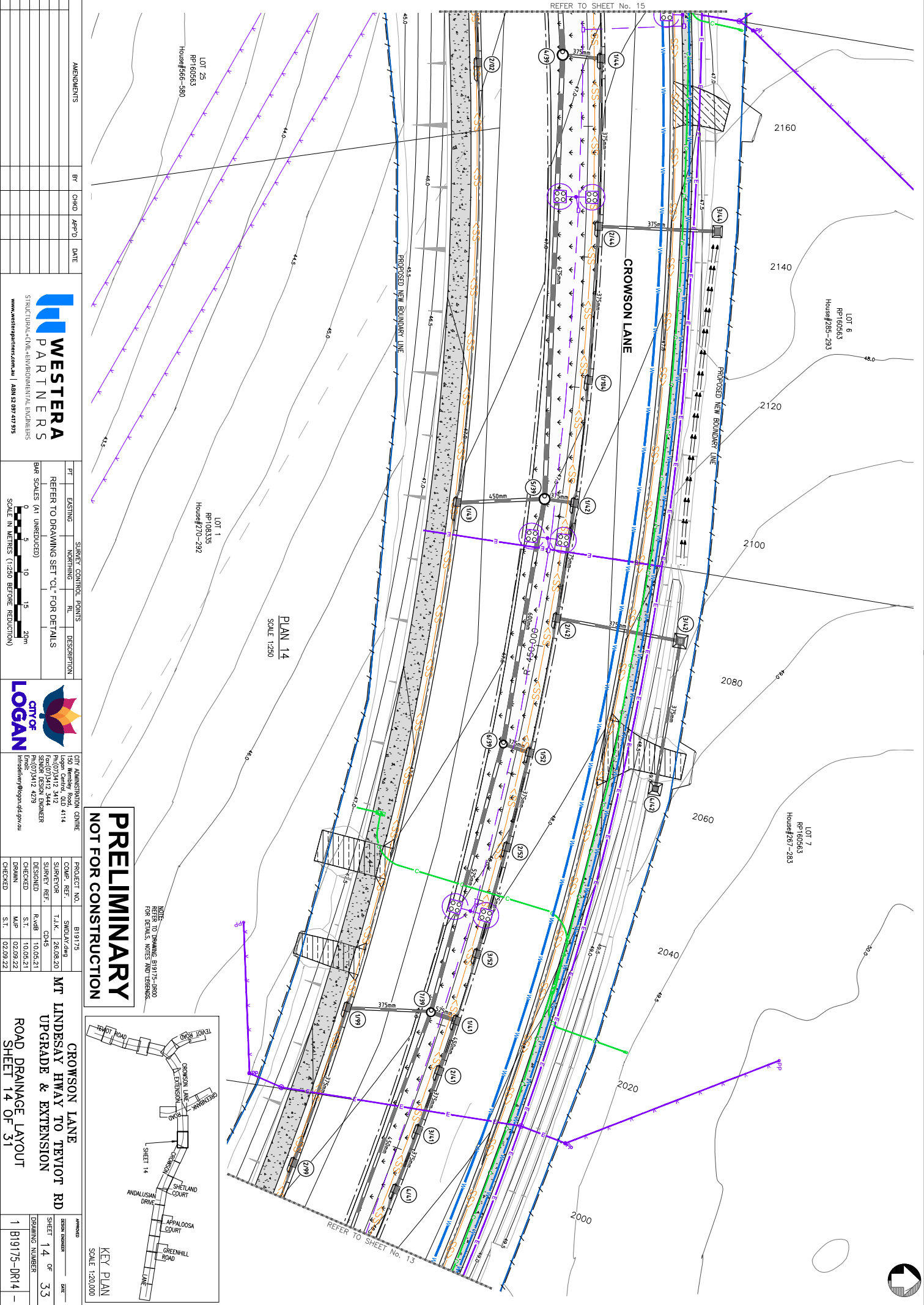
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BY		CHNO	APP'D	DATE					
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P/T		EASTING	NORTHING	N.L.	DESCRIPTION				
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 CITY OF LOGAN CITY ADMINISTRATION CENTRE Logan Central, QLD 4114 Ph:(0)73412 3412 Fax:(0)73412 4279 Email: info@cityoflogan.qld.gov.au									
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B1917-5		SMULV-DMG		T.J.K. / 26.08.20		R.W.B / 10.05.21		S.T. / 10.05.21	
MT LINDESBAY HWAY TO TEVIOT UP GRADE & EXTENSION		ROAD DRAINAGE LAYOUT SHEET 12 OF 31		DRAWN		MAP		S.T.	
						02.09.22			
APPROVED		DESIGN NUMBER		DATE					
[Signature]		B1917-5-DRI12 -							



PRELIMINARY
NOT FOR CONSTRUCTION

NOTE:
REFER TO DRAWING B19175-DR00
FOR DETAILS, NOTES AND LEGENDS

[illegible]



AMENDMENTS			
BY	CHKD	APP'D	DATE

**WESTERNA**
PARTNERS
STRUCTURAL-CIVIL-ENVIRONMENTAL ENGINEERS
www.westernpartners.com.au | A/NZ 02 997 417 915

PT	EASTING	NORTHING	RL	DESCRIPTION
REFER TO DRAWING SET 'CL' FOR DETAILS				
BAR SCALES (A1 UNREDUCED)				
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SCALE IN METRES (1:250 BEFORE REDUCTION)				

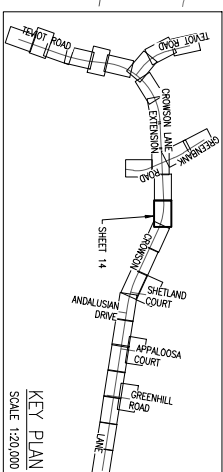
**CITY OF**
LOGAN

CITY ADMINISTRATION CENTRE
150 Kennedy Road, 4114
Logan City, QLD 4114
Phone: (07) 3412 3444
Fax: (07) 3412 3444
SENIOR DESIGN ENGINEER
Phone: (07) 3412 4279
Email: hiroshima@logan.qld.gov.au

PROJECT NO.	B19175
COMP. REF.	SMOULAY, DWG
SURVEYOR	T.J.K. 1/26/08/20
SURVEY REF.	CD45
DESIGNED	R.W.B. 11/06/21
CHECKED	S.T. 11/06/21
DRAWN	M.P. 10/08/22
CHECKED	S.T. 10/08/22

CROWSON LANE
MT LINDSAY HWAY TO TEVIOT RD
UPGRADE & EXTENSION
ROAD DRAINAGE LAYOUT
SHEET 14 OF 31

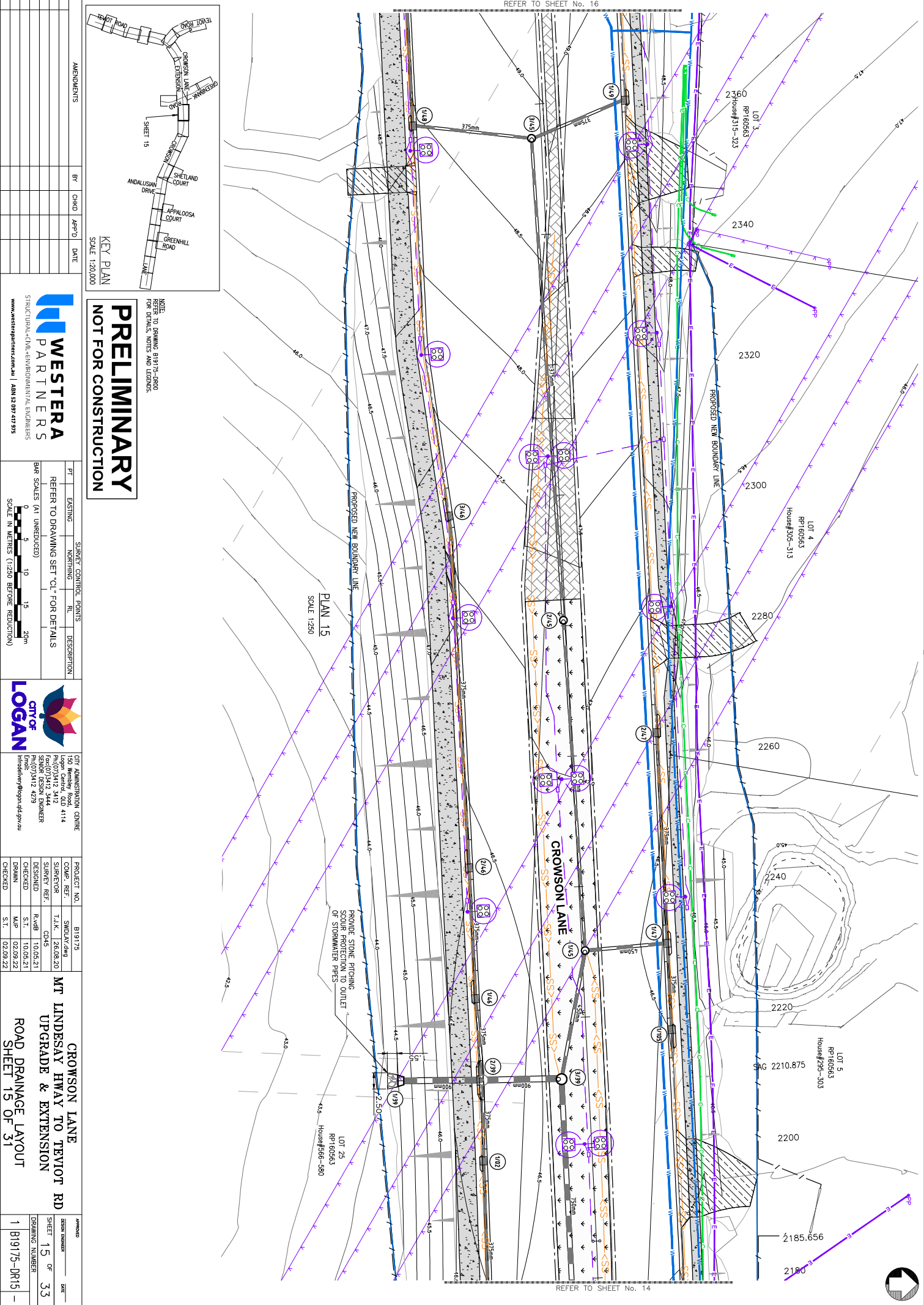
KEY PLAN
SCALE 1:20,000



APPROVED
DESIGN DRAINAGE
SHEET 14 OF 31
DRAWING NUMBER
1 B19175-DR14 -

PRELIMINARY
NOT FOR CONSTRUCTION

NOTE:
REFER TO DRAWING B19175-PROJ
FOR DETAILS, NOTES AND TENDERS.



KEY PLAN
SCALE 1:20,000

**PRELIMINARY
NOT FOR CONSTRUCTION**

NOTE:
REFER TO DRAWING B19175-DR00
FOR DETAILS, NOTES AND LEGENDS.

AMENDMENTS	BY	CHKD	APP'D	DATE

**WESTERA
PARTNERS**
STRUCTURAL-CIVIL-ENVIRONMENTAL ENGINEERS
www.westerapartners.com.au | A/NZ 82 897 417 915

PT	EASTING	NORTHING	RL	DESCRIPTION

REFER TO DRAWING SET "CL" FOR DETAILS

BAR SCALES (AS UNREduced)

0 5 10 15 20m

SCALE IN METRES (1:250 BEFORE REDUCTION)

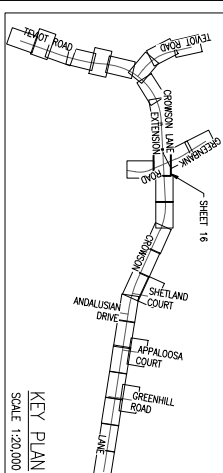


CITY ADMINISTRATION CENTRE
150 Kennedy Road, 4114
Logan City, QLD 4114
Phone: (07) 3412 3444
Fax: (07) 3412 3444
SENIOR DESIGN ENGINEER
Phone: (07) 3412 4279
Email: info@logancity.qld.gov.au

PROJECT NO.	B19175
COMP. REF.	SMOLAY, Dwg
SURVEYOR	T.J.K. 126.08.20
SURVEY REF.	C945
DESIGNED	R.W.B. 11.06.21
CHECKED	S.T. 11.06.21
DRAWN	M.P. 10.09.22
CHECKED	S.T. 02.09.22

**CROWSON LANE
MT LINDSEY HWY TO TEVIOT RD
UPGRADE & EXTENSION
ROAD DRAINAGE LAYOUT
SHEET 15 OF 31**

APPROVED	
DESIGN NUMBER	
SHEET 15 OF 33	
DRAWING NUMBER	
1 B19175-DR15 -	

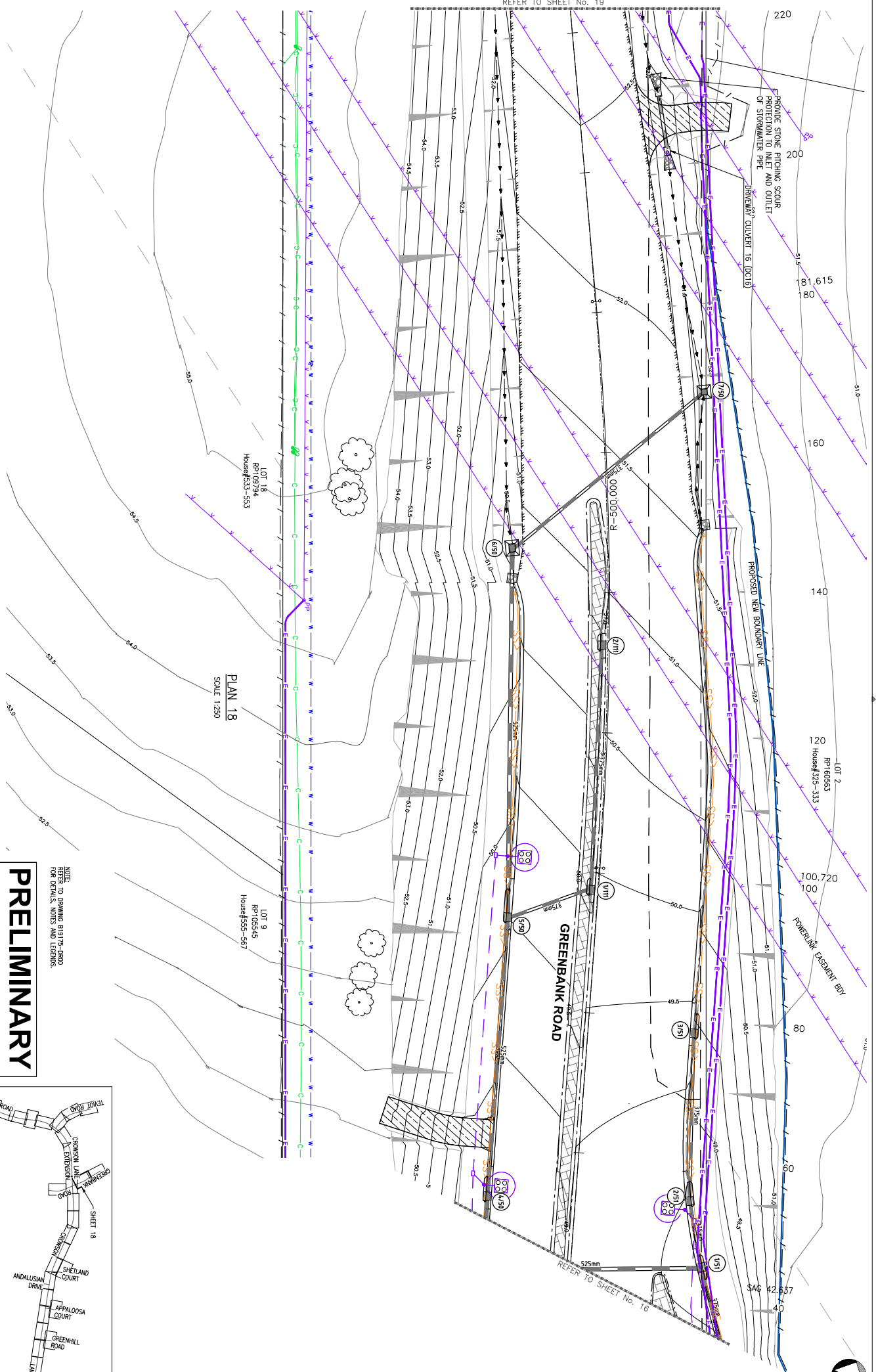


PRELIMINARY
NOT FOR CONSTRUCTION

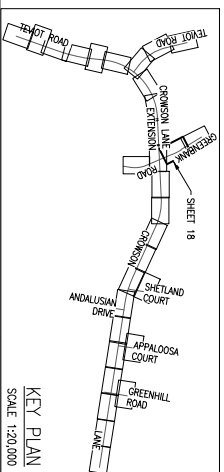
PLAN 16

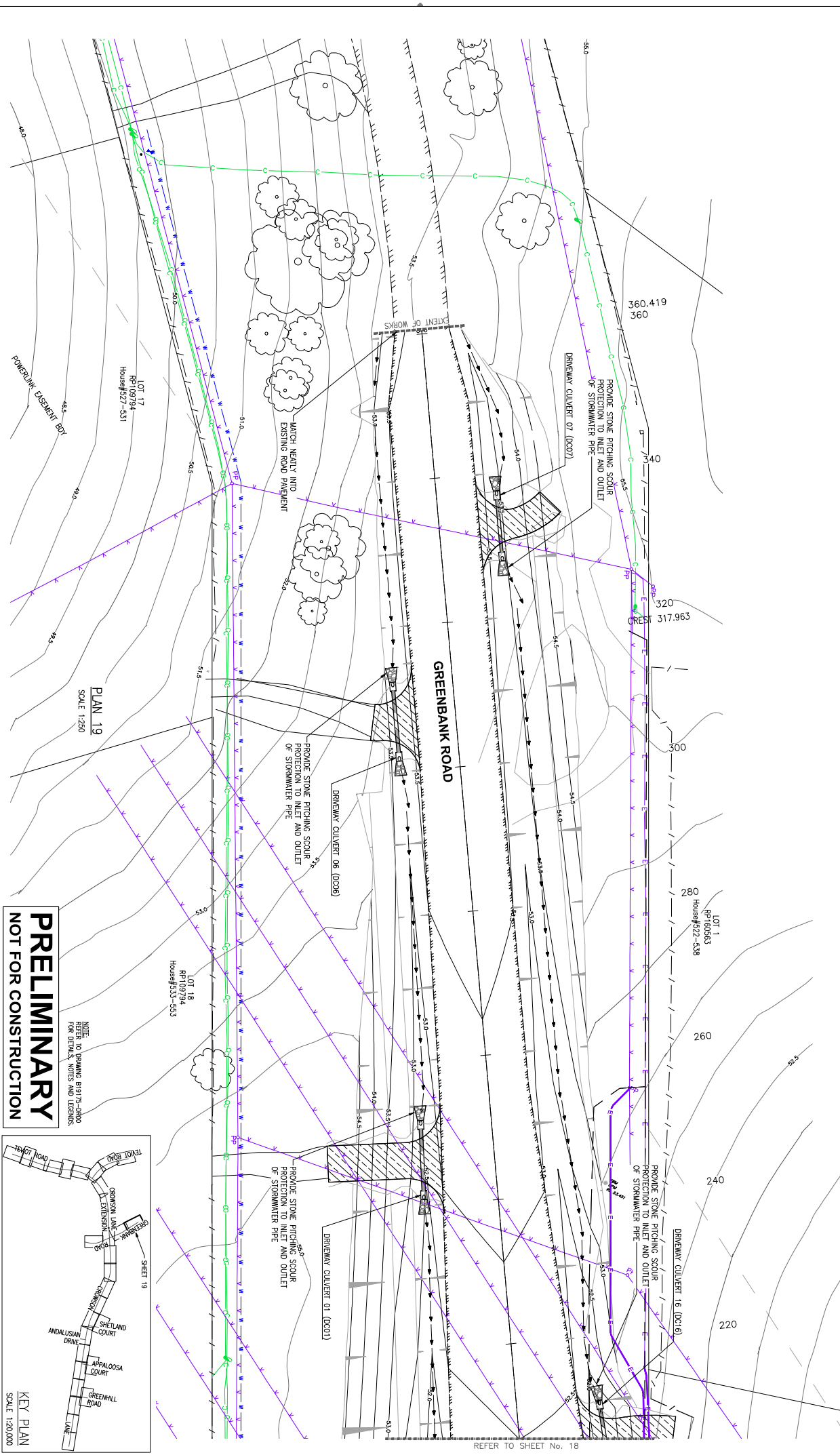
SCALE 1:250

AMENDMENTS					
BY	CHKD	APP'D	DATE		
 WESTERA PARTNERS STRUCTURAL-CIVIL-ENVIRONMENTAL ENGINEERS www.westerapartners.com.au ABN 52 097 417 975					
PT	EASTING	NORTHING	RL	DESCRIPTION	
REFER TO DRAWING SET "C" FOR DETAILS					
BAA SCALES (A1 UNREduced)					
					
SCALE IN METERS (1:250 BEFORE REDUCTION)					
 CITY OF LOGAN 150 Mentwyl Road Logan Central, QLD 4114 Ph: (0)13412 3412 SENIOR DESIGN ENGINEER Ph: (0)13412 4279 Email: infrastructure@logan.qld.gov.au					
PROJECT NO.:	8717/2	COMM. REF.:			
SURVEY OR:	T.I.N. 26.08.20	SURVEY REF.:			
DESIGNED:	S.W.	CHECKED:	R.V.	10.05.21	
DRAWN:	M.T.	DATE:	10.05.22	10.05.22	
CHECKED:	S.T.	DATE:	10.05.22	10.05.22	
CROWSON LANE UPGRADE & EXTENSION ROAD DRAINAGE LAYOUT SHEET 16 OF 31 1 B19175-DR16 -					

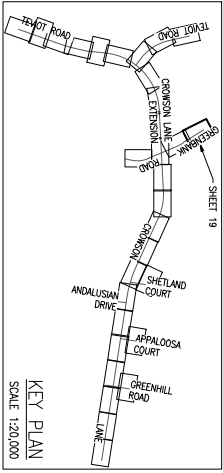


PRELIMINARY
NOT FOR CONSTRUCTION

[illegible]



PRELIMINARY
NOT FOR CONSTRUCTION



AMENDMENTS				SURVEY CONTROL POINTS				PROJECT NO.		DESIGN NO.		DRAWING NO.	
	BY	CHKD	APP'D	DATE	PT	EASTING	NORTHING	RL	DESCRIPTION	COMP. REF.	SMOUL/ANG	DESIGN REF.	DATE
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					BAR SCALES (A1 UNREduced)								
													
					SCALE IN METRES (1:250 BEFORE REDUCTION)								
													
					STRUCTURAL-CIVIL-ENVIRONMENTAL ENGINEERS								
					www.westerapartners.com.au AEN 32 897 417 975								
													
					CITY ADMINISTRATION CENTRE								
					150 Merivale Road, 4114								
					Logan City Council								
					Phone: (07) 3412 3444								
					Fax: (07) 3412 3444								
					SENIOR DESIGN ENGINEER								
					Phone: (07) 3412 4279								
					Email: info@logan.qld.gov.au								
					PROJECT NO.								
					B19175								
					COMP. REF.								
					SMOUL/ANG								
					SURVEY REF.								
					C245								
					DESIGNED								
					R1408 11.06.21								
					S.D.								
					S.T.								
					11.06.21								
					CHECKED								
					M4P								
					10.09.22								
					S.T.								
					10.09.22								
					CROWSON LANE								
					MT LINDSAY HWAY TO TEVIOT RD								
					UPGRADE & EXTENSION								
					ROAD DRAINAGE LAYOUT								
					SHEET 19 OF 31								
					1 B19175-DR19								



LOT 1
RP004731
House#2

LOT 1
RP004731
House#268-278

DRAINWAY CULVERT 13 (DC13)

PROVIDE STONE PITCHING SCOUR
PROTECTION TO INLET AND OUTLET
OF STORMWATER PIPES

DRAINWAY CULVERT 14 (DC14)

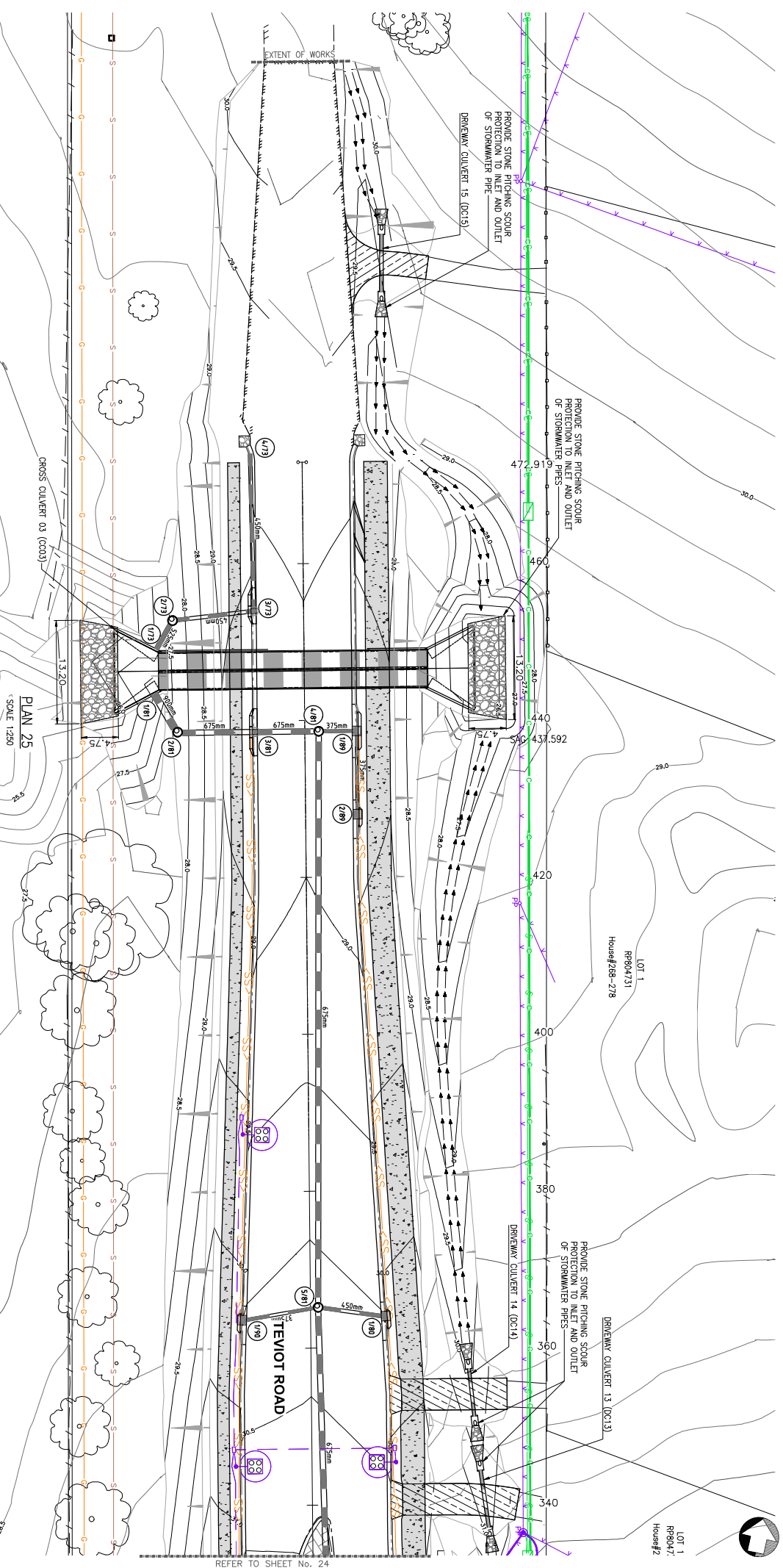
PROVIDE STONE PITCHING SCOUR
PROTECTION TO INLET AND OUTLET
OF STORMWATER PIPE

DRAINWAY CULVERT 15 (DC15)

TEVIOT ROAD

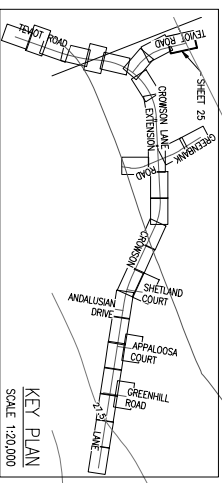
EXTENT OF WORKS

REFER TO SHEET No. 24



PLAN 25
SCALE 1:250

CROSS CULVERT 03 (CC03)



KEY PLAN
SCALE 1:20,000

NOTES:
1. TO DRAWING B19175-1900
FOR DETAILS, NOTES AND LEGENDS.

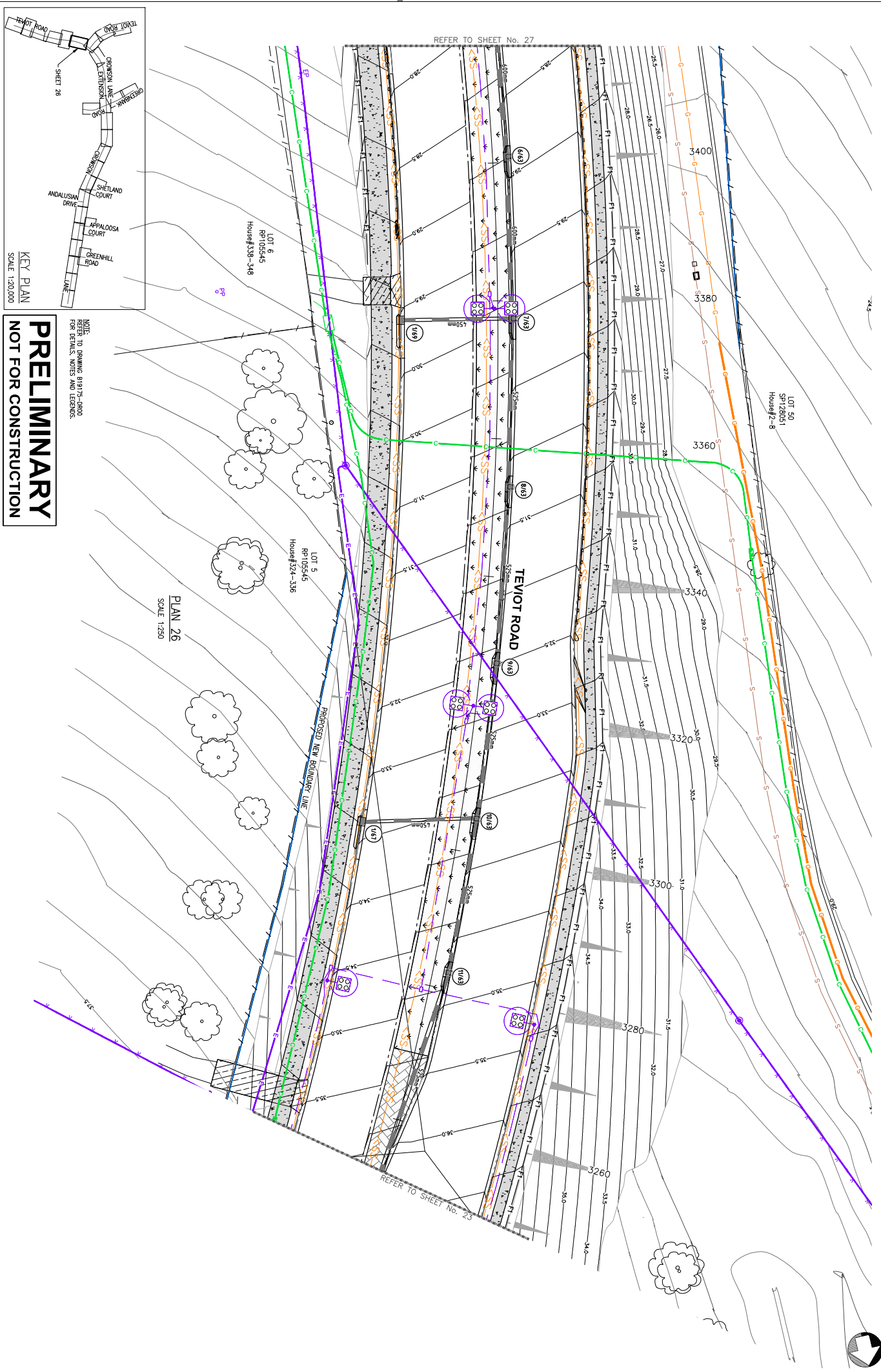
PRELIMINARY
NOT FOR CONSTRUCTION

AMENDMENTS				BY	CHKD	APP'D	DATE

WESTERA
PARTNERS
STRUCTURAL-CIVIL-ENVIRONMENTAL ENGINEERS
www.westerapartners.com.au | AEN 32 897 417 975



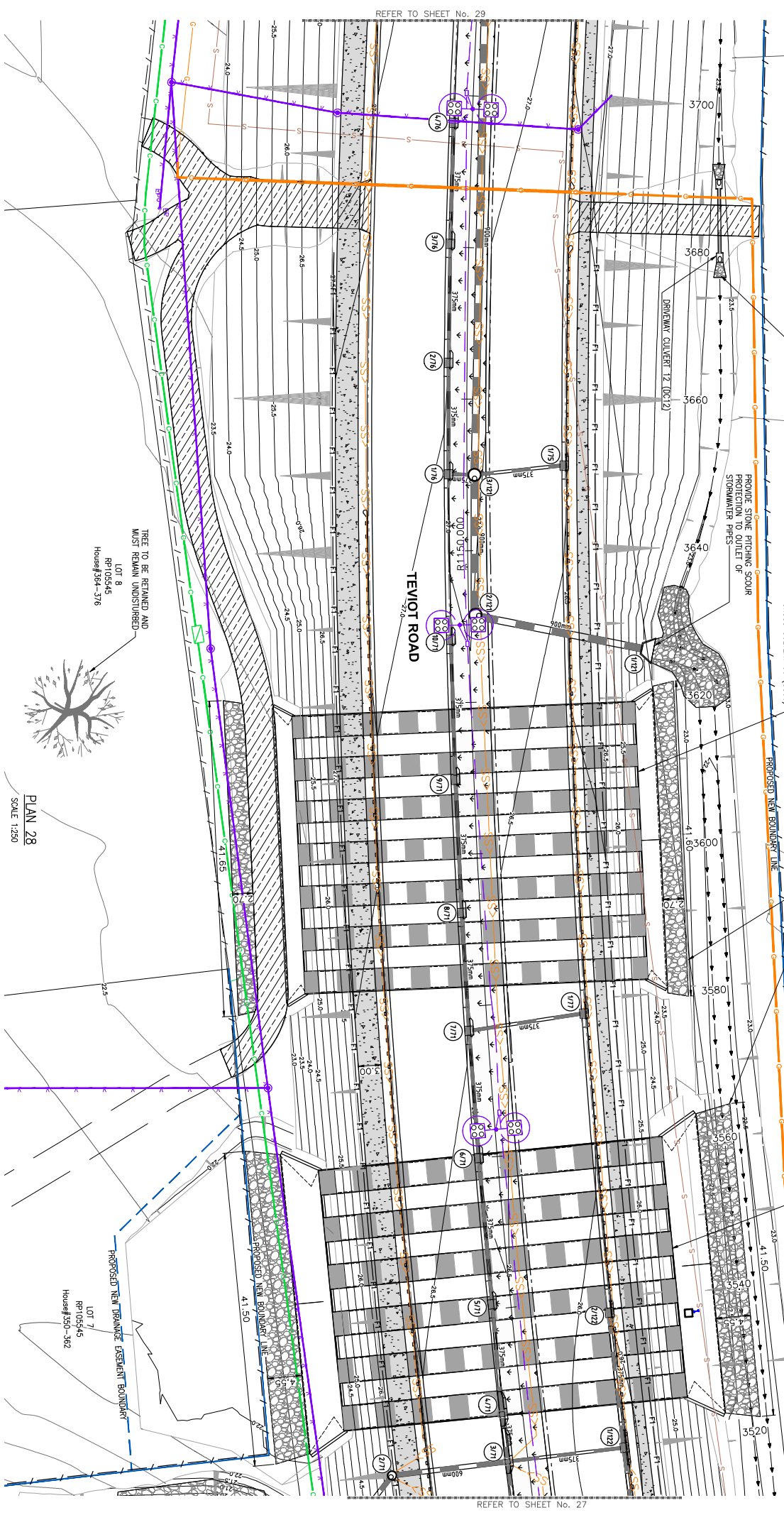
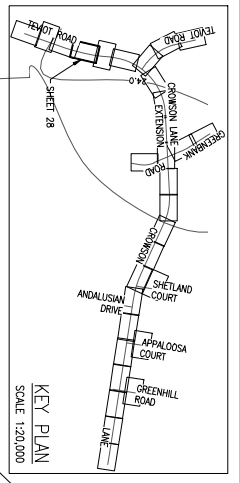
CITY ADMINISTRATION CENTRE
150 Winbury Road, 4114
Logan City Council, QLD 4114
Phone: (07) 3412 3444
Fax: (07) 3412 3444
Senior Design Engineer
Hindmarsh@logancity.qld.gov.au



AMENDMENTS		BY		CHKD	APP'D	DATE
 WESTERNA PARTNERS STRUCTURAL-CIVIL-ENVIRONMENTAL ENGINEERS www.westernpartners.com.au ABN 52 097 417 915		 CITY OF LOGAN 100 Waterloo Way Logan Central QLD 4114 Tel: (07) 3412 4279 info@cityoflogan.qld.gov.au				
PT	EXISTING	SURVEY CONTROL POINTS	NORTHING	Easting	DESCRIPTION	
REFER TO DRAWING SET "C" FOR DETAILS						
BAR SCALES (A1 UNREduced)  SCALE IN METRES (1:250 BEFORE REDUCTION)						
PROJECT NO.		B19175		CROWSON LANE		
COMP. REF.		SMULTRY.dwg		MT		
SURVEYOR		T.J.K. 12.08.20		LINDSEAY HWAY TO TEVIOT		
SURVEY REF.		CD45		UPGRADE & EXTENSION		
DESIGNED		R.vdB 10.05.21		ROAD DRAINAGE LAYOUT		
CHECKED		S.T. 10.05.21		SHEET 26 OF 35		
DRAWN		D.W.M. 02.09.22		DRAWING NUMBER		
CHECKED		M.P. 02.09.22		1 B19175-0826 -		

PRELIMINARY
NOT FOR CONSTRUCTION

NOTE:
REFER TO DRAWING B19175-DR00
FOR DETAILS, NOTES AND LEGENDS.



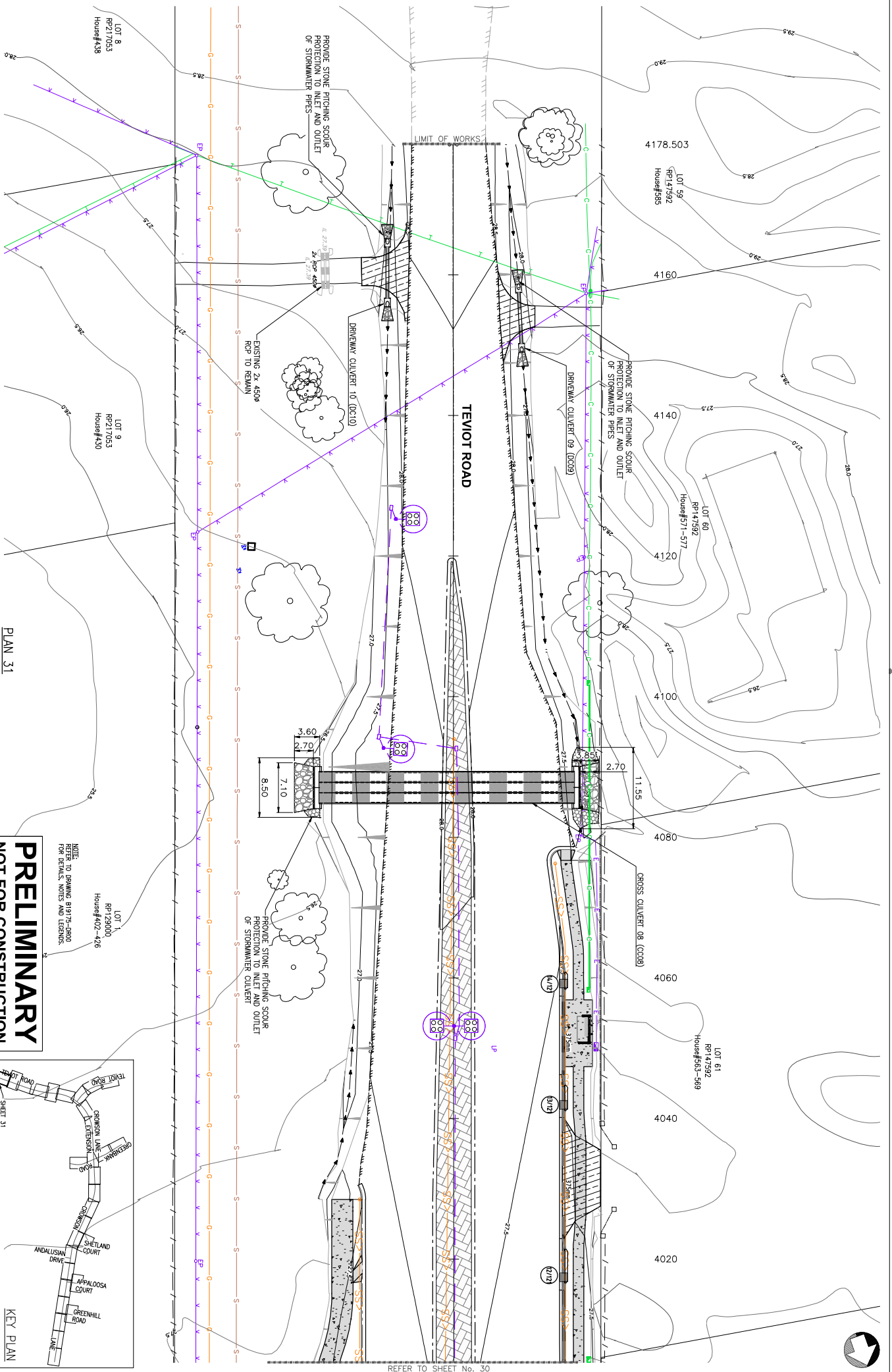
PLAN 28
SCALE 1:250

AMENDMENTS				SURVEY CONTROL POINTS				PROJECT NO.		CROWSON LANE MT LINDSAY HWY TO TREVOT RD UPGRADE & EXTENSION ROAD DRAINAGE LAYOUT SHEET 28 OF 31	
BY	CHKD	APP'D	DATE	PT	EASTING	NORTHING	RL	DESCRIPTION	COMP. REF.	SMOULY/ANG	DATE
								REFER TO DRAWING SET 'CL' FOR DETAILS BAR SCALES (A1 UNREduced)			
					0	5	10	15	20m		
					SCALE IN METRES (1:250 BEFORE REDUCTION)						
								CITY ADMINISTRATION CENTRE		DESIGN NUMBER	
								150 Kennedy Road, 4114 Logan City, QLD 4114 Phone: (0)7 3412 3444 Fax: (0)7 3412 3444 Senior Design Engineer Phone: (0)7 3412 4278 Info: info@logancity.qld.gov.au		SHEET 28 OF 33	
								PROJECT NO.		DRAWING NUMBER	
								B19175		1 B19175-DR28	
								COMP. REF.		DATE	
								T.L.K. 126.08.20			
								SURVEY REF.			
								C045			
								RWD 11.00.21			
								S.T. 10.08.21			
								CHECKED			
								MWP			
								10.08.22			
								CHECKED			
								S.T.			
								10.08.22			



CROWSON LANE
MT LINDSAY HWY TO TREVOT RD
UPGRADE & EXTENSION
ROAD DRAINAGE LAYOUT
SHEET 28 OF 31

REFER TO SHEET No. 27



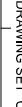
PLAN 31
SCALE 1:250

PRELIMINARY
NOT FOR CONSTRUCTION

KEY PLAN
SCALE 1:20,000

REFER TO SHEET No. 30

LOGAN CITY COUNCIL DM FILE NUMBER: 1089382-1

AMENDMENTS		BY	CHKD	APP'D	DATE
 WESTER PARTNERS STRUCTURAL-CIVIL-ENVIRONMENTAL ENGINEERS www.westernpartners.com.au ABN 52 097 417 975					
SURVEY CONTROL POINTS		FT	EASTING	NORTHING	RL
REFER TO DRAWING SET 'CJ' FOR DETAILS					
BAR SCALES (1 UNREDOUCED)		 SCALE IN METRES (1:250 BEFORE REDUCTION)			
 LOGAN CITY		 150 Administration Road Logan Shire, QLD 4114 Ph: (07) 3412 3412 Fax: (07) 3412 3444 Email: info@logancity.qld.gov.au			
PROJECT NO.		B19175		PROJECT NAME	
COMP. REF.		SMDUAT/444		ROAD NUMBER	
SHIRE/OR		T.A.K.		SHEET 31 OF 33	
SURVEY REF.		C245		DRAWING NUMBER	
DESIGNED		R.W.B.		1 B19175-DR31 -	
CHECKED		S.T.			
DRAWN		M.M.			
CHECKED		S.T.			

Existing Decision Notice Approval

APPENDIX C



Our ref: DEV2018/961/8

27 September 2023

Department of
**State Development, Infrastructure,
Local Government and Planning**

CH Hydrangea Pty Ltd
C/- Wolter Consulting Group Pty Ltd
Att: Ms Jen Taylor
PO Box 436
NEW FARM QLD 4005

Email: jtaylor@wolterconsulting.com.au

Dear Ms Taylor

Section 99 Approval - Application to Change PDA Development Approval
PDA Development Permit for Reconfiguring a Lot – 1 Lot into 11 Lots, New Roads and Open Space and Context Plan at 4499-4651 Mount Lindesay Highway, North Maclean described as Lot 39 on RP253739

On 27 September 2023 the Minister for Economic Development Queensland (MEDQ) decided to grant **all** of the amendment application applied for, subject to PDA development conditions set out in this PDA decision notice.

The PDA decision notice and approved plans/documents can be viewed in the MEDQ Development Approvals Register via the Department website www.dsdilgp.qld.gov.au/pda-da-applications.

If you require any further information, please contact Mrs Jennifer Davison, Principal Planner Development Assessment, in Economic Development Queensland, by telephone on (07) 3452 7127 or at jennifer.davison@dsdilgp.qld.gov.au, who will assist.

Yours sincerely

Brandon Bouda
A/Director
Development Assessment
Economic Development Queensland

PDA Decision Notice – Approval

Site information		
Name of priority development area (PDA)	Greater Flagstone PDA	
Site address	4499-4651 Mount Lindesay Highway, North Maclean	
Lot on plan description	Lot number	Plan description
	39	SP258739
PDA development application details		
DEV reference number	DEV2018/961	
'Properly made' date	29 August 2023	
Type of application	☐ PDA development application for: ☐ Material change of use ☐ Preliminary approval ☐ Development permit ☐ Reconfiguring a lot ☐ Preliminary approval ☐ Development permit ☐ Operational work ☐ Preliminary approval ☐ Development permit ☒ Application to change PDA development approval ☐ Application to extend currency period	
Description of proposal applied for	Reconfiguring a Lot - 1 into 11 Lots, New Road, and Open Space; and Context Plan	
PDA development approval details		
Decision of the MEDQ	The MEDQ has decided to grant all of the PDA development approval applied for, subject to PDA development conditions forming part of this decision notice. The changes relate to the inclusion of new drainage lots, pump station lot, additional industrial lot, temporary access easements and amended lot sizes.	
Original Decision date	10 September 2021	
Change to approval date	27 September 2023	
Currency period	6 years from the original decision date	

Approved Plans and Documents

The plans and documents approved by the MEDQ and referred to in the PDA development conditions for the PDA development approval are detailed below.

Approved plans and documents		Number	Date
1.	Plan of Reconfiguration, prepared by Wolter Consulting	22-0007P/01-02 Version E	14/08/2023
2.	Staging Sketch Plan, prepared by Wolter Consulting	22-0007P/01-03 Version E	14/08/2023
3.	Traffic Impact Assessment, prepared by Bitzos Consulting	P5708.001R North Maclean Industrial Estate TIA	15 August 2023
4.	Site Based Stormwater Management Plan (Quantity), prepared by Arcadis	EAG001-30109334-AAR Revision 9	15 August 2023
5.	Site Based Stormwater Quality Management Plan, prepared by Arcadis	EAG003-30109334-AAR Revision 4	15 August 2023
6.	Overall Bulk Earthworks Sketch Layout Plan, prepared by Arcadis	30109334-AAP-WS00OP-CV-SKT-030 Issue 1	15 August 2023
7.	Overall Water Main Sketch Layout Plan, prepared by Arcadis	30109334-AAP-WS00OP-CV-SKT-031 Issue 1	8/08/2023
8.	Overall Sewer Sketch Layout Plan, prepared by Arcadis	3010933-AAP WS00OP-CV-SKT-032 Issue 1	22/08/2023
9.	Swale and Channel Typical Details, prepared by Arcadis	30109334-AAP-WS00OP-CV-DRG-0164 Issue 5	31/07/2023
10.	Swale and Channel Longitudinal Section Sheet 2, prepared by Arcadis	30109334-AAP-WS00OP-CV-DRG-0162 Issue 5	31/07/2023
Plans and documents previously approved on 10 September 2021		Number	Date
11.	Bushfire Management Plan	Report 16014, Final V3	13 July 2018
12.	Addendum to the Bushfire Management Plan for the proposed development at 4499-4651 Mount Lindsay Highway, North Maclean	N/A	18 February 2019
13.	North Maclean Enterprise Precinct (4499-4651 Mount Lindesay Highway, North Maclean) – Progression of Ecological Issues	N/A	31 March 2017

Supporting Plans and Documents

To remove any doubt, the following documents are not approved documents for the purposes of this PDA development approval, but rather are supporting documents.

Supporting Plans, Reports and Specifications		Number	Date
Endorsed Context Plan			
1.	North Maclean Enterprise Context Plan Land Use and Road Network	N/A	12/07/2021 (as amended in red dated 03/09/2021)
2.	North Maclean Enterprise Context Plan Land Use and Road Network (Wider Locality)	N/A	12/07/2021
3.	North Maclean Enterprise Context Plan Ultimate Water and Sewer Network	N/A	12/07/2021
4.	North Maclean Enterprise Context Plan Ultimate Stormwater Network	N/A	12/07/2021 (as amended in red dated 03/09/2021)

Supporting Plans, Reports and Specifications

5.	Site Based Stormwater Management Plan	TEL202159, Issue A	08 July 2021
6.	Engineering Services Report	TEL202159, Issue A	06/07/21.

PDA Development Conditions

PREAMBLE AND ABBREVIATIONS

PREAMBLE

For the purpose of interpreting this PDA Development Approval, including the PDA Development Conditions, the following applies:

COMPLIANCE ASSESSMENT

Where a condition of this approval requires Compliance Assessment, Compliance Assessment is required in accordance with the following:

- a) The applicant must:
 - i) pay to MEDQ at the time of submission the relevant fee for Compliance Assessment, including any third party peer review costs which will be charged on a 100% cost recovery basis. The Compliance Assessment fees are set out in EDQ Development Assessment Fees and Charges Schedule¹ (as amended from time to time).
 - ii) submit to EDQ DA a duly completed Compliance Assessment form².
 - iii) submit to EDQ DA the documentation as required under the relevant condition.
- b) Where EDQ is satisfied the documentation submitted for Compliance Assessment meets the requirements of the relevant condition (or element of the condition), EDQ will endorse the documentation and advise by written notice.
- c) Compliance Assessment and endorsement can be repeated where a different design or solution, to that already endorsed, is sought.

¹ The EDQ Development Assessment Fees and Charges Schedule is available at EDQ's website.

² The Compliance Assessment form is available at EDQ's website. It sets out how to submit documentation for Compliance Assessment and how to pay Compliance Assessment fees.

- d) The process and timeframes that apply to Compliance Assessment are as follows:
- i) applicant submits items required under a) above to EDQ DA for Compliance Assessment.
 - ii) **within 30 business days** – EDQ assesses the documentation and:
 - 1. if satisfied, endorses the documentation; or
 - 2. if not satisfied, notifies the applicant accordingly.
 - iii) if the applicant is notified under ii.2. above, revised documentation must be submitted **within 30 business days** from the date of notification.
 - iv) **within 30 business days** – EDQ assesses the revised documentation and:
 - 1. if satisfied, endorses the revised documentation; or
 - 2. if not satisfied, notifies the applicant accordingly.
 - v) where EDQ notifies the applicant as stated under iv.2. above, repeat steps iii. and iv. above. If either party is not satisfied by the outcome of this process, that party can elect to enter into a mediation process with an independent mediator agreed to by both parties.

Despite note v. above, the condition (or element of the condition) is determined to have been met only when EDQ endorses relevant documentation.

SUBMITTING DOCUMENTATION TO EDQ:

Where a condition of this approval requires documentation to be submitted to either EDQ DA or EDQ IS, submit the documentation to:

- a) EDQ DA at: pdadevelopmentassessment@dsmip.qld.gov.au.
- b) EDQ IS at: EDQ_PrePostConstruction@dsmip.qld.gov.au.

ABBREVIATIONS

For the purposes of interpreting the PDA Development Conditions, the following is a list of abbreviations utilised:

- 1. **AILA** means a Landscape Architect registered Australian Institute Landscape Architect.
- 2. **Certification Procedures Manual** means the document titled *Certification Procedures Manual*, prepared by the Department of Infrastructure, Local Government and Planning, dated 16 October 2017 (as amended from time to time).
- 3. **Contributed Asset** means an asset constructed under a PDA development approval or Infrastructure Agreement that will become the responsibility of an External Authority. For the purposes of operational works for a Contributed Asset, the following definitions apply:
 - a. **External Authority** means a public-sector entity other than the MEDQ;
 - b. **Parkland** means carrying out operational work related to the provision of parkland infrastructure;
 - c. **Roadworks** means carrying out any operational work within existing or proposed road(s), to a depth of 1.5m measured from the top of kerb, and includes Streetscape Works;
 - d. **Sewer Works** means carrying out any operational work related to the provision of wastewater infrastructure;
 - e. **Streetscape Works** means carrying out any operational work within the verge of a road, including footpath surface treatments, street furniture, street lighting and landscaping;
 - f. **Stormwater Works** means carrying out any operational work related to the provision of stormwater infrastructure; and
 - g. **Water Works** means carrying out any operational work related to the provision of water infrastructure.
- 4. **Council** means Logan City Council.

5.	DSDILGP means The Department of State Development, Infrastructure, Local Government and Planning.	
6.	EDQ means Economic Development Queensland.	
7.	EDQ DA means Economic Development Queensland's – Development Assessment team.	
8.	EDQ IS means Economic Development Queensland's – Infrastructure Services team.	
9.	IFF means Infrastructure Funding Framework.	
10.	MEDQ means The Minister of Economic Development Queensland.	
11.	PDA means Priority Development Area.	
12.	RPEQ means Registered Professional Engineer of Queensland.	
No.	Condition	Timing
General		
1.	Carry out the Approved Development Carry out the approved development generally in accordance with the approved plans and documents; and any other documentation endorsed via Compliance Assessment as required by these conditions.	Prior to survey plan endorsement for the relevant stage
2.	Street Naming Submit to EDQ DA a schedule of street names approved by Council.	Prior to survey plan endorsement for the relevant stage
Construction		
3.	Hours of Work – Construction Unless otherwise endorsed, via Compliance Assessment for out of hours work, construction hours for the approved development are limited to Monday to Saturday between 6:30am to 6:30pm, excluding public holidays.	During construction unless otherwise endorsed
4.	Out of Hours Work – Compliance Assessment Where out of hours work is proposed, submit to EDQ DA, for Compliance Assessment, an out of hours work request. The out of hours work request must include a duly completed out of hours work request form ³ .	Minimum of 10 business days prior to proposed out of hours work commencement date
5.	Certification of Operational Work Carry out all Operational Work under this approval in accordance with the <i>Certification Procedures Manual</i> .	At all times

³ The out of hours work request form is available at EDQ's website.

6.	Construction Management Plan a) Submit to EDQ IS a site-based Construction Management Plan (CMP), prepared by the principal site contractor and reviewed by a suitably qualified and experienced person responsible for overseeing the site works, to manage construction impacts, including: i) noise and dust in accordance with the EP Act; ii) stormwater flows around and through the site without increasing the concentration of total suspended solids or Prescribed Water Contaminants (as defined in the EP Act), causing erosion, creating any ponding and causing any actionable nuisance to upstream and downstream properties; iii) contaminated land, where required under a site suitability statement prepared in accordance with section 389 of the EP Act; iv) complaints procedures; v) site management: 1. for the provision of safe and functional alternative pedestrian routes, past, through or around the site; 2. to mitigate impacts to public sector entity assets, including street trees, on or external to the site; 3. for safe and functional temporary vehicular access points and frequency of use; 4. for the safe and functional loading and unloading of materials including the location of any remote loading sites; 5. for the location of materials, structures, plant and equipment; 6. of waste generated by construction activities; 7. detailing how materials are to be loaded/unloaded; 8. of proposed external hoardings and gantries (with clearances to street furniture and other public sector entity assets); 9. of employee and visitor parking areas; 10. of anticipated staging and programming; 11. for the provision of safe and functional emergency exit routes; and 12. any out of hours work as endorsed via Compliance Assessment. b) A copy of the CMP submitted under part a) of this condition must be current and available on site. c) Carry out all construction work generally in accordance with the CMP submitted under part a) of this condition.	a) Prior to commencing work for the relevant stage b) During construction c) During construction
7.	Erosion and Sediment Management a) Submit to EDQ IS an Erosion and Sediment Control Plan (ESCP), certified by a RPEQ or an accredited professional in erosion and sediment control, and prepared generally in accordance with the following: i) construction phase stormwater management design objectives of the <i>State Planning Policy 2017</i> (Appendix 2 Table A);	a) Prior to commencing work for the relevant stage

	ii) <i>Healthy Land and Water Technical Note: Complying with the SPP – Sediment Management on Construction Sites.</i> b) Implement the certified ESCP submitted under part a) of this condition.	b) During construction
8.	Dispersive Soil Management a) Submit to EDQ IS a Dispersive Soil Management Plan, prepared by a soil science/soil chemistry specialist that details for the design, construction, and operational phases of the development including: i) the suite of methods required to identify and address potential issues associated with the exposure and re-use of dispersive soils, ii) details of the areas where dispersive soils will be disturbed and treated/rehabilitated. b) Implement and monitor the actions identified in the Dispersive Soil Management Plan as required under part a) of this condition.	a) Prior to commencing site works b) At all times during construction
9.	Traffic Management Plan a) Submit to EDQ IS a Traffic Management Plan (TMP), certified by a person holding a current Traffic Management Design qualification. The TMP must include the following: i) provision for the safe and functional management of traffic around and through the site during and outside of construction work hours; ii) provision for the safe and functional management of pedestrian traffic, including alternative pedestrian routes past, through or around the site; iii) provision of parking for workers and materials delivery; iv) risk identification, assessment and identification of mitigation measures; v) ongoing monitoring, management review and certified updates (as required); and vi) traffic control plans and/or traffic control diagrams, prepared in accordance with <i>Austroads Guide to Temporary Traffic Management</i>, for any temporary part or full road closures. b) Carry out all construction work generally in accordance with the certified TMP submitted under part a) of this condition, which is to be current and available on site. Advice Note: <i>Operational traffic changes, such as temporary and permanent lane modifications, relaxation of clearway zone hours or footpath closures may require authorisation from Council or DTMR as road manager. It is recommended that applicants engage directly with the applicable road manager.</i>	a) Prior to commencing work for the relevant stage b) During construction
10.	Public Infrastructure (Damage, Repairs and Relocation) a) Repair any damage to existing public infrastructure caused by works carried out in association with the approved development.	a) Prior to survey plan endorsement for the relevant stage

	b) Where existing public infrastructure require repair or relocation, due to the approved development and/or works associated with the approved development, repair and/or relocate the public infrastructure at no cost to others and in accordance with statutory requirements and adopted design standards. Advice Note: <i>It is recommended applicants record their own dated photographic evidence of the condition of relevant existing public infrastructure both before and after works carried out in association with the approved development.</i>	b) Prior to survey plan endorsement for the relevant stage
Earthworks and retaining walls		
11.	Compliance Assessment – Earthworks a) Submit to EDQ DA for Compliance Assessment detailed earthworks plans, certified by a RPEQ, and designed generally in accordance with: i) Australian Standard AS3798 – 2007 Guidelines on Earthworks for Commercial and Residential Developments and ii) the approved Overall Bulk Earthworks Sketch Layout Plan, 30109334-AAP-WS00OP-CV-SKT-030 Issue 1, prepared by Wolter Consulting. The certified earthworks plans are to: i) include a geotechnical soils assessment of the site; ii) accord with the Erosion and Sediment Control Plan, as required by condition 7 – Erosion and sediment management; iii) accord with the Dispersive Soil Management Plan, as required by condition 8 – Dispersive soil management; iv) include the location and finished surface levels of any cut and/or fill; v) provide details of any areas where surplus soils are to be stockpiled; vi) detail protection measures to: 1. ensure adjoining properties and roads are not impacted by ponding or nuisance stormwater resulting from earthworks associated with the approved development; 2. preserve all drainage structures from structural loading impacts resulting from earthworks associated with the approved development. b) Carry out earthworks generally in accordance with the certified plans endorsed by EDQ through part a) of this condition. c) Submit to EDQ IS RPEQ certification that: i) all earthworks have been carried out generally in accordance with the certified plans submitted under part a) of this condition; and ii) any unsuitable material encountered has been treated or replaced with suitable material.	a) Prior to commencing earthworks for the relevant stage b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage

12.	Retaining Walls (Excluding the Western Boundary Retaining Wall) a) Submit to EDQ IS detailed engineering plans, certified by a RPEQ, of all retaining walls 1m or greater in height. Retaining walls must be: i) certified to achieve a minimum 50 year design life; ii) designed generally in accordance with <i>AS4678 – Earth Retaining Structures</i> and relevant material standards (e.g., <i>AS3600 – Concrete Structures</i>); b) Construct retaining walls generally in accordance with the certified plans required under part a) of this condition. c) Submit to EDQ IS certification from an RPEQ that all retaining wall works 1.0m or greater in height have been constructed generally in accordance with the certified plans submitted under part a) of this condition.	a) Prior to commencing earthworks for the relevant stage b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage
13.	Compliance Assessment – Western Boundary Retaining Wall a) Submit to EDQ DA for Compliance Assessment preliminary engineering plans, certified by a RPEQ, of the proposed western boundary retaining wall adjoining the swale. The retaining wall must be: i) fully contained, including footings, within the private lots; ii) designed based on a professional geotechnical advice; iii) take into consideration scour and flood impacts from the adjoining swale; and iv) appropriately fenced (fauna exclusion). b) Submit to EDQ IS detailed engineering plans, certified by a RPEQ, of the proposed retaining wall along the western swale, generally in accordance with the endorsed plans required under part a) of this condition. The retaining wall must be: i) certified to achieve a minimum 100 year design life; ii) designed generally in accordance with <i>AS4678 – Earth Retaining Structures</i> and relevant material standards (e.g., <i>AS3600 – Concrete Structures</i>); c) Construct retaining walls generally in accordance with the certified plans required under part b) of this condition. d) Submit to EDQ IS: i) 'as-constructed' plans, certified by a RPEQ, demonstrating that the retaining wall has been constructed generally in accordance with the certified plans submitted under part a) of this condition. ii) A survey plan identifying the location of wall and footings to the property boundary.	a) Prior to commencing earthworks for Stage 2 b) Prior to survey plan endorsement for Stage 2 c) Prior to survey plan endorsement for Stage 2 d) Prior to survey plan endorsement for Stage 2

Roadworks, Urban Servicing and Stormwater Management

14.	Compliance Assessment – Internal Roads a) Submit to EDQ DA for Compliance Assessment functional layout plans, certified by a RPEQ, for the internal roads generally in accordance with: i) PDA Guideline No. 13 Engineering standards; and ii) Plan of Reconfiguration, Ref No. 22-0007P/01-02 Version E prepared by Wolter Consulting and dated 14/08/2023; and iii) Industrial Connector Street Cross-Section as identified in the Engineering Services Report prepared by Telford Civil and dated 06/07/21. The roads are to be designed to allow for the use of heavy vehicles (B-doubles). b) Submit to EDQ IS detailed engineering plans, certified by a RPEQ, for roadworks for the internal roads, including parking bays, traffic devices and footpaths generally in accordance with: i) PDA Guideline No. 13 Engineering standards; and ii) functional layout plans endorsed under part a) of this condition. c) Construct roadworks generally in accordance with the certified plans submitted under part b) of this condition. d) Submit to EDQ IS: i) certification from a RPEQ that all roadworks have been constructed generally in accordance with the certified plans submitted under part a) of this condition; and ii) all documentation as required by the <i>Certification Procedures Manual</i>. iii) as-constructed drawings, asset register and test results, certified by a RPEQ, in a format acceptable to the end asset owners for all roadworks constructed under this condition.	a) Prior to commencing site works b) Prior to commencing roadworks for the relevant stage c) Prior to survey plan endorsement for the relevant stage d) Prior to survey plan endorsement for the relevant stage
15.	Compliance Assessment – Crowson Lane and Greenhill Road Intersection Interim Layout Unless ultimate intersection works are already delivered by Council as part of the Crowson Lane augmentation project: a) Submit to EDQ DA for Compliance Assessment engineering design and construction drawings, certified by a RPEQ, for the auxiliary left-turn treatment and channelised right turn lane treatment at the Crowson Lane/Greenhill Road intersection, generally in accordance with the following plans/documents: i) PDA Guideline No. 13 Engineering standards; and ii) Traffic Impact Assessment, document reference P5708.001R North Maclean Industrial Estate TIA prepared Bitzos Consulting and dated 15 August 2023 b) Construct the works generally in accordance with the endorsed plans submitted under part a) of this condition.	a) Prior to commencing intersection works b) Prior to survey plan endorsement for the first stage

	c) Submit to EDQ IS: i) certification from a RPEQ that the intersection works have been constructed generally in accordance with the certified plans submitted under part b) of this condition; and ii) all documentation as required by the Certification Procedures Manual. iii) as-constructed drawings, asset register and test results, certified by a RPEQ, in a format acceptable to the end asset owners for all roadworks constructed under this condition.	c) Prior to survey plan endorsement for the first stage
16.	Mount Lindesay Highway Service Road a) Submit to EDQ IS, approval from the Department of Transport and Main Roads for the entirety of the Mount Lindesay Highway service lane as shown on Staging Sketch Plan, document reference 22-0007P/01-03 Version E, prepared by Wolter Consulting and dated 14/08/2023. The service lane is to be designed to allow for the use of heavy vehicles (B-doubles). b) Construct the extent of the service road as shown on Staging Sketch Plan, document reference 22-0007P/01-03 Version E, prepared by Wolter Consulting and dated 14/08/2023 from the intersection with the new internal road in Stage 1 to the Crowson Lane Interchange with the first stage of development in accordance with the approval from DTMR as required under part a). c) Construct the remainder of the service road as shown on staging Sketch Plan, document reference 22-0007P/01-03 Version E, prepared by Wolter Consulting and dated 14/08/2023 with the second stage of development in accordance with the approval from DTMR as required under part a). d) Submit to EDQ IS, certification from a RPEQ that all roadworks have been constructed generally in accordance part a) of this condition. Advice Note: Construction of this service lane in accordance with the Industrial Connector cross-section or as alternatively agreed to by EDQ and meets EDQ's minimum requirements for offsetable infrastructure, can be considered offsetable.	a) Prior to commencing works for Stage 1 b) As indicated c) As indicated d) Prior to survey plan endorsement for the relevant stage
17.	Street lighting Comply with either parts a) and c) or parts b) and c) of this condition. a) Design and install a <u>Rate 2</u> street lighting system, certified by a RPEQ, to all roads, including footpaths/bikeways within road reserves. The design of the street lighting system must: i) meet the relevant standards of Energex; ii) be endorsed by Energex as 'Rate 2 Public Lighting'; iii) be endorsed by Council as the Energex 'billable customer'; iv) be generally in accordance with <i>Australian Standards AS1158 – 'Lighting for Roads and Public Spaces</i>.	a) Prior to survey plan endorsement for the relevant stage

	b) Design and install a <u>Rate 3</u> street lighting system, certified by a suitably qualified and experienced RPEQ, to all roads, including footpaths/bikeways within road reserves. The design of the street lighting system must: i) be in accordance with <i>Australian Standards AS1158 – ‘Lighting for Roads and Public Spaces’</i> ii) meet the requirements of AS3000 – ‘SAA Wiring Rules’. iii) meet the requirements of Energex for unmetered supply iv) be endorsed by the relevant ownership authority. c) Submit to EDQ IS ‘as-constructed’ plans and test documentation, certified by a RPEQ, in a format acceptable to Council.	b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage
18.	Compliance Assessment - Water reticulation a) Submit to EDQ DA for Compliance Assessment a detailed water network plan, supported by hydraulic analysis, certified by RPEQ. The water network plan shall be prepared in accordance with: i) <i>SEQ Water Supply and Sewerage Design and Construction Code</i>; and ii) Overall Water Main Sketch Layout Plan, Plan no. 30109334-AAP-WS00OP-CV-SKT-031, Issue 1, prepared by Arcadis and dated 08/08/2023. b) Submit to EDQ IS detailed water reticulation design plans, certified by a RPEQ. The certified water reticulation design plans must be designed generally in accordance with: i) <i>SEQ Water Supply and Sewerage Design and Construction Code</i>; and ii) the endorsed water network analysis required under part a) of this condition. c) Construct water reticulation works generally in accordance with the certified plans submitted under part a) of this condition. d) Submit to EDQ IS ‘as constructed’ plans, certified by a RPEQ, of all water reticulation infrastructure constructed in accordance with this condition, including an asset register, pressure and bacterial test results in accordance with <i>SEQ Water Supply and Sewerage Design and Construction Code – Asset Information</i>.	a) Prior to commencing works for Stage 1 b) Prior commencing water reticulation work for the relevant stage c) Prior to survey plan endorsement for the relevant stage d) Prior to survey plan endorsement for the relevant stage
19.	Compliance Assessment – Internal Sewer Reticulation a) Submit to EDQ DA for Compliance Assessment a detailed internal sewerage network plan, supported by hydraulic analysis, certified by RPEQ. The internal sewer network plan shall be prepared in accordance with: i) <i>SEQ Water Supply and Sewerage Design and Construction Code</i>; and ii) Overall Sewer Sketch Layout Plan, Plan No. 3010933-AAP-WS00OP-CV-SKT-032, Issue 1, prepared by Arcadis and dated 22/08/23. The sewerage network plan shall include the extension of the internal sewer reticulation to the southern boundary to service the external catchment falling to the site.	a) Prior to commencing works for the relevant stage

	b) Submit to EDQ IS detailed sewer reticulation design plans, certified by a RPEQ. The certified sewer reticulation design plans must be designed generally in accordance with: i) <i>SEQ Water Supply and Sewerage Design and Construction Code</i>; and ii) the endorsed sewer network plan required under part a) of this condition c) Construct the internal sewer reticulation works generally in accordance with the certified plans submitted under part b) of this condition. d) Submit to EDQ IS 'as constructed' plans, certified by an RPEQ, of all internal sewer reticulation infrastructure constructed in accordance with this condition, including an asset register, pressure and CCTV results in accordance with <i>SEQ Water Supply and Sewerage Design and Construction Code - Asset Information</i>. Advice Note: <i>The Sub-Regional sewerage pump station NM1 and external sewer rising main will be constructed and put in operation by Council.</i>	b) Prior to commencing works for the relevant stage c) Prior to survey plan endorsement for the relevant stage d) Prior to survey plan endorsement for the relevant stage
20.	Temporary Sewage Tankering of Wastewater Unless the Sub-Regional sewerage pump station NM1 and external rising main is completed and in operation by Council: a) Enter into a tankering agreement with Council for the collection and disposal of wastewater for any lots created; and b) Maintain the tankering agreement required by part a) of this condition until Sub-Regional sewerage pump station NM1 is commissioned.	a) Prior to survey plan endorsement for the first stage b) As indicated
21.	Compliance Assessment – Updated Site Based Stormwater Management Plan Submit to EDQ DA for Compliance Assessment an updated Site Base Stormwater Management Plan (SBSMP), certified by a RPEQ, for the management of stormwater within the site to ensure non-worsening to downstream properties, including Mt Lindesay Highway, generally in accordance with <i>PDA Guideline No. 13 Engineering standards, Stormwater Quantity and Stormwater Quality</i>. The updated SBSMP shall include the following: i) Confirmation that the subject site is not impacted by flooding. This confirmation is to be provided through the undertaking of a site based flood model. If impacted by flood, provide further details on the Q100 line and the type of inundation – conveyance and/or storage; OR Demonstrate that the updated current solution identified in the SBSMP ensures that there is no worsening at lawful point of discharge based on Council's nominated 1% AEP flood level at Mt Lindesay Highway. ii) the on-site detention/bio-retention basins form part of the overall solution. Provide an engineering and legal	Prior to commencing works

	strategy/mechanism (e.g., Easement) to ensure that these devices can continue to perform as designed into the future. iii) Demonstrate that the design of the road stormwater system will convey runoff from the road reserve and the pre-developed lots to the proposed detention / bio-retention basin. iv) Demonstrate that the configuration, sizing and operation of the proposed detention / bio-retention basin system will accommodate runoff from the road stormwater system as per part (iii) above and result in no net worsening downstream of the site. v) Conveyance of existing external flows to the existing lawful point of discharge, ensuring no-net worsening downstream of the site.	
22.	Stormwater Conveyance System a) Submit to EDQ IS detailed engineering drawings and hydraulic calculations, certified by a RPEQ, for the stormwater conveyance system designed generally in accordance with: i) <i>PDA Guideline No. 13 Engineering standards – Stormwater quantity</i>; and ii) Updated Site Based Stormwater Management Plan, required by Condition 21 of this approval. b) Construct stormwater network generally in accordance with the certified plans submitted under part a) of this condition. c) Submit to EDQ IS "as constructed" plans, certified by a RPEQ including an asset register in a format acceptable to Council.	a) Prior to commencing works for the relevant stage b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage
23.	Compliance Assessment - Stormwater detention/bio-retention basin a) Submit to EDQ DA for Compliance Assessment detailed engineering drawings and hydraulic calculations, certified by a RPEQ, for the proposed detention/bio-retention basin designed generally in accordance with: i) <i>PDA Guideline No. 13 Engineering standards – Stormwater Quantity and Stormwater Quality</i>; and ii) Updated Site Based Stormwater Management Plan, required by Condition 21 of this approval. b) Construct the basin generally in accordance with the endorsed plans required under part a) of this condition. c) Submit to EDQ IS "as constructed" plans, certified by a RPEQ including an asset register in a format acceptable to Council. Advice Note: <i>The proposed industrial allotments will have lot-based on-site stormwater detention and water quality treatment measures in the post-development phase. These treatment devices will be installed by the future lot owner with their size and location being allocated to suit the end use. Maintenance of these devices will be the responsibility of the future lot owners.</i>	a) Prior to commencing works b) Prior to survey plan endorsement for the first stage c) Prior to survey plan endorsement for the first stage

24.	Compliance Assessment – Swale a) Submit to EDQ DA for Compliance Assessment detailed engineering drawings and hydraulic calculations, certified by a RPEQ, for the stormwater swale on the western boundary of the land designed generally in accordance with: i) PDA Guideline No. 13 Engineering standards – Stormwater quantity and: ii) Swale and Channel Longitudinal Section, Plan No. 30109334-AAP-WS00OP-CV-DRG-0162, Issue 5, Prepared by Arcadis and dated 31/07/2023 iii) Swale and Channel Typical Sections, Plan No. 30109334-AAP-WS00OP-CV-DRG-0164, Issue 5, Prepared by Arcadis and dated 31/07/2023 The detailed design shall ensure that the swale: iv) has adequate capacity to convey overland flow up to including the 1 in 100 year event with appropriate freeboard v) is free flowing with no ponding vi) is provided with an adjacent track to allow future maintenance vii) maintain a depth*velocity product not exceeding 0.6 up to including 1 in 100 year event unless agreed in writing by Council viii) is appropriately fenced (fauna exclusion) along the eastern side of the swale. b) Construct the swale generally in accordance with the endorsed plans required under part a) of this condition. c) Submit to EDQ IS swale "as constructed" plans, certified by a RPEQ including an asset register in a format acceptable to Council.	a) Prior to commencing works b) Prior to survey plan endorsement for Stage 2 c) Prior to survey plan endorsement for Stage 2
25.	Electricity a) Submit to EDQ IS a Certificate of Electricity Supply from ENERGEX for the provision of electricity supply to the approved development. b) Connect the approved development in accordance with the Certificate of Electricity Supply submitted under part a) of this condition.	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage
26.	Telecommunications a) Submit to EDQ IS documentation from an authorised telecommunication service provider confirming that an agreement has been entered into for the provision of underground telecommunication services to the approved development. b) Connect the approved development in accordance with the documentation submitted under part a) of this condition.	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage

27.	Broadband a) Submit to EDQ IS written agreement, from an authorised telecommunications service provider, confirming that fibre-ready pit and pipe infrastructure designed to service the approved development can accommodate services compliant with <i>Industry Guideline G645:2017 Fibre-Ready Pit and Pipe Specification for Real Estate Development Projects</i>. b) Construct the fibre-ready pit and pipe infrastructure specified in the agreement submitted under part a) of this condition.	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage
28.	Gas a) Submit to EDQ IS, documentation from an authorised gas service provider, confirming that an agreement has been entered into for the provision of underground gas services to the proposed development. b) Connect the development to underground gas services in accordance with the agreement mentioned in part a) of this condition.	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage
Landscape and Environment		
29.	Streetscape Works – Compliance Assessment a) Submit to EDQ DA, for Compliance Assessment, detailed streetscape works drawings, certified by an AILA, for proposed streetscape works for all internal roads, including a schedule of proposed standard and non-standard Contributed Assets to be transferred to Council. The certified drawings are to include, where relevant: i) location and type of street lighting in accordance with AS1158 – ‘Lighting for Roads and Public Spaces’; ii) footpath treatments; iii) location and specifications of streetscape furniture; iv) location and size of stormwater treatment devices; and v) street trees and plants, including species, size and location generally in accordance with Council’s adopted planting schedules and guidelines. b) Construct streetscape works generally in accordance with the streetscape plans endorsed under part a) of this condition. c) Submit to EDQ IS ‘as constructed’ plans, certified by an AILA, and asset register in a format acceptable to Council.	a) Prior to commencing streetscape work for the relevant stage b) Prior to survey plan endorsement for the relevant stage c) Prior to survey plan endorsement for the relevant stage
30.	Vegetation Clearing a) Submit to EDQ IS a vegetation clearing plan prepared by an ecologist for each stage that excludes the 25m buffer corridor and lot identified for open space.	a) Prior to commencement of clearing for relevant stage

	b) Undertake vegetation clearing generally in accordance with the plan submitted under part a) of this condition. The clearing is to be undertaken with the stage to be developed. c) Vegetation clearing is to be supervised by an Ecologist. d) Submit to EDQ IS written certification from an Ecologist that vegetation clearing has been carried out generally in accordance with part b) of this condition.	b) At all times c) At all times d) Within 3 months of completion of clearing of the relevant stage
31.	Fauna Spotter a) A licensed Wildlife Spotter/Catcher under the <i>Nature Conservation Act 1992</i> is to undertake a survey of the site to identify any fauna or habitat features (e.g., nests, tree hollows) and certify that any necessary fauna protection measures or relocation procedures have been implemented. b) A licensed Wildlife Spotter/Catcher must be present during the vegetation clearing. c) Submit to EDQ IS certification from the licensed Wildlife Spotter/Catcher that vegetation clearing, and fauna protection measures was carried out generally in accordance with the conditions of approval. Advice Note: <i>Where an Environmental Protection and Biodiversity Conservation Act 1999 (EPBC) approval has been granted and includes fauna spotter requirements, the fauna spotter requirements under this condition will not be applicable for the same matters under the EPBC approval.</i>	a) Prior to commencement of vegetation clearing for the relevant stage b) At all times during vegetation clearing c) Within 3 months of the completion of vegetation clearing of the relevant stage
32.	Vegetation – Compensatory Planting a) Submit to EDQ IS a planting plan certified by an ecologist showing the extent of compensatory planting to be undertaken in lot identified as 'Open Space' on Proposed Development Layout Plan, Plan No. TIEL2020159.CIV.DA, Dwg 10, Issue H dated 07/07/2021, excluding the minimum 25m buffer on the western boundary, including, type and extent of planting, as set out in the EDQ Guideline 17: Remnant Vegetation and Koala Habitat Obligations in Greater Flagstone and Yarrabilba PDAs dated May 2015. b) Undertake compensatory planting in accordance with a) of this condition. c) Once compensatory planting has been undertaken, submit to EDQ IS confirmation from a qualified arborist (AQF Level 5) or ecologist that the compensatory planting has been undertaken in accordance with b) of this condition.	a) Prior to commencement of vegetation clearing for the relevant stage b) Within 3 months of commencement of vegetation clearing c) Within 12 months of commencement of vegetation clearing of the relevant stage

33.	Bushfire Management a) Carry out Bushfire Management Works in accordance with: - Section 6 of the approved Bushfire Management Plan, Report 16014, Final V3, dated 13 July 2018; and - Addendum to the Bushfire Management Plan for the proposed development at 4499-4651 Mount Lindsay Highway, North Maclean dated 18 February 2021. b) Submit to EDQ IS verification from a suitably qualified professional that the works required for bushfire management and mitigation within the relevant stages have been carried out generally in accordance with the relevant approved plans and documents. Advice Note: <i>If the adjoining landowner obtains approval for vegetation clearing that reduces bushfire impact, then this can be articulated though an updated context plan supported by a new bushfire advice.</i>	a) Prior to survey plan endorsement for the relevant stage b) Prior to survey plan endorsement for the relevant stage
Surveying, Land Transfers and Easements		
34.	Land Transfers – Contaminated Land Submit to EDQ IS a copy of a site suitability statement, as required under the EP Act, confirming that all land conditioned to be transferred to a trustee is suitable for the intended purpose(s). The site suitability statement must be prepared by a suitably qualified person and be certified by an approved auditor in accordance with the EP Act. NOTES: <i>For the purpose of this condition a suitably qualified person is defined in the EP Act. A list of approved auditors can be found at the following website:</i> https://www.qld.gov.au/environment/pollution/management/contaminated-land/auditor-engagement.	Prior to survey plan endorsement for the relevant stage
35.	Land Transfers – Drainage and Offset Area Transfer, in fee simple, to Council as trustee, the Lot identified as Open Space as shown on the approved plans for drainage and offset open space purposes.	At registration of survey plan for Stage 2
36.	Land transfers – Sewerage pump station Transfer in fee simple, to Council as trustee, Lot 905 as shown on Plan of Subdivision, Plan No. 22-0007P/01-02, Version E prepared by Wolter Consulting and dated 14/08/23. The land metes and bounds must be to the satisfaction of the Chief Executive Officer of the authority. Advice Note: <i>This land forms part of the sub-regional sewer infrastructure to be delivered by Council. Offsets for the land may be available.</i>	At registration of survey plan for the first stage

37.	Rising Main Easement Provide a 6m wide easement, in favour of and at no cost to the Council, along the southern boundary for the proposed sub-regional sewerage rising main generally in accordance as shown on Overall Sewer Sketch Layout Plan, Plan No. 3010933-AAP-WS00OP-CV-SKT-032, Issue 1, prepared by Arcadis and dated 22/08/23. The terms of public utility easements are to be to the satisfaction of the Chief Executive Officer of the authority which is to accept and maintain the Contributed Assets. Advice Note: <i>If an alternative route for the rising main is pursued, the easement can be cancelled at the agreement of Council.</i>	At registration of survey plan for the first stage
38.	Easements over Infrastructure Provide public utility easements, in favour of and at no cost to the grantee, over infrastructure located in land (other than road) for Contributed Assets. The terms of public utility easements are to be to the satisfaction of the Chief Executive Officer of the authority which is to accept and maintain the Contributed Assets.	At registration of survey plan for the relevant stage

STANDARD ADVICE

Please note that to lawfully undertake development, it may be necessary to obtain approvals other than this PDA development approval. For advice on other approvals that may be necessary in relation to your proposal, it is recommended that you seek professional advice.

**** End of Package ****

TUFLOW Mapping

APPENDIX D

Figure E-1 - Flood Depths - Existing Case 2 year ARI - 50% AEP

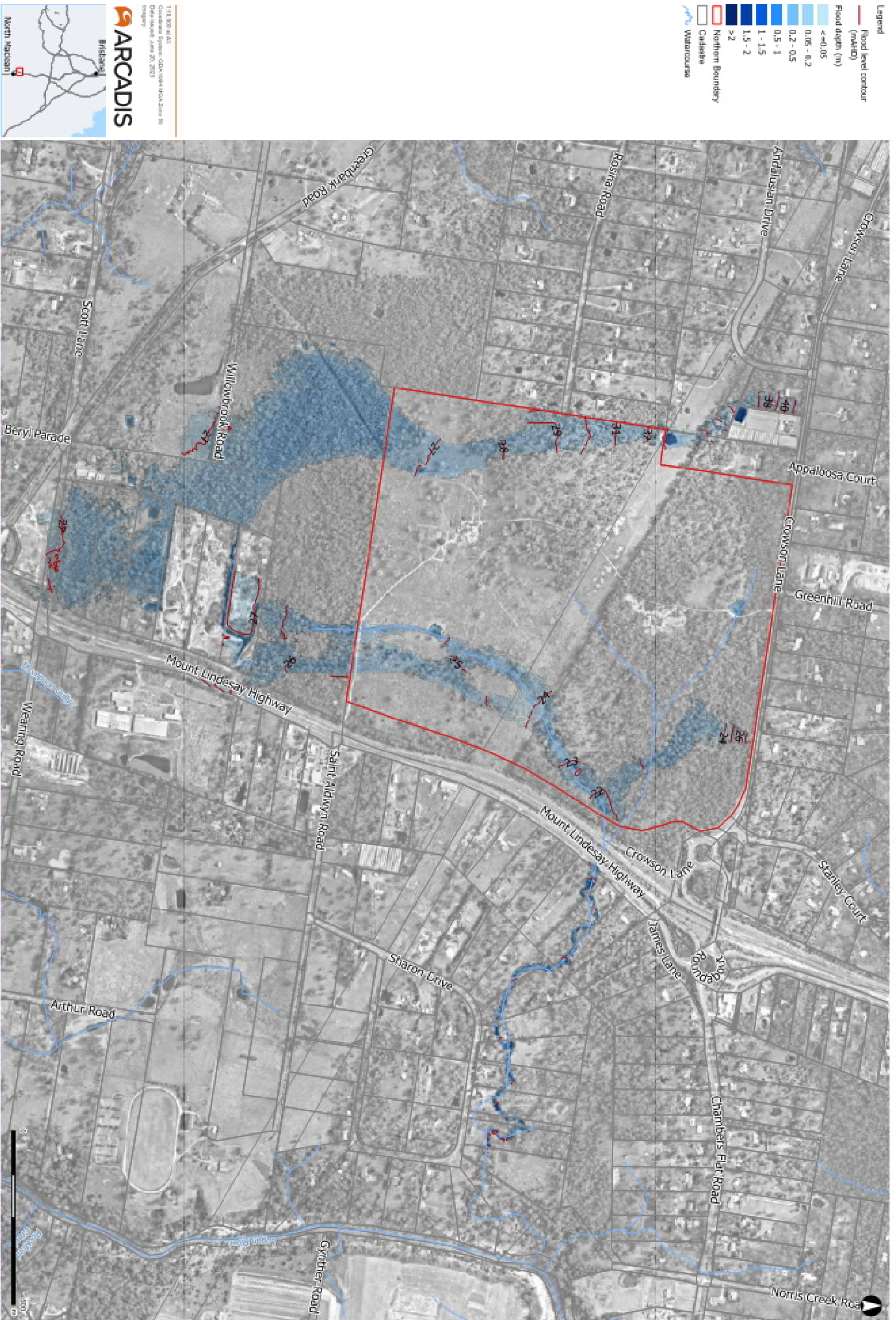
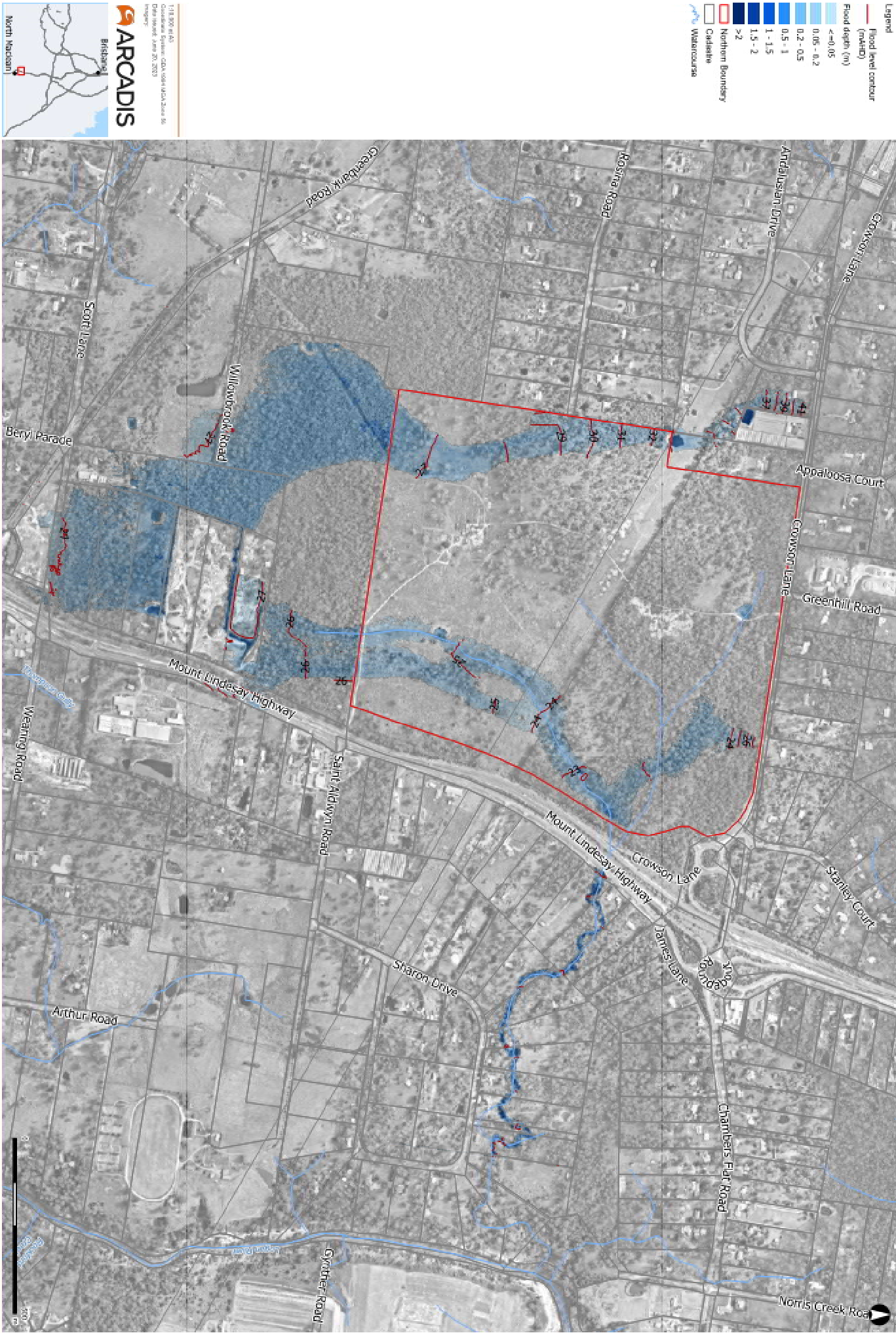


Figure E-2 - Flood Depths - Existing Case 5 year ARI - 20% AEP



Legend

Flood level contour (mMAD)

Flood depth (m)

0.05 - 0.2

0.2 - 0.5

0.5 - 1

1 - 1.5

1.5 - 2

>2

Northern Boundary

Cardinalite

Watercourse

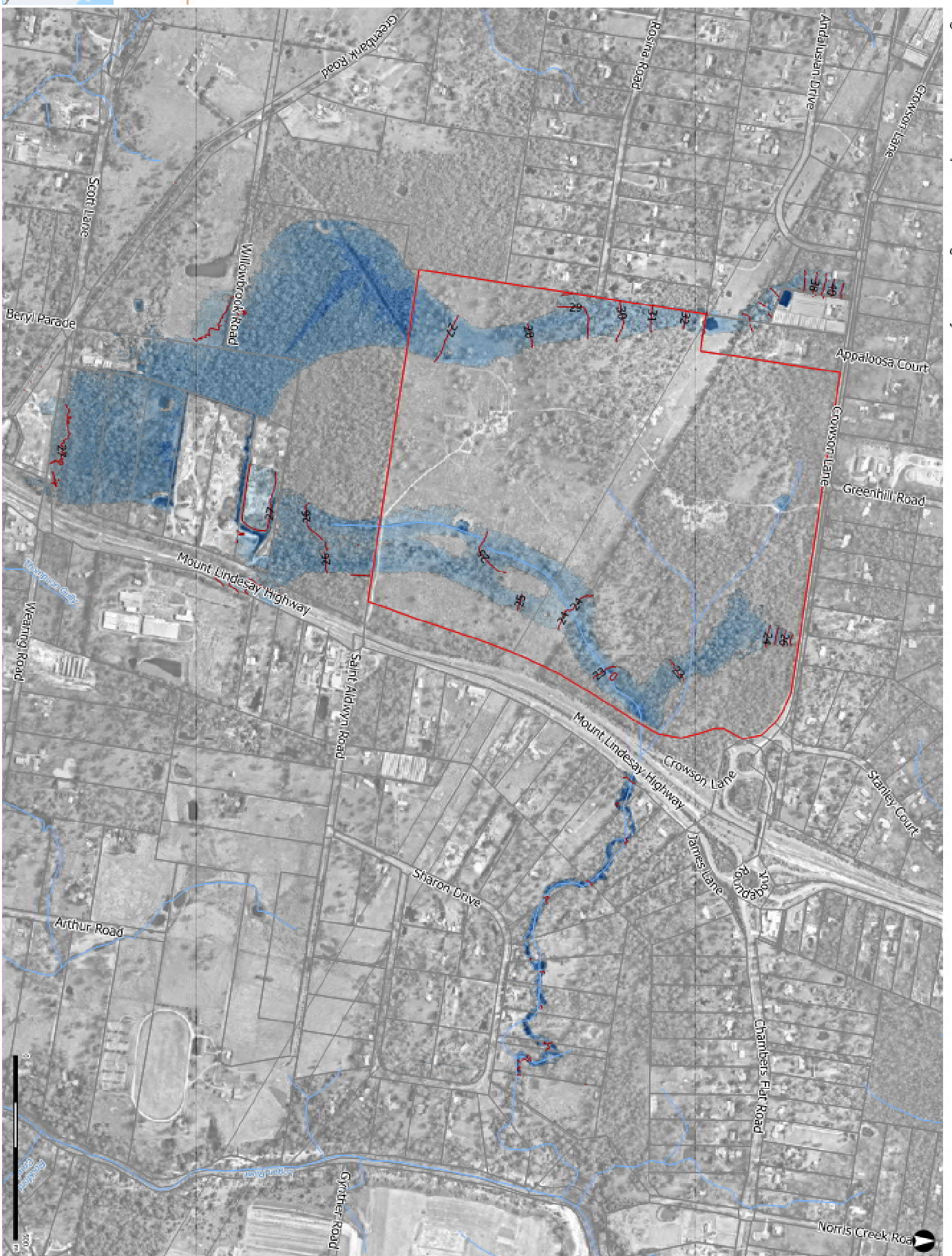


Figure E-4 - Flood Depths - Existing Case 20 year ARI - 5% AEP

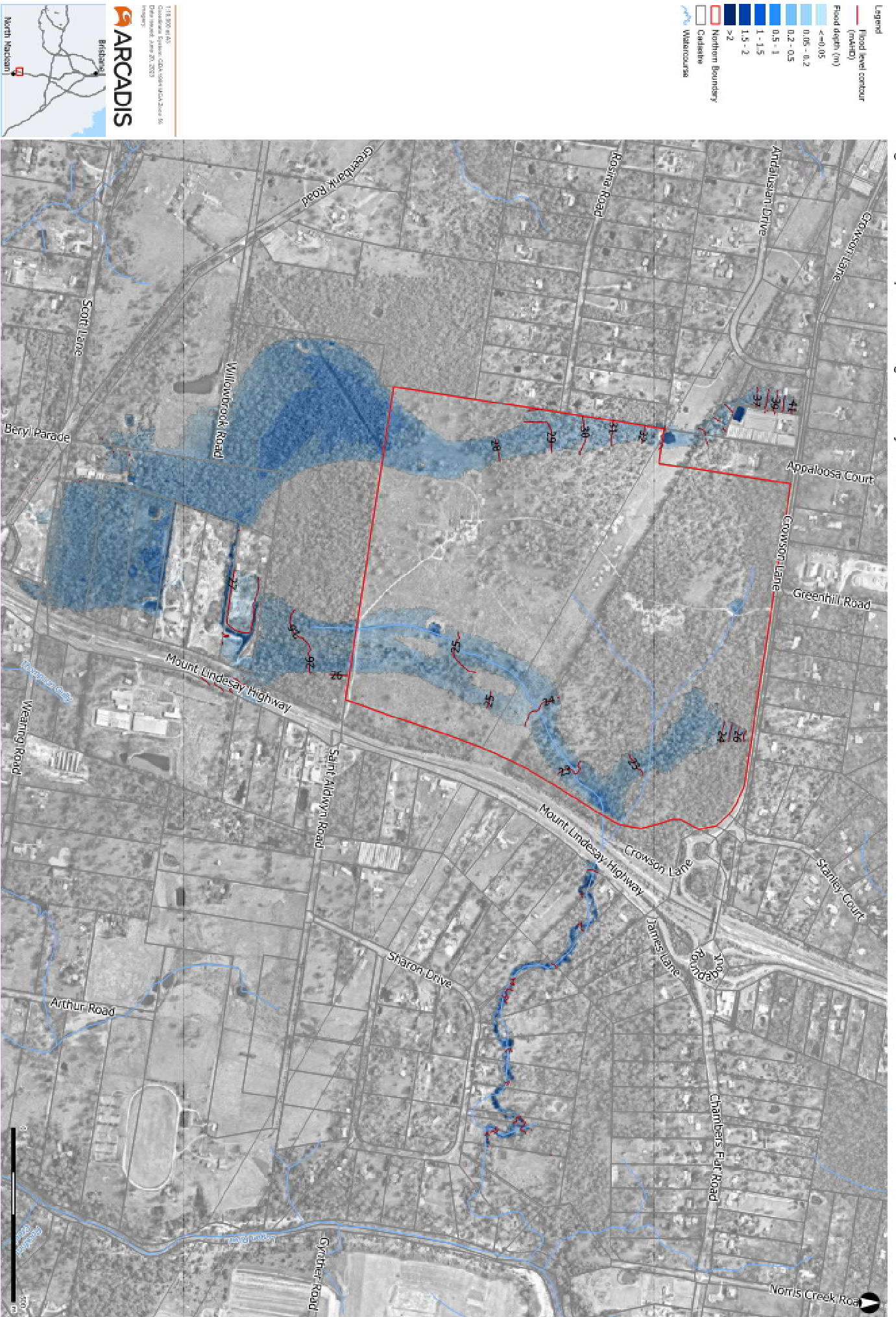


Figure E-5 - Flood Depths - Existing Case 50 year ARI - 2% AEP

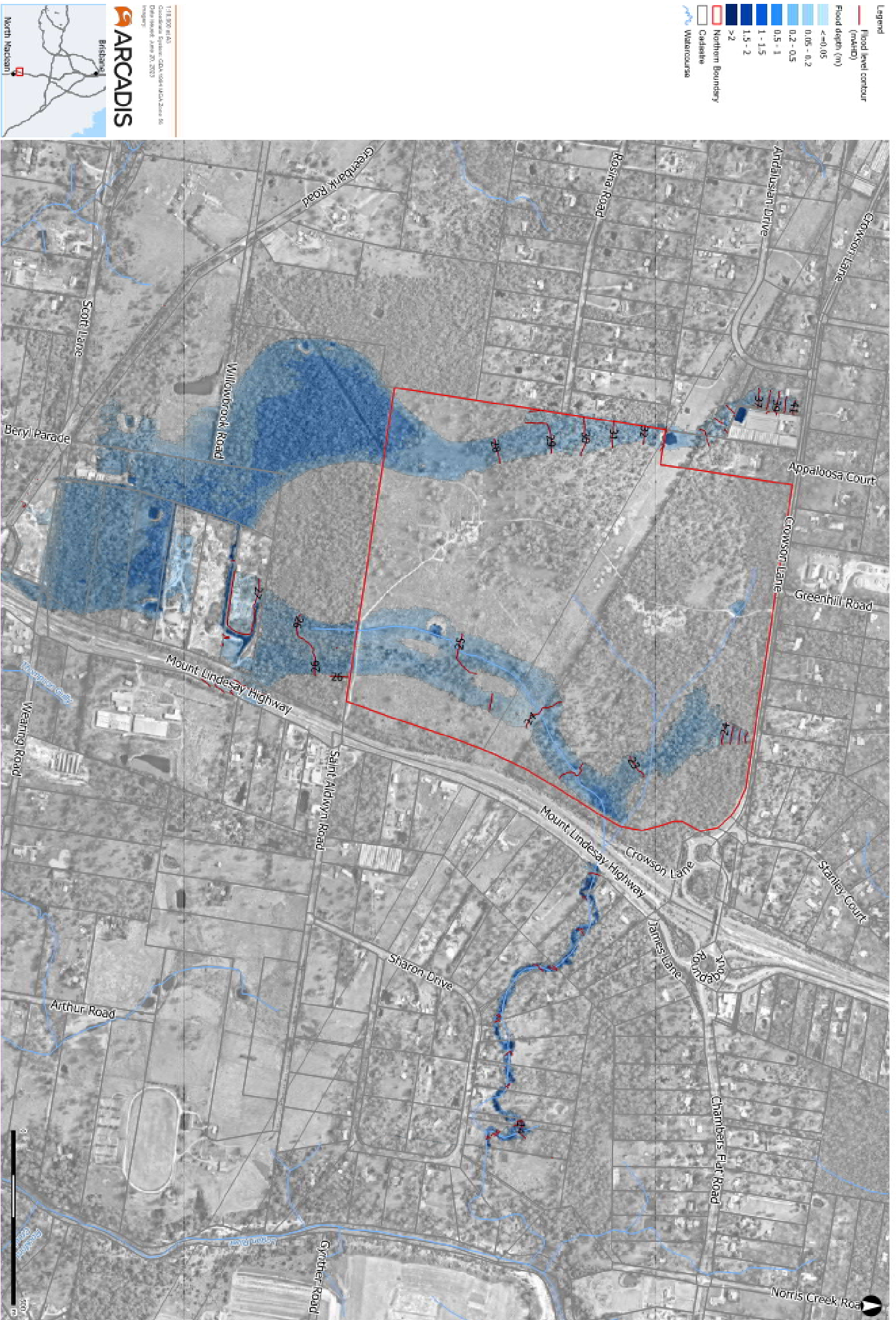


Figure E-7 - Flow Velocity - Existing Case - 50% AEP



Figure E-8 - Flow Velocity - Existing Case - 20% AEP



Figure E-9 - Flow Velocity - Existing Case - 10% AEP



Figure E-12 - FlowVelocity - Existing Case - 1% AEP





Figure D-3 - Flood Depths - Design Case - 10% AEP

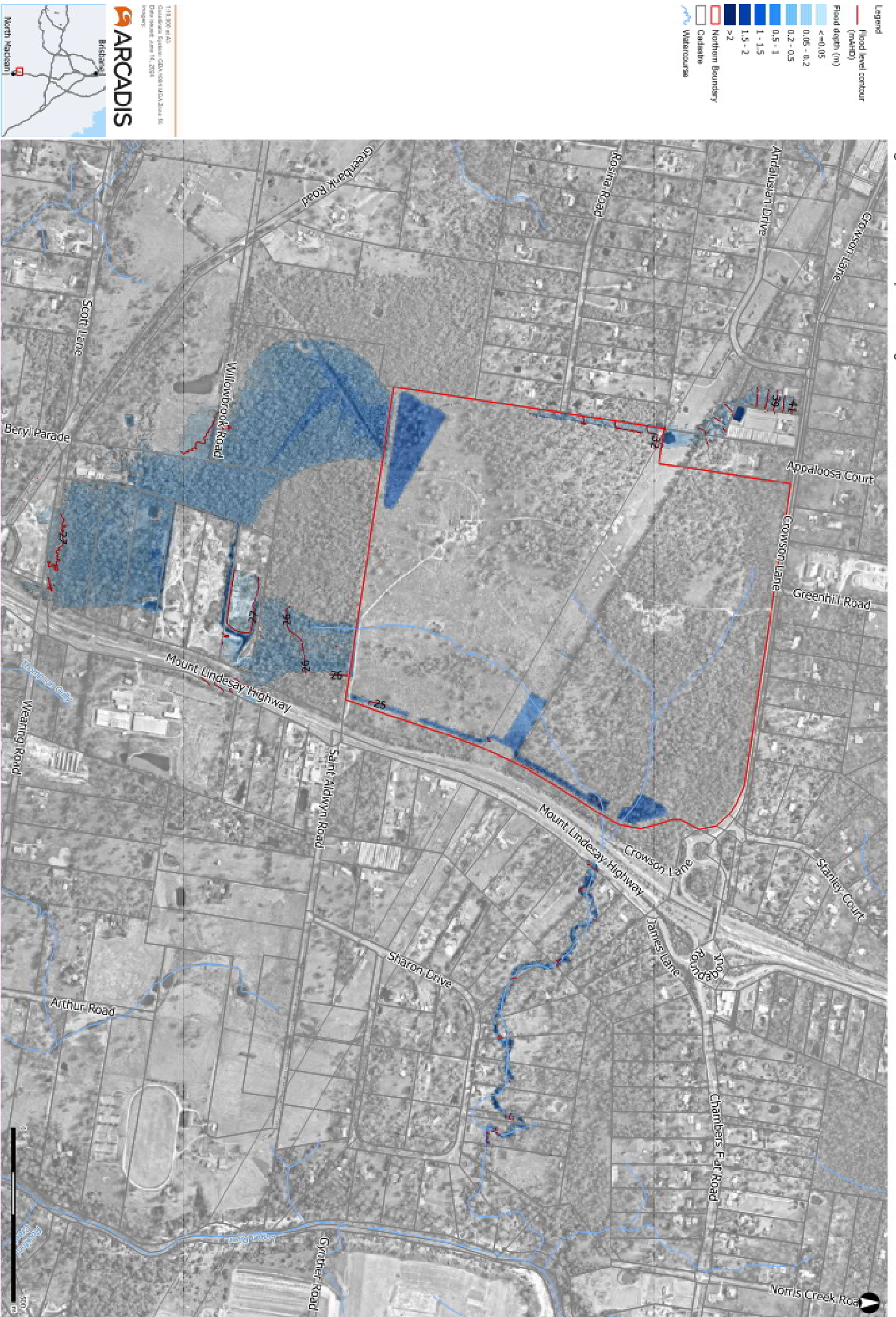


Figure D-4 - Flood Depths - Design Case - 5% AEP

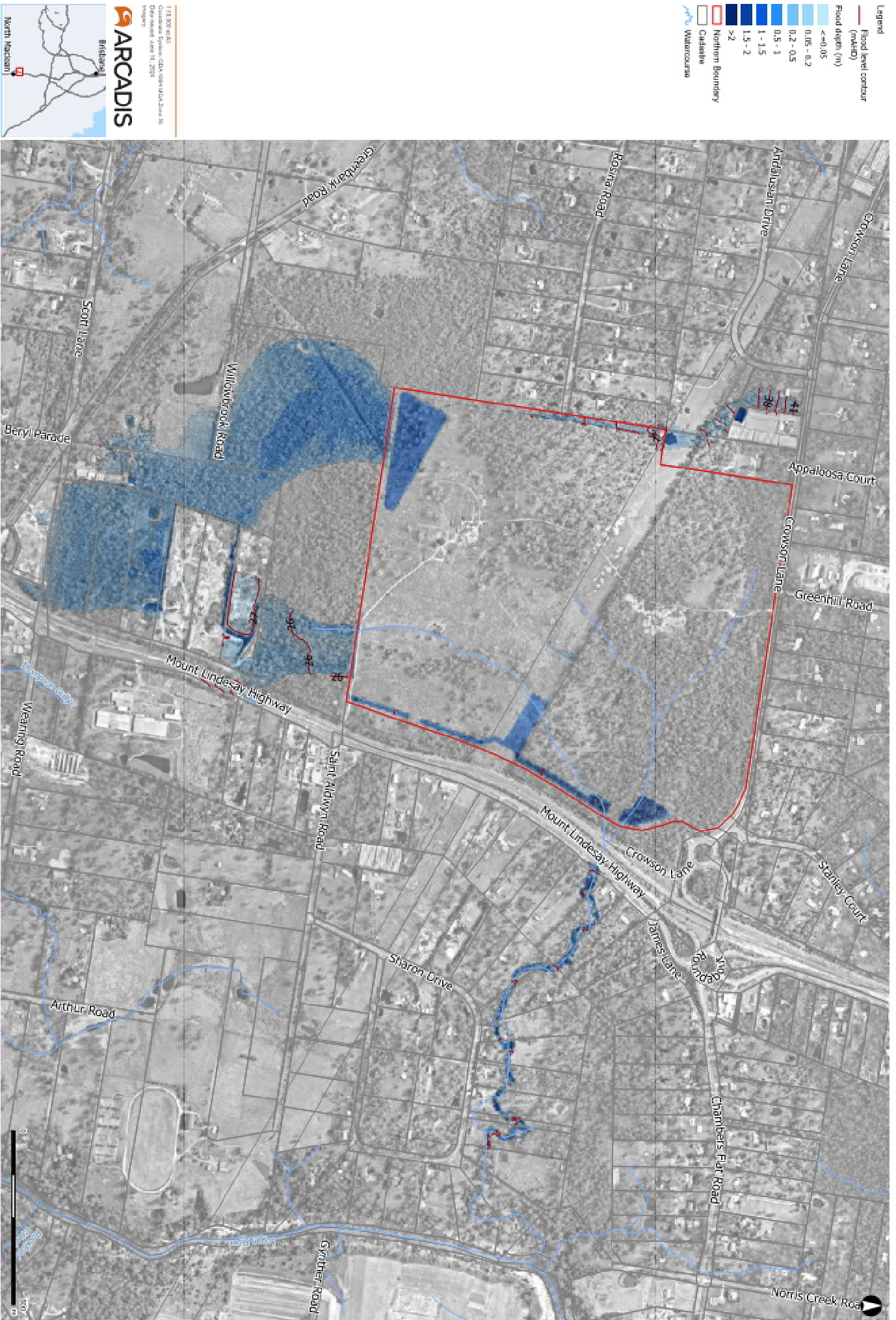


Figure D-5 - Flood Depths - Design Case - 2% AEP

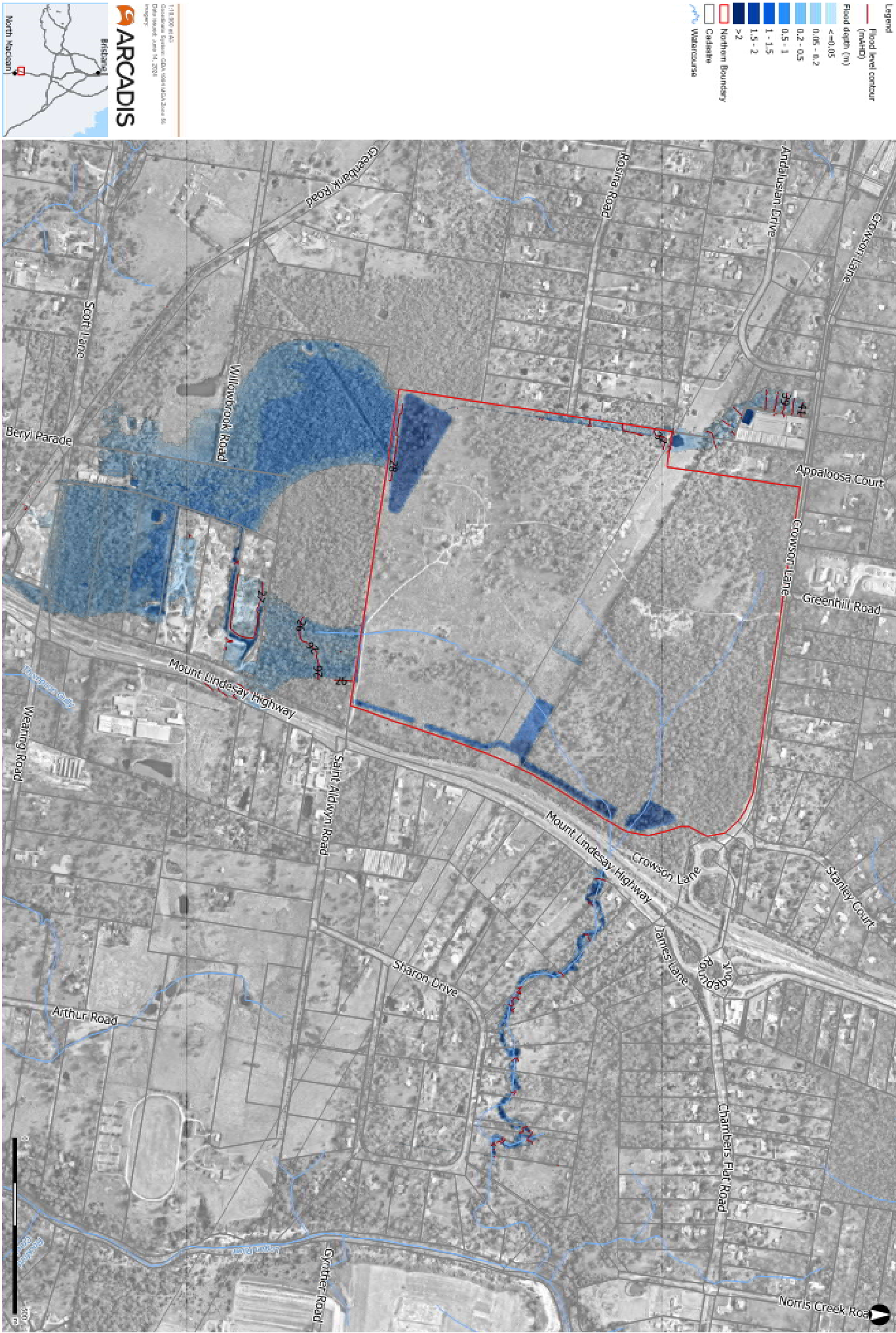


Figure D-6 - Flood Depths - Design Case - 1% AEP

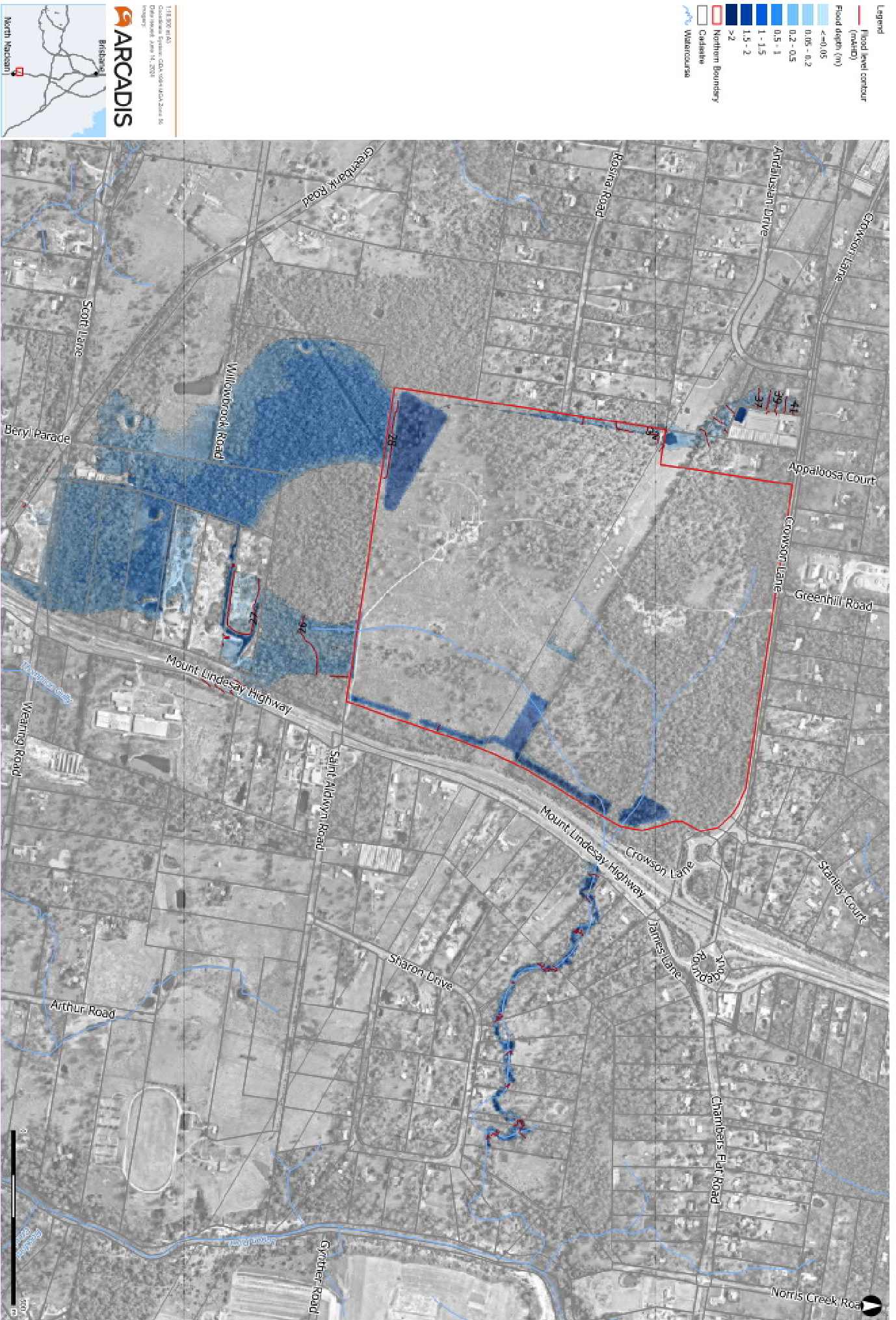


Figure D-7 - Flow Velocity - Design Case - 50% AEP

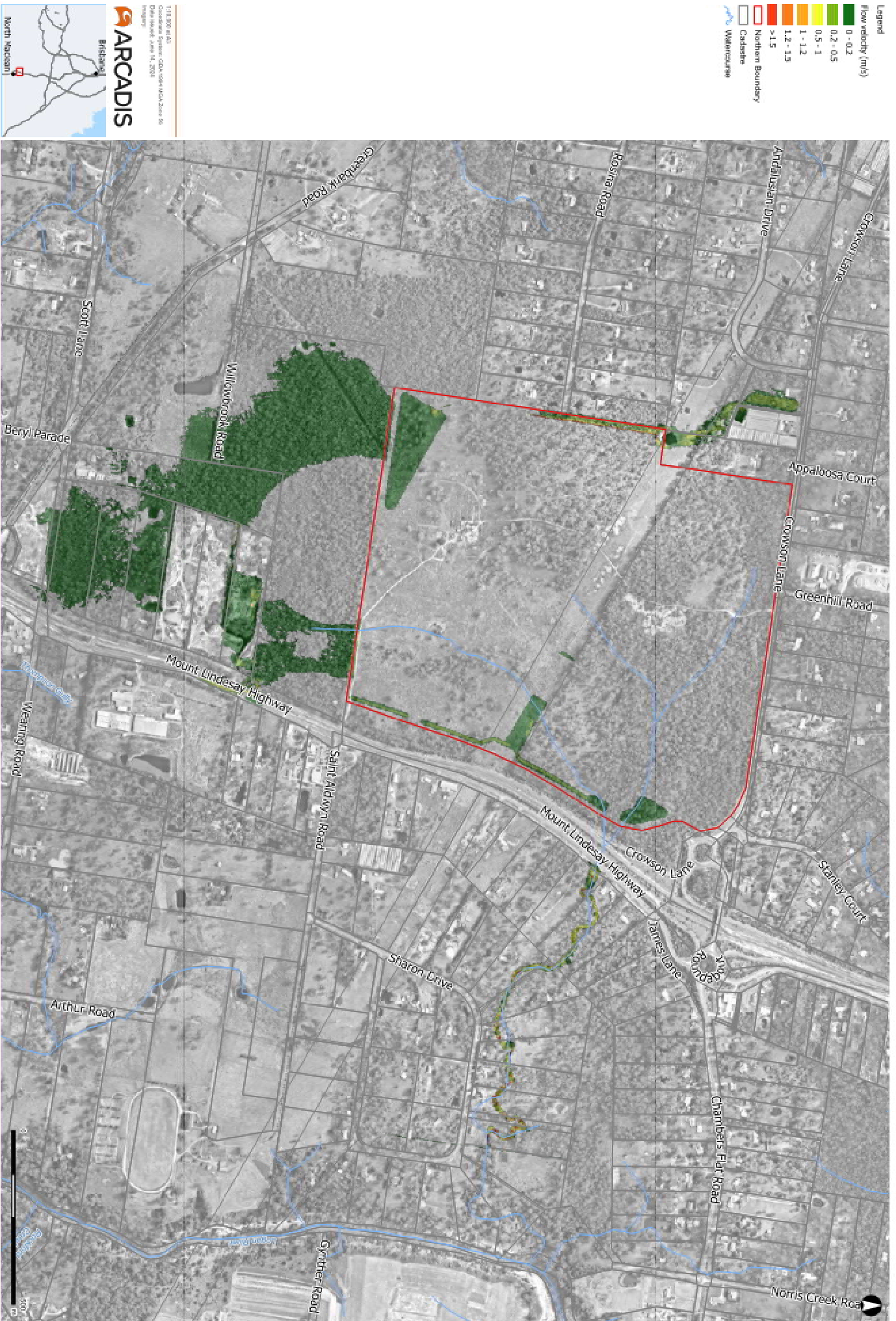


Figure D-8 - Flow Velocity - Design Case - 20% AEP



Figure D-9 - Flow Velocity - Design Case - 10% AEP

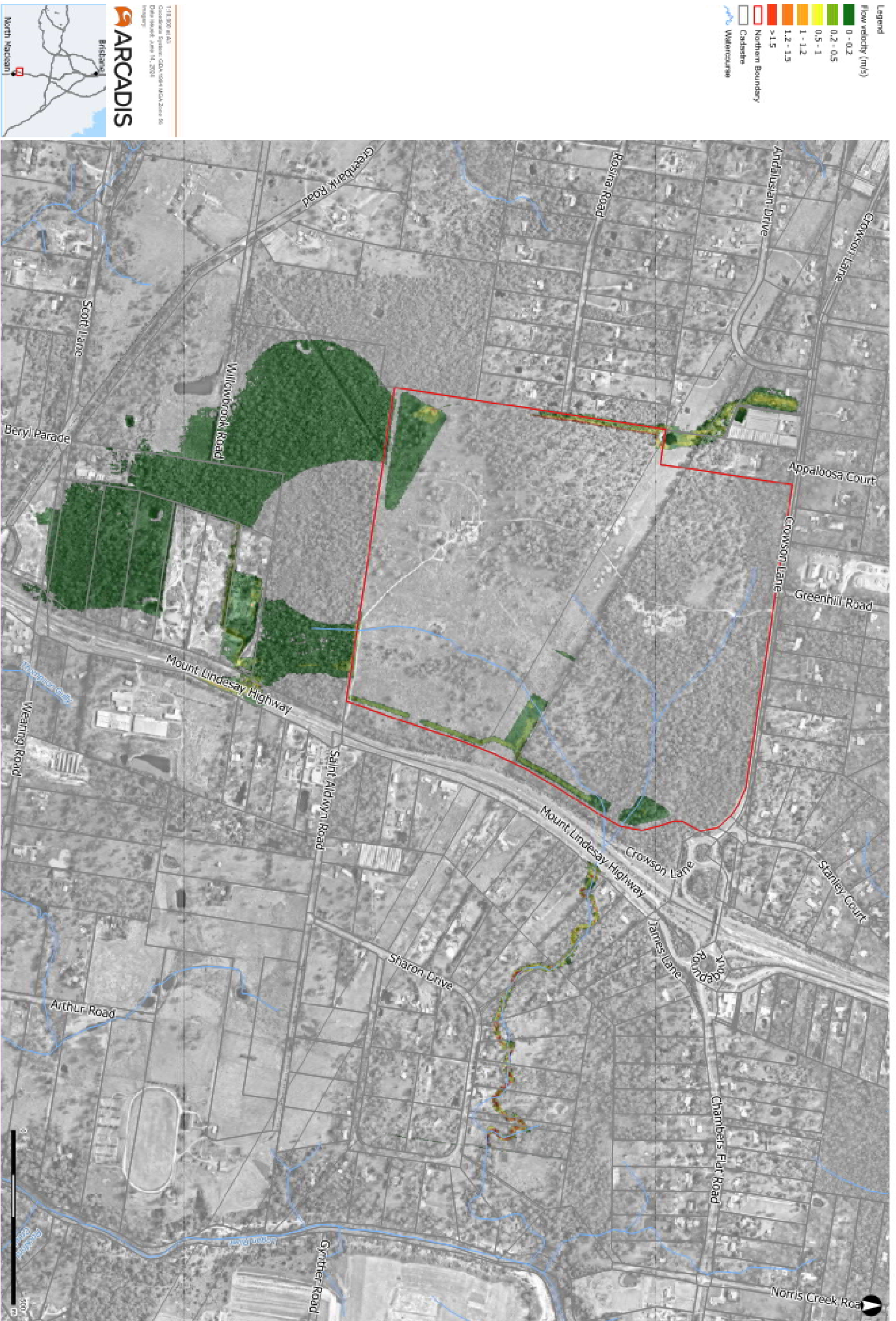


Figure D-11 - Flow Velocity - Design Case - 2% AEP



Figure D-15 - Flood Level Afflux - 10% AEP



Figure D-16 - Flood Level Afflux - 5% AEP





Figure D-18 - Flood Level Afflux - 1% AEP



Figure D-21 - Velocity Change - 10% AEP



Figure D-22 - Velocity Change - 5% AEP



Figure D-23 - Velocity Change - 2% AEP



Figure D-24 - Velocity Change - 1% AEP



Figure S-1 - Flood Depths - Sensitivity BLK 20% - 1% AEP

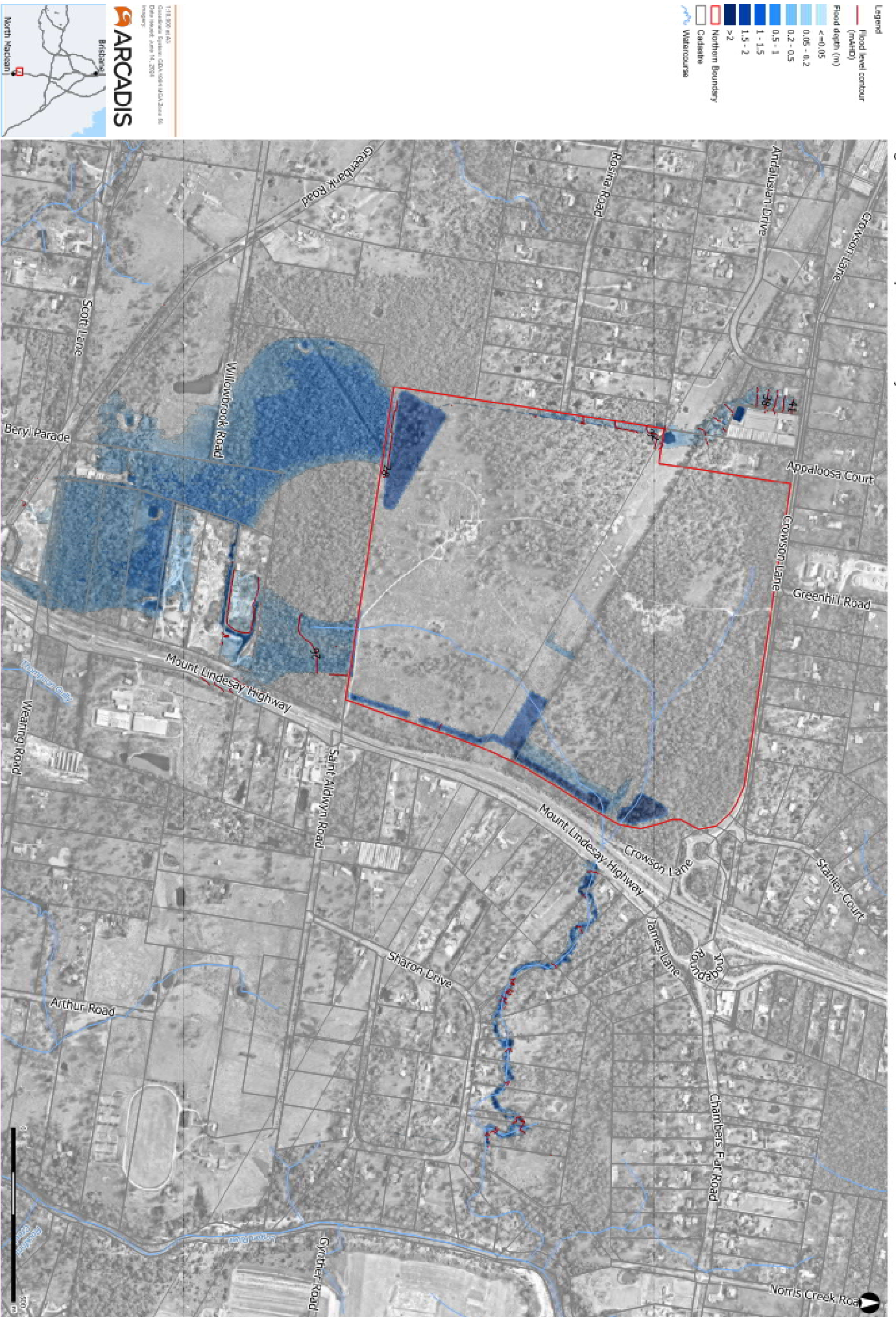
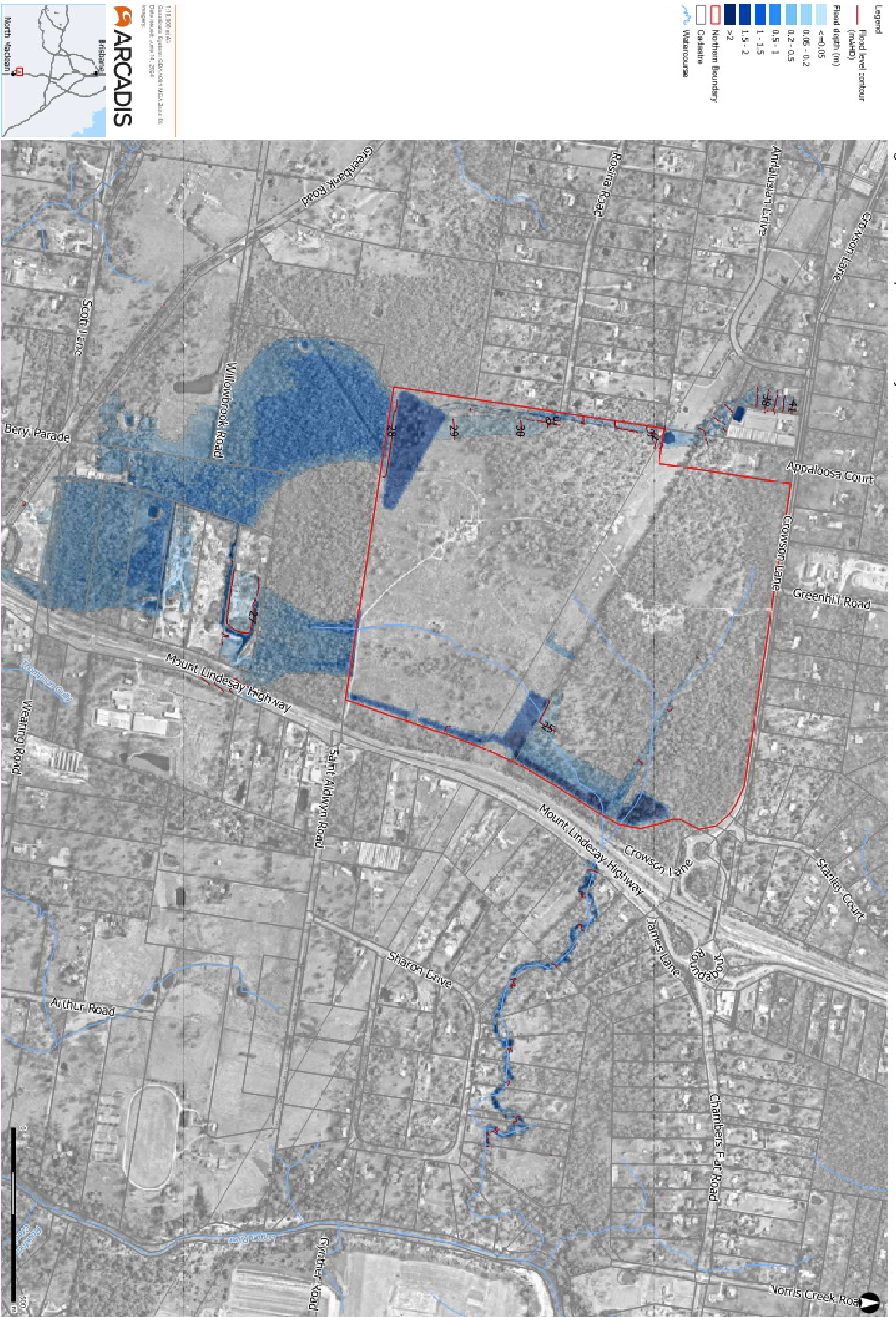


Figure S-2 - Flood Depths - Sensitivity BLK 50%- 1% AEP



Stormwater Drainage Safety Audit

APPENDIX E

Date 17/06/2024
To Gary Ellis – Technical Director
From Thea Fanning – Civil Engineer / Darlan Castro – Associate Technical Director
Copy to
Subject North Maclean – Stormwater Drainage Infrastructure (structures/conduits) Safety Audit

INTRODUCTION

This Technical Memo assesses the proposed stormwater overland conveyance and attenuation drainage infrastructure, specifically associated structures (hydraulic hazards) proposed as part of the Flagstone Industrial Subdivision at North Maclean and provides recommendations on any safety mitigation measures for the proposed stormwater drainage network structures.

This assessment excludes other stormwater drainage structures associated with road system design and minor and major flows which are to be designed in accordance with QUDM with road gully pit inlets to include standard pin-lock inlet grates to deter entry or interference.

This analysis has been prepared in accordance with the Queensland Urban Drainage Manual (QUDM) section 12. The table below provides the Contact Classification as per QUDM Table 12.3.1 for the stormwater conveyance system as presented in Appendix A – Channel Sketch Plan.

Table 1 – Contact Classification for Stormwater Drainage Infrastructure

Stormwater Drainage Infrastructure	Contact Classification
Northern combined bioretention and detention basin - Outlets	Class C1
Southern detention basin - Outlets	Class C2
Western diversion channel - Box culvert	Class C1
Eastern conveyance channel – outlet Structure	Class C1
Eastern Channel – Road 02 Culvert	Class C1
Service Road Outlet/Existing Highway culvert Inlet	Class D

QUDM Table 12.3.1 defines Class C1 as follows:

More than 100 metres from a school, park, childcare centre, or existing or future urban residential area. Access to the inlet or upstream channel is unrestricted and/or there is reasonable risk of a person being swept towards the inlet during a storm or flood.

QUDM Table 12.3.1 defines Class C2 as follows:

As above except access to potentially dangerous waters or inlets is unlikely and/or severely restricted.

QUDM Table 12.3.1 defines Class D as follows:

Within an area surrounded by heavily trafficked arterial roads, childproof fencing, or is otherwise considered inaccessible (legally or illegally) to the general public.

Arcadis considers the classifications listed in Table 1, above, are appropriate given the proposed development land use is industrial, the Mount Lindesay Highway forms the eastern site boundary and the remaining adjacent land is either heavily vegetated buffer/bio-diversity corridor or comprises a low density rural residential land use. Class C2 has been applied to the southern detention basin given the remote location adjoining the bio-diversity corridor.

Table 2, below, assesses each of the stormwater drainage elements against the assessment criteria recommended by QUDM Table 12.3.2.

Table 2 – Stormwater Drainage Infrastructure Risk Ranking

Stormwater Drainage Infrastructure	Potential Safety Risk (QUDM Table 12.3.2)					Cumulative Consequence Score
	Conduit Flowing Full	Length	Velocity (m/s)	Flow Conditions Within a Conduit	Flow Conditions at the Outlet of a Conduit	
Northern basin – outlets (single inlet structure)						
0.3m RCP (x2)	High (6)	Medium (3)	2.62	High (6)	High (6)	21
0.9m x 0.45m RCBC	High (6)	Medium (3)	3.94	High (6)	High (6)	21
Southern detention basin – Multiple outlets						
0.9m RCP (x2)	High (6)	Low (1)	2.80	High (6)	Low (1)	14
0.9m RCP (800mm orifice plate in front)						
Western Swale - Box culvert (2.4m x 1.2m RCBC)	Medium (3)	High (6)	3.26	High (6)	Low (1)	16
Eastern conveyance channel (outlet structure)						
1.7m x 0.9m opening, at 1.35 m above channel invert	Low (1)	Medium (3)	3.85	High (6)	High (6)	16
900mm diameter Orifice at invert level	High (6)	Medium (3)	4.39	High (6)	High (6)	21
Eastern Channel – Road 02 Culvert						
2.1m x 1.2m RCBC (x2)	Low (1)	Medium (3)	1.5	High (6)	Low (1)	11
Service Road Outlet/Existing Highway culvert Inlet	Low (1)	High (6)		Medium (3)	Low (1)	11

The Risk Ranking Matrix included in Table 12.3.6 of QUDM has been replicated in Table 3.

Table 3 – Risk Ranking Matrix

Contact Class	Cumulative Consequence Score				
	1 - 4	5 - 9	10 - 14	15 - 19	20 - 24
	Risk Ranking				
A1	13	7	4	2	1
A2, B1	16	12	8	5	3
B2, C1	18	14	11	9	6
C2, D	20	19	17	15	10

The below table provides a summary of each stormwater drainage element, the risk ranking and mitigation case, in conjunction with the proposed risk mitigation measure(s). The mitigation case was determined from QUDM Table 12.3.7.

Notably, a ranking of “1” represents the highest risk. A ranking of ‘20’ represents the lowest risk.

Table 4 – Cumulative Consequence Score

Stormwater Drainage Infrastructure	Contact Classification	Cumulative Consequence Score	Risk Ranking	Mitigation Option Case	Proposed Risk Mitigation Measure(s)
Northern basin – outlets (single inlet structure)	C1	21	6	Case 4	Liberal placement of Warning signs to be erected around perimeter of basin with water depth measuring stick. Single inlet screen applied to upstream end of stormwater inlets with openings exceeding 300mm diameter. Detailed design to maintain maximum 1200mm depth for 5% AEP design storm event. Basin batters which are steeper than 1 in 6 are to include high density plantings to assist individual egressing basin (note wet turf can be slippery under foot where steeper than 1 in 6). No batter slope to exceed 1 in 4.
Southern detention basin – outlets					
0.9m RCP (x2)	C2	14	17	Case 7	
0.9m RCP (800mm orifice plate in front)					

Registered office: Level 16, 580 George Street, Sydney NSW 2000, Australia ABN 76 104 485 289

<https://arcadiso365.sharepoint.com/teams/project-30109334/ProjectDocuments/G-C-Correspondence/GC-TechnicalNotes/GC004> - Stormwater Drainage Safety Audit/30109334-GC004-02 - Stormwater Drainage Safety Audit.docx

Liberal placement of Warning signs to be erected along with water depth measuring stick.

Basin batters and floor to include high density plantings to discourage person/child wishing to enter during storm events. Plantings / trees provide assistance for egress on batter slopes. Provide property boundary fence for adjoining development lots to discourage a person/child wishing to enter swale area during storm events.

Detailed design to maintain maximum 1200mm depth for 5% AEP design storm event with maximum 1 in 4 batters.

Stormwater Drainage Infrastructure	Contact Classification	Cumulative Consequence Score	Risk Ranking	Mitigation Option Case	Proposed Risk Mitigation Measure(s)
Box culverts beneath western diversion swale (2.4m x 1.2m RCBC)	C1	16	9	Case 4	Inlet screen applied to upstream end of culvert designed in accordance with QUDM. Additionally, provision of fauna exclusion fencing (and acoustic barrier) which interfaces with development lots will discourage a person/child wishing to enter swale area during storm events from the development area.
Eastern conveyance channel (outlet structure) 1.7m x 0.9m opening, at 1.35 m above channel invert 900mm diameter Orifice at invert level	C1	16 21	9 6	Case 4 Case 4	Inlet screens applied to upstream end of stormwater inlets with openings exceeding 300mm diameter. Designed in accordance with QUDM. Provide liberal warning signage along channel. Maximum batter slope (conveyance) to be 1 in 4. Tree planting to be provided to provide egress assistance.
Eastern Channel – Road 02 Culvert 2.1m x 1.2m RCBC (x2)	C1	11	11	Case 4	Inlet screen applied to upstream end of culvert configuration, designed in accordance with QUDM. Provide barrier fencing to culvert headwall (DS and US) and associated batter (fall hazard and discourage access to slip risk batter). Provide high density plantings to these batters – outside conveyance areas.
Service Road Outlet/Existing Highway culvert Inlet	D	11	17	Case 7	In conjunction with existing fauna exclusion fencing located along highway, provide exclusion fence to new headwall and immediate surrounds. In conjunction provide high density planting for disturbed areas (including batter) to screen and discourage person/child wishing to enter during storm events.

This Stormwater Drainage Safety Audit has provided a risk assessment of the stormwater conveyance drainage elements (Structures/Conduits) and proposed mitigation measures to be implemented for the detailed design of the Industrial Subdivision proposed to be constructed at 4499 – 4651 Mount Lindesay Highway, North Maclean.

Kind regards,



Darlan Castro

Associate Technical Director

I concur with this assessment and recommended mitigation measures.

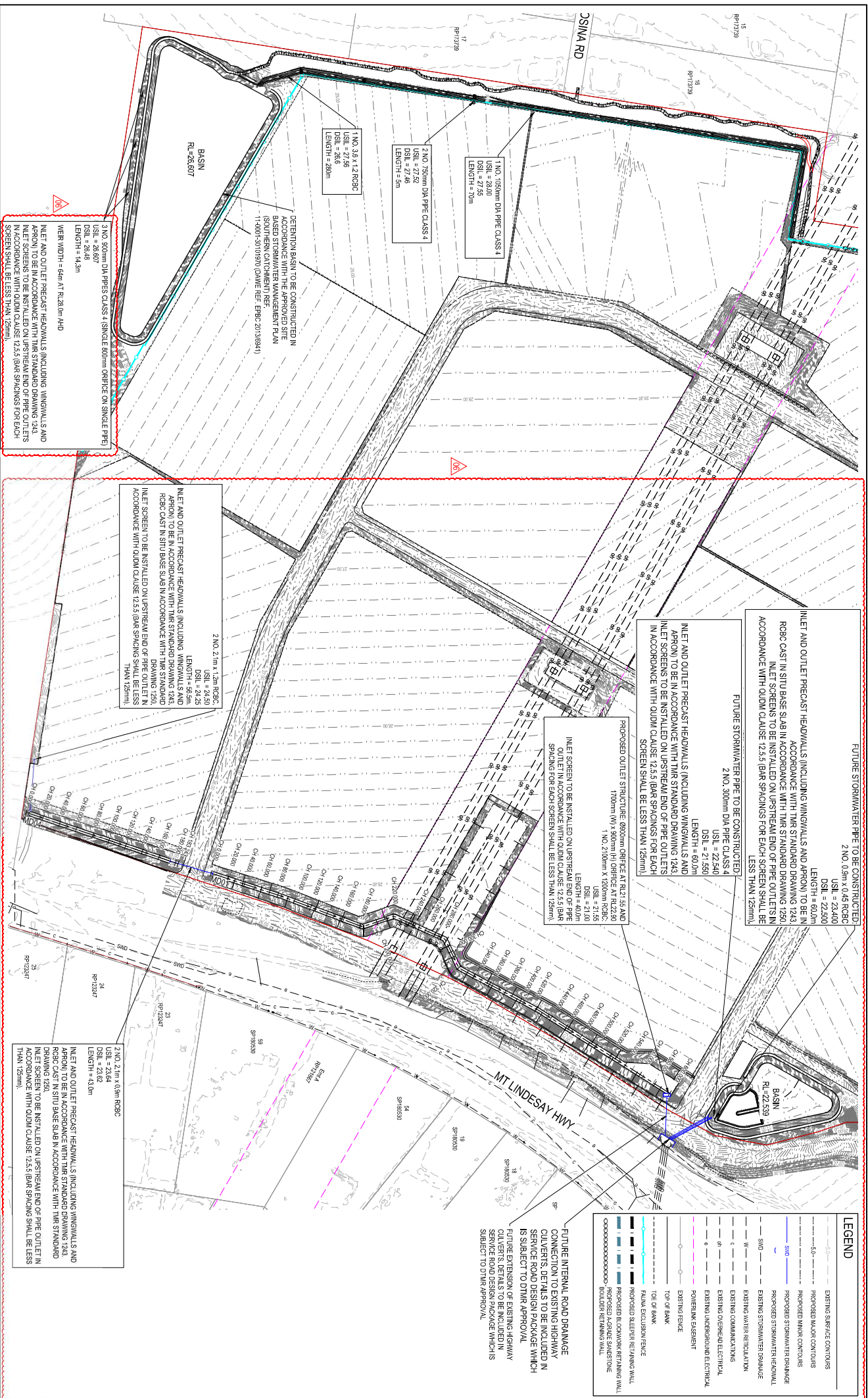


Gary Ellis

Technical Director - RPEQ

APPENDIX A

Channel Sketch Plan



INLET AND OUTLET PRECAST HEADWALLS INCLUDING WINGWALLS AND APRONS TO BE IN ACCORDANCE WITH THE STANDARD DRAWING 1243. ROBC CAST IN SITU BASE SLAB IN ACCORDANCE WITH THE STANDARD DRAWING 1243. INLET SCREENS TO BE INSTALLED ON UPSTREAM END OF PIPE OUTLET IN ACCORDANCE WITH QUDM CLAUSE 12.5 (BAR SPACING SHALL BE LESS THAN 125mm).

FUTURE STORMWATER PIPE TO BE CONSTRUCTED
2 NO. 300mm DIA PIPE CLASS 4
USL = 22.540
LENGTH = 60.0m
INLET AND OUTLET PRECAST HEADWALLS INCLUDING WINGWALLS AND APRONS TO BE IN ACCORDANCE WITH THE STANDARD DRAWING 1243. ROBC CAST IN SITU BASE SLAB IN ACCORDANCE WITH THE STANDARD DRAWING 1243. INLET SCREENS TO BE INSTALLED ON UPSTREAM END OF PIPE OUTLET IN ACCORDANCE WITH QUDM CLAUSE 12.5 (BAR SPACING SHALL BE LESS THAN 125mm).

PROPOSED OUTLET STRUCTURE: 6000mm DUCT AT RL 21.55 AND 1700mm (W) x 900mm (H) OFFICE AT RL 22.80
1 NO. 2100mm x 1000mm RCB
USL = 21.55
LENGTH = 40.0m
INLET SCREENS TO BE INSTALLED ON UPSTREAM END OF PIPE OUTLET IN ACCORDANCE WITH QUDM CLAUSE 12.5 (BAR SPACING FOR EACH SCREEN SHALL BE LESS THAN 125mm).

2 NO. 2.1m x 1.2m RCB
USL = 24.50
LENGTH = 24.25m
INLET AND OUTLET PRECAST HEADWALLS INCLUDING WINGWALLS AND APRONS TO BE IN ACCORDANCE WITH THE STANDARD DRAWING 1243. ROBC CAST IN SITU BASE SLAB IN ACCORDANCE WITH THE STANDARD DRAWING 1243. INLET SCREENS TO BE INSTALLED ON UPSTREAM END OF PIPE OUTLET IN ACCORDANCE WITH QUDM CLAUSE 12.5 (BAR SPACING SHALL BE LESS THAN 125mm).

2 NO. 2.1m x 0.9m RCB
USL = 23.64
LENGTH = 43.0m
INLET AND OUTLET PRECAST HEADWALLS INCLUDING WINGWALLS AND APRONS TO BE IN ACCORDANCE WITH THE STANDARD DRAWING 1243. ROBC CAST IN SITU BASE SLAB IN ACCORDANCE WITH THE STANDARD DRAWING 1243. INLET SCREENS TO BE INSTALLED ON UPSTREAM END OF PIPE OUTLET IN ACCORDANCE WITH QUDM CLAUSE 12.5 (BAR SPACING SHALL BE LESS THAN 125mm).

- LEGEND**
- EXISTING SURFACE CONTOURS
 - PROPOSED MAJOR CONTOURS
 - PROPOSED MINOR CONTOURS
 - PROPOSED STORMWATER DRAINAGE
 - PROPOSED STORMWATER HEADWALL
 - EXISTING STORMWATER DRAINAGE
 - EXISTING WATER RETICULATION
 - EXISTING COMMUNICATIONS
 - EXISTING OVERHEAD ELECTRICAL
 - EXISTING UNDERGROUND ELECTRICAL
 - POWERLINE ALIGNMENT
 - EXISTING FENCE
 - TOP OF BANK
 - TYPE OF BANK
 - PLANNED ENCLOSURE FENCE
 - PROPOSED SLEEPER RETAINING WALL
 - PROPOSED B-CONCRETE RETAINING WALL
 - PROPOSED ASHRAE SANDSTONE
 - BRICKLIER RETAINING WALL

Issue	Description	DR	CH	VE	Date
06	DESIGN UPDATES	GP	GP	GE	17/08/24
05	WEIR WIDTH ADDED	A.O	TF	BA	06/07/23
04	DESIGN UPDATES	A.O	TF	GE	20/06/23
03	DESIGN UPDATES	A.O	EP	GE	21/02/23
02	DESIGN UPDATES	UG	EP	GE	08/02/23
01	ORIGINAL ISSUE	UG	EP	GE	24/02/22

Scale

0 50 100 150 200m

1:2000

Survivor

WOLTER
consulting group

Client

Charter Hall

Project

4499-4651 MOUNT LINDSAY HIGHWAY, NORTH MACLEAN

Channel Sketch Plan

ARCADIS

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www.arcadis.com.au

30/09/24 - AAP - WS000P - CV - SKT - 011 - 06

APPENDIX E

OCEANPROTECT OG200 OCEANGUARD OPERATION & MAINTENANCE MANUAL



OceanGuard™

Operations & Maintenance Manual

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Introduction

The primary purpose of stormwater treatment devices is to capture and prevent pollutants from entering waterways, maintenance is a critical component of ensuring the ongoing effectiveness of this process. The specific requirements and frequency for maintenance depends on the treatment device and pollutant load characteristics of each site. This manual has been designed to provide details on the cleaning and maintenance processes as recommended by the manufacturer.

The OceanGuard technology is a gully pit basket designed to fit within new and existing gully pits to remove pollution from stormwater runoff. The system has a choice of Filtration liners, designed to remove gross pollutants, total suspended solids and attached pollutants as either a standalone technology or as part of a treatment train with our StormFilter or Jellyfish Filtration products. OceanGuard pit baskets are highly effective, easy to install and simple to maintain.

Why do I need to perform maintenance?

Adhering to the maintenance schedule of each stormwater treatment device is essential to ensuring that it functions properly throughout its 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 is also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner.

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), but most of all ensures the long term effective operation of the OceanGuard.

Health and Safety

Access to pits containing an OceanGuard typically requires removing (heavy) access covers/grates, but typically it is not necessary to enter into a confined space. Pollutants collected by the OceanGuard will vary depending on the nature of your site. There is potential for these materials to be harmful. For example, sediments may contain heavy metals, carcinogenic substances or sharp objects such as broken glass and syringes. For these reasons, there should be no primary contact with the waste collect and all aspects of maintaining and cleaning your OceanGuard require careful adherence to Occupational Health and Safety (OH&S) guidelines.

It is important to note that the same level of care needs to be taken to ensure the safety of non-work personnel, as a result it may be necessary to employ traffic/pedestrian control measures when the device is situated in, or near areas with high vehicular/pedestrian activity.

Personnel health and safety

Whilst performing maintenance on the OceanGuard pit insert, precautions should be taken in order to minimise (or when possible prevent) contact with sediment and other captured pollutants by maintenance personnel. In order to achieve this the following personal protective equipment (PPE) is recommended:

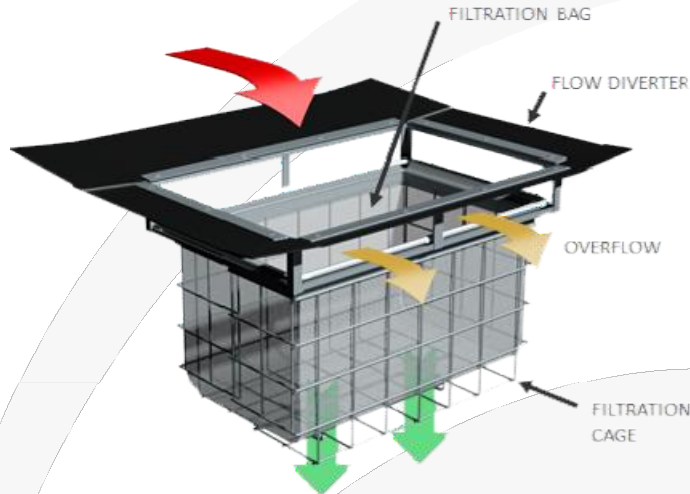
- Puncture resistant gloves
- Steel capped safety boots,
- Long sleeve clothing, overalls or similar skin protection
- Eye protection
- High visibility clothing or vest

During maintenance activities it may be necessary to implement traffic control measures. Ocean Protect recommend that a separate site specific traffic control plan is implemented as required to meet the relevant governing authority guidelines.

The OceanGuard pit insert is designed to be maintained from surface level, without the need to enter the pit. However depending on the installation configuration, location and site specific maintenance requirements it may be necessary to enter a confined space occasionally. It is recommended that all maintenance personnel evaluate their own needs for confined space entry and compliance with relevant industry regulations and guidelines. Ocean Protect maintenance personnel are fully trained and carry certification for confined space entry.

How does it Work?

OceanGuard is designed to intercept stormwater as it enters the stormwater pits throughout a site. The OceanGuard has diversion panels that sit flush with the pit walls, this ensures that as stormwater enters at the top of the pit it is directed to the middle of the insert where the Filtration bag is situated. The filtration bag allows for screening to occur removing 100% of pollutants greater than the opening of the filtration material (200micron, 1600micron bags available).



During larger rain events the large flows overflow slots in the flow diverter of the OceanGuard ensure that the conveyance of stormwater is not impeded thus eliminating the potential for surface flooding. As the flow subsides, the captured pollutants are held in the OceanGuard Filtration bag dry. The waste then starts to dry which reduces the magnitude of organic material decomposition transitioning between maintenance intervals.

Maintenance Procedures

To ensure that each OceanGuard pit insert achieves optimal performance, it is advisable that regular maintenance is performed. Typically the OceanGuard requires 2-4 minor services annually, pending the outcome of these inspections additional maintenance servicing may be required.

Primary Types of Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the OceanGuard.

	Description of Typical Activities	Frequency
Minor Service	Filter bag inspection and evaluation Removal of capture pollutants Disposal of material	2-4 Times Annually
Major Service	Filter Bag Replacement Support frame rectification	As required

Maintenance requirements and frequencies are dependent on the pollutant load characteristics of each site. The frequencies provided in this document represent what the manufacturer considers to be best practice to ensure the continuing operation of the device is in line with the original design specification.

Minor Service

This service is designed to return the OceanGuard device back to optimal operating performance. This type of service can be undertaken either by hand or with the assistance of a Vacuum unit.

Hand Maintenance

1. Establish a safe working area around the pit insert
2. Remove access cover/grate
3. Use two lifting hooks to remove the filtration bag
4. Empty the contents of the filtration bag into a disposal container
5. Inspect and evaluate the filtration bag
6. Inspect and evaluate remaining OceanGuard components (i.e. flow diverter, filtration cage and supporting frame)
7. Rejuvenate filtration bag by removing pollutant build up with a stiff brush, additionally the filtration bag can be washed using high pressure water
8. Re-install filtration bag and replace access cover/grate

Vacuum Maintenance

1. Establish a safe working area around the pit insert
2. Remove access cover/grate
3. Vacuum captured pollutants from the filtration bag
4. Remove filtration bag
5. Inspect and evaluate the filtration bag
6. Inspect and evaluate remaining OceanGuard components (i.e. flow diverter, filtration cage and supporting frame)
7. Rejuvenate filtration bag by removing pollutant build up with a stiff brush, additionally the filtration bag can be washed using high pressure water
8. Re-install filtration bag and replace access cover/grate

Major Service (Filter Bag Replacement)

For the OceanGuard system, a major service is a reactionary process based on the outcomes from the minor service.

Trigger Event from Minor Service	Maintenance Action
Filtration bag inspection reveals damage	Replace the filtration bag ^[1]
Component inspection reveals damage	Perform rectification works and if necessary replace components ^[1]

[1] Replacement filtration bags and components are available for purchase from Ocean Protect.

Additional Reasons of Maintenance

Occasionally, events on site can make it necessary to perform additional maintenance to ensure the continuing performance of the device.

Hazardous Material Spill

If there is a spill event on site, all OceanGuard pits that potentially received flow should be inspected and cleaned. Specifically all captured pollutants from within the filtration bag should be removed and disposed in accordance with any additional requirements that may relate to the type of spill event. All filtration bags should be rejuvenated (replaced if required) and re-installed.

Blockages

The OceanGuards internal high flow bypass functionality is designed to minimise the potential of blockages/flooding. In the unlikely event that flooding occurs around the stormwater pit the following steps should be undertaken to assist in diagnosing the issue and implementing the appropriate response.

1. Inspect the OceanGuard flow diverter, ensuring that they are free of debris and pollutants
2. Perform a minor service on the OceanGuard
3. Remove the OceanGuard insert to access the pit and inspect both the inlet and outlet pipes, ensuring they are free of debris and pollutants

Major Storms and Flooding

In addition to the scheduled activities, it is important to inspect the condition of the OceanGuard pit insert after a major storm event. The inspection should focus on checking for damage and higher than normal sediment accumulation that may result from localised erosion. Where necessary damaged components should be replaced and accumulated pollutants disposed.

Disposal of Waste Materials

The accumulated pollutants found in the OceanGuard must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. If the filtration bag has been contaminated with any unusual substance, there may be additional special handling and disposal methods required to comply with relevant government/authority/industry regulations.

Maintenance Services

With over a decade and a half of maintenance experience Ocean Protect has developed a systematic approach to inspecting, cleaning and maintaining a wide variety of stormwater treatment devices. Our fully trained and professional staff are familiar with the characteristics of each type of system, and the processes required to ensure its optimal performance.

Ocean Protect has several stormwater maintenance service options available to help ensure that your stormwater device functions properly throughout its design life. In the case of our OceanGuard system we offer long term pay-as-you-go contracts, pre-paid once off servicing and replacement filter bags.

For more information please visit www.OceanProtect.com.au



StormFilter
Operations & Maintenance Manual

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Introduction

The primary purpose of stormwater treatment devices is to capture and prevent pollutants from entering waterways, maintenance is a critical component of ensuring the ongoing effectiveness of this process. The specific requirements and frequency for maintenance depends on the treatment device and pollutant load characteristics of each site. This manual has been designed to provide details on the cleaning and maintenance processes for the StormFilter as recommended by the manufacturer.

The StormFilter is designed and sized to meet stringent regulatory requirements. It removes the most challenging target pollutants (including fine solids, soluble heavy metals, oil, and soluble nutrients) using a variety of media. For more than two decades, StormFilter has helped clients meet their regulatory needs and, through ongoing product enhancements, the design continues to be refined for ease of use and improved performance.

Why do I need to perform maintenance?

Adhering to the inspection and maintenance schedule of each stormwater treatment device is essential to ensuring that it functions properly throughout its 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 is also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner.

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), but most of all ensures the long term effective operation of the StormFilter.

Health and Safety

Access to a StormFilter unit requires removing heavy access covers/grates, and it is necessary to enter into a confined space. Pollutants collected by the StormFilter will vary depending on the nature of your site. There is potential for these materials to be harmful. For example, sediments may contain heavy metals, carcinogenic substances or objects such as broken glass and syringes. For these reasons, all aspects of maintaining and cleaning your StormFilter require careful adherence to Occupational Health and Safety (OH&S) guidelines.

It is important to note that the same level of care needs to be taken to ensure the safety of non-work personnel. As a result, it may be necessary to employ traffic/pedestrian control measures when the device is situated in, or near areas with high vehicular/pedestrian activity.

Personnel health and safety

Whilst performing maintenance on the StormFilter, precautions should be taken in order to minimise (or, if possible, prevent) contact with sediment and other captured pollutants by maintenance personnel. The following personal protective equipment (PPE) is subsequently recommended:

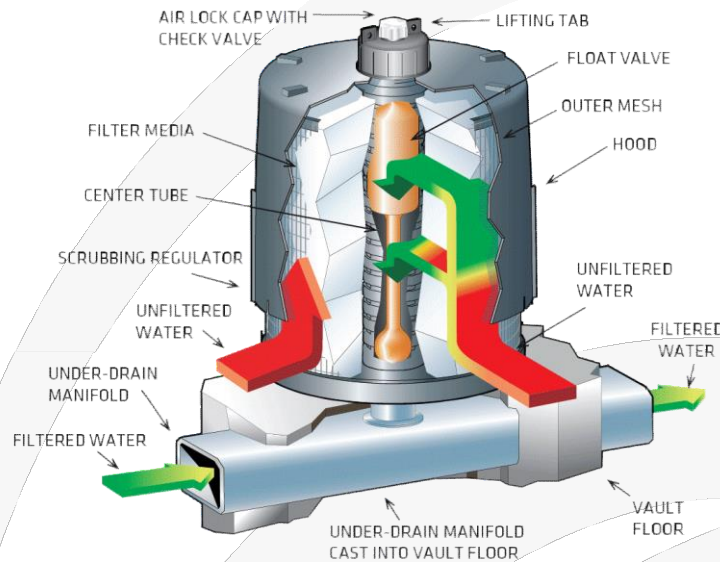
- Puncture resistant gloves
- Steel capped safety boots
- Long sleeve clothing, overalls or similar skin protection
- Eye protection
- High visibility clothing or vest

During maintenance activities, it may be necessary to implement traffic control measures. Ocean Protect recommend that a separate site-specific traffic control plan is implemented as required to meet the relevant governing authority guidelines.

Whilst some aspects of StormFilter maintenance can be performed from surface level, there will be a need to enter the StormFilter system (confined space) during a major service. It is recommended that all maintenance personnel evaluate their own needs for confined space entry and compliance with relevant industry regulations and guidelines. Ocean Protect maintenance personnel are fully trained and carry certification for confined space entry applications.

How does it Work?

Stormwater enters the cartridge chamber, passes through the filtration media and begins filling the cartridge center tube. When water reaches the top of the cartridge the float valve opens and filtered water is allowed to drain at the designed flow rate. Simultaneously, a one-way check valve closes activating a siphon that draws stormwater evenly throughout the filter media and into the center tube. Treated stormwater is then able to discharge out of the system through the underdrain manifold pipework.



As the rain event subsides, the water level outside the cartridge drops and approaches the bottom of the hood, air rushes through the scrubbing regulators releasing the water column and breaking the siphon. The turbulent bubbling action agitates the surface of the cartridge promoting trapped sediment to drop to the chamber floor. After a rain event, the chamber is able to drain dry by way of an imperfect seal at the base of the float valve.

Maintenance Procedures

To ensure optimal performance, it is advisable that regular maintenance is performed. Typically, the StormFilter requires an inspection every 6 months with a minor service at 12 months. Additionally, as the StormFilter cartridges capture pollutants the media will eventually become occluded and require replacement (expected media life is 1-3 years).

Primary Types of Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the StormFilter.

	Description of Typical Activities	Frequency
Inspection	Visual Inspection of cartridges & chamber Remove larger gross pollutants Perform minimal rectification works (if required)	Every 6 Months
Minor Service	Evaluation of cartridges and media Removal of accumulated sediment (if required) Wash-down of StormFilter chamber (if required)	Every 12 Months
Major Service	Replacement of StormFilter cartridge media	As required

Maintenance requirements and frequencies are dependent on the pollutant load characteristics of each site. The frequencies provided in this document represent what the manufacturer considers to be best practice to ensure the continuing operation of the device is in line with the original design specification.

Inspection

The purpose of the inspecting the StormFilter system is to assess the condition of the StormFilter chamber and cartridges. When inspecting the chamber, particular attention should be taken to ensure all cartridges are firmly connected to the connectors. It is also an optimal opportunity to remove larger gross pollutants and inspect the outlet side of the StormFilter weir.

Minor Service

This service is designed to ensure the ongoing operational effectiveness of the StormFilter system, whilst assessing the condition of the cartridge media.

1. Establish a safe working area around the access point(s)
2. Remove access cover(s)
3. Evaluate StormFilter cartridge media (if exhausted schedule major service within 6 months)
4. Measure and record the level of accumulated sediment in the chamber
(if sediment depth is less than 100 mm skip to step 9)
5. Remove StormFilter cartridges from the chamber
6. Use vacuum unit to removed accumulated sediment and pollutants in the chamber
7. Use high pressure water to clean StormFilter chamber
8. Re-install StormFilter cartridges
9. Replace access cover(s)

Major Service (Filter Cartridge Replacement)

For the StormFilter system a major service is reactionary process based on the outcomes from the minor service, specifically the evaluation of the cartridge media.

Trigger Event	Maintenance Action
Cartridge media is exhausted ^[1]	Replace StormFilter cartridge media ^[2]

[1] Multiple assessment methods are available, contact Ocean Protect for assistance

[2] Replacement filter media and components are available for purchase from Ocean Protect.

This service is designed to return the StormFilter device back to optimal operating performance

1. Establish a safe working area around the access point(s)
2. Remove access cover(s)
3. By first removing the head cap, remove each individual cartridge hood to allow access to the exhausted media.
4. Utilise a vacuum unit to remove exhausted media from each cartridge
5. Use vacuum unit to remove accumulated sediment and pollutants in the chamber
6. Use high pressure water to clean StormFilter chamber
7. Inspect each empty StormFilter cartridges for any damage, rectify damage as required
8. Re-fill each cartridge with media in line with project specifications
9. Re-install replenished StormFilter cartridges
10. Replace access cover(s)

Additional Types of Maintenance

Occasionally, events on site can make it necessary to perform additional maintenance to ensure the continuing performance of the device.

Hazardous Material Spill

If there is a spill event on site, the StormFilter unit should be inspected and cleaned. Specifically, all captured pollutants and liquids from within the unit should be removed and disposed in accordance with any additional requirements that may relate to the type of spill event. Additionally, it will be necessary to inspect the filter cartridges and assess them for contamination, depending on the type of spill event it may be necessary to replace the filtration media.

Blockages

In the unlikely event that flooding occurs upstream of the StormFilter system the following steps should be undertaken to assist in diagnosing the issue and determining the appropriate response.

1. Inspect the upstream diversion structure (if applicable) ensuring that it is free of debris and pollutants
2. Inspect the StormFilter unit checking the underdrain manifold as well as both the inlet and outlet pipes for obstructions (e.g. pollutant build-up, blockage), which if present, should be removed.

Major Storms and Flooding

In addition to the scheduled activities, it is important to inspect the condition of the StormFilter after a major storm event. The focus is to inspect for damage and higher than normal sediment accumulation that may result from localised erosion. Where necessary damaged components should be replaced and accumulated pollutants should be removed and disposed.

Disposal of Waste Materials

The accumulated pollutants found in the StormFilter must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. If the filter media has been contaminated with any unusual substance, there may be additional special handling and disposal methods required to comply with relevant government/authority/industry regulations.

Maintenance Services

With over a decade and a half of maintenance experience Ocean Protect has developed a systematic approach to inspecting, cleaning and maintaining a wide variety of stormwater treatment devices. Our fully trained and professional staff are familiar with the characteristics of each type of system, and the processes required to ensure its optimal performance.

Ocean Protect has several stormwater maintenance service options available to help ensure that your stormwater device functions properly throughout its design life. In the case of our StormFilter system we offer long term pay-as-you-go contracts, pre-paid once off servicing and replacement media for cartridges.

For more information please visit www.OceanProtect.com.au