MOOREBANK PRECINCT EAST – STAGE 2

Warehouse 1 Precinct

Stormwater Management Plan

03 JULY 2018

MOOREBANK PRECINCT EAST – STAGE 2

Warehouse 1 Precinct

Stormwater Management Plan

Author

Checker

Approver

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REVISIONS

Revision	Date	Description	Prepared by	Approved by
0	11/05/2018	DRAFT		
1	24/05/2018	Amended to address staging as per DP&E meeting 21/05/18 and discussion with DP&E on 24/05/18		
2	28/06/2018	Amended to address independent review and DP&E comments		
3	03/07/2018	Update of Section 6.2.2 to address DP&E comments in approval letter dated 02/07/18		

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KEY TERMS

Term	Definition
General Terms	
The Moorebank Precinct	Refers to the whole Moorebank intermodal precinct, i.e. the MPE site and the MPW site
Moorebank Precinct West (MPW) Project (formerly the MIC Project)	The MPW Intermodal Terminal Facility as approved under the MPW Concept Plan Approval (SSD_5066) and the MPW EPBC Approval (No. 2011/6086).
Moorebank Precinct West (MPW) Site (formerly the MIC site)	The site which is the subject of the MPW Concept Plan Approval, MPW EPBC Approval and MPW Planning Proposal. The MPW site does not include the rail link as referenced in the MPW Concept Plan Approval or MPE Concept Plan Approval.
Moorebank Precinct East (MPE) Concept Plan Approval (formerly the SIMTA Concept Plan Approval)	MPE Concept Plan Approval (SSD_0193) granted by the NSW Department of Planning and Environment on 29 September 2014 for the development of former defence land at Moorebank to be developed in three stages; a rail link connecting the site to the Southern Sydney Freight Line, an intermodal terminal, warehousing and distribution facilities and a freight village.
Moorebank Precinct East (MPE) Project (formerly the SIMTA Project)	The MPE Intermodal Terminal Facility, including a rail link and warehouse and distribution facilities at Moorebank (eastern side of Moorebank Avenue) as approved by the Concept Plan Approval (MP 10_0913) and the MPE Stage 1 Approval (14_6766).
Moorebank Precinct East (MPE) Site (formerly the SIMTA Site)	Including the former DSNDC site and the land owned by SIMTA which is subject to the Concept Plan Approval. The MPE site does not include the rail corridor, which relates to the land on which the rail link is to be constructed.
MPE Stage 1 Specific Terms	
Rail Corridor	Area defined as the 'Rail Corridor' within the MPE Concept Plan Approval.
Rail Link	The rail link from the South Sydney Freight Line to the MPE IMEX Terminal, including the area on either side to be impacted by the construction works included in MPE Stage 1.
MPE Stage 1	Stage 1 (14-6766) of the MPE Concept Plan Approval for the development of the MPE Intermodal Terminal Facility, including the rail link at Moorebank. This reference also includes associated conditions of approval and environmental management measures which form part of the documentation for the approval.
MPE Stage 1 Site	Includes the MPE Stage 1 site and the Rail Corridor, i.e. the area for which approval (construction and operation) was sought within the MPE Stage 1 Proposal EIS.
MPE Stage 2 Specific Terms	
MPE Stage 2 Project / the Project	The subject of this report; being Stage 2 of the MPE including the construction and operation of 300,000m2 of warehousing and distribution facilities on the MPE site

Term	Definition
	and the Moorebank Avenue upgrade within the Moorebank Precinct.
MPE Stage 2 Site	The area within the MPE site which would be disturbed by the MPE Stage 2 Project (including the operational area and construction area). The MPE Stage 2 site includes the former DSNDC site and the land owned by SIMTA which is subject to the MPE Concept Plan Approval. The MPE site does not include the rail corridor, which relates to the land on which the rail link is to be constructed.
Warehouse 1 Precinct (W1P)	The area for which this Stormwater Management Plan has been prepared for. The area is located within the north west of MPE Stage 2 site and includes Warehouse 1 and OSD 9.
The Moorebank Avenue Upgrade	Raising of the vertical alignment of Moorebank Avenue for 1.5 kilometres of its length, from the Moorebank Avenue/Anzac Road intersection to approximately 185 metres south of the MPE site. The Moorebank Avenue upgrade also includes upgrades to intersections, ancillary works and the construction of an on-site detention basin to the west of Moorebank Avenue within the MPW site.
Construction Area	Extent of construction works, namely areas to be disturbed during the construction of the MPE Stage 2 Project (the Project).
Operational Area	Extent of operational activities for the operation of the MPE Stage 2 Project (the Project).

ACRONYMS AND DEFINITIONS

Acronym	Meaning
ARI	Average Recurrence Interval
CBD	Central Business District
CEMP	Construction Environmental Management Plan
CoC	Conditions of Consent
DJLU	Defence Joint Logistics Unit
DNSDC	Defence National Storage and Distribution Centre
DP&E	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
ESCP	Erosion and Sediment Control Plan
FCMMs	Final Compilation of Mitigation Measures
GFA	Gross Floor Area
GPT	Gross Pollutant Trap
Ha	Hectare
Km	Kilometre
LGA	Local Government Area
M	Metre
mAHD	Metres Australian Height Datum
ML	Megalitres
MPE	Moorebank Precinct East
MPW	Moorebank Precinct West
OEMP	Operational Environmental Management Plan
OSD	On-site Detention Basin
PAC	Planning Assessment Commission
PMF	Probable Maximum Flood

Acronym	Meaning
PMP	Probable Maximum Precipitation
RCBC	Reinforced Concrete Box Culvert
RL	Reduced Level
RMS	Roads and Maritime Services
RtS	Response to Submissions
SEI	Stream Erosion Index
SIMTA	Sydney Intermodal Terminal Alliance
SIOMP	Stormwater Infrastructure Operation and Maintenance Plan
SMP	Stormwater Management Plan
SSD	State Significant Development
SSFL	Southern Sydney Freight Line
SWMP	Soil and Water Management Plan
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UDLP	Urban Design and Landscape Plan
W1P	Warehouse 1 Precinct
WSUD	Water Sensitive Urban Design

1 INTRODUCTION

The Sydney Intermodal Terminal Alliance (SIMTA) received consent for the construction and operation of Stage 2 of the Moorebank Precinct East (MPE) Project (hereafter, 'the Project') (SSD 7628), which comprises the second stage of development under the MPE Concept Approval (MP10_0193).

This Stormwater Management Plan (SMP) has been developed for the Warehouse 1 Precinct (hereafter, 'the W1P') of the Project in accordance with the Conditions of Consent (CoC). This report should be read in conjunction with the latest Project CEMP, Flood Emergency Response Plan and Soil and Water Management Plan during construction, and in conjunction with the OEMP and Stormwater Infrastructure Operation and Maintenance Plan (SIOMP) during operations.

1.1 Project Overview

The MPE site, including the Project site, is located approximately 27 km south-west of the Sydney Central Business District (CBD) and approximately 26 km west of Port Botany and includes the former Defence National Storage and Distribution Centre (DNSDC) site. The MPE site is situated within the Liverpool Local Government Area (LGA), in Sydney's South West subregion, approximately 2.5 km from the Liverpool City Centre.

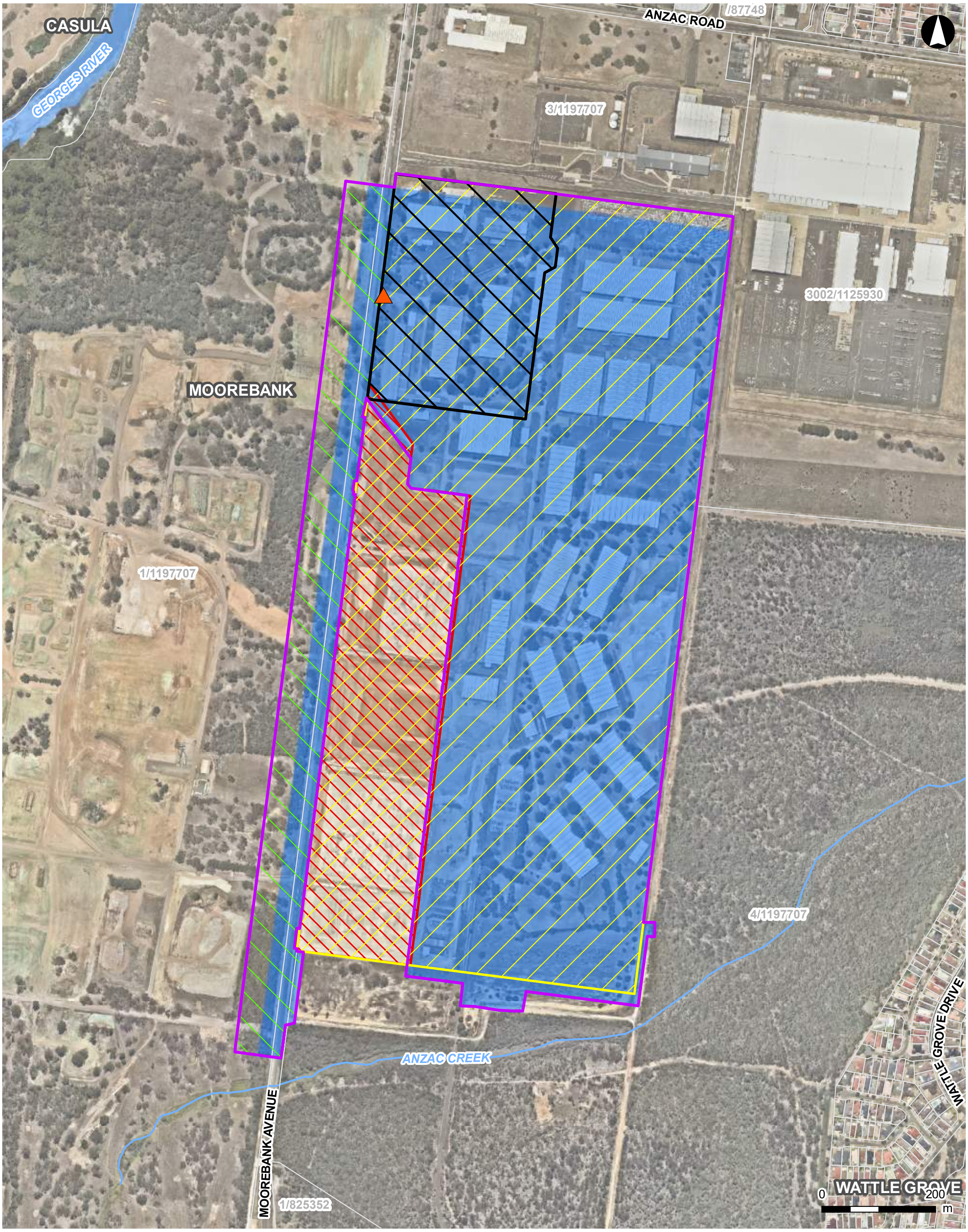
The MPE Project involves the development of an intermodal facility including warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank.

Stage 2 of the MPE Project involves the construction and operation of warehousing and distribution facilities on the MPE site and upgrade to approximately 1.5 kilometres of Moorebank Avenue from approximately 35 metres south of the northern boundary of the MPE site to approximately 185 metres south of the southern MPE site boundary. The footprint of the Project is shown in **Figure 1-1**.

Key components of the Project include:

- Warehousing comprising approximately 300,000m^2 GFA and additional ancillary offices.
- A freight village, comprising 8,000m^2 GFA of retail, commercial and light industrial land uses.
- Establishment of an internal road network, and connection of the Project to the surrounding public road network.
- Ancillary supporting infrastructure within the Project site, including:
  - Stormwater, drainage and flooding infrastructure
  - Utilities relocation and installation
  - Vegetation clearing, remediation, earthworks, signage and landscaping.
- An upgrade to Moorebank Avenue comprising the following key components:
  - Modifications to the existing lane configuration, including some widening
  - Earthworks, including construction of embankments and tie-ins to existing Moorebank Avenue road level at the southern and northern extents of the Project
  - Raking of the existing pavement and installation of new road pavement

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

- MPE Stage 2 construction area
- MPE Stage 2 operational area
- MPE site
- MPE Stage 1 operational area
- Moorebank Avenue upgrade
- Warehouse 1 Precinct
- Site access
- Cadastre (NSW DFSI, 2017)
- Watercourse

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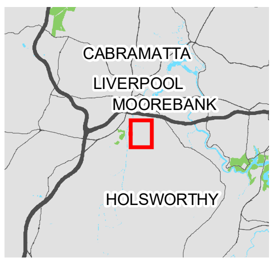


Figure 1-1: Project Footprint

  - Establishment of temporary drainage infrastructure, including temporary basins and / or swales
  - Adjusting the vertical alignment by about two metres from the existing levels, including kerbs, gutters and a sealed shoulder
  - Signalling and intersection works.
- Upgrading existing intersections along Moorebank Avenue, including:
  - Moorebank Avenue / MPE Stage 2 access
  - Moorebank Avenue / MPE Stage 1 northern access
  - Moorebank Avenue / MPE Stage 2 central access
  - MPW Northern Access / MPE Stage 2 southern emergency access.

The Project will interact with the MPE Stage 1 Project (SSD 6766) via the transfer of containers between the MPE Stage 1 and the Project's warehousing and distribution facilities. This transfer of freight will be via a fleet of heavy vehicles capable of being loaded with containers and owned by SIMTA. The fleet of vehicles will be stored and used on the MPE Stage 2 site, but registered and suitable for on-road use. The Project is expected to operate 24 hours a day, seven days per week.

1.2 Summary of Project Delivery Phases

The Project construction period is anticipated to be approximately 24 to 36 months, which will be generally divided into three works phases, as detailed in the following sections.

The terminology for the project phases or periods has developed from the preparation of the EIS and RtS documentation in response to the language of the CoCs and the need to stage the delivery of the environmental management documentation required by the CoCs. Current terminology, and the equivalent terminology from the CoCs and RtS are included in **Table 1-1**. Further detail on each of the Project delivery phases is provided in Section 1.3 of the CEMP.

Table 1-1 Project Delivery Phase Terminology

Project Delivery Phase	CoC A18 Phase Equivalent	MPE Stage 2 RtS Works Period Equivalent
Early Works	Early Works Fill importation (to 60,000m^3)	Works Period A: Pre-construction Works Period B: Site preparation
Construction Phase A	Fill importation Construction	Works Period B: Site preparation Works Period E: Bulk Earthworks Works Period F: Construction and internal fit out of warehousing Works Period G: Miscellaneous construction works
Construction Phase B	Fill importation Construction	Works Period C: Construction of Moorebank Avenue Diversion Road Works Period D: Pavement and intersection works along Moorebank Avenue

1.2.1 SMP Staging

This Stormwater Management Plan has been staged (in accordance with CoC A14 and A15) to allow for the commencement of Early Works and Construction of the Warehouse 1 Precinct (W1P); it will be delivered as follows:

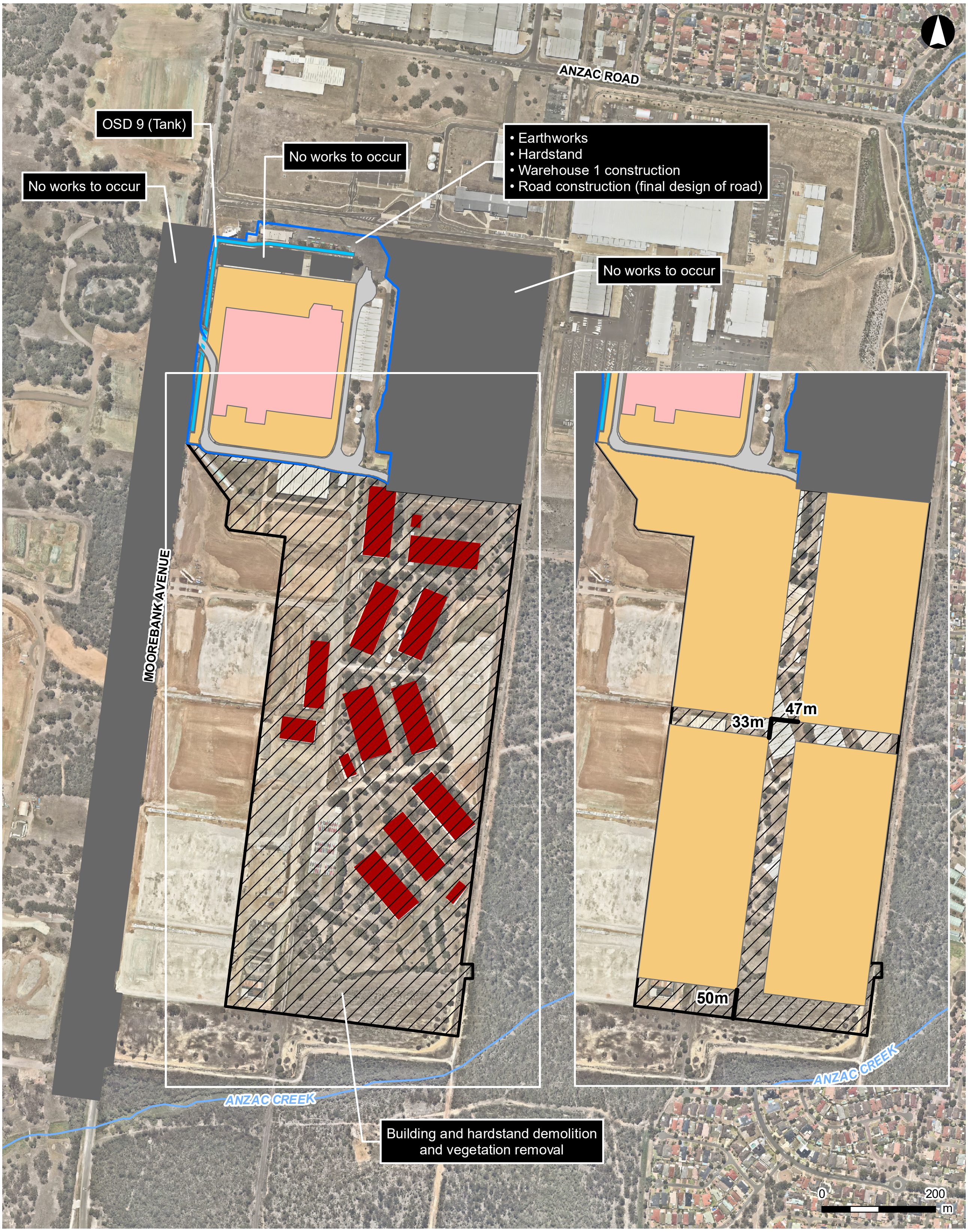
- Stormwater Management Plan – Warehouse 1 Precinct. To be approved by DP&E prior to commencement of Construction. Construction Phase A would then commence across the W1P, and Construction Phase A limited to Works Period B and E across the remainder of the site. Bulk earthworks would be limited to the areas defined in **Figure 1-2** and does not commit the Project to a final design which has not yet been finalised, nor does it restrict or constrain delivery of a compliant final design. This would allow the Project to preserve surface area from any permanent bulk earthworks activity to provide for future permanent stormwater infrastructure in compliance with the conditions.
- Stormwater Management Plan – Remainder of the Site. To be submitted to DP&E prior to achieving 80% bulk earthworks, and approved prior to commencing works beyond bulk earthworks. Works Period F and G will only commence upon approval of the Stormwater Management Plan – Remainder of the Site i.e. once a compliant design has been provided to DP&E and approved.

The W1P (shown in **Figure 1-1**) consists of an area of approximately 11.4ha located within the north-west corner of the MPE Stage 2 site within a standalone catchment area not impacted by other catchments across the MPE Site, (site catchments are shown in **Figure 2-3**, and drawing **SSS2-ARC-CV-DWG-1431** in **Appendix A)**. The area of works includes Warehouse 1 and OSD9. During construction activities, soil and water will be managed in accordance with the Early Works and Construction Soil and Water Management Plans.

Construction activities across the remainder of the site will be limited to demolition and bulk earthworks; bulk earthworks would be limited to the areas defined in **Figure 1-2**. Works will only progress beyond demolition and bulk earthworks upon approval of the Stormwater Management Plan – Remainder of the Site. The earthworks have been restricted to this footprint to provide enough space for the installation of compliant OSDs (i.e. with 1V:4H batters) to be undertaken as part of the SMP – Remainder of the Site. **Figure 1-2** identifies the widths on site available in which to construct the OSDs; given a base width of 6m and 2m high OSD, we would require a minimum of 24m width if we only required internal batters. With both internal and external batters, we would require 38m of space including provision for maintenance/access track. This is provided for in the south, whilst the internal cross drainage is only expected to require internal batters; therefore the nominated allowable width 47m for the north - south OSD is considered sufficient. The design will be developed such that water quality and water quantity objectives will be met in accordance with the requirements of the CoC and have no impact upon the biodiversity offset values within the Bootland.

In some instances, this report provides additional information of proposed works elsewhere within MPE Stage 2 which will be addressed in the subsequent Stormwater Management Plan – Remainder of the Site.

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

- Excluded work area
- Demolition and vegetation removal area (bulk earthworks exclusion zone)
- Northwest precinct
- Buildings to be demolished
- Bulk earthworks
- Internal road
- Underground stormwater detention tank
- Warehousing

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Figure 1-2: Proposed Activities

1.2.2 Integration with Other Plans

Soil and water impacts associated with the works will be managed under the Construction Soil and Water Management Plan during construction. Permanent infrastructure relating to stormwater detention and treatment systems will be managed in accordance with this SMP-W1P or SMP-Remainder of Site. OSDs will only come online once 80% of the upstream catchment has been stabilised as a minimum.

During construction, the Construction Environmental Management Plan (CEMP) is the overarching management document under which the SMP will sit. Monitoring, review and non-compliances will be managed as per requirements detailed in Section 4 of the CEMP, incidents will be managed in accordance with Section 2.8 of the CEMP, complaints will be managed in accordance with Section 2.6.3 of the CEMP and the Community Communication Strategy.

Once the site is operational, stormwater will be managed in accordance with the overarching Operational Environmental Management Plan and the Stormwater Infrastructure Operational and Maintenance Plan (SIOMP) (currently under development).

During adverse conditions in construction, such as flooding, the Flood Emergency Response Management Plan will be enacted. An Operational Flood Emergency Response Plan is also currently being developed which will detail the requirements to be undertaken during operation of the Project.

1.3 Development Consent

The MPE Stage 2 Project has been assessed by the Department of Planning and Environment (DP&E) under Part 4, Division 4.1 (now Division 4.7 as of 1 March 2018) of the Environmental Planning and Assessment Act 1979 (EP&A Act) as State Significant Development (SSD).

The Planning Assessment Commission (PAC) granted approval for the MPE Stage 2 Project on 31 January 2018 and is subject to the CoCs (SSD 7628). The Project, including its potential impacts, consultation and proposed mitigation and management, is documented in the following suite of documents:

- State Significant Development (SSD) Approval SSD 7628
- Moorebank Precinct East – Stage 2 – Environmental Impact Statement (Arcadis Australia Pacific Pty Limited, December 2016)
- Moorebank Precinct East – Stage 2 – Response to Submissions (Arcadis Australia Pacific Pty Limited, July 2017)
- Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) Approval (No. 2011/6229) granted on March 2014.

1.3.1 Road Infrastructure Upgrades

The development also includes several road upgrades as outlined in **Table 1-2** as required by CoC B13. These works are to be undertaken in accordance with Austroads and RMS drainage standards and will be approved by RMS. These works will be designed in accordance with Australian Rainfall and Runoff, the NSW Floodplain Development Manual, Austroads and any relevant RMS standards as per CoC B41.

Table 1-2: Required Upgrades and Specified Timing Requirements (CoC B13)

Upgrade	Specific Timing Requirements		
	Upgrade Requirements	**Required Timing for 100% Design Approval by RMS**	**Required Timing for Completion of Upgrade**
Moorebank Avenue / M5 Motorway intersection	Indicative layout to be provided by the applicant, subject to design development and approval by RMS	To be obtained prior to the issue of the first occupation Certificate for warehousing	Prior to issue of the first Occupation Certificate for warehousing in excess of 100,000m^2, or no later than December 2020, or a later date as agreed with the Secretary of Transport for NSW
Moorebank Road/ Moorebank Avenue Intersection	Indicative layout to be provided by Applicant, subject to design development and approval by RMS	To be obtained prior to the issue of the first Occupation Certificate for warehousing	By December 2022
Moorebank Avenue/ Heathcote Road Intersection	a. As strategically described for intersection I-5 Moorebank/Heathcote Road (page 76, MPE Stage 2 EIS operational Traffic and Transport Impact Assessment) b. Heathcote Road bus jump lane must be retained or a bus jump lane of equivalent length replaced by the Applicant. c. Indicative layout provided by the Applicant, subject to design development and approval by RMS, and incorporating a bicycle/pedestrian share lane	To be obtained prior to the issue of the first Occupation Certificate for warehousing	By December 2022
Moorebank Avenue Upgrade, being the upgrade of Moorebank	Indicative layout provided by Applicant, subject to design development and approval by RMS, and incorporating a	To be obtained within 12 months of the date of this consent, or prior to the issue of the	Prior to issue of the first Occupation Certificate for warehousing in

Upgrade	Specific Timing Requirements		
	Upgrade Requirements	**Required Timing for 100% Design Approval by RMS**	**Required Timing for Completion of Upgrade**
Avenue to four lanes between Anzac Avenue and the IMEX Terminal Main access point	bicycle/pedestrian share lane	first Occupation Certificate for warehousing, whichever is the sooner	excess of 100,000m^2 of gross floor area

1.3.2 Compliance Monitoring and Tracking

CoC B46 of the MPE Stage 2 development consent states the following: "*all permanent stormwater infrastructure must be constructed in accordance with the Stormwater Management Plan approved by the Secretary and properly maintained on an on-going basis*".

Compliance monitoring and tracking with the MPE Stage 2 Conditions of Consent (CoC) (for CoC B46 and all CoCs) will be undertaken in accordance with CoC C21, which requires the preparation of a Compliance Tracking Program and Reporting. The Compliance Tracking Program would be provided to Secretary prior to the commencement of construction and operations (and each stage of development).

In particular, the following reporting is to be undertaken:

- Pre-Construction Compliance Report prior to commencement of construction
- Quarterly Construction Compliance Reports, for the duration of construction
- A Pre-Operation Compliance Report prior to the commencement of operation, and six monthly operational compliance reports.

In addition to compliance tracking, environmental auditing (of compliance with the CoCs) is also required to be undertaken by SIMTA (throughout construction) and independently (within 1 year of commencement of construction and every 3 years thereafter).

The above will ensure that the drainage basins and rainwater harvesting systems are constructed and operate in accordance with the information provided in the Stormwater Management Plan.

1.3.3 Compliance Matrix

The Project is being delivered under Part 4, Division 4.1 (now Division 4.7) of the EP&A Act. The Conditions of Consent (CoC) include requirements to be addressed in this plan and delivered during the Project. These requirements and how they are addressed in relation to the W1P is provided within **Table 1-3**.

Table 1-3: Conditions of Consent (CoC)

CoC	Requirement	Report Reference	How Addressed
A1	**In addition to meeting the specific performance measures and criteria established under this consent all reasonable measures must be implemented**	**Section 4** – Stormwater Management Overview	Management measures to minimise impacts are detailed in **Section 4**.

CoC	Requirement	Report Reference	How Addressed
	to prevent, and if prevention is not reasonable, minimise, any harm to the environment that may result from the construction and operation of the development, and any rehabilitation required under this consent.		The OEMP & CEMP set out the processes for monitoring and reviewing the effectiveness of these management measures. Opportunities to further minimise environmental harm will be identified through the ongoing evaluation of environmental management performance and effectiveness of this plan.
A2	**The development may only be carried out:** **(a) in compliance with the conditions of this consent;** **(b) in accordance with all written directions of the Secretary in relation to this consent;** **(c) in accordance with the EIS, Submissions Report, Consolidated assessment clarification responses and updated Biodiversity Assessment Report;** **(d) in accordance with the amended Development Layout Plans and Design Plans, amended WSUD plans and amended architectural plans to be submitted for the Secretary's approval as part of this consent; and** **(e) in accordance with the management and mitigation measures at APPENDIX B of this consent.**	This plan	This plan has been developed to comply with the Condition of Consent (CoCs), written directions of the Secretary, amended development layout and management and mitigation measures outlined in Appendix B of the CoCs.
A14	**With the approval of the Secretary, the Applicant may submit any strategy, plan or program required by this consent on a staged basis.**	**Section 1.2.1**	Staging letter provided to DP&E. **Section 1.2.1** details the staging of construction and the staging of the SMP. The SMP will be staged as W1P and the Remainder of the Site.

CoC	Requirement	Report Reference	How Addressed
A15	**If the submission of any strategy, plan or program is to be staged, then the relevant strategy, plan or program must clearly describe the specific stage of the development to which the strategy, plan or program applies, the relationship of the stage to any future stages and the trigger for updating the strategy, plan or program.**	**Section 1.2.1** **Figure 1-2**	This section details the geographical area upon which this SMP will be staged i.e. the W1P with bulk earthworks occurring on the remainder of the site (within the restricted area identified in Figure 1-2). The W1P SMP is to be approved by DP&E prior to commencement of Construction. Construction Phase A would then commence across the W1P, and Construction Phase A limited to Works Period B and Works Period E across the remainder of the site. The SMP – Remainder of the Site would be submitted prior to progressing beyond bulk earthworks.
B13	**The applicant is to undertake the following upgrades, accordance with the specified timing requirements, as set out in Table 1-2 (of this report)**	**Table 1-2** **Section 1.3.1**	CoC B13 is referenced within this document. The SMP commits to delivering RMS approved works in accordance with CoC B13.
B34	**Prior to early works, fill importation or any other surface disturbance, the Applicant must prepare a Soil and Water Management Plan (SWMP) to the satisfaction of the Secretary. The plan must form part of the CEMP required by condition C1 and must include:** **(j) evidence that a drainage easement is in place to discharge stormwater through the MPW site, and to provide OSD basins within the MPW site, for this development, and that drainage infrastructure within the MPW site to the Georges River has been repaired or upgraded to**	Construction Soil and Water Management Plan **Section 6.2.2**	The Construction Soil and Water Management Plan contains details of the drainage easement across the MPW site. **Section 6.2.2** of this plan details the raingarden to be included as part of the proposed upgrade and repair works to be undertaken as part of the MPW drainage infrastructure. The channel will be upgraded prior to the

CoC	Requirement	Report Reference	How Addressed
	the satisfaction of the Secretary prior to completion of construction of the temporary MPE Stage 2 sediment basins.		completion of construction of the temporary MPE Stage 2 sediment basins with raingarden included once the OSD is online when 80% of the upstream catchment has been stabilised.
B40	**Prior to the commencement of early works and fill importation, an amended Stormwater Management Plan must be submitted and approved by the Secretary. The plans must be prepared by a suitably qualified person, and independently reviewed to ensure it meets the following criteria for:**	This plan	This plan has been prepared by [redacted] has over 10 years' experience as a Water Resources Engineer. Her qualifications include a Bachelor of Environmental Engineering and Master of Engineering Science in Water Resources. This report will be independently reviewed. Details of the independent review will be provided to DP&E.
B40	**(a) Drainage:** (i) convey flows from low order events (up to and including the 10% AEP event) from the main part of the site within the formal drainage system, with flows from rarer events (up to the 1% AEP event) conveyed in controlled overland flow paths;	(i) **Section 5.3.3** – Drainage System Capacities and Grades	This plan specifies the drainage capacity requirements for the detailed design of the site drainage network. These drainage capacities comply with the CoC.
B40	(ii) show the location and width of controlled overland flow paths; and	(ii) **Section 5.3.3** – Drainage System Capacities and Grades **Figure 5-2**: Post Development Overland Flow Paths **Appendix A Concept Design Drawings – Drawing SSS2-ARC-CV-DWG-1201**	Roadways will act as overland flow paths. The location and direction of these overland flow paths are illustrated in **Figure 5-2**. The widths of the overland flow paths are generally restricted to the width of the road reserve as depicted in **Figure 5-2** and on drawing **SSS2-ARC-**

CoC	Requirement	Report Reference	How Addressed
			CV-DWG-1201 in Appendix A.
B40	(iii) provide levels to AHD confirming building floor levels are a minimum of 150 mm above the maximum design flow path levels.	(iii)**Section 5.3.6** – Minimum Floor Levels **Appendix A** Concept Design Drawings – **Drawing SSS2-ARC-CV-DWG-1201**	This plan specifies the requirement for building floor levels relative to the 100 year ARI overland flow path levels in accordance with the CoC. This is shown on drawing **SSS2-ARC-CV-DWG-1201 in Appendix A**
B40	**(b) Water Sensitive Urban Design:** (i) incorporate water sensitive urban design principles, be generally in accordance with relevant Council policies, plans and specifications	(i) **Section 6** – Stormwater Quality Management	The stormwater quality strategy outlined in this plan has been developed in accordance with the Liverpool City Council Development Control Plan (2008) and incorporates WSUD principles. A detailed compliance matrix for the water quality strategy against Liverpool Council policies is provided in **Appendix F.**
B40	(ii) ensure that adequate overland flow paths have been provided in the event of stormwater system blockages and flows in excess of the 1% ARI rainfall event;	(ii) **Section 5.3.1** – On-site Detentions (OSDs) **Section 5.3.3** – Drainage System Capacities and Grades **Figure 5-2**: Post Development Overland Flow Paths **Appendix A** Concept Design Drawings – **SSS2-ARC-CV-DWG-1201** and **SSS2-ARC-CV-DWG-1491**	Overland flow paths for larger events have been nominated as the roadways. These are considered adequate for the larger events. The location and direction of these overland flow paths are illustrated in **Figure 5-2** and on drawing **SSS2-ARC-CV-DWG-1201** in **Appendix A.** Blockages of stormwater inlet pits will be incorporated in the detailed design of the site stormwater drainage network. Additional blockage protection will also be provided to the outlets of the OSDs. This is shown on drawing

CoC	Requirement	Report Reference	How Addressed
			SSS2-ARC-CV-DWG-1491 in **Appendix A.**
B40	(iii) ensure on site detention basins are visually unobtrusive and ensure public safety;	(iii) **Section 5.3.1** – On-site Detentions (OSDs)	Access to the OSDs will be controlled via locked access grates/coves limited to trained maintenance personnel only. Safety will be addressed both within and surrounding the OSDs in the form of fencing, step irons and hazard signage. Refer to **Section 5.3.1** for further details. The OSDs have been designed to either be flush with final site levels, or constructed with vertical walls 2-3m in height. It is considered, based on the overall development, that the OSDs will be visually unobtrusive. Further detail of visual mitigation will be provided in the Urban Design Landscape Plan, Sections 3.1.8 & 3.1.9.
B40	(iv) ensure rainwater harvesting is provided for each warehouse;	(iv) **Section 6.2** – Proposed Water Quality Measures **Section 7.5** – Rainwater Harvesting & Water Reuse	Rainwater harvesting will be implemented for each warehouse on site.
B40	(v) ensure adequate site area has been provided for stormwater treatment;	(v) **Section 6.2.1**– Gross Pollutant Traps **Section 6.2.2** – Raingardens	Stormwater treatment will be achieved via GPTs and a raingarden (bioretention systems).
B40	(vi) ensure design of stormwater treatment systems minimises the risk of failure; and	(vi) **Section 6.5** – Detailed Design Requirements to Minimise the Risk	Section 6.5 details the design considerations of the stormwater treatment systems to minimise risk of

CoC	Requirement	Report Reference	How Addressed
		of Failure Appendix G SIOMP	failure. Features of the system include, pre-treatment by GPTs, provision of raingardens, scour protection, plant species selection, maintenance access and monitoring, bypass channel for larger flow events to minimise damage to raingardens downstream of OSD9. **Appendix G** provides a planting palette for the raingardens illustrating the variety of species for varying sunlight exposure. The Stormwater Infrastructure Operation and Maintenance Plan will detail ongoing inspections and maintenance of the raingardens. Maintenance activities will utilise light vehicles and turfed access tracks.
B40	(vii) develop concept options for how 20% of the average annual volume of stormwater from the site can be reused via rainwater capture and reuse for activities including but not limited to: • irrigation, • all internal non-potable uses, • washdown, • cooling towers, • heating, ventilation, and air conditioning, and • ground source heat exchange. The Applicant is to brief the Department on how these initiatives will be implemented prior to the completion of the Stormwater Management Plan.	(vii) **Section 7.5** – Water Reuse **Section 7.5.8** for specific W1P details	Rainwater harvesting will be implemented for each warehouse on site. Section 7.5.8 details the specific details of sizing of the rainwater tank for W1P. Concept options have been developed and discussed with DP&E as detailed in **Section 7.5**. The Project proposes to reuse rainwater for irrigation, toilet and washdown demands. Cooling towers, heating, ventilation, air conditioning and ground source heat exchange were found to be unsuitable for

CoC	Requirement	Report Reference	How Addressed
			reuse as justified in **Section 7.5.2**.
B40	**(c) Water quantity:** (i) on site detention is to be provided to attenuate peak flows from the development such that both the: • 1 in 1 year ARI event post development peak discharge rate is equivalent to the pre-development (un-developed catchment) 1 in 1 year ARI event • 1 in 100 year ARI event post development peak discharge rate is equivalent to the predevelopment (un-developed catchment) 1 in 100 year ARI event;	(i) **Section 5.2** – Post Development Conditions Assessment **Appendix D –** Flow Comparisons **Table 5-1**	The OSDs have been designed to attenuate the post development peak discharge rate to the pre-development peak discharge rate for the 1 and 100 year ARIs. A comparison of the peak flow rates as illustrated in **Table 5-1** and **Appendix D**.
B40	(ii) no new drainage infrastructure work within the Defence Joint Logistics Unit (DJLU) site;	(ii) **Section 5.3.7** – Works within Neighbouring Properties	No works are to be undertaken within the Defence Joint Logistics Unit under this approval.
B40	(iii) all on site detention basins to have maximum batter slopes of 1V:4H or, for works immediately adjacent to the Moorebank Avenue upgrade, an alternate slope gradient agreed to by RMS;	(iii) **Section 5.3.1** – On-site Detentions (OSDs)	The proposed design incorporates an underground OSD. No batters are proposed for the OSD 9.
B40	(iv) siting and design of on site detention basins to eliminate/ minimise excavation within the southern ordinance burial pits; and	(iv) **Section 5.3.1** – On-site Detentions (OSDs)	Only OSD 2 is located within the southern ordinance burial pits. This area, however, has been surveyed and a clearance certificate provided. Any Unexpected Ordinance identified during construction of the OSD will be managed in accordance with the Unexpected Finds Procedure detailed within Section 11 of the Contamination Management Plan prepared as part of the CEMP.

CoC	Requirement	Report Reference	How Addressed
B40	(v) maintenance access to be provided to each on site detention basin.	(v) **Section 5.3.1** – On-site Detentions (OSDs) Appendix A – Concept Design Drawings Drawing SSS2-ARC-CV-DWG-1201	Maintenance access to the OSD will be via access grates/covers. These will be locked to prevent unauthorised access. This is shown on drawing **SSS2-ARC-CV-DWG-1201** in **Appendix A**.
B40	**(d) Connection to natural creeklines:** (i) on site detention basin outlets to natural drainage lines must be constructed of natural materials to facilitate natural geomorphic processes and to include vegetation as necessary (gabion baskets and gabion mattresses are not acceptable).	(i) **Section 5.3.7** – Works within Neighbouring Properties	All outlets from the Project site discharge to constructed drainage lines, as such the material requirement is not considered applicable as there is no direct discharge to natural drainage lines. A plan view of the outlet from OSD 9 is provided in drawing **SSS2-ARC-CV-DWG-1201** of **Appendix A.**
B40	**(e) Stormwater Quality** (i) have a stormwater quality treatment train comprised of gross pollutant traps and biofiltration/bioretention systems designed to meet the following criteria compared to a base case if there were no treatment systems in place: • reduce the average annual load of total nitrogen by 45%; • reduce the average annual load of total phosphorus by 65%; and • reduce the average annual load of total suspended solids by 85%.	(i) **Section 6** – Stormwater Quality Management. **Table 6-3**: Georges River – Water Quality Treatment Performance	The proposed stormwater quality treatment train includes GPTs and a raingarden. The MUSIC modelling demonstrates that the proposed treatment measures achieve the required performance targets for TN, TP and TSS.
B40	(ii) all stormwater quality elements are to be modelled in MUSIC as per the NSW MUSIC Modelling Guide.	(ii) **Section 6.3** – Assessment Methodology **Appendix E –** MUSIC Modelling Information	MUSIC modelling parameters have been selected in accordance with the NSW MUSIC Modelling Guidelines (BMT WBM, 2015). Modelling parameters are provided in **Appendix E**.

CoC	Requirement	Report Reference	How Addressed
B40	(iii) all stormwater quality elements are to be installed upstream of stormwater detention basins, unless it can be demonstrated that biofiltration/ bioretention systems within the OSD basins will not suffer damage from design flows and can be maintained to achieve the water quality criteria.	(iii) **Section 6.2.1** – Gross Pollutant Traps **Section 6.2.2** – Raingardens **Section 6.5** – Detailed Design Requirements to Minimise the Risk of Failure	GPTs will be located on all major stormwater drainage lines from non-roof areas upstream of the OSDs. A raingarden (bioretention systems) will be located downstream the OSD 9. Numerous design features will be incorporated to ensure the raingardens are protected from design flows such as pre-treatment, scour protection and plant species selection. Maintenance access will also be provided to ensure that the raingardens can be regularly maintained in accordance with the OSD operational and maintenance plan.
B40	(iv) the area of biofiltration / bioretention systems is to be at least 1% of the catchment draining to the system, to ensure there is no short-circuiting of the system.	(iv) **Section 6.2.2** – Raingardens **Section 1.2.1 –** SMP Staging **Appendix E –** MUSIC Modelling Information **Table E-5**: Bioretention Modelling Parameters	The proposed raingardens have been designed as a minimum of 1% of the upstream catchment area as illustrated in **Appendix E**, **Table E-5**.
B40	(v) bioretention systems which are greater than 1,000m2 in area, are to be divided into cells with no individual cell greater than1,000m2.	(v) **Section 6.2.2** – Raingardens	Raingarden areas will be divided into cells no greater than 1,000m^2.
B40	(vi) all filter media used in stormwater treatment measures must: • be loamy sand with an appropriately high permeability under compaction and must be free of rubbish, deleterious material, toxicants, declared	(vi) **Section 6.2.2** – Raingardens (filter media)	Raingarden filter media will be specified in accordance with the CoC requirements.

CoC	Requirement	Report Reference	How Addressed
	plants and local weeds, and must not be hydrophobic; • have an hydraulic conductivity = 100-300 mm/hr, as measured using the ASTM F1815-06 method • have an organic matter content less than 5% (w/w) • be provided adequate solar access, considering the design and orientation of OSD basins.		
B40	A copy of the independent review must be submitted with the Plan. A statement from the reviewer confirming their independence and declaring any actual, potential or perceived conflicts of interest must be provided as part of the reporting of the findings and recommendations of the review.	To be provided.	This report will be independently reviewed and a copy of independent review is included in this report.
B41	Notwithstanding condition B40, the Stormwater Management Plan does not require the Secretary to approve drainage works that would be designed, approved by RMS, and delivered, in accordance with condition B13. However, the Stormwater Management Plan must: (a) Include confirmation that any such works are proposed to be designed and delivered in accordance with condition B13; and	**Section 1.3.1 -** Road Infrastructure Upgrades	The MPE Stage 2 project also includes several road upgrades as outlined in **Table 1-2** as required by CoC B13. Works outlined in condition B13 are not addressed within this Plan. Works outlined in condition B13 are proposed to be designed and delivered in accordance with condition B13.
	(b) Incorporate, and be designed in consideration of, preliminary principles for that road drainage.	**Section 1.3.1 Road Infrastructure Upgrades**	Works outlined in condition B13 are to be delivered to Australian Rainfall and Runoff, NSW Floodplain Development Manual, Austroads and RMS drainage standards.
C7	The Applicant must ensure that the environmental management plans required under this consent are prepared in accordance with any relevant guidelines and include:	This plan	

CoC	Requirement	Report Reference	How Addressed
C7	a) detailed baseline data;	**Section 2.3-** Existing Site Conditions **Section 2.3** – Existing conditions Assessment **Section 7.4** – Rainfall Runoff Process	These sections identify current site conditions, as well as parameters used within modelling and assessment.
C7	b) a description of: (i) the relevant statutory requirement (including any relevant approval, licence or lease conditions)	(i) **Section 1.3** – Development Consent	**Section 1.3** details the Project approval process and the relevant Conditions of Consent applicable to the development of this plan.
C7	(ii) any relevant limits or performance measures/criteria; and	(ii) **Section 6.1**– Objectives and Performance Targets	Objectives and targets are identified in **Section 6.1**. Water quality targets are identified in **Table 6-1**.
C7	(iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management plans	(iii) **Table 6-1, Table 6-3, Table 6-4**	**Table 6-1** identifies pollutant reduction targets to be met through the implementation of Stormwater Management Plan, particularly measures identified in **Section 6.2.**
C7	c) a description of the management measures to be implemented to comply with the relevant statutory requirements, limits or performance measures/criteria	**Section 6.2**– Proposed Stormwater Quality Measures **Section 6.5**– Detailed Design Requirements to Minimise the Risk of Failure **Section 6.6**– Monitoring	These sections identify the management measures considered, and where appropriate, integrated into design and implemented during construction and operation.

CoC	Requirement	Report Reference	How Addressed
		Section 6.7 – Construction Phase **Section 7.5**– Rainwater Harvesting and Reuse	
C7	d) a program to monitor and report on the: (i) impacts and environmental performance of the development; and (ii) effectiveness of any management measures (see (c) above);	**(i) Section 1.3.2** – Compliance Monitoring and Tracking **Section 6.6** – Monitoring	The program to monitor and report on SMP is detailed within **Section 1.3.2**. **Section 6.6** details stormwater monitoring requirements.
C7	e) a contingency plan to manage any unpredicted impacts and their consequences;	**Section 5.3.1** **Section 6.5** **Section 6.6** CEMP Section 2.8 SIOMP	Section 2.8 of the CEMP details the response requirements to be undertaken in an emergency. **Section 5.3.1** details the design considerations to minimise the risk of failure of the OSD particularly items 6, 7, 8, 9 and 10. **Section 6.5** details the design considerations to minimise the risk of failure of the bioretention system Section 6.6 details the monitoring requirements to be undertaken The SIOMP will detail the specific maintenance programme for the water treatment systems, including the clean out of GPTs and replanting of bioretention etc.
C7	f) a program to investigate and implement ways to improve the environmental	**Section 1.3.2** – Compliance	**Section 1.3.2** describes how compliance tracking

CoC	Requirement	Report Reference	How Addressed
	performance of the development over time;	Monitoring and Tracking **Section 6.6 -** Monitoring	requirements and that monitoring will be undertaken for a period of 5 years after completion of construction and that monitoring requirements will be included within the OEMP.
C7	g) a protocol for managing and reporting any: (i) incidents and non-compliances; (ii) complaints; (iii) non-compliances with statutory requirements; and;	**Section 1.2.2** CEMP section 2.8, 2.6.3 and 4 Community Communication Strategy	**Section 1.2.2** details integration with other management plans, In particular the requirement of the CEMP.
C7	h) a protocol for periodic review of the plan	**Section 1.6**	**Section 1.6** details periodic review of this plan and triggers for requiring a review e.g. design changes.
C7	*Note; The Secretary may waive some of these requirements if they are unnecessary or unwarranted for a particular management plan.*	Noted	Noted.

The Final Compilation of Mitigation Measures (FCMMs) were prepared as part of the MPE Stage 2 Submissions Report (Arcadis 2017). A list of the FCMMs as relevant to the Project and how they have been complied with in this plan are provided in **Table 1-4**.

Table 1-4: Final Compilation of Mitigation Measures (FCMM)

FCMM	Requirement	Report Reference	How Addressed
5D	Stormwater quality improvement devices management measures would be designed and installed on site as presented in the stormwater and Flooding Environmental Assessment (Appendix P of the EIS), including: • Gross pollutant traps (GPTs) at Section 6.2.1 • Rain gardens in the base of the OSD channels, as shown in Figure 6-1 of Appendix P of the EIS. Stormwater quality improvement devices would be designed	**Section 6 –** Stormwater Quality Management	GPTs will be located on all major stormwater drainage lines from non-roof areas prior to flows discharging into the OSD located upstream of the raingarden. Note the CoC performance targets supersede the FCMM targets.

FCMM	Requirement	Report Reference	How Addressed
	to meet the performance targets identified in Georges River Estuary CZMP.		The MUSIC modelling demonstrates that the proposed treatment measures achieve the required FCMM 5D & CoC B40 (e) (i) performance targets for TN, TP and TSS.
5H	Measures associated with the OSDs to be developed during the detailed design phase would include: • Security fences – security fencing with locks would keep general public from entering the OSD basins. Only maintenance personnel or other relevant personnel with induction would be allowed into the basins. • Ladders – ladders are to be provided at regular intervals to provide safe access and egress • Access Ramp/ Sloped Driveway – would be provided for maintenance and emergency vehicles. • All OSD basins would have minimum base width of 6.0m. Maintenance access is to be provided along the base of the basin with access points via ramp/ sloped driveway. • Appropriate scour protection and energy dissipation will be provided at drainage outlets to control velocities in the OSD channels to less than 1.0m/s. • Raingarden (bioretention) will be located in areas sufficiently away from drainage outlets to avoid re-suspension of sediments. The OSD outlets will be protected from blockage via combination of anti-blockage measures, such as palisade fencing, surcharge pit inlet grate and orifice trash screen in accordance with the Australian Rainfall and Runoff 2016 Project 11.	**Section 5.3.1** – On-site Detentions (OSDs) **Section 6.5** – Detailed Design Requirements to Minimise the Risk of Failure **Appendix A** – Concept Design Drawings	The detailed design of OSD 9 will be in accordance with the FCMM where the requirements remain suitable for an underground tank OSD as outlined in **Section 5.3.1** and **Section6.5**. The scour protection is shown on drawing **SSS2-ARC-CV-DWG-1201** in **Appendix A**

1.4 Report Structure

This report provides an overview of the stormwater management strategy of the Project site and includes:

- A site description (**Section 2**)
- A summary of previously prepared flooding and stormwater reports and plans (**Section 3**)
- An overview of the stormwater management strategy for the project (**Section 4**)
- Details of the proposed Water Quantity (**Section 5**) and Quality (**Section 6**) Management Strategies
- A Site Water Balance and discussion on rainwater reuse (**Section 7**)
- An overall conclusion of the report, with respect to stormwater management and potential flood impacts (**Section 8**).

Concept design drawings of the proposed development of the W1P have been prepared to support this report as provided as **Appendix A**.

1.5 Purpose of this Report

The purpose of this report is to provide an overview of the stormwater management strategy of the W1P of the Project.

This report has been developed to address the requirements for a Stormwater Management Plan under the CoC B40 as detailed in the compliance matrix (see **Table 1-3**). The detailed design of the W1P is to be developed in accordance with the strategy outlined in this report.

MPE Stage 1 and MPW works are included as base-case (i.e. existing) conditions of the project. The proposed conditions presented in this report include the proposed works across the remainder of the MPE Stage 2 site in addition to the W1P works.

1.6 Review

The SMP-W1P will be reviewed annually, as a minimum, but may be revised more regularly depending on process changes and refinements in accordance with changes to the CEMP. Revisions may result from:

- Design changes
- CEMP review
- Audits (either internal or by external parties)
- Changes to procedures, scope of works and/or systems after an incident or potential incident
- Changes in the CoCs
- Identification of opportunities for improvement or deficiencies in the Project system (e.g. through the course of site inspections)
- Following complaints.

2 SITE DESCRIPTION

2.1 Location

2.1.1 Regional Context

The MPE site, including the Project site, is located approximately 27 km south-west of the Sydney Central Business District (CBD) and approximately 26 km west of Port Botany (refer to **Figure 2-1**). The MPE site is situated within the Liverpool Local Government Area (LGA), in Sydney's south west sub-region, approximately 2.5 km from the Liverpool City Centre.

The MPE site is located approximately 800 m south of the intersection of Moorebank Avenue and the M5 Motorway. The regional context of the Project is shown on **Figure 2-1**.

2.1.2 Local Context

The Project site is located approximately 2.5 km south of the Liverpool City Centre, 800 m south of the Moorebank Avenue/M5 Motorway interchange and one kilometre to the east of the Southern Sydney Freight Line providing convenient access to and from the site for rail freight (via a dedicated freight rail line) and for trucks via the Sydney Motorway Network. The local context of the Project is shown on **Figure 2-2**.

The majority of land surrounding the MPE site is owned and operated by the Commonwealth and comprises:

- The MPW site, formerly the School of Military Engineering (SME), on the western side of Moorebank Avenue directly adjacent to the MPE site (subject to the MPW Concept Plan Approval).
- The Holsworthy Military Reserve, to the south of the MPE site on the southern side of the East Hills Rail Corridor, which is owned and operated by Sydney Trains.
- Residual Commonwealth Land (known as the Boot Land), to the east of the MPE site between the site boundary and the Wattle Grove residential area.

Glenfield Waste Services, south-west of the Project is proposing to develop a Materials Recycling Facility on land owned by the Glenfield Waste Services Group within the boundary of the current landfill site at Glenfield.

The area immediately south of the MPE site, known as the 'Southern Boot Land', includes an existing rail spur within heavily vegetated remnant bushland. The Southern Boot Land to the south of the Project and forming part of the MPE Stage 1 site includes a range of vegetation, varying from remnant bushland to the north-east of the Sydney Trains East Hills Rail Corridor.

A number of residential suburbs are located in proximity to the Project site including:

- Wattle Grove - 360m to the north-east
- Moorebank - 1300m to the north
- Casula - 820m to the west
- Glenfield - 1830m to the south-west.

Stormwater Management Plan - Warehouse 1 Precinct

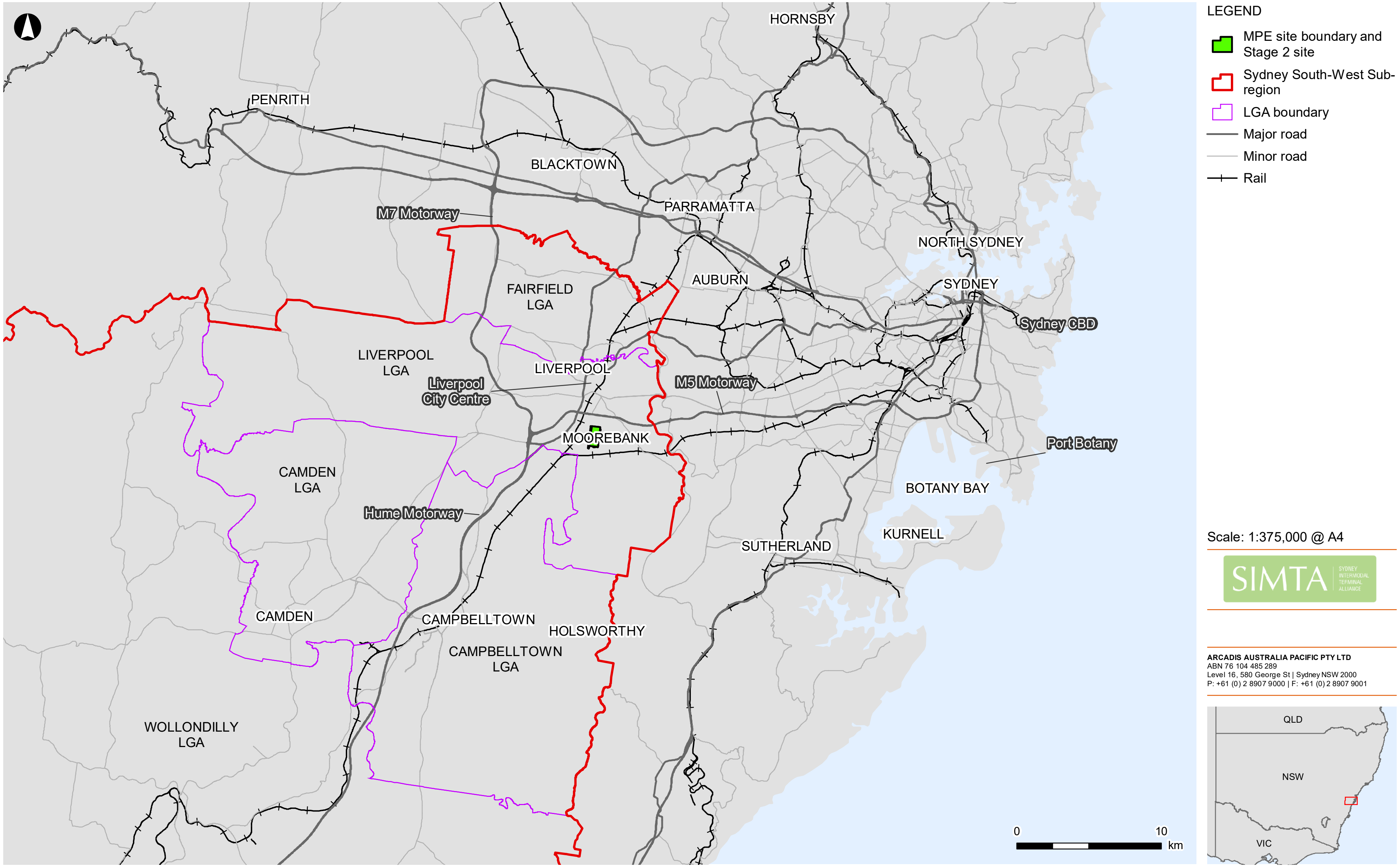
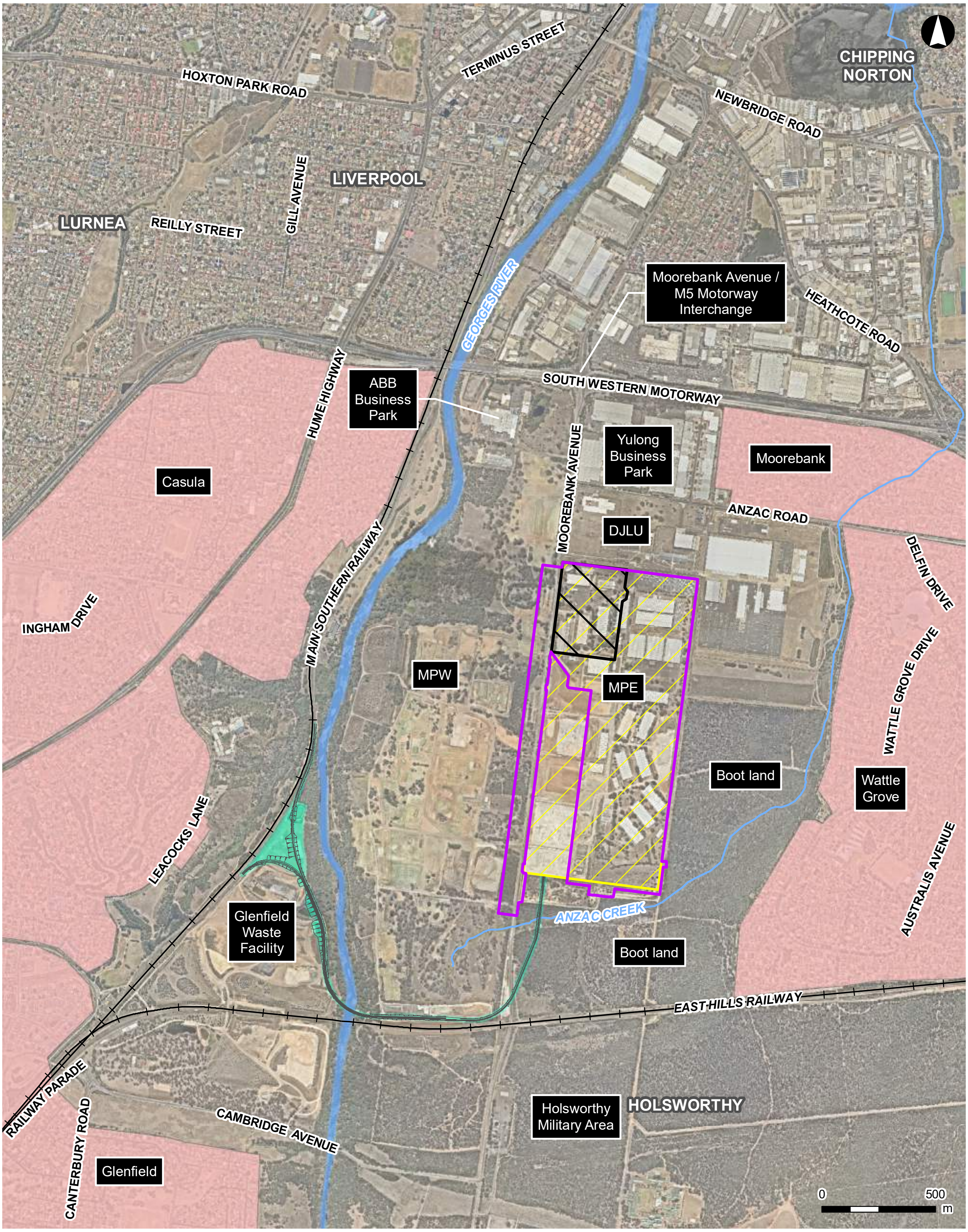


Figure 2-1: Regional Context of the Project



LEGEND

- MPE Stage 2 construction area
- MPE site
- Warehouse 1 Precinct
- Residential Areas
- Rail Link (including 20m width and variable buffer)
- Rail link (Stage 1 Proposal)
- Existing railway
- Watercourse

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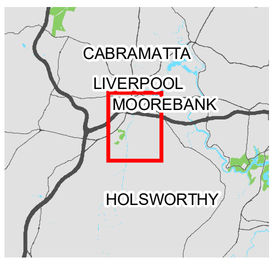


Figure 2-2: Local Context of the Project

The closest industrial precinct to the Project is at Moorebank, comprising approximately 200 hectares of industrial development. This area includes (but is not limited to) the Yulong and ABB sites to the south of the M5 Motorway and the Goodman M5 Business Park and miscellaneous industrial and commercial development to the north of the M5 Motorway. The majority of this development is located to the north of the M5 Motorway between Newbridge Road, the Georges River and Anzac Creek. The Moorebank Industrial Area supports a range of industrial and commercial uses, including freight and logistics, heavy and light manufacturing, offices and business park developments.

2.2 Regional Environment

The Project site is bisected in a north-south direction by a catchment boundary with the eastern portion discharging to Anzac Creek (approximately 50 metres to the southeast of the Project site) and the western portion discharging to the Georges River (approximately 450 metres to the west of the Project site).

Anzac Creek is a small tributary of the Georges River. A flood study of the area (BMT WBM, 2008) indicated that the Anzac Creek catchment covers an area of 10.6 km2 and is 4 km long forming in the MPW site. Anzac Creek flows to the north past the suburb of Wattle Grove and underneath the M5 Motorway at the intersection with Heathcote Road. From there, the creek continues northwards, through Ernie Smith Recreation Reserve, fringed by the Moorebank Industrial Area to the west and the suburb of Moorebank to the east, under Newbridge Road and through McMillan Park, into Lake Moore at Chipping Norton. Anzac Creek discharges to the Georges River approximately 2.5 kilometres to the north-east of the Project site (see **Figure 2-2**) and is classified as a first order stream, having a defined channel where water flows intermittently.

The Georges River enters the Liverpool LGA from the south on the western side of the Defence lands at Holsworthy and flows to the north, meeting with Glenfield Creek at Casula. The river then continues to flow north past the Liverpool City Centre, under Newbridge Road, past Lighthorse Park and over the Liverpool Weir. Downstream of the Liverpool Weir, the Georges River becomes brackish and is subject to tidal influences.

2.3 Existing Site Conditions

The current site contains the following infrastructure and features:

- A number of existing buildings previously utilised by the Department of Defence, comprising a mixture of warehouses, offices and administrative facilities.
- An internal road network and areas of large hardstand, typically comprising asphalt and concrete.
- Planted vegetation along site boundaries, walkways, internal roads and areas of open space.

The topography of the MPE site is relatively flat, with reduced levels (RLs) ranging between 14 and 16 metres Australian Height Datum (mAHD). Along the eastern site boundary, the land rises from about RL14 mAHD at each end to a localised peak of RL22 mAHD about midway along the length.

There are three internal catchments within the MPE site and a number of small external catchments that discharge into the site. The site catchments are shown in **Figure 2-3**, and drawing **SSS2-ARC-CV-DWG-1431** in **Appendix A**. The existing stormwater pit and pipe drainage network surveyed within the Project site is illustrated in **Figure 2-4**.

There are three existing stormwater culvert outlets from the site. Two outlets discharge eastward to Anzac Creek and cross under the Greenhills Road formation via pipes and headwalls (Outlets A and B). Stormwater to these two culvert outlets is conveyed through the site via formal open grass lined channels. From Greenhills Road to Anzac Creek the channels appear less formalised.

On the western portion of the site water from both the site and the eastern side of Moorebank Avenue is collected in a formal concrete lined channel which runs within the site parallel to Moorebank Avenue. These channel flows discharge via a culvert under Moorebank Avenue (Outlet C) into a channel which leads to Georges River. The following provides additional drainage information within specific MPE site areas.

2.3.1 MPE Site - East of Moorebank Avenue

To the east of Moorebank Avenue is the MPE site which is bisected in a north-south direction by a catchment boundary. The eastern and western portions of the area are described in the following.

A. Eastern Portion

The eastern portion of the area is substantially developed and surface water currently discharges to Anzac Creek via two culvert outlets under the Greenhills Road corridor, one in the north-east of the site (Outlet A) and the other in the south-east (Outlet B).

i. North-east Site Area

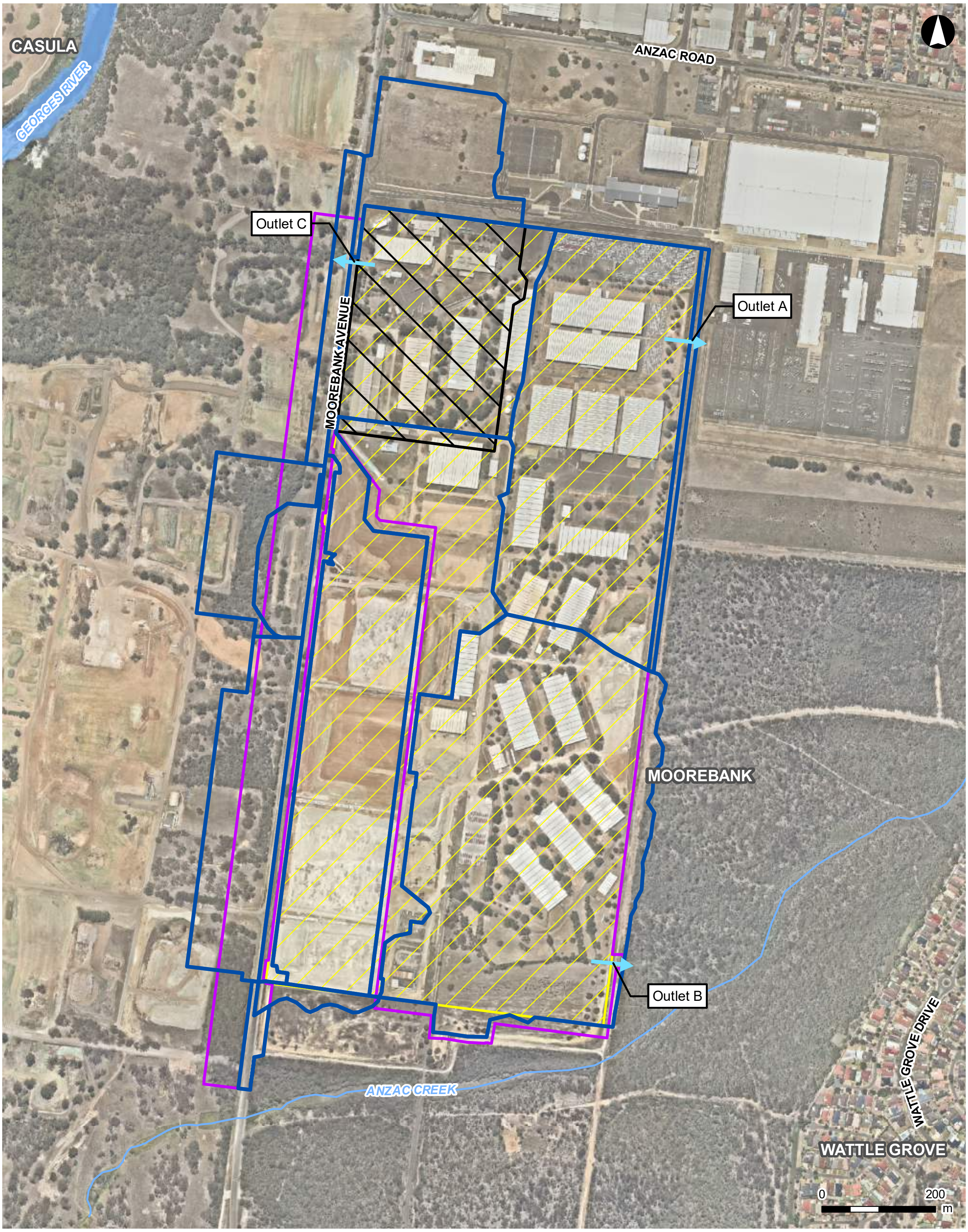
The north-east area is illustrated in **Figure 2-5** and has significant flood storage capacity.

The neighbouring land to the north-east of the Project site has been redeveloped for the DJLU. The culvert is to serve as the MPE site outlet system under the Greenhills Road corridor. It is noted that during site visits on 2 November 2015 and 13 December 2017 attended by Arcadis staff the culverts appeared to be 80% blocked with vegetation and sediment.

ii. South-east Site Area

This south-east area also has significant flood storage capacity as illustrated in **Figure 2-5**.

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

- MPE Stage 2 construction area
- MPE site
- Warehouse 1 Precinct
- Existing catchment
- Watercourse

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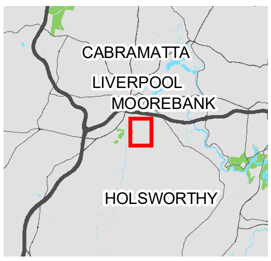
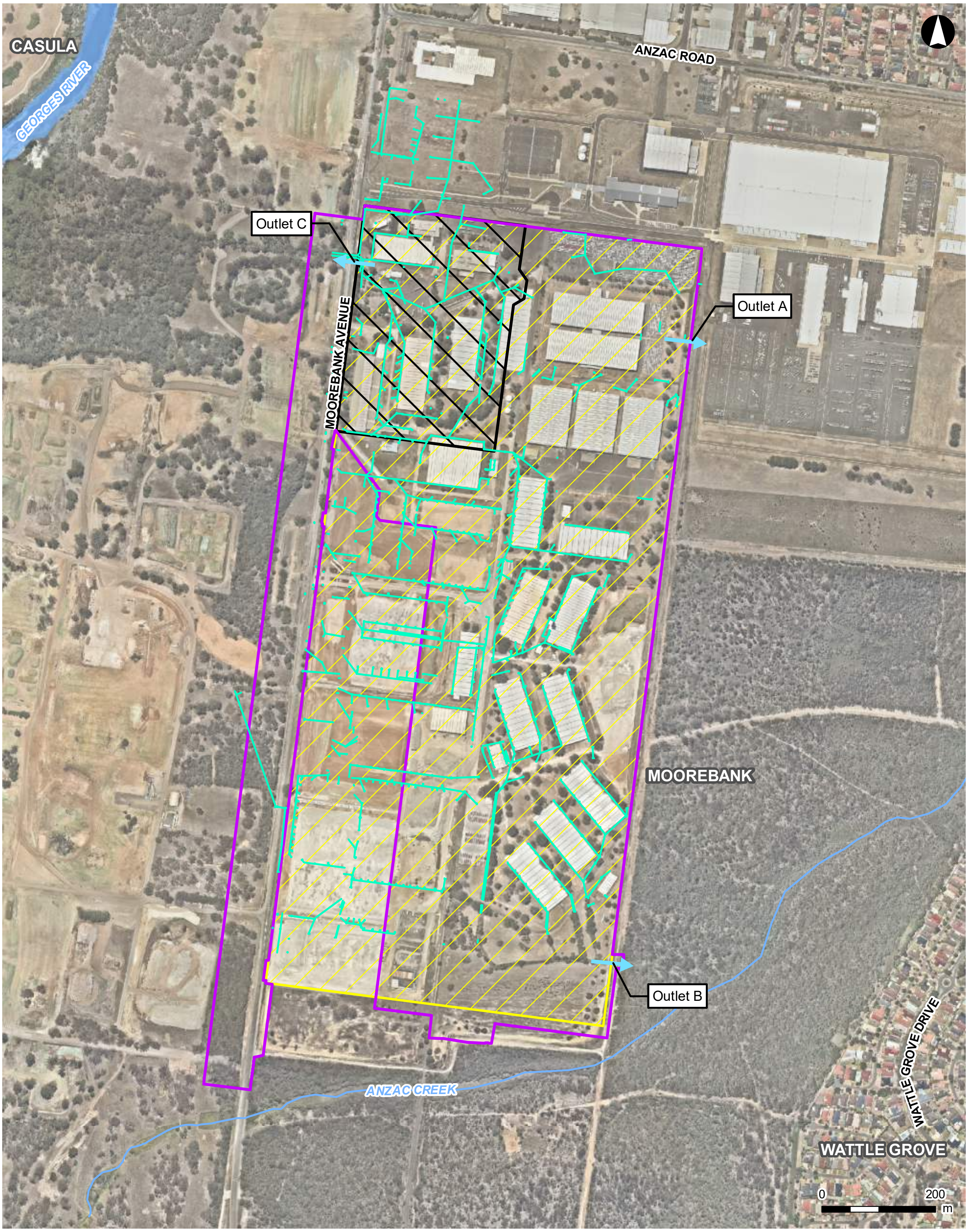


Figure 2-3: Existing Catchments of the MPE Site

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

- MPE Stage 2 construction area
- MPE site
- Warehouse 1 Precinct
- Existing stormwater infrastructure
- Watercourse

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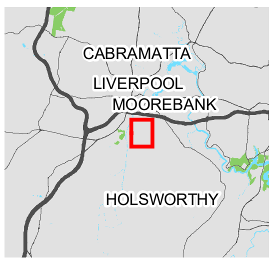
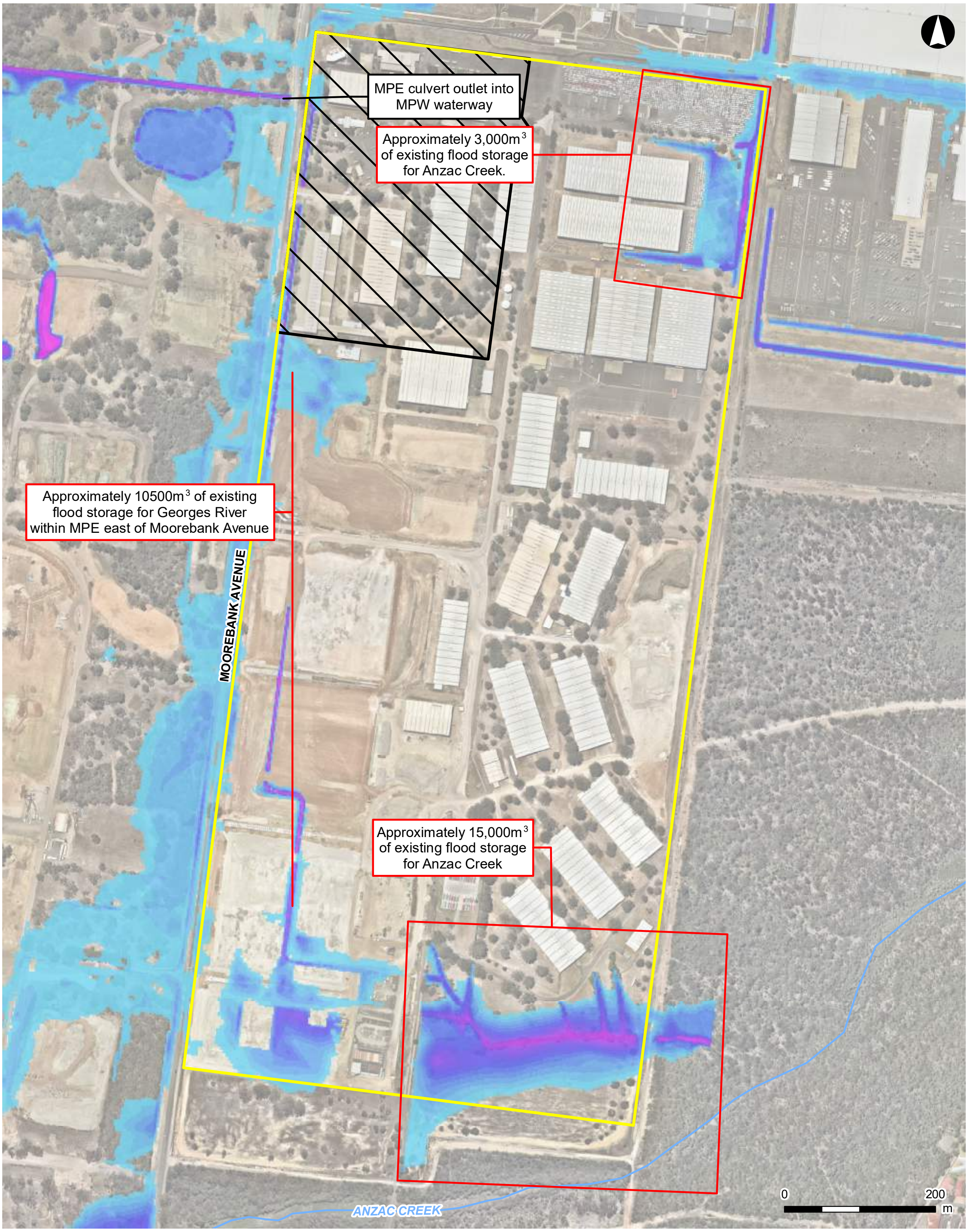


Figure 2-4: Existing Drainage Network

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

- MPE site
- Warehouse 1 Precinct
- Watercourse

Existing 100 year flood depth (m)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 0.6
- 0.6 to 0.7
- 0.7 to 0.8
- 0.8 to 0.9
- 0.9 to 1.0
- 1.0 to 1.2
- 1.2 to 1.4
- > 1.4

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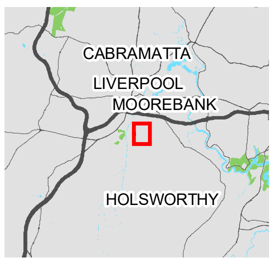

Figure 2-5: MPE site 100 year ARI flood levels (mAHD) and flood storage

B. Western Portion

The western portion of the area (including the W1P) discharging to the Georges River via a culvert under Moorebank Avenue, into a channel which conveys flows 600m to the Georges River. This area is also significantly developed and relatively flat, and includes:

- A partially covered open channel which captures and conveys surface runoff to the north-western corner of the site. This area also has significant flood storage potential (as illustrated in **Figure 2-5**).
- A twin culvert (2, 1.8m(h) x 2.0m(w)) which conveys flows from the MPE site under Moorebank Avenue, into an open channel and to the Georges River. However as shown in **Plate 2-1**, the upstream headwall entrance appears highly susceptible to blockage due to a combination of full height channel grating, walkway and fencing.
- A number of small external catchment areas which discharge into the MPE site (as outlined in **Figure 2-3** and identified in the 'SIMTA Moorebank Intermodal Terminal Facility - Stage 1 Stormwater *and Flooding Environmental Assessment'* by Hyder Consulting, 10 April 2015).

Plate 2-1: Moorebank Avenue, upstream of culvert, viewing west (downstream)

2.3.2 Moorebank Avenue

Moorebank Avenue has a crest located just to the south of the MPE site southern boundary. To the south of the road crest, runoff discharges to Anzac Creek. To the north of this road crest, overland flows generally discharge northward along the road corridor to the culvert under Moorebank Avenue (located just south of the MPE northern site boundary). There are however a number of local pit and pipe systems on the western side of Moorebank Avenue including:

- A conduit system which discharges from Moorebank Avenue westward under the MPW site then into the Georges River (shown in **Figure 2-6**).
- Several other stormwater pits which may also discharge eastward into the MPE site, northward to the culvert under Moorebank Avenue or westward under the MPW site before discharging to the Georges River.

2.3.3 MPW Site - West of Moorebank Avenue

To the west of Moorebank Avenue the MPE works interface with the MPW site. A portion of MPW drains into the Project site along Moorebank Avenue.

The south eastern portion of the MPW site drains eastward, and is an upper catchment area of Anzac Creek. The remainder of the MPW site discharges to the Georges River, either via Moorebank Avenue, or more directly from areas grading westward.

As outlined in **Figure 2-6**, the open channel which conveys flows from the MPE site and works area, through the MPW site, and into the Georges River, is initially a concrete lined trapezoidal shape (see **Plate 2-2**). Approximately halfway between Moorebank Avenue and the Georges River, the concrete lined portion of the open channel is served by an energy dissipater which has catastrophically failed, resulting in major scouring (see **Plate 2-3** and **Plate 2-4**). Downstream is very inaccessible, and appears to be an incised and scoured unlined waterway, dropping away quite steeply down to the Georges River.

Plate 2-2: Open Channel West of Moorebank Avenue in MPW Site

Plate 2-3: Channel Failure and Scouring Upstream (Eastward)

Plate 2-4: Channel Failure and Scouring Viewing Downstream (Westward)

Stormwater Management Plan - Warehouse 1 Precinct

LEGEND

- MPE site
- Warehouse 1 Precinct
- MPW site
- MPE Stage 1 site
- Watercourse

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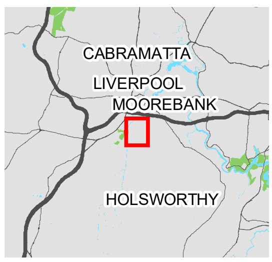


Figure 2-6: Existing Site Conditions Catchment Plan

3 PREVIOUS FLOODING AND STORMWATER REPORTS

Previous flooding and stormwater reports that have relevance to the Project include:

1. *SIMTA Sydney Intermodal Terminal Alliance: Flood Study and Stormwater Management Part 3A Concept Plan Application* (12/08/2011) (Concept Plan report). The Concept Plan report was completed to support a Concept Plan application for the development of the SIMTA (MPE) Project. The main components of the report have been summarised in **Section 3.1**.
2. *SIMTA Moorebank Intermodal Terminal Facility – Stage 1 Stormwater and Flooding Environmental Assessment* (10/04/2015). This environmental assessment report was completed to support a state significant development application for the construction and operation of Stage 1 of the SIMTA (MPE) Stage 1. The report has been summarised in **Section 3.2**.
3. *Moorebank Intermodal Terminal Surface Water Assessment*' by Parsons Brinkerhoff Australia Pty Ltd (dated 25/6/2014), for the Moorebank Intermodal Company. This surface water assessment report was completed to support a state significant development application for the development of the MPW Project. Findings of the June 2014 report which are relevant to MPE Stage 2 have been incorporated into the MPW Stage 2 summary of **Section 3.3**.
4. *Moorebank Precinct Intermodal Terminal Facility – MPW Stage 2 Stormwater and Flooding Environmental Assessment* (01/08/2016). This environmental assessment report was completed to support a state significant development application for the construction and operation of Stage 2 of the MPW. Findings of the August 2016 report which are relevant to MPE Stage 2 have been summarised in **Section 3.3**.
5. *Moorebank Precinct East – Stage 2 Stormwater and Flooding Environmental Assessment* (23/11/2016). This assessment report formed part of the environmental impact statement completed to support a state significant development application for the construction and operation of Stage 2 of the MPE. Findings of the November 2016 report which are relevant to MPE Stage 2 have been summarised in **Section 3.4**.
6. *SMITA Moorebank Precinct East – Response to Submissions Report (28/07/2017).* The response to submissions report was prepared to address submissions raised by government agencies and the community during the public exhibition of the Moorebank Precinct East Stage 2 Environmental Impact Statement previously mentioned. This July 2017 report formed the basis of this report as outlined in **Section 3.5**.

3.1 SIMTA Flood Study & Stormwater 12/08/2011

The Concept Plan report was completed to support a Concept Plan application for the development of the SIMTA (MPE) Project, including a rail link and warehouse and distribution facilities on the SIMTA (MPE) site. This previous Concept Plan report:

- Detailed existing catchments, hydrology and hydraulics relevant to the SIMTA (MPE) Project.
- Presented flooding and stormwater management and mitigation measures for the post-development site condition including concept designs for on-site detention (OSD) and options for managing external (neighbouring area) catchment flows.

The post-development conditions would result in an increased imperviousness with approximately 100 per cent of the site becoming impervious.

Measures adopted to mitigate stormwater impacts associated with the development would include:

- The provision of OSD structures to mitigate potential increases in peak flows discharging from the site up to and including the 100 year average recurrence interval (ARI) event. It was anticipated that the mitigating OSD storage would be achieved:
  - By configuring the OSD channels with vertical walls, and horizontal inverts (with raingarden inverts)
  - By raising site ground levels
  - Where necessary, providing above ground storages within or adjacent to proposed buildings.
- Incorporating swales and culverts to adequately convey neighbouring property flows through the SIMTA (MPE) site in order to prevent adverse flood impacts on adjacent lands as a result of the site development.
- A number of stormwater treatment devices including rainwater tanks, gross pollutant traps, buffer strips, bio-retention and bio-swales.

3.2 SIMTA Stage 1 Flood Study & Stormwater 10/04/2015

SIMTA (MPE) Stage 1 works areas are outlined in **Figure 1-1**. The MPE Stage 1 works areas are included as base-case (i.e. existing) conditions for the MPE (SIMTA) Stage 2 Project.

The following conclusions and recommendations (relevant to the Project) were made within this earlier report.

- TUFLOW model results indicated that the impact of the proposed Rail link and associated culvert would result in negligible flood impacts within the Anzac Creek catchment area.
- The DRAINS and HEC-RAS modelling results indicate that the proposed drainage systems and OSD can provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Stage 1 Operational Area works. Design considerations to optimise stormwater management on the Stage 1 Operational area were identified.
- Stormwater management structures for the Rail link have been identified to predominantly maintain existing surface water conditions.
- Stormwater quality modelling was undertaken, which demonstrated that implementation of the WSUD measures identified, including the use of gross pollutant traps and raingardens, would result in a ‘net or better effect’ on water quality as a result of the Stage 1 proposal during operation.
- A site water balance was prepared that concluded that Stage 1 would result in an increase in surface water runoff of 30 ML. Opportunities for reuse within the Stage 1 site are limited, however the impacts associated with the increase are expected to be negligible in the context of the Georges River catchment as a whole.

3.3 MPW Stage 2 Stormwater & Flooding 01/08/2016

The MPW Stage 2 works areas are outlined in **Figure 3-1**. The MPW works areas are included as base-case (i.e. existing) conditions for the MPE (SIMTA) Stage 2 Project.

The following conclusions and recommendations (relevant to the Project) were made within this earlier (MPW Stage 2) report.

- The DRAINS modelling results indicate that:
  - The proposed drainage systems and OSDs would provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the MPW Stage 2 site works.
  - The introduction of a significant channel system downstream of the existing MPE site culvert crossing Moorebank Avenue, would adequately convey flows through the MPW Stage 2 site to the Georges River.
- Design considerations to optimise stormwater management along Moorebank Avenue have been identified. However:
  - The next stages of design and analysis should include 2-dimensional rainfall-runoff modelling analysis of the Moorebank Avenue corridor (e.g. using TUFLOW software to more adequately quantify flow regimes for existing conditions and site development conditions). Such modelling is to facilitate design of the northern Moorebank Avenue widening and channel system (at the MPE culvert crossing location) and confirm hydraulic performance and stormwater/flood mitigation adequacy.
  - It is also recommended that consideration be given to the construction timing of future design stages with respect to management of greater than 100 year ARI flows.

3.4 MPE Stage 2 Stormwater and Flooding Environmental Assessment 23/11/2016

This stormwater assessment formed part of the environmental impact statement (EIS) completed to support a state significant development application for the construction and operation of Stage 2 of the MPE.

This report builds upon the stormwater management strategy developed in this report, which was further amended as part of the response to submissions (refer to **Section 3.5**).

The following conclusions and recommendations have been made within this report:

- The DRAINS and TUFLOW analysis indicated that the proposed drainage systems and OSDs would provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the MPE Stage 2 site works.
- Approval is required from neighbouring land owner(s) for proposed drainage works to be carried out, including:
  - Areas adjacent to the southern MPE Stage 2 boundary
  - Drainage outlet works to the east of MPE Stage 2.
- It is recommended at future design stages to carry out refined TUFLOW flood modelling (with improved waterway, local drainage and surface level definition) of the north-eastern Proposal area and neighbouring site, to more adequately define the local area flow regimes of extreme event flooding, and determine whether further flood mitigation measures are necessary.

- The water quality modelling has demonstrated that the water quality targets for the site can be met.

3.5 SIMTA MPE Response to Submissions Report 28/07/2017

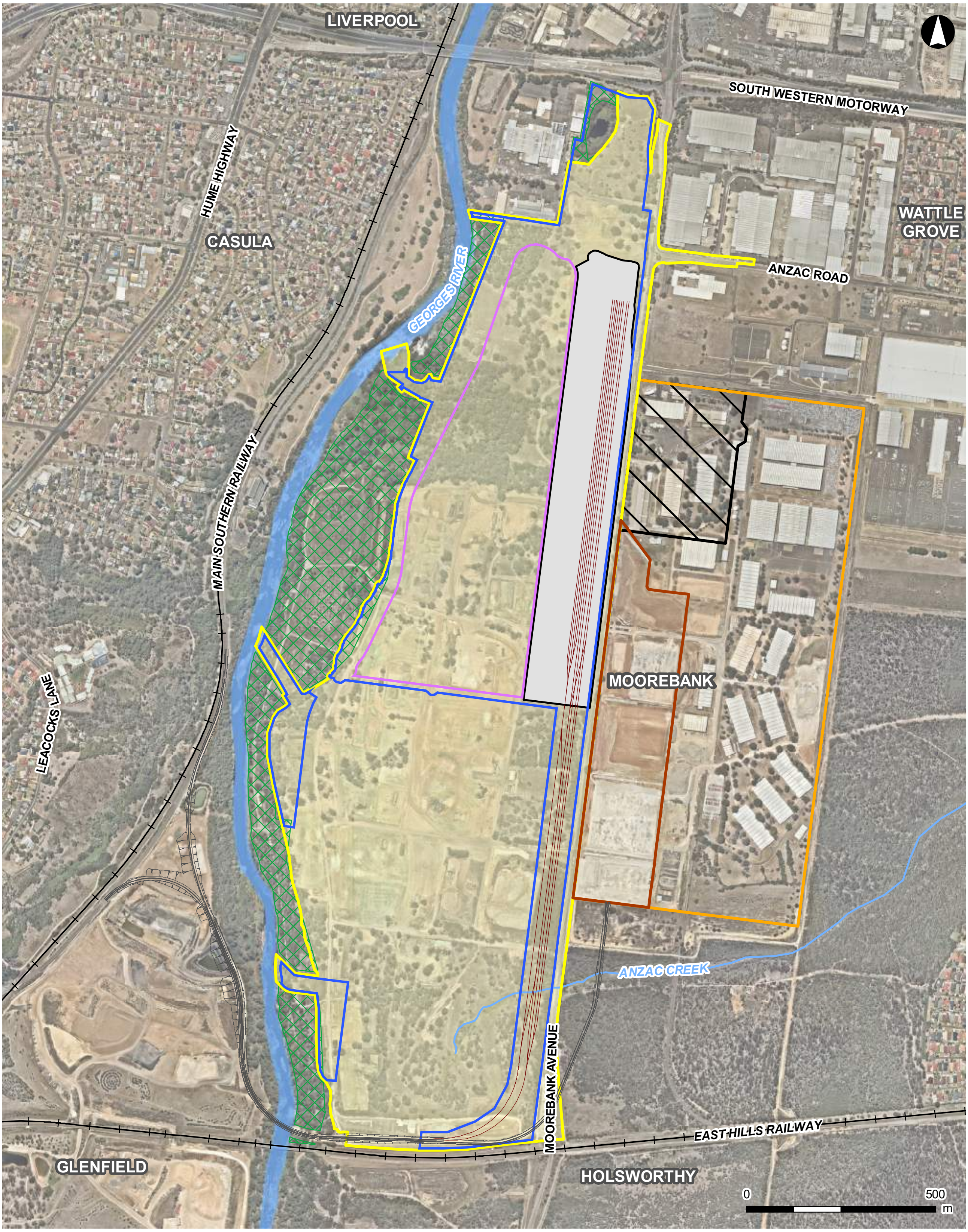
The response to submissions report was prepared to address submissions raised by government agencies and the community during the public exhibition of the Moorebank Precinct East Stage 2 Environmental Impact Statement previously mentioned.

The amended Proposal included:

- Realignment of the OSD in the north-eastern corner of the site
- Changes to the horizontal extent of the Moorebank Avenue Upgrade
- Changes to warehouse layout in two separate locations
- Alterations to drainage design to the south of the MPE site
- Amendments to the Construction Area and Operational Area as a result of the above amendments
- Potential Flood Impact assessment of the Proposal impacts on the DJLU.

Where required the environmental impact of the amended Proposal was reassessed in line with the preceding EIS methodology (refer to **Section 3.4**) obtaining consistent findings and recommendations.

The concept design developed for the preceding EIS and updated for the response to submissions report has been used as the basis for this report.



LEGEND

- MPW Construction area
- MPW Operational area
- MPW Stage 2 site
- MPE site
- MPE Stage 1 site
- MPW Warehousing footprint
- Warehouse 1 Precinct
- IMT facility area
- Conservation area
- MPE Rail link connection
- MPW Rail link connection
- Existing railway
- Watercourse

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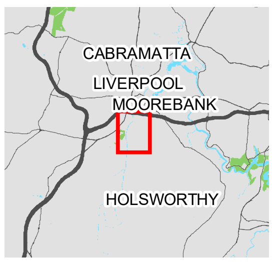


Figure 3-1: MPW Stage 2 Project Overview

4 STORMWATER MANAGEMENT OVERVIEW

An overview of the Project Stormwater Management strategy for the Project is summarised below for the construction (**Section 4.1**) and operational (**Section 4.2**) phases of the Project.

The strategy aims to implement measures to avoid, minimise and mitigate potential stormwater and flooding impacts during construction and operation of the Project area. Details of the Stormwater Quantity and Quality Management are outlined in **Section 5** and **Section 6**.

The detailed design of the Project site is to be developed in accordance with this strategy.

4.1 Construction

During the construction phase the following flooding and stormwater mitigation measures will be incorporated into the Project.

- A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP) has been incorporated into the CEMP for the construction of the Project, in accordance with CoC B34 & B39. The SWMP and ESCPs were developed in accordance with the principles and requirements of Managing Urban Stormwater – Soils & Construction Volume 1 (‘Blue Book’) (Landcom, 2004) and Volume 2 (DECC 2008). The following aspects are addressed within the SWMP and ESCPs:
  - Construction traffic restricted to delineated access tracks, and maintained until construction complete.
  - Appropriate sediment and erosion controls to be implemented prior to soil disturbance.
  - Stormwater management to avoid flow over exposed soils which may result in erosion and impacts to water quality.
  - Location of stockpiles outside of flow paths on appropriate impermeable surfaces as well as outside of riparian corridors.
  - Inspection of all permanent and temporary erosion and sedimentation control works prior to and post rainfall events and prior to closure of the construction area.
  - Wheel wash or rumble grid systems installed at exit points to minimise dirt on roads.
- Flood mitigation measures for the construction phase of the Project are to include (and be documented in the SWMP):
  - The maintaining of existing site catchment and sub-catchment boundaries as far as practicable.
  - Limiting site imperviousness and grades (as far as practical) to that of existing condition imperviousness and grades.
- A Flood Emergency Response Plan, will be prepared and implemented for the construction phase of the Project to provide on-site refuge during major flooding, and subsequent to such an event, safe evacuation and Project site recovery. The plan will form part of the CEMP in accordance with CoC B52 & B53.

4.2 Operation

Under operational conditions the following flooding and stormwater mitigation measures will be incorporated into the Project site development:

- On-site detention (OSD) storages which capture, convey and adequately control site discharges to the existing downstream waterways (refer to **Section 5**).
- Stormwater quality improvement devices designed to meet the required performance targets (refer to **Section 6**) including:
  - Gross Pollutant Traps (GPTs); and
  - Raingardens.
- A water quality monitoring program for the operational phase of the Project prepared as part of the OEMP for the Project in accordance with CoC B43 & B44, that details:
  - The frequency and duration of sampling
  - Background water quality conditions
  - Sampling methodology
  - Reporting requirements
- Water quality monitoring will include the following parameters:
  - Total suspended solids (TSS)
  - Total phosphorous (TP)
  - Total nitrogen (TN)
  - Oils and grease.
- A Flood Emergency Response Plan, is to be prepared and implemented for the Project to provide on-site refuge during major flooding, and subsequent to such an event, safe evacuation and Project site recovery. The plan will form part of the OEMP in accordance with CoC B52 & B53.

5 STORMWATER QUANTITY MANAGEMENT

The Project site requires adequate stormwater system capacity and management to support the operation of the Project. Furthermore, development of the site also has the potential to impact upon:

- The hydrology of adjacent land including:
  - the Defence Joint Logistics Unit (DJLU) site to the north and north-east of the Project
  - the bootland to the south and south-east of the Project
  - Moorebank Avenue to the north of the Project
- Adjacent Proposals and Projects, with interfacing stormwater systems, including:
  - the MPE Stage 1 Project.
  - the MPW Stage 2 Project
- Flood levels in neighbouring properties.

As such, stormwater and flood analysis undertaken for the Project has involved several components of analysis and design to address site stormwater requirements, and inform on stormwater and flood management measures necessary to mitigate potential adverse flood impacts that may otherwise result from the Project.

DRAINS software has been used to generate rainfall runoff models that represent both existing site conditions and post development site conditions to enable a comparison of discharges and to quantify on-site detention (OSD) performance.

Initially, **Section 5.1** describes the hydraulic modelling undertaken for the existing stormwater drainage conditions for the Project site. Stormwater analysis and design for proposed development conditions, including associated flooding and stormwater mitigation measures, are summarised in **Section 5.2**.

Subsequently, commentary is provided on the W1P regarding:

- Considerations for the detailed design of the project site (**Section 5.3**)
- Stormwater management and mitigation works during construction of the Project (**Section 5.3.4**).

5.1 Existing Conditions Assessment

The following details the hydraulic modelling undertaken for the existing stormwater drainage conditions for the Project site as described in **Section 2.3**.

5.1.1 Assessment Methodology

An existing conditions DRAINS hydraulic model was developed for the Project site. Under existing conditions, the model catchments, impervious areas and drainage systems have been determined based on:

- Aerial photography
- Aerial laser survey
- Ground survey of the site where available
- Site inspection carried out during the course of this assessment to clarify catchment features.

A catchment plan that represents the layout adopted for the existing conditions DRAINS model is included as drawing **SSS2-ARC-CV-DWG-1431** in **Appendix A**.

It should be noted that although the MPE Stage 2 base case condition includes drainage to be provided as part MPE Stage 1; the assessment of the Project has adopted existing condition (i.e. pre-MPE Stage 1) site discharges for the purposes of setting discharges target flows for the MPE Stage 2 works, since the requirements are that MPE Stage 1 discharges are to be no greater than for existing conditions.

The parameters used in the DRAINS modelling include:

- Paved area and Supplementary area depression storage = 1mm, and pervious area depression storage = 5mm
- Soil type = 3.0
- Antecedent moisture condition = 3.0 (rather wet)
- Initial and continuing losses of 20mm and 2.5mm/hr for pervious areas represented by the XP-RAFTS module of DRAINS
- XP-RAFTS module 'Storage Coefficient Multiplication Factor' (Bx) = 1.0

The impervious percentage and catchment slopes adopted for the existing catchment areas have been based on review of recent site survey information and aerial photography with values provided in **Appendix B**.

Floodplain storage estimates within the Project site and tailwater levels on each of the three outlet systems have been based on modelling of the outlet waterways.

The DRAINS modelling has been undertaken for storm durations of 15 minute to 18 hours for the 1 year, 2 year, 5 year, 10 year, 20 year, 50 year, and 100 year ARIs, and 15 minute to 6 hours Probable Maximum Precipitation (PMP) events.

A summary of the modelling input data is included in **Appendix B**.

5.1.2 Results

A summary of peak flows discharging from the Project site is presented in **Table 5-1**. A summary of model outputs and sub-catchment flows leaving the Project site are included in **Appendix B**. for a range of storm durations.

5.2 Post Development Conditions Assessment

5.2.1 Overview

The analysis and design of the Project site under developed conditions has included:

- DRAINS rainfall runoff modelling
- Mitigation of potential adverse flood impacts that may otherwise result from the proposed site development by the provision of:
  - On-site detention (OSD)
  - Drainage and flow relief from Moorebank Avenue westward through the MPW site to the Georges River.

The concept design drawings of the proposed development are provided as **Appendix A**. The proposed conditions presented include the proposed works across the entire MPE Stage 2 site in addition to the W1P works.

5.2.1.1 Eastern (Anzac Creek) Detention Storages

Two detention storages; OSD 1 and OSD 2 discharge east into Anzac Creek via Outlet A and Outlet B, respectively (refer to **Figure 5-1**). This will be detailed further in the Stormwater Plan for these areas.

5.2.1.2 Western (Georges River) Detention Storages

The two detention storages, OSD 9 and OSD 10, that discharge westward from the Project's operational area have been configured such that:

- OSD 9 discharges westward into the channel/culvert system which extends from Moorebank Avenue to the Georges River.
- OSD 10 discharges northward into the channel/culvert system which extends from Moorebank Avenue to the Georges River.

5.2.2 Assessment Methodology

To represent proposed development conditions, the existing conditions DRAINS modelling (discussed in **Section 5.1**) was adjusted to represent the post development site conditions as illustrated in **Figure 5-1** and **Appendix C**. Model adjustments have included:

- Changes to sub-catchment boundaries.
- Increased imperviousness and reduced flow travel times representative of the proposed development.
- Introduction of Moorebank Avenue concept cross-drainage and long-drainage systems.
- Detention storages.

A summary of the modelling input data is included in **Appendix C.** A rainfall increase sensitivity analysis has also been undertaken, and a summary of the modelling input data is included in **Appendix C**.

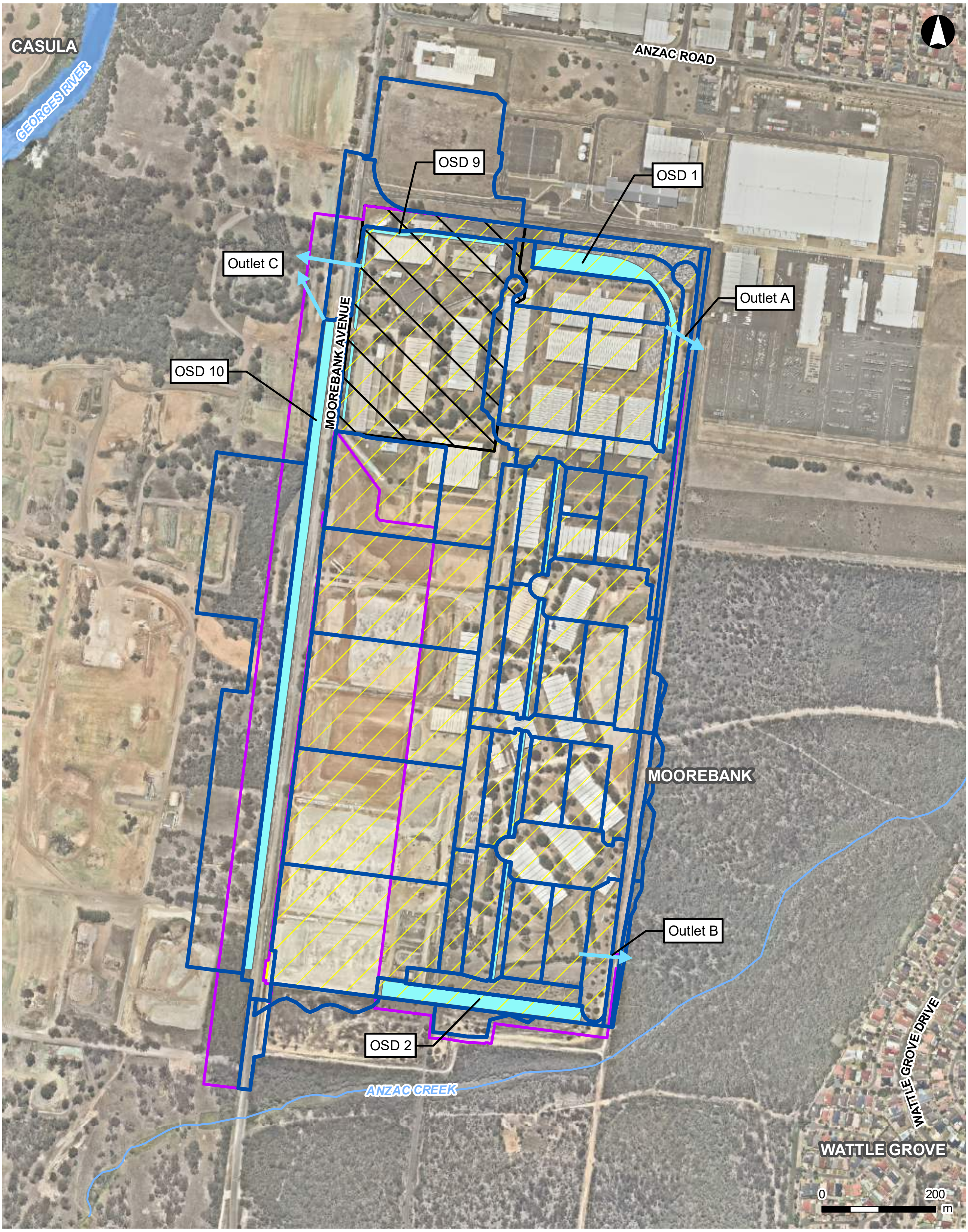
5.2.1 Results

In accordance with CoC B40 the OSDs are required to attenuate the post development peak flows to the pre-development peak flows for both the 1 year and 100 year ARIs. The OSDs have been designed to attenuate these flows at each of the three discharge locations (Outlets A, B and C). In addition to meeting the required critical duration peak flow for both ARIs, the OSDs also attenuate the peak flow for a range of intermediate durations and ARIs as illustrated in **Appendix D**.

A comparison of the DRAINS model peak flow results for existing conditions and post-development condition flows at downstream locations of the W1P is included in **Table 5.1**, with a fuller comparison (being for a range of storm durations) provided in **Appendix D**. These results indicate that the proposed detention storages should adequately mitigate potential flow increases leaving the Project site.

A summary of the performance of OSD 9 is provided in **Table 5-2**. The outlet configurations have been sized to control flows up to the 100 year ARI. The performance of the OSDs to mitigate flows to pre-development conditions is illustrated in **Appendix D**.

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

- MPE Stage 2 construction area
- MPE site
- Warehouse 1 Precinct
- Proposed catchment
- OSD
- Watercourse

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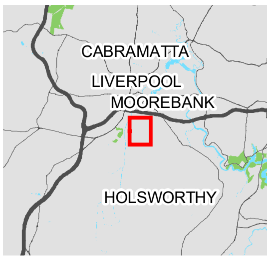


Figure 5-1: Proposed Catchments of the MPE Site

Table 5-1: Comparison of Peak Flows

Discharge Location	Site Condition	Catchment Area (ha)	DRAINS Model Label	Flow (m3/s)#		
				1yr ARI	20yr ARI	100yr ARI
OSD C	Existing	59.50	EX Channel	3.19	9.80	12.9
	Proposed	**61.71**	**Channel**	**2.30**	**5.29**	**6.46**

The tabulated peak flows do not indicate mitigation adequacy in themselves, rather refer to **Appendix C** for same storm duration comparisons
[Models: MPEStage2SMPExisting-18-02-26.drn & MPEStage2SMPProposed-18-02-27.drn]

Table 5-2: Detention Storage Performance Summary – 100yr ARI

Storage	Catchment Area (ha)	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Peak Water Level (mAHD)	Volume (m^3)
OSD 9	11.57	6.52	0.88	15.5	7,000

Storage parameters & outlet configuration are included in **Appendix C**.
[Model: MPEStage2SMPProposed-18-02-27.drn]

5.2.2 Sensitivity Assessment

A sensitivity assessment has been carried out with 100 year rainfall intensities increased by 10%. This resulted in an increase in OSD water levels (compared with 100 year ARI conditions) of approximately:

- OSD 1 - 0.15m
- OSD 2 - 0.05m
- OSD 9 - 0.2m
- OSD 10 - 0.2m

Based on these sensitivity results, consideration of OSD water levels should be given to the setting of minimum floor levels for the Project (discussed further in **Section 5.3**).

In doing so, it should be noted that a 10% rainfall intensity increase assessment is considered representative of potential climate change impacts for the Sydney metropolitan area (being consistent with projected rainfall increases in accordance with the New South Wales Department of Environment and Climate Change (DECC) 'Floodplain Risk Management Guideline Practical Consideration of Climate Change' (Table 1, October 2007).

Furthermore, such mitigation measures should take into consideration:

- The design life of the Project, and
- Establishing a median flood risk commensurate with a design period of equivalent risk under existing climate conditions.

That is, the median climate change condition for the Project design life, be the basis for stormwater system design capacity (not the end of design life, say the last day of a (100 year) design life for climate change design storm event estimates.

Such considerations would indicate that for a 100 year (Project) design life, and for climate change rainfall increase (of say 10%), OSD 100 year water level increases of approximately half of the (0.05m to 0.25m) estimated water level increase may be appropriate for providing 'climate change' drainage system capacity with respect to Project site floor level flood protection.

5.3 Detailed Design Considerations

The DRAINS modelling results indicate that the proposed drainage systems and OSDs would provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Project.

The detailed design of the W1P will be developed in accordance with the strategy outlined in this report. There are, however, several design issues and potential refinements (itemised below) that should be taken into consideration during detailed design.

5.3.1 On-Site Detention (OSD)

Construction sediment basins will be utilised to manage water during construction within W1P and the remainder of site, as described in the CSWMP, for bulk earthworks. OSDs will progressively come on line once upstream catchments have been stabilised to at least 80% to minimise sediment ingress into the OSD.

Design of the OSDs allows for alternative configurations with respect to OSD footprint. There is flexibility to alter catchment boundaries and areas, however such changes would require a similar process of pre and post development rainfall-runoff analysis (for multiple recurrence interval and rainfall durations) to demonstrate adequate mitigation of potential flow increases discharging to neighbouring and downstream areas.

Furthermore, should such OSD and/or catchment area changes be considered, then all of the catchments and OSDs require assessing individually and in combination (with respect to mitigation performance).

Additional consideration for the detailed design of the OSD 9 include:

1. The OSD is considered to be visually unobtrusive as it will be flush with final design ground levels within the site. The walls along the edge of the external boundary are to be designed in accordance with the Urban Design and Landscape Plan, Section 3.1.9, to ensure they are visually unobtrusive. Landscaping design for the OSDs is addressed within the Urban Design and Landscape Plan, Section 3.1.8.
2. The structure of the OSD will be designed by a suitably qualified structural Engineer. Wall loading will allow for hydrostatic pressure of a full storage.
3. OSD 9 is proposed to be a large underground tank. A minimum freeboard of 0.3m above the 100 year water level will apply to the tank roof and any other overhanging structures. A typical section of OSD 9 has been provided in drawing **SSS2-ARC-CV-DWG-1491** of **Appendix A.**
4. The proposed OSD serves a dual purpose role of mitigation and conveyance. The OSD is to have minimum grades of 0.5% unless inverts are provided with a porous base and subsoil drainage systems.
5. The OSD outlet is to be set above the 100 year ARI water level/hydraulic grade line of the downstream system into which it discharges. That is, the OSD outlet is to be freely discharging in all events up to 100 year ARI events. The concept design OSD outlet is shown in drawing **SSS2-ARC-CV-DWG-0411** of **Appendix A.**
6. The OSD outlet is to be protected to minimise the potential for blockage. The OSD outlet will have three layers of blockage protection. Firstly, all outlet control pits will have a fence around them to deter large items. Secondly all orifices will be with pits with a grate on top. Thirdly all orifices are to have a trash screen in front of them designed in accordance with the Upper Parramatta River Council Trust specifications.
7. Spillways to manage greater than 100 year ARI events should be located and configured so as to limit potential flow impacts on downstream neighbouring development(s). OSD 9 spillway discharge should be directed to the west across Moorebank Avenue rather than northward towards the DJLU.

8. Public safety needs to be addressed both within and surrounding the OSD. Access into the OSD will be controlled and limited to trained maintenance personnel only. Access to the OSD by the general public will be prevented through the use of lockable access grates/covers. Hazard signage will be located at all entry points to the OSD along with step irons.
9. Access manholes are to be provided regularly along the length of the OSD. Access into the OSD for maintenance activities will only be conducted during dry weather with no forecast rain for the expected duration of maintenance activities. Access will occur in accordance with the Australian Standard for safe working in confined space.
10. Security fencing is to be provided where a significant height difference occurs at the boundary of the OSD to the surrounding ground surface.
11. Operational and maintenance plans will be developed for the ongoing management and maintenance of the OSD to ensure it meets its performance objectives and safety requirements.

5.3.2 Catchments and Development Flexibility

Catchment areas and site levels/gradings will be a crucial component of the development with respect to OSD sizes and locations, and interfacing the broader land-use and aims of the Project site.

In particular, since warehouse roof areas/buildings are a dominant feature of the Project site, development controls will be necessary, ensuring that individual building development discharge areas and locations are adhered to in order to effectively utilise the stormwater conduits and OSDs, and hence comply with flooding and stormwater mitigation requirements. Flexibility for individual warehouse developments would still remain (following the installation of stormwater infrastructure) however such flexibility would require assessment of adequacy of the OSDs and associated stormwater systems to support the altered warehouse arrangements.

5.3.3 Drainage System Capacities and Grades

Overland flows within the W1P and the remainder of site will be managed through the CSWMP during construction and diverted to temporary construction sediment basins as detailed in the Erosion and Sediment Control Plan. Controls as stipulated in the CSWMP include:

- Low flow and high flow channel designs for conveyance of construction runoff in accordance with the Blue Book.
- Low flow earth banks and associated check dams located to divert water to temporary construction sediment basins. Low flow banks will be constructed in accordance with the Blue Book Standard Drawing (SD) 5-5 and high flow channels will be constructed in accordance with SD 5-6.

Once the OSD 9 within the W1P is operational, stormwater runoff from minor rainfall events (up to and including the 10% AEP event) will be conveyed via a pit and pipe drainage network to the OSDs. An indicative concept site trunk drainage layout is provided in **Appendix A**.

In larger events (up to the 1% AEP event) the roadways will act as overland flow paths to convey flow to the OSDs. The OSDs also provide conveyance of flows through the site given their extensive lengths. The widths of the flow paths are restricted to the width of the road reserves and OSDs which are depicted in **Figure 5-2.**

Drainage systems are to have:

- 10 year ARI minor drainage system capacity.
- surface gradings and inlets that, in combination with stormwater conduit capacities, would limit 100 year ARI surface ponding to no greater than 0.2m, and depth x

velocity limited to no greater than $0.4m^2/s$ within the Project site (excluding open waterways).

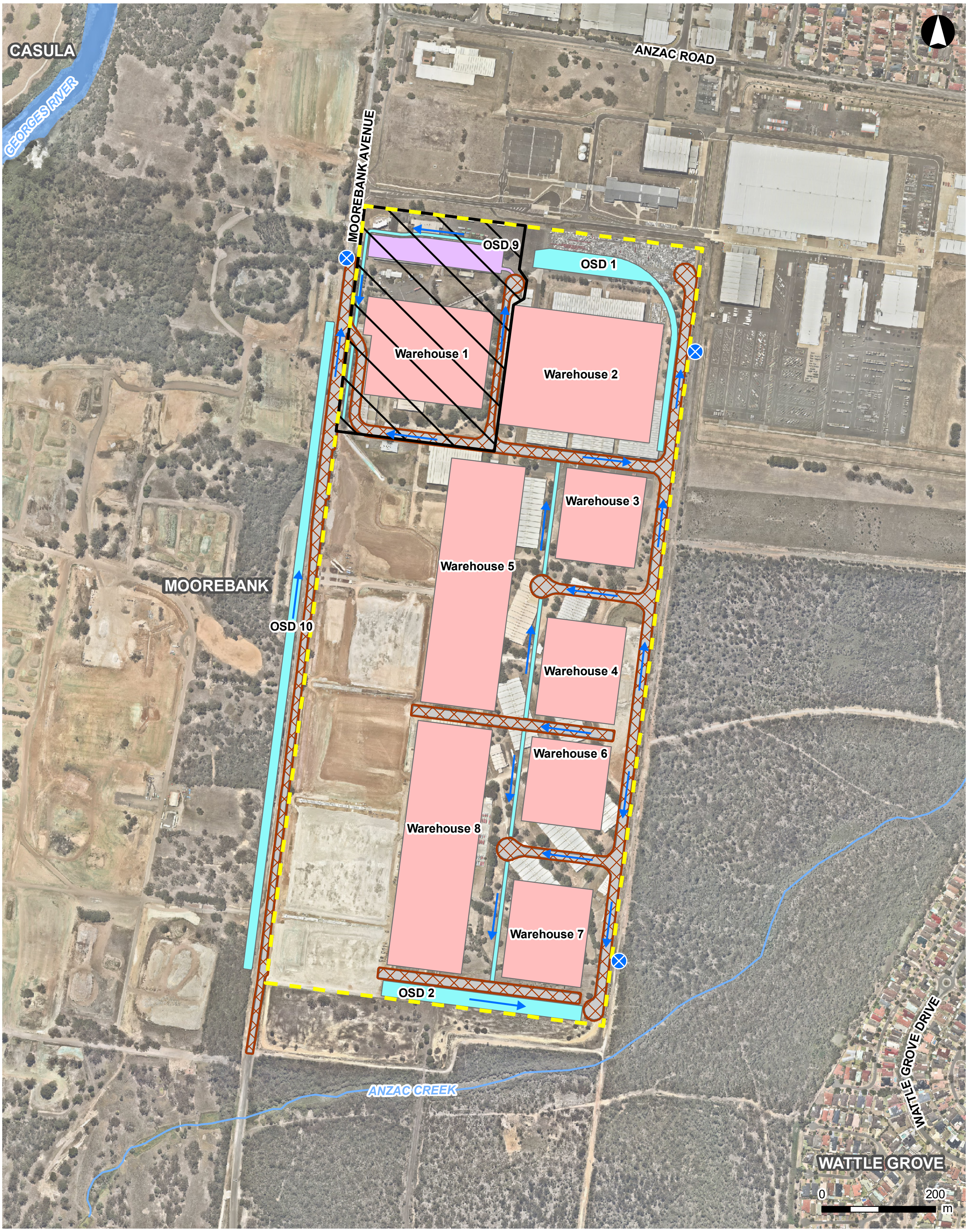
Drainage conduits are to typically have:

- minimum grades of 1%, however where necessary 0.5% minimum grades may be adequate as long as it can be demonstrated that self-cleansing minimum velocities of 0.6m/s are achieved.
- 20mm minimum fall across stormwater pits.
- 0.6m minimum cover for pipe systems, considering minimum cover requirements as necessary for pavement performance, loadings and clearance requirements in accordance with AS3725.

Stormwater inlets are to be designed for:

- minimum 20% blockage on-grade.
- minimum 50% blockage at sags.

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

- MPE Site
- Warehouse 1 Precinct
- Overland flow
- Discharge point
- Overland flow direction
- Freight Village
- OSD
- Road
- Warehouse
- Watercourse

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Coordinate System: GDA 1994 MGA Zone 56
Aerial imagery supplied by nearmap (January, 2018)

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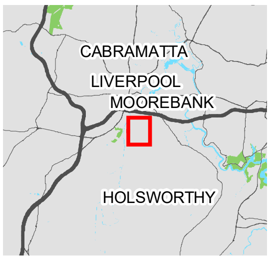


Figure 5-2: Post Development Overland Flow Paths

5.3.4 Warehouse Area Drainage

The proposed building/warehouse footprints cover a significant portion of the Project site. All roof area and building drainage systems are to capture and convey (from roof to ground level stormwater systems) rainfall-runoff for all storm events up to and including 100 year ARI events. Rainwater harvesting will be incorporated in the design of each warehouse as discussed in **Section 7.5**.

5.3.5 Pavement Grades

Across the Project site there may be varying pavements types and associated drainage configurations, with a key consideration being the surface grading. To minimise local ponding and breakdown of pavement areas, minimum grades are necessary across the Project site. For concrete pavements, 1% minimum grading is recommended and for pavers and bitumen surfaces, 2% minimum grading. Steeper than the minimum grades may further limit potential water damage to pavement. All pavements are to grade away from building footprints.

5.3.6 Minimum Floor Levels

In accordance with CoC B40 building floor levels are to be a minimum of 150mm above the maximum design flow path levels. The design flow path levels are to be based on 100 year ARI events. For the Project site design flow paths are formed along roadways in major events.

In some instances, floor levels may need to be raised above the PMF flood level to provide on-site refuge in accordance with the Operational Flood Emergency Response Plan.

5.3.7 Works Within Neighbouring Properties

All outlets from the Project site discharge to constructed drainage lines. As such CoC B40 (d) specifying material requirements for natural drainage lines is not applicable.

The proposed outlet from OSD 9 and OSD 10 drains westward into the existing concrete channel located within the MPW site. This channel will be remediated in accordance with the Construction Soil and Water Management Plan, Section 3.2.1.1. The proposed raingarden for the W1P will be located alongside this channel as outlined in **Section 6.2.2**.

5.4 Construction Phase

To avoid potential adverse flood impacts on neighbouring properties during construction, flood mitigation measures may be required. Mitigation measures aim to maintain existing condition flow regimes and distributions leaving the construction area (so as to maintain runoff to no greater than existing conditions). Such mitigation measures should include consideration of:

- Maintaining existing site catchment/sub-catchment boundaries.
- Limiting site imperviousness and grades to no greater than under existing development conditions.
- Provision of all the Project site OSDs (with associated catchment areas) in a completed operational state prior to the introduction of impervious areas (additional to existing conditions).
- Smaller detention storages that provide adequate rainfall runoff mitigation during partial construction/site development. If proposed, all such alternative/temporary

detention storages will require analysis, in accordance with the assessment methodology and objectives outlined in **Section 5.2**, to determine the adequacy of their flood mitigation performance.

6 STORMWATER QUALITY MANAGEMENT

6.1 Objectives and Performance Targets

The stormwater quality objectives and performance targets for the project have been derived from CoC B40 and the Liverpool City Council Development Control Plan (2008) incorporating WSUD principles as outlined below.

The key objectives for stormwater quality management for the Project include:

- Maintain or improve existing water quality
- Protect the aquatic environment of the downstream waterways including the Georges River
- Prevent bed and bank erosion and instability of waterways
- Provide sufficient flows to support aquatic environments and ecological processes
- Incorporate a Water Sensitive Urban Design (WSUD) approach.

A detailed compliance matrix for the water quality strategy against Liverpool Council policies, highlighting how key WSUD principles have been incorporated, is provided in **Appendix F**.

The water quality performance targets for the Project, in accordance with CoC B40, are provided in **Table 6-1**. The pollutant reduction targets specify the percentage reduction in average annual load of pollutants relative to no treatment being provided for the proposed development.

Table 6-1: Water Quality Performance Targets

Pollutant	Reduction Target
Total Suspended Solids (TSS)	85%
Total Phosphorus (TP)	65%
Total Nitrogen (TN)	45%

6.2 Proposed Stormwater Quality Measures

To address potential impacts on stormwater quality, WSUD principles and a treatment train approach have been applied. Two key treatment measures are proposed for the Project to meet the performance targets:

- Gross Pollutant Traps (GPTs)
- Raingardens (Bioretention systems).

In addition to these treatment measures, rainwater harvesting and reuse will also be implemented for each warehouse in accordance with CoC B40, as discussed in **Section 7.5**

6.2.1 Gross Pollutant Traps

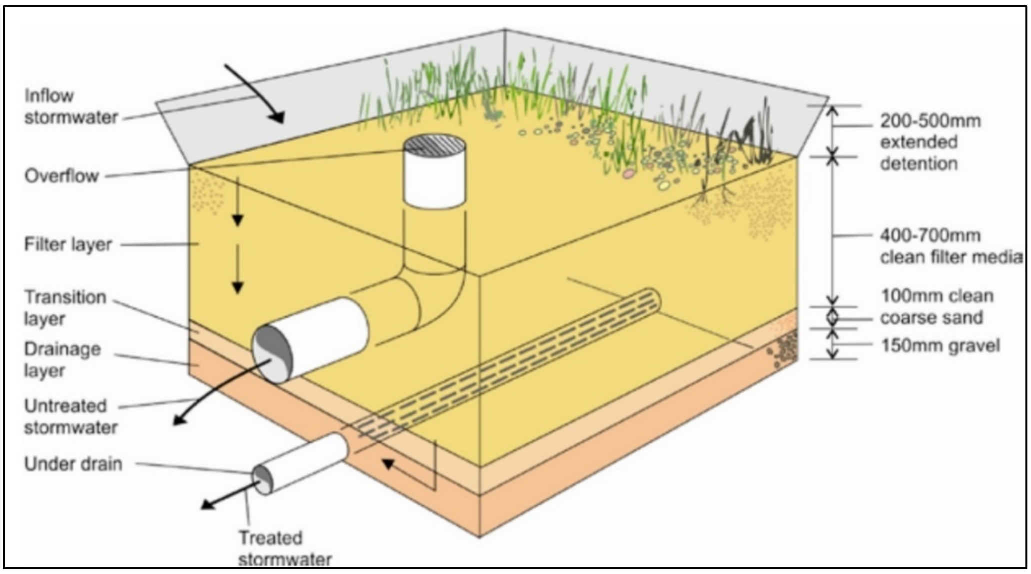
Gross pollutant traps (GPTs) are primary stormwater treatment measures, typically applied as the first measure in a stormwater treatment train. GPTs come in varying forms from simple trash racks through to more complex devices with continuous deflection screens and hydrodynamic separation.

GPTs will be located on all major stormwater drainage lines from non-roof areas prior to flows discharging into the OSD, as indicatively shown in the concept drawings **SSS2-ARC-CV-DWG-1201** of **Appendix A**.

The performance of GPTs varies according to the type of device selected. In this case, a Rocla CDS device has been selected with continuous deflection screens and hydrodynamic separation to target the removal of a significant proportion of the Total Suspended Solid (TSS) load. Removal of TSS is important for protecting and minimising maintenance of downstream treatment devices such as raingardens which are sensitive to high TSS loads.

6.2.2 Raingarden

Raingardens are bioretention systems that comprise a combination of vegetation and filter substrate (refer **Figure 6-1**). They provide treatment of stormwater through the processes of settling, filtration and biological uptake and are very effective in the removal of fine sediments and nutrients. Additional details of the proposed raingarden are outlined below:



Source: Using MUSIC in Sydney's Drinking Water Catchment (Sydney Catchment Authority, Dec. 2012)
Figure 6-1: Typical Raingarden Concept

1) Location & Size

As shown in the concept drawings **SSS2-ARC-CV-DWG-1451** of **Appendix A**, A raingarden will be placed downstream of OSD 9 alongside the concrete channel running through MPW as part of the works to be undertaken to repair the channel in accordance with CoC B34(j). The repair of the channel will be undertaken prior to the completion of construction of the temporary MPE Stage 2 sediments basins detailed within the CSWMP. The raingarden (bioretention) will not come on line until the OSD construction has been completed and is itself online i.e. when 80% of the upstream catchment has been stabilised (as detailed within the CSWMP).

In accordance with CoC B40, the raingarden will be:

- Sized as a minimum of 1% of the area requiring treatment.
- Divided into cells no greater than 1,000m^2.

Placing the bioretention system downstream of the OSD allows for it to be configured as an offline system. This removes the risk of high flows depositing large volumes of sediment into the bioretention as well as the risk of scour. This can be achieved via a weir that diverts up to the 3 month flow to the bioretention system while allowing larger flows to overtop.

Bioretention systems aim to capture up to the 3 month ARI as the frequent small storm events can make up in excess of 90% of the annual pollutant loads from the catchment.

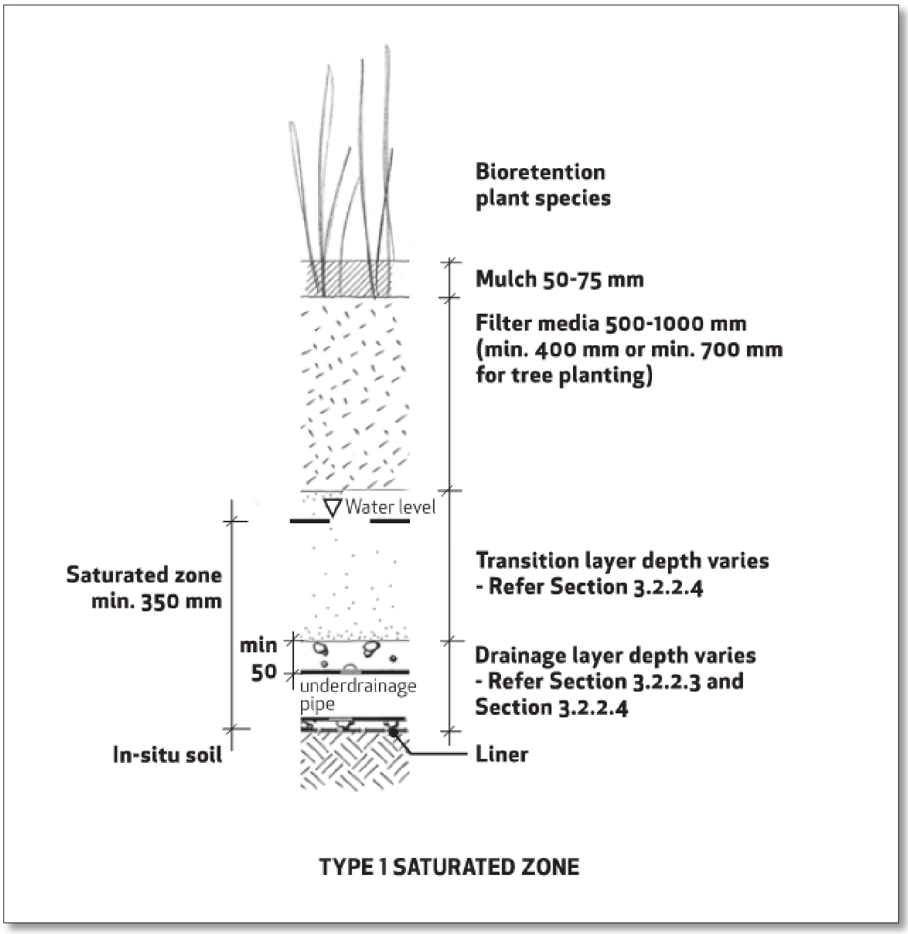
OSD 9 will provide sufficient capacity for a 1 in 100-year event and will aid in controlling flow-rates into the downstream bioretention area as described in Section 5.3.1. Once flows have left OSD9 they will be conveyed to the splitter weir described above which will ensure flows up to the 3 month event will be treated by the bioretention system as per standard industry practice prior to discharge into Georges River.

2) Lining

In general, raingardens are lined to protect adjacent structures or if there are known salinity hazards. The Project site is located in an area of 'moderate salinity potential' as defined by the 'Salinity Potential in Western Sydney 2002' map distributed by the NSW Office of Environment and Heritage (OEH). This salinity classification in itself does not mean the proposed raingardens need to be lined, however the site's soils are predominantly clays and sandy clays which are associated with shrinkage and differential settlement.

In addition to protection of adjacent structures and salinity hazards, the proposed raingardens have been designed to a have a saturated zone due to the lack of grade on site. These systems integrate a water storage (wet sump) in the transition and drainage layer, which requires an impermeable liner to ensure water is retained in the base of the system. The water storage allows the vegetation to access water during dry periods, facilitate plant and soil biological heath, and helps maintain ongoing treatment performance (Water by Design – Bioretention Technical Design Guidelines, October 2014). These systems also result in increased phosphorous within the soil due to the anaerobic conditions. This has been allowed for by specifying a low concentration of orthophosphate of 10mg/kg in the filter media. A typical section of a raingarden with saturated zone is provided in **Figure 6-2**. Typical details of the proposed raingarden are provided in **SSS2-ARC-CV-DWG-1471** of **Appendix A**.

It is also noted that further consultation with a geotechnical engineer is expected to be undertaken during detailed design regarding additional lining requirements.



Source: Bioretention Technical Design Guidelines (Water by Design, Oct. 2014)
Figure 6-2: Typical Raingarden Section - Saturated Zone

3) Filter Media

The filter media used in all raingardens will be tested prior to installation to ensure it meets the following criteria:

- Be loamy sand with an appropriately high permeability under compaction and must be free of rubbish, deleterious material, toxicants, declared plants and local weeds, and must not be hydrophobic.
- Have a hydraulic conductivity = 100-300 mm/hr, as measured using the ASTM F1815-06 method.
- Have an organic matter content less than 5% (w/w)
- Orthophosphate <10mg/kg

6.3 Assessment Methodology

Assessment of the performance of the proposed stormwater quality measures has been undertaken using the industry standard Model for Urban Stormwater Improvement Conceptualisation (MUSIC, v6.2). The MUSIC model has been developed in accordance with the parameters outlined in the NSW MUSIC Modelling Guidelines (BMT WBM, 2015).

A MUSIC model for the MPE Stage 2 site has been developed by applying the land uses and imperviousness values for existing and proposed conditions included in **Table 6-2**. The MUSIC model layout and other key modelling parameters are included in **Appendix E**.

Table 6-2: MPE Stage 2 Land Use Areas and Imperviousness

Land Use	Area Draining to Georges River	
	(ha)	(% impervious)
Roof	12.18	100
Road	3.98	100
Industrial	36.75	93
Landscaping (within OSDs)	2.87	50*

* - Landscaped areas within OSDs, although 100% pervious, are represented as 50% impervious in MUSIC model due to presence of liner.

6.4 Results

The MUSIC model was used to estimate the average annual pollutant loads generated by the proposed development, as well as the resultant pollutant loads after flows pass through the proposed treatment train.

6.4.1 Georges River Outlet

Based on the proposed stormwater quality measures the performance of the treatment measures included in the MPE Stage 2 site area discharging to Georges River are presented in **Table 6-3**. The proposed structures draining to Georges River includes OSD 9 and OSD 10. The water quality assessment has demonstrated that the performance of the proposed treatment measures (i.e. GPTs and raingardens) complies with the CoC B40 requirements.

Table 6-3: Georges River – Water Quality Treatment Performance

Scenario	Pollutant			
	TSS	TP	TN	Gross Pollutants
Post Development Loads (kg/yr) (no treatment)*	63600	114	897	11100
Post Development Loads (kg/yr) (with treatment)*	8430	39.7	445	28
% Reduction Achieved	86.7	65.3	50.4	99.7
% Reduction Targets	85	65	45	-

** Node: 'Georges_River, MPEStage2SMPProposed-18-03-06.sqz*

As the proposed treatment train meets the required reduction targets, the five GPTs and the 2600m^2 of bioretention provided is adequate for stormwater treatment.

6.5 Detailed Design Requirements to Minimise the Risk of Failure

The detailed design of the W1P will be developed in accordance with the strategy outlined in this report. This will be confirmed through the compliance tracking outlined in **Section 1.3.2.**

The detailed design will consider the following to minimise the chance of failure of the bioretention system:

1. ***Pre-treatment***

   GPTs (CDS unit) will be provided to reduce the sediment loading entering the raingardens in accordance with the NSW Music Modelling Guidelines (BMT WBM, 2015). GPTs will be located on all major stormwater drainage lines from non-roof areas prior to flows discharging into the OSD, as indicatively shown in concept drawings **SSS2-ARC-CV-DWG-1201** in **Appendix A**. The sediment load from the catchment, relative to the size of the raingardens is not expected to be significant given the high impervious percentage of the catchment areas.

   It is considered unlikely even in infrequent large storm events that a large sediment load would be conveyed into the raingarden. As the proposed catchment is mostly paved and will have negligible pervious areas that could be subject to scouring in such events, the site sediment load should be conveyed as part of the 'first flush'.

2. ***Flow Distribution & Scour Protection***

   Flow entering the bioretention system will be suitably distributed through a level spreader to avoid short circuiting of the system and enable an even loading on the filter media area. Prior to entering the bioretention system flows will have been sufficiently reduced in energy to ensure there is no scour within the bioretention system.

3. ***Solar Access and Plant Species Selection***

   The raingarden will be located in an area with sufficient sun light exposure. Plant species will be selected by a suitably experienced landscape architect to withstand the expected sunlight exposure. The raingarden planting palette for the project for various levels of sun light exposure is provided in **Appendix G**.

4. ***Operation and Maintenance***

   Operational and maintenance plans will be developed for the ongoing management and maintenance of the OSD and raingarden to ensure they meet their performance objectives. Maintenance access will be provided for the raingarden. The Stormwater Infrastructure Operation and Maintenance Plan, a sub plan of the Operational Environmental Management Plan will detail regular ongoing inspections and maintenance of the raingarden, as well as following large rainfall events. These regular inspections and maintenance activities will utilise light vehicles and a turfed access track. Maintenance activities will include:

   - Litter collection
   - Minor replanting
   - Repair of localised scouring
   - Spot weeding
   - Testing for contaminants
   - Any other minor rectification works required.

5. ***Offline System***

   By placing the biorention system downstream of the OSD tank it is able to be

configured as an offline system. This removes the risk of high flows scouring out the bioretention system during extreme events. A weir will be sized to ensure all flows up to the 3 month event are diverted to the system while larger flows are able to bypass the system.

6.6 Monitoring

Ongoing water quality monitoring for the Project will be undertaken in accordance with CoC B43 & B44 during construction and for a period of 5 years following completion of construction. The water quality monitoring program has been prepared within the Construction Soil and Water Management Plan (CSWMP), and will be included within the OEMP, which details:

- The frequency and duration of sampling
- Reporting requirements
- Sampling parameters including:
  - Total suspended solids and turbidity (construction and operation)
  - Total phosphorous (operation)
  - Total nitrogen (operation)
  - Oils and grease (construction and operation)
  - pH (construction).

Where monitoring identifies a water quality parameter not achieving predicted targets, recommendations for improvement will be made in the monitoring reports and implemented as part of the OEMP.

6.7 Construction Phase

While all construction activities have the potential to impact on water quality, the key activities are:

- Vegetation clearing and topsoil stripping
- Demolition
- Site remediation
- Stockpiling of materials
- Fill importation and truck movements
- Bulk earthworks
- Stormwater and drainage works
- Landforming works to establish a fill mound that will direct surface flows away from the MPE Site on the southern boundary.

The following describes the overall approach to managing and mitigating risks to water quality during construction of the Project.

A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP) have been developed in accordance with the principles and requirements of Managing Urban Stormwater – Soils & Construction Volume 1 (‘Blue Book’) (Landcom, 2004) and Volume 2 (DECC 2008) and will be implemented for the construction of the Project as part of the CEMP.

6.7.1 Erosion Controls

Erosion control is the first priority of any erosion and sediment control strategy. Effective and practical erosion control can be achieved through:

- Limiting the area of disturbance and implementing progressive stabilisation to limit the time of disturbance and exposure to erosion potential.
- Integrating measures that reduce the volume of water moving over exposed surfaces. These include the diversion of non-site water around the site and the adoption of measures within the construction area to minimise the size of local catchments and transfer clean water via a stabilised channel (e.g. pipe or lined channel) to stabilised outlets.
- Utilising measures that slow the movement of water over exposed areas to velocities which do not lead to scour of the surface. This may be achieved by creating flat gradients, introducing roughness or installing flow checking measures within channels / on slopes.
- Providing additional protection, cover or stability to exposed surfaces so that it is less readily eroded. Options include additional compaction, spray on stabilisers, mulches, blankets and temporary vegetation.
- Progressive landscaping as areas are completed.

There approaches will be included in the planning phases for each work activity and integrated with the works at each site.

In areas close to sensitive environment (e.g. the Bootland to the south of the MPE site) or where there is a lack of available space for sediment control (i.e. sediment basins), temporary and immediate protection can be achieved through covering the soil surface using geotextile, plastic or polymer.

6.7.2 Sediment Controls

Sediment control should be viewed as secondary to erosion control in minimising ground and surface water pollution resulting from construction. Sediment basins have been sized and located to ensure sediment concentrations in site runoff are within acceptable limits. Preliminary basin sizes have been calculated in accordance with the Blue Book and are based on Berkshire Park Group soils ('Type F'). These soils are fine grained and require a relatively long residence time to allow settling. Details of the sediment basins are provided within the ESCP. Construction water will be diverted to sediment basins through construction whilst the OSDs are being constructed. The OSDs will only come online once there is a minimum of 80% groundcover in the upstream catchment. Once the OSD is online, the construction sediment basins will be decommissioned.

Other measures for sediment control will include:

- Use of sediment fences, mulch bunds and sandbags along work area perimeters
- Sweeping of hard areas
- Stabilised site entries
- Use of inlet traps and inlet protections at existing drainage structures
- Contour controls.

7 SITE WATER BALANCE

7.1 Objectives

The objective of the site water balance is to identify any potential impacts on surface water and assess management options where appropriate.

7.2 Methodology

Given that rainfall-runoff processes dominate the water balance for the site, a site water balance model was established using MUSIC (the same model used to assess water quality impacts, refer **Section 6**) for both existing and proposed conditions. MUSIC enables a continuous simulation of rainfall-runoff processes to be undertaken for a long time period. In this case, a 10 year period of rainfall was selected which includes a range of rainfall depths across both wet and dry years.

Other components of the site water balance include potable water supply to the Project and wastewater discharge to sewer, although the volumes associated with these are relatively minor and have therefore not been assessed in detail.

7.3 Water Demand & Wastewater Generation

The water demands for the Project are small relative to the size of the development and are largely associated with the offices adjacent to each warehouse. The demands have been estimated to be a maximum of approximately 45ML/year as per the 'MPE Stage 2 Utilities Strategy Report' (Arcadis, November 2016). This is proposed to be supplied from Sydney Water's potable water supply network via a connection from MPE Stage 1, and supplemented via rainwater harvesting as discussed in **Section 7.5**. No extraction from any local surface water or groundwater resources is proposed.

Wastewater generation, allowing for an 80% sewer discharge factor relative to the total estimated water demands, is estimated to be approximately 36ML/year. This is proposed to be discharged to sewer via MPE Stage 1.

The water demand and wastewater generation associated with the previous land use for the site (i.e. as the DNSDC) are unknown. However, given that the previous and proposed land uses are relatively similar, while previous water demand and wastewater generation are most likely less than for the proposed conditions, they would be a similar order of magnitude for the purpose of the water balance assessment.

7.4 Rainfall Runoff Processes

The existing conditions for the site include pervious surfaces and impervious surface areas in the form of roads and roofs. From aerial photography it has been estimated that the existing nature of the Project site is approximately 30% impervious. While the remainder of the Project site is pervious (grassed/vegetated), it is underlain by predominantly clay soils which limit the potential for infiltration.

The proposed conditions for the Project are predominantly paved surfaces. For the site water balance it has been conservatively assumed that the proposed development is 90% impervious

The average annual rainfall-runoff volumes for the site are shown in **Figure 7-1**.

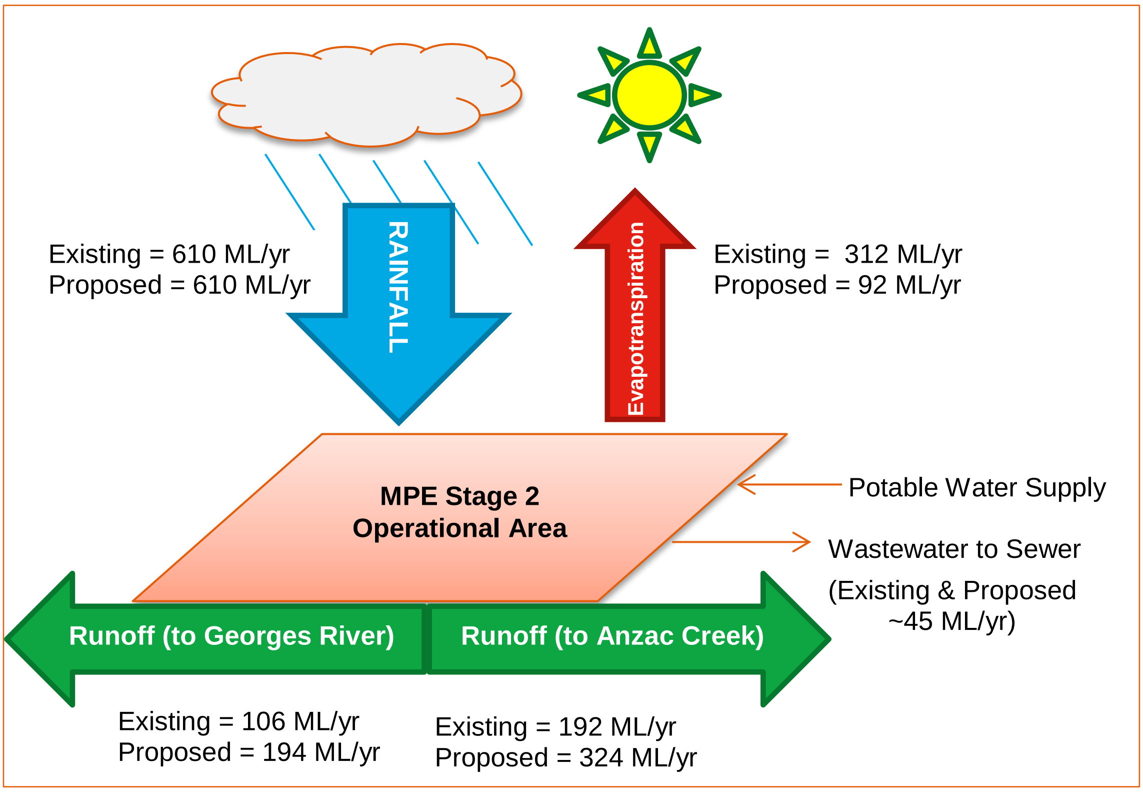


Figure 7-1: MPE Stage 2 Water Balance

7.5 Rainwater Harvesting & Water Reuse

Water reuse will be implemented on site through rainwater harvesting at each warehouse. The following discusses the feasibility of rainwater harvesting and reuse for the Project site.

The CoC requires the development of concept options to demonstrate how 20% of the average annual volume of stormwater from the site can be reused via rainwater capture and reuse. Such concept options were presented to DP&E in a meeting held in their offices on 26/02/2018. In this meeting the demand target for the site, water reuse options and indicative tank sizing were discussed.

As shown in **Figure 7-1** the average annual rainfall on the site, MPE Stage 1 and a portion of MPW Stage 2 is approximately 610ML. Of this rainfall approximately 256ML/yr will fall on roof areas within MPE Stage 2 where runoff may be collected by rainwater harvesting. This value of 610ML includes part of MPE Stage 1 and MPW Stage 2 which flow through OSDs within MPE Stage 2.

The target water reuse for the Project has been taken as 20% of the annual rainfall on MPE Stage 2 equalling 86ML/yr.

Possible water demands which could utilise this reuse volume have been identified as:

- Irrigation
- Toilet Flushing
- Washdown Facilities.

Other site water demands such as cooling towers, heating, ventilation, air conditioning and ground source heat exchange were considered and found unsuitable for rainwater reuse as discussed in **Section 7.5.2**.

The three identified water reuse options listed above are estimated to generate a total water demand of approximately 19ML/yr as outlined in **Section 7.5.1**. This demand is less than the target water reuse identified as 86ML/yr.

7.5.1 Detailed Site Reuse Demand Calculation

Three sources of demand were identified as applicable to the Project; toilet flushing, irrigation and washdown facilities. For each of these an average yearly demand was estimated based on the site operational requirements and in consideration of industry best practice water conservation techniques.

7.5.1.1 Irrigation

Landscaping for the Project has been conceptually designed by GroundInk with various areas of turf and gardens. The Project site is to be 10% soft landscaping with the planting specified predominantly as Australian native plants. After the initial establishment phase of 3 to 6 months the average landscaping demand is estimated to be 10mm/week according to the Landscape Architect. This results in a required water depth of 520mm annually. The average annual rainfall for Moorebank is 865mm. As directed by Tactical a resulting 5mm/week has been applied. These values were run through MUSIC to determine the effect of rainfall and evapotranspiration and tank sizing. Approximately 36% of the landscaping prescribed is located within the OSD basins. Planting within these areas are considered to be passively watered by frequent runoff generated by the site catchment.

Based on the proposed landscaping area and irrigation requirements the average annual demand is estimated to be 14ML/yr. Unlike the other reuse demands this volume is strongly weather dependent.

7.5.1.2 Toilet Flushing (Internal Non-Potable Uses)

The Project is committed to meeting a minimum 3 Star Green Star Rating[1]. To achieve this a minimum of a four star Water Efficiency Labelling and Standards (WELS) rating for toilets is required as described in AS6400[2].

A summary of the yearly demand for toilet flushing (per toilet) based on toilet WELS rating is shown in **Table 7-1**. This demand was calculated by allowing for 4 flushes per day, 260 days per year for 1430 people.

Table 7-1: Toilet Water Usage WELs Rating

Toilet WELS Rating	Yearly Demand (ML/yr)
1 Star (Not allowed for installation)	8.2
3 Star	5.9
4 Star (Minimum Site Requirement)	5.2
5 Star (Proposed Site Implementation)	4.5

As shown in **Table 7-1** the estimated toilet flushing demand for the Project site is 4.5ML/yr. This is achieved through the adoption of water efficient toilet fixtures on site.

The Project is also committed to installing other water efficient fixtures for potable water demands to further reduce water usage.

[1] The CFC agreement requires a minimum of 3 Star Green Star Rating. Notwithstanding this, as a 3 star rating cannot be certified a 4 or 5 star rating is more likely to be set as a target.

[2] *AS 6400 – Water Efficient Products - Rating and Labelling*

7.5.1.3 Washdown

Wash-down facilities are generally quite water efficient. For the purposes of rainwater reuse a total demand of 0.5ML/yr has been identified for the Project site.

7.5.2 Unsuitable Demands

The CoC also identifies several other possible sources of demand and rainwater reuse options on the Project site. Each of these has been investigated and shown to be unsuitable for a variety of reasons as discussed below.

7.5.2.1 Cooling Towers

Cooling towers are highly sensitive to the water quality. If careful controls are not in place they can become breeding grounds for bacteria particularly Legionella. For example, the Public Health and any Wellbeing Regulations 2009 require that cooling tower systems be continuously treated with:

- One or more biocides to protect against micro-organisms including Legionella;
- Chemicals or other agents to minimise scale formation, corrosion and fouling; and
- Bio dispersants.

Additionally, the Victorian guideline for developing risk management plans for cooling tower systems recommends not using cooling towers as a primary way of reducing the spread of infection.

In summary, the use of rainwater for cooling towers is considered to, even after treatment, increase health risks to employees and is therefore not considered best practice. As a result, and based on the operational requirements for the Project, the reuse of rainwater in cooling towers is not considered suitable.

7.5.2.2 Heating, Ventilation, Air Conditioning and Ground Source Heat Exchange

Heating, ventilation, air conditioning and ground source heat exchange seek to use water to achieve either heating or cooling on a site. However, once the water has been used to achieve the heat transfer the volume remains and needs to be discharged. Further, these applications require high quality water to stop the spread of disease and ensure the system does not corrode.

Additionally, the Project warehouses are not expected to require air-conditioning or heating. The offices and freight village may require air conditioning and heating however this type of heating is generally associated with uses that have a much higher demand. The size of the offices and freight village are not of a scale that could reasonably reuse rainwater for air-conditioning or heating due to the extent of infrastructure and filtration required.

In summary, the reuse of rainwater for the purposes of heating, ventilation, air conditioning and ground source heat exchange is not considered suitable based on the operational requirements of the site, the relatively small scale of air conditioning use (comparable to non-air-conditioned warehouses) proposed.

7.5.3 Concept Options Analysis

To meet the goal of 86ML/yr of rainwater reuse would require a total tank volume of approximately 4ML. This equates to approximately 130kL/ha of warehouse roof. Water demand on the site has been calculated as 19ML/yr as shown in **Section 7.5.1**.

To increase demand to 86ML/yr would require significant changes to the land use on site such as increasing the landscaped area from 10% to 50%, increasing the number of people using the site from 1430 to 30,000 or using the site to add supply to the potable water network.

7.5.3.1 Concept Tank Sizing for 20% of Annual Runoff

The average yearly demand target of 86ML/yr was used to size rainwater tanks in MUSIC. This resulted in a required 130kL of tank storage per hectare of roof area to meet 80% of the demand as is industry practice as shown in **Figure 7-2**.This tank sizing when applied to Warehouse 1 which has a roof area of approximately 5ha, requires a 650kL tank. This would require a tank which is 26m long, 10m wide and has a storage depth of 2.5m. Tanks of this scale would need to be incorporated into each warehouse at significant cost which if demands were not increased to match the supply would remain full almost all of the time. At this size, the tanks are quite large compared with those required for like developments as discussed in **Section 7.5.6** and **Section 7.5.7**

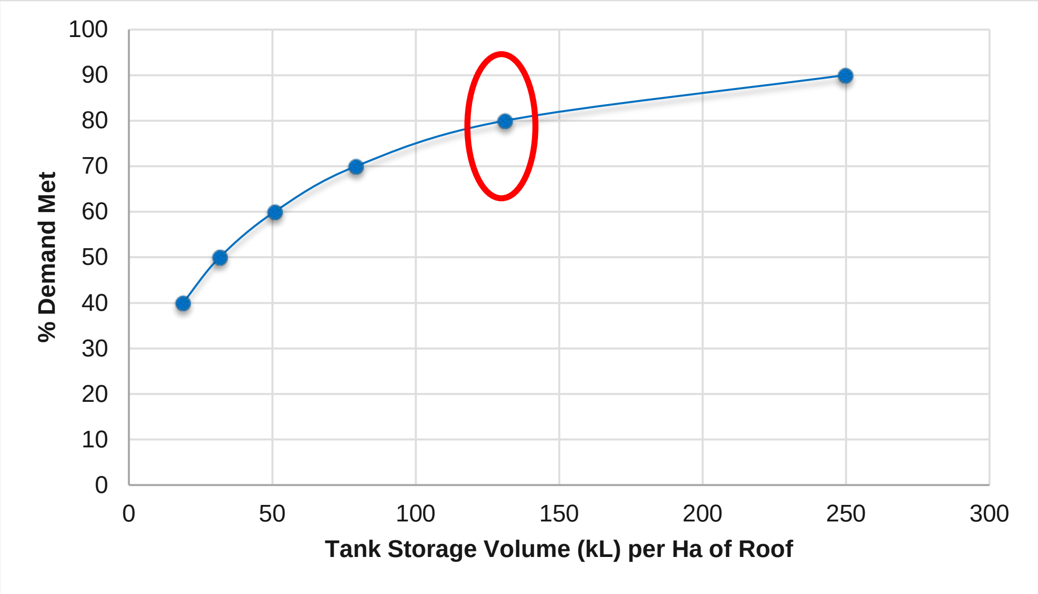


Figure 7-2:Concept Rainwater Tank Sizing & Percentage Demand Relationship

7.5.3.2 Concept Irrigation

As identified in **Section 7.5.1.1** the average annual irrigation demand for the precinct is 14ML/yr. This demand accounts for more than 70% of the demand for the precinct and as such changes to the irrigation demand will have the largest impact on the total demand for the precinct. To meet the goal of 20% of annual average runoff reused the irrigation demand would need to be increased to 81ML/yr approximately 5.8 times the current demand. Options to achieve this are discussed below however they have been found to be unsuitable for this development.

The plants specified for the precinct are Australian natives from the local region. These plants have a low water demand. Changing the planting selection to non-natives could increase the irrigation demand two-fold however this would not be in accordance with the approved planting for the precinct. A further option would be to increase the amount of landscaped areas on site. This would require landscaped areas to increase to 60% of the sites area. With this proportion of landscaped areas, it would not be possible to fit the warehouse roof areas required to source the rainwater.

7.5.3.3 Concept Internal Non-Potable Uses

The internal non-potable use is 4.5ML/yr as identified in **Section 7.5.1.2**. This value has been derived through the use of water conservative fittings and practices. To increase this value while pursuing water conservation would require an increase in people on site. The site population would need to increase from 1430 to roughly 30,000 to meet the full target. This would require a land use significantly different from the one proposed for the site.

7.5.3.4 Concept Option Conclusion

Meeting the target as identified by the condition is not feasible both in terms of the reuse demands on site and the infrastructure that would be required to store such large volumes of water.

It is understood that the percentage annual site runoff intent of the CoC, and rainwater reuse generally within the industry, is for on-site water conservation. An example of requirements for water conservation is provided within Liverpool City Council Development Control Plan (2008) and includes the following:

"*Water conservation*

- *Water conservation shall be promoted in all developments. The development should incorporate water efficient fittings and processes and incorporate water reuse options should be pursued.*
- *All development is to harvest and collect rainwater or where possible connect to a recycled water scheme in order to utilise non-potable water sources for landscape irrigation, firefighting and toilet flushing"*

If the intent of the CoC is water conservation then the Project achieves this intent, proposing that key non-potable demands on site (irrigation, toilet flushing and washdown facilities) will be met with rainwater reuse. Reuse of rainwater to meet operational demand is considered the most sustainable and long-term approach to achieving water conservation.

Furthermore, creating additional demands on site to meet an unsuitable target is considered counterproductive to the goal of water conservation. It is also noted that under the Liverpool City Council Development Control Plan (2008) water conservation for industrial developments is through meeting the demands of landscape irrigation and toilet flushing, as is proposed for the Project.

It is therefore recommended that the tanks are sized to meet the demands on site of 19Ml/yr as identified in **Section 7.5.1**.

7.5.4 Rainwater Tank Sizing

The identified water demand was analysed against historical rainfall data in MUSIC to determine the required tank size to meet the 19ML/yr reuse target with an 80% reliability in accordance with standard industry practice. As shown in **Figure 7-3** the Project has the opportunity to meet the demand of 19ML/yr with 80% reliability through the use of a 20kL rainwater tank per hectare of roof area.

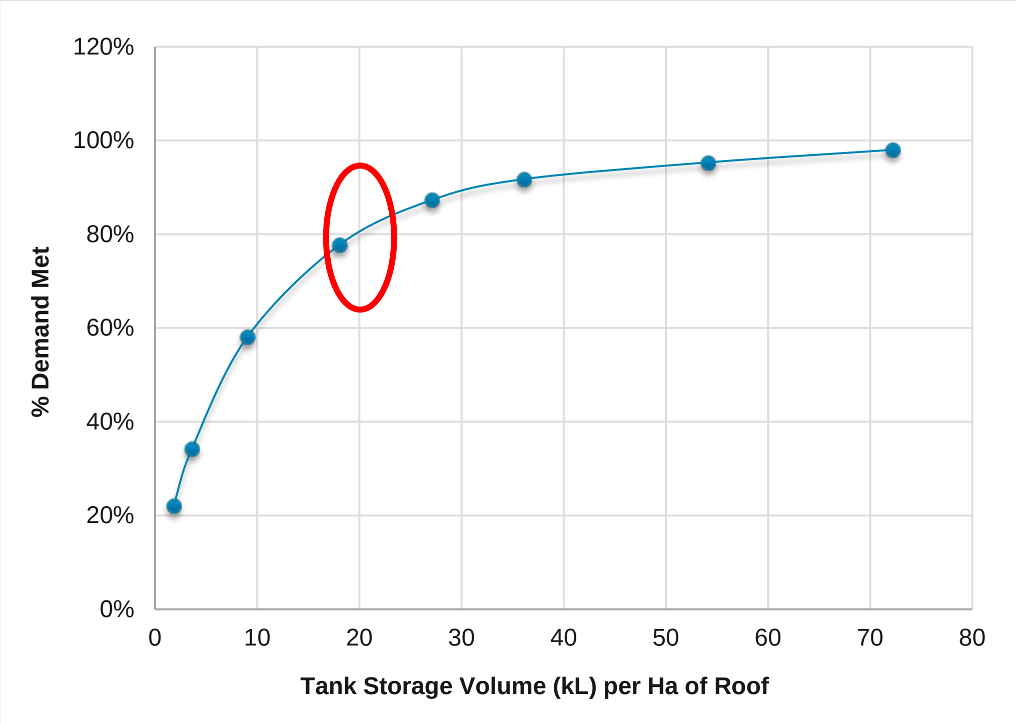


Figure 7-3: Rainwater Tank Sizing & Percentage Demand Relationship

7.5.5 Rainwater Tank Placement

Water demands vary for each warehouse according to the number of occupants, proximity to landscaping areas, and washdown facilities. The rainwater runoff generated by each warehouse also varies according to roof area.

Each rainwater tank will be sized proportional to its contributing roof area and water demand with the goal of meeting the total demands of toilet flushing, landscaping and washdown facilities with a 80% reliability. Across the precinct the average tank size is expected to be in the order of 20kL per hectare of roof area. Some warehouses may contribute to a local joint system so that all rainwater is used as efficiently as possible.

Suitable locations for rainwater tanks will be determined at detailed design. This will be confirmed through the compliance tracking outlined in **Section 1.3.2.**

7.5.6 Comparison with Industrial

The Rohlig Australia warehouse is located north of the Project site on the corner of Moorebank Avenue and Anzac Road, shown below in **Figure 7-4**. On the north-eastern corner of the site is a rainwater tank approximately 2m high with a 5m diameter. This tank is estimated to have a storage in the order of 40kL. The Rohlig Australia warehouse roof area is approximately 1.7ha equating to a tanks size in the order of 24kL/ha which is comparable to the sizing identified for the Project outlined in **Section 7.5.4**.

7.5.7 Comparison with Residential

A possible reason for the difficulty in finding a possible demand to meet the target in the CoC is that it is taken from residential or commercial developments. The main driver for toilet flushing is the number of people on site. For the Project this has been taken as 1,430 people for the 68ha site area. In a medium density, residential environment this density of people would likely be 4 to 5 times as large.

Figure 7-4: Rohlig Australia Warehouse

In terms of irrigation, medium density developments typically are 30% landscaping the majority of which is turf. The Project is approximately 10% landscaping the majority of which is native planting with low water requirements. Turf water demands are close to double the demands of non-native planting. This results in a landscaping demand for residential areas which is 5 or 6 times larger than what is expected on the Project site. With this much larger demand residential developments the CoC 20% reuse target is more achievable. For a warehousing precinct, however additional demand would need to be created to come close to this target. As discussed above, creating additional demand to meet an unsuitable target is considered unsustainable and not an appropriate approach to long term water conservation.

7.5.8 Warehouse 1 Precinct

The total MPE Stage 2 warehouse roof area is 31.08ha. Within the W1P there is 4.1ha of roof or 13% of the total roof area. As Warehouse 1 has a roof area of 3.7ha requiring a minimum rainwater tank of 74kL. The freight village in the north has a roof area of 0.4 and will require combined tank size of 16kL.

7.6 Comments

The key changes to the Project site water balance from existing to proposed conditions are a reduction in evapotranspiration of 220 ML/yr and an increase of the same magnitude to runoff. This is largely a result of the increase in impervious areas from existing conditions (30%) to proposed conditions (95%).

Options considered to reduce the stormwater runoff volume from the site include collecting runoff for reuse purposes and/or infiltration. Water reuse will be implemented on site through rainwater harvesting at each warehouse. Rainwater reuse will reduce the site potable water demand of 45 ML/yr. In relation to infiltration, the clay soils would limit infiltration rates and the groundwater is also expected to have high levels of salinity. Infiltration is therefore not considered to be practical or desirable.

For the Georges River, the potential increase in runoff volume from the Project site should be considered in the context of flow volumes conveyed in the Georges River. The total Georges River catchment area is approximately 960 km^2 and would generate annual flow volumes many orders of magnitude greater than that from the Project site (which represents less than 0.07% of the total catchment area).

8 CONCLUSION

This Stormwater Management Plan has been prepared for approval by DP&E in accordance with CoC B40 for Warehouse 1 Precinct located within Stage 2 of the MPE Project (SSD 7628).

The following conclusions have been made within this report:

- A Soil and Water Management Plan and Erosion and Sediment Control Plan has been prepared and will be implemented to mitigate construction impacts on stormwater.
- A Flood Emergency Response Plan has been prepared and will be implemented for construction, and will be developed for operations of the Project to provide on-site refuge during major flooding, and subsequent to such an event, safe evacuation and Project site recovery.
- The DRAINS and TUFLOW analysis indicate that the proposed drainage systems and OSDs will provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Project.
- The water quality modelling has demonstrated that the water quality targets for the site can be met by the proposed water quality treatment train. Ongoing water quality monitoring will be undertaken as part of the Project.

The stormwater and flood analysis, design and management summarised in this report for the Project site address the assessment requirements and demonstrates compliance with the relevant CoC listed **Table 1-3**.

APPENDIX A

Concept Design Drawings

Drawing List

GENERAL	
SSS2-ARC-CV-DWG-1001	COVER SHEET AND DRAWING LIST
SSS2-ARC-CV-DWG-1002	GENERAL ARRANGEMENT PLAN
SSS2-ARC-CV-DWG-1003	TYPICAL ROAD CROSS SECTIONS
SITE PREPARATION	
SSS2-ARC-CV-DWG-1101	EROSION AND SEDIMENT CONTROL PLAN
SSS2-ARC-CV-DWG-1102	EROSION AND SEDIMENT CONTROL DETAILS
SSS2-ARC-CV-DWG-1111	BULK EARTHWORKS PLAN
CIVIL WORKS	
SSS2-ARC-CV-DWG-1201	CIVIL AND STORMWATER PLAN
SSS2-ARC-CV-DWG-1211	ROAD LONGITUDINAL SECTIONS
STORMWATER	
SSS2-ARC-CV-DWG-1411	STORMWATER DRAINAGE OSD OUTLET 09
SSS2-ARC-CV-DWG-1431	EXISTING CATCHMENT PLAN
SSS2-ARC-CV-DWG-1432	PROPOSED CATCHMENT PLAN
SSS2-ARC-CV-DWG-1451	STORMWATER DRAINAGE WATER QUALITY PLAN OSD 09
SSS2-ARC-CV-DWG-1471	STORMWATER BIORETENTION TYPICAL DETAILS
SSS2-ARC-CV-DWG-1491	OSD 09 TYPICAL SECTION AND DETAILS

Design & Consultancy for natural and built assets

MOOREBANK PRECINCT EAST (MPE) STAGE 2 - WAREHOUSE 1 PRECINCT

CONDITIONS OF CONSENT - STORMWATER MANAGEMENT PLAN

CIVIL WORKS

DRAWING LIST

GENERAL	
SSS2-ARC-CV-DWG-1001	COVER SHEET AND DRAWING LIST
SSS2-ARC-CV-DWG-1002	GENERAL ARRANGEMENT PLAN
SSS2-ARC-CV-DWG-1003	TYPICAL ROAD CROSS SECTIONS
SITE PREPARATION	
SSS2-ARC-CV-DWG-1101	EROSION AND SEDIMENT CONTROL PLAN
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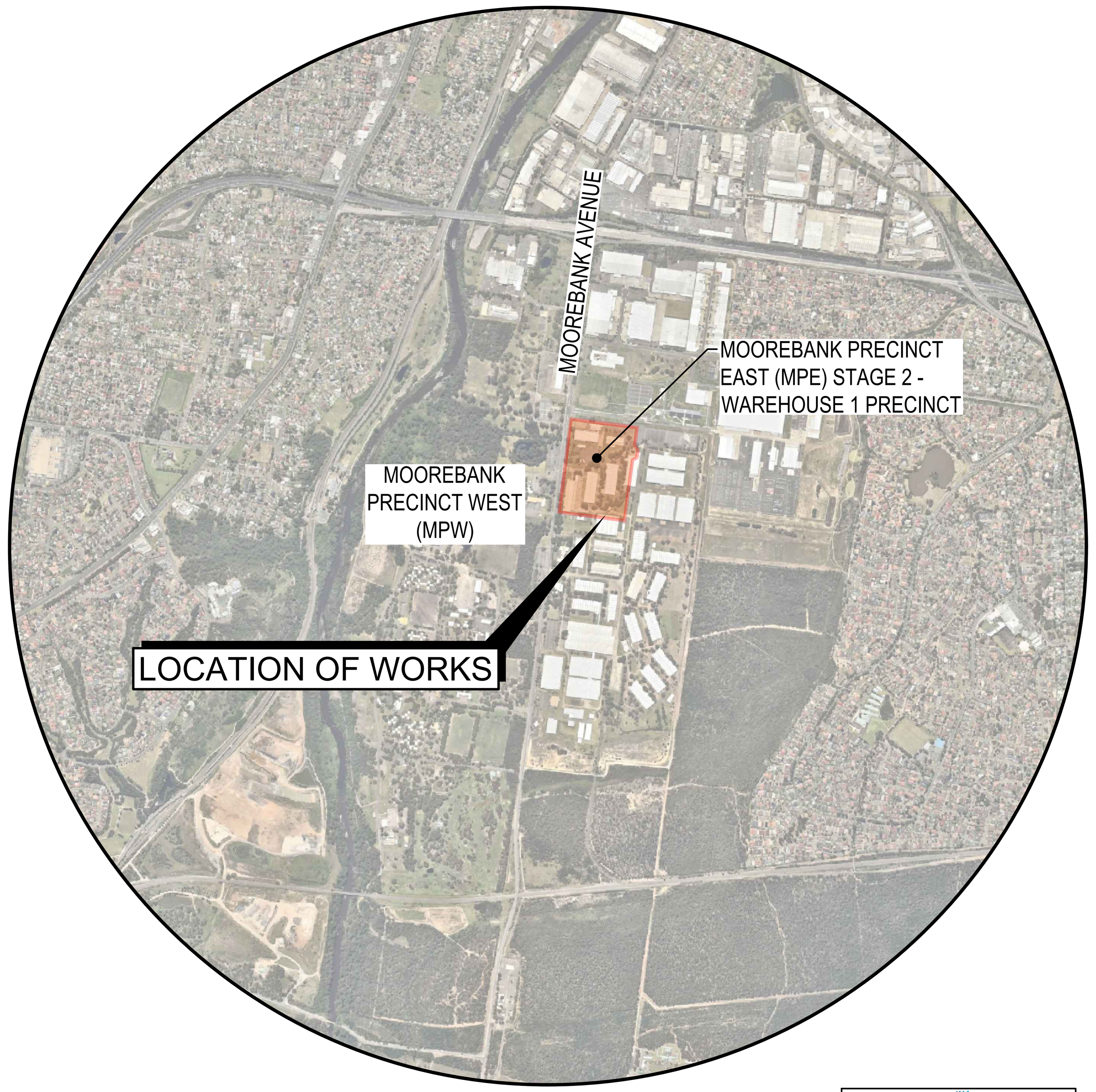
SSS2-ARC-CV-DWG-1471	STORMWATER BIORETENTION TYPICAL DETAILS
SSS2-ARC-CV-DWG-1491	OSD 09 TYPICAL SECTION AND DETAILS



LOCALITY PLAN
1 : 20,000

IMAGERY EXTRACTED FROM nearmap.com

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Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

0 500 1000 1500 2000m
1 : 20000

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE; TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

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		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1001-CoverSheetAndDrawingList.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: COVER SHEET AND DRAWING LIST

Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
ABN 76 104 485 289

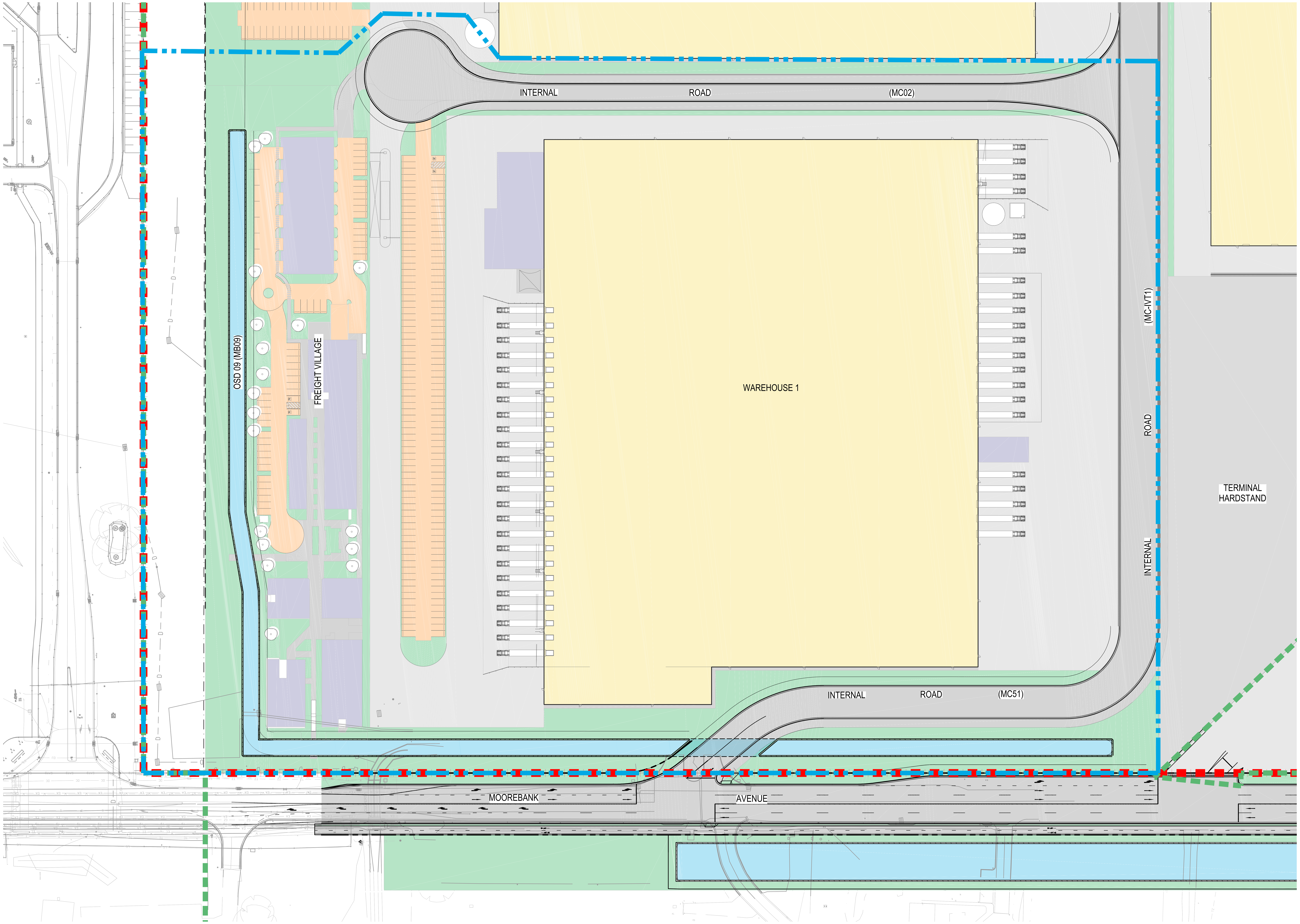
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG- 1001- Issue 01

100mm on Original

Date Plotted: 11 May 2018 - 04:25PM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1001-CoverSheetAndDrawingList.dwg V1



LEGEND

- MPE SITE BOUNDARY
- MPE STAGE 1 OPERATIONAL BOUNDARY
- MPE STAGE 2 APPROVAL BOUNDARY
- WAREHOUSE 1 PRECINCT BOUNDARY
- PROPOSED UNDERGROUND ON SITE DETENTION TANK

NOTES

1. ONLY WORKS CONTAINED WITHIN THE WAREHOUSE 1 PRECINCT BOUNDARY ARE CONSIDERED WITHIN THE MOOREBANK PRECINCT EAST STAGE 2 - WAREHOUSE 1 PRECINCT STORMWATER MANAGEMENT PLAN.

Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

0 15 30 45 60 75m

1 : 750

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE
TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	1 : 750	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1002-GeneralArrangementPlan.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: GENERAL ARRANGEMENT PLAN

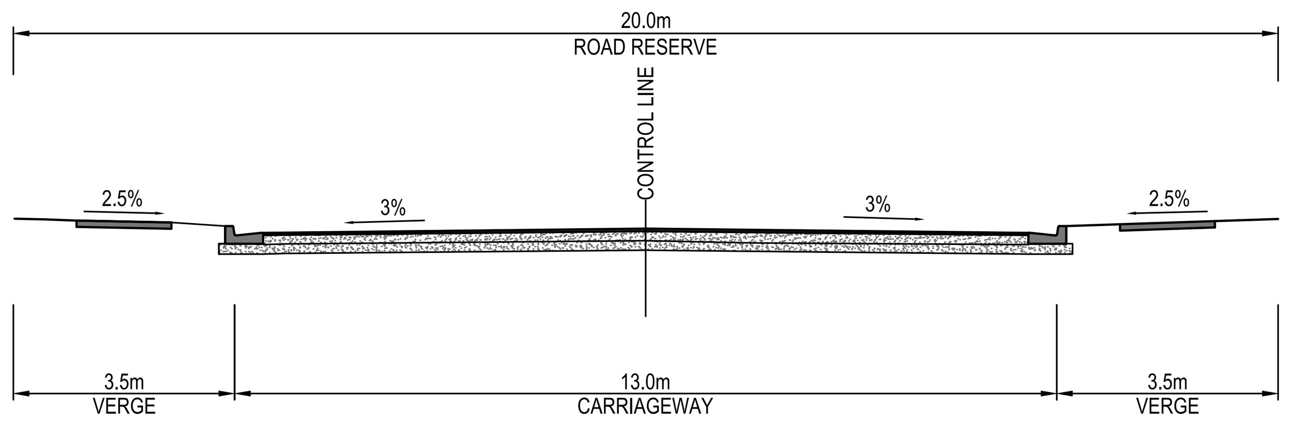
ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
ABN 76 104 485 289
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG- 1002- Issue 01

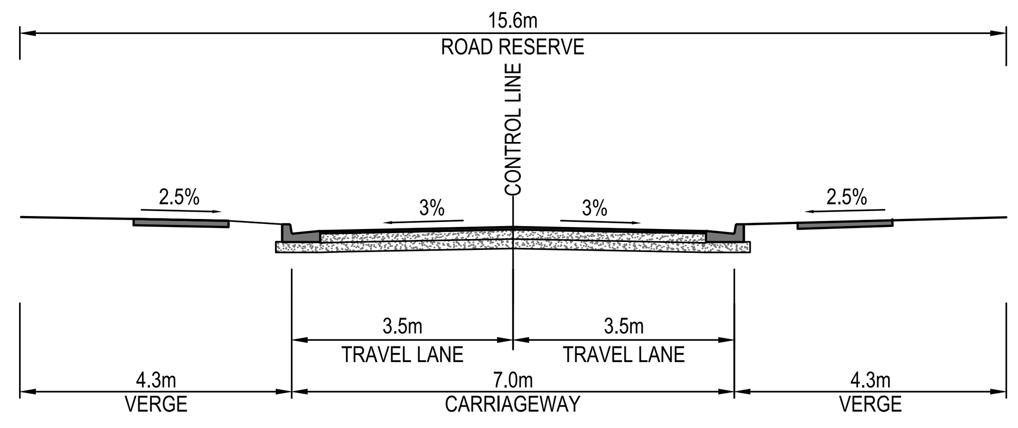
100mm on Original

Date Plotted: 11 May 2018 - 03:30PM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1002-GeneralArrangementPlan.dwg



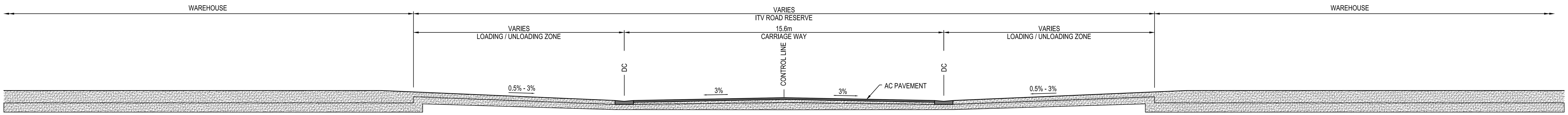
TYPICAL CROSS SECTION - INTERNAL ROAD (MC51)

SCALE 1 : 100



TYPICAL CROSS SECTION - INTERNAL ROAD (MC02)

SCALE 1 : 100



TYPICAL CROSS SECTION - INTERNAL ROAD (ITV ROAD)

SCALE 1 : 100

Issue	Description	Date
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0 2 4 6 8 10m

1 : 100

Client

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

TACTICAL GROUP

Status

PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	1 : 100	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1003-TypicalRoadCrossSections.dwg

Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2
WAREHOUSE 1 PRECINCT

Title

TYPICAL ROAD CROSS SECTIONS

ARCADIS

Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
ABN 76 104 485 289

Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG-1003-

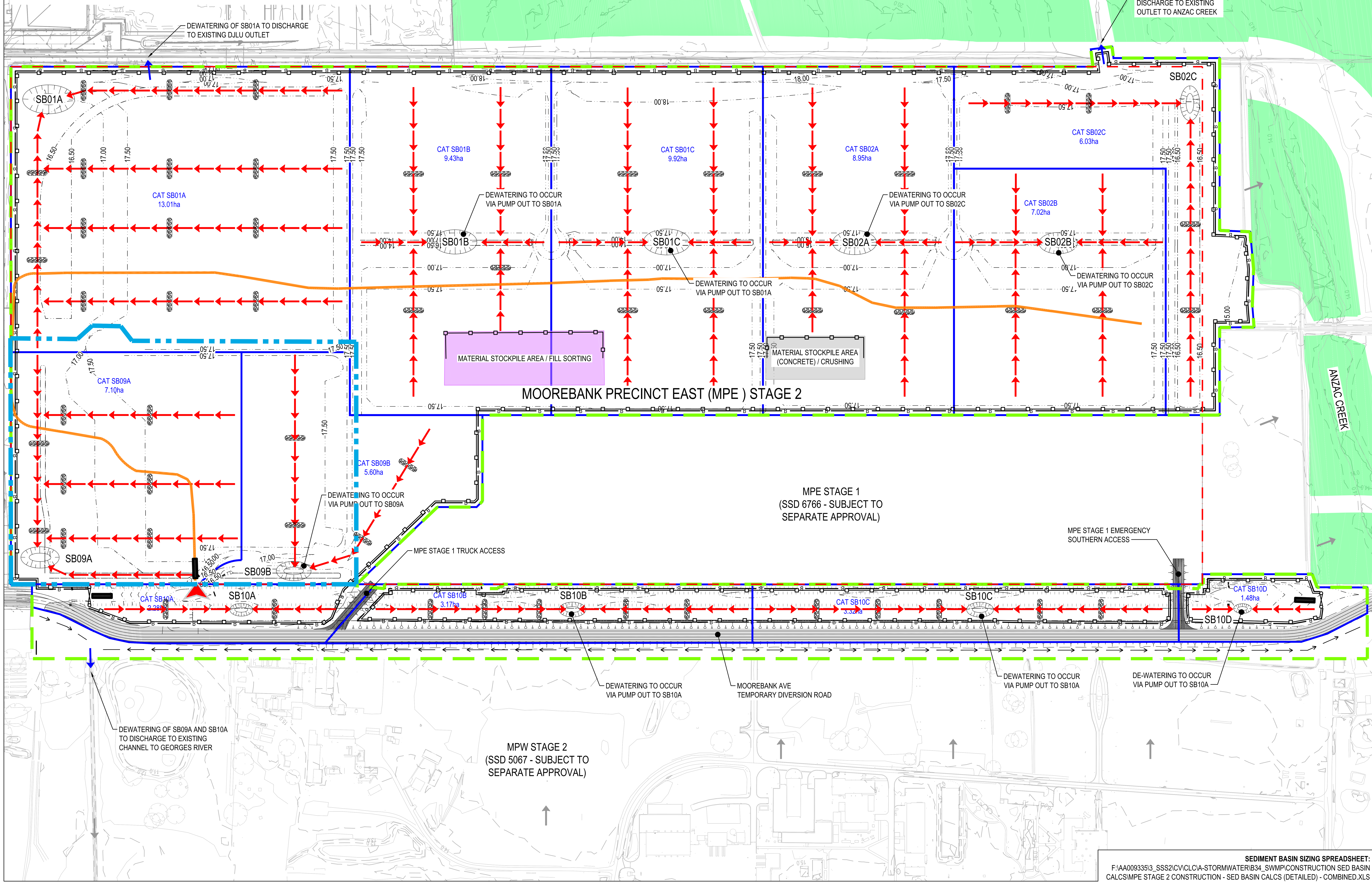
Issue 01

100mm on Original

Date Plotted: 11 May 2018 - 11:40AM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1003-TypicalRoadCrossSections.dwg

NOTES

1. THE SITE CONTRACTOR SHALL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE APPROPRIATE CONSIDERING ACTUAL SITE CONDITIONS AND CONSTRUCTION STAGING. EROSION AND SEDIMENT CONTROLS ARE TO BE IMPLEMENTED PRIOR TO ANY SOIL DISTURBANCE.
2. (SD X-X) REFERS TO STANDARD DETAIL PROVIDED IN THE LANDCOM 2004 PUBLICATION "MANAGING URBAN STORMWATER, SOILS AND CONSTRUCTION" (REFER TO DRAWING SSS2-ARC-CV-SKC-0068).
3. SEDIMENT BASINS ARE TO HAVE MINIMUM DEPTH 1500mm. FLOCCULATE AS REQUIRED AS DESCRIBED IN DEWATERING PROCEDURE.
4. STABILISED SITE ACCESS AREAS WILL BE LOCATED THROUGHOUT THE PROJECT SITE AND ARE TO INCLUDE RUMBLE GRIDS, WHEEL WASHES AND VEHICLE WASHDOWN BAYS, OR A COMBINATION OF THE ABOVE AS REQUIRED.
5. STORMWATER INFRASTRUCTURE IS TO BE PROTECTED USING MESH & GRAVEL INLET FILTERS (SD 6-11) AND/OR GEOTEXTILE INLET FILTERS (SD-12) AS REQUIRED.



LEGEND

- MPE SITE BOUNDARY
- PROPOSED MOOREBANK PRECINCT EAST (MPE) STAGE 2 CONSTRUCTION BOUNDARY
- WAREHOUSE 1 PRECINCT BOUNDARY
- COMPOUND ACCESS ROAD
- EXISTING CONTOURS
- PROPOSED CONTOURS
- PROPOSED SEDIMENT FENCE (SD 6-8)
- PROPOSED KERB SIDE TURF STRIP (SD 6-13)
- PROPOSED 1.8m HIGH CHAINWIRE BARRIER FENCE WITH DUST CLOTH LOCATION TO BE CONFIRMED ON SITE BY CONTRACTOR
- PROPOSED SEDIMENT BASIN (SD 6-4) (WITH EMERGENCY SPILLWAY OUTLET)
- PROPOSED SEDIMENT BASIN CATCHMENT BOUNDARIES
- CAT XX X.XXha — PROPOSED SEDIMENT BASIN CATCHMENT AREAS
- PROPOSED STABILISED SITE ACCESS (SD 6-14) WITH RUMBLE GRIDS, WHEEL WASHES, AND/OR VEHICLE WASHDOWN BAYS AS REQUIRED
- PROPOSED GATE
- PROPOSED EARTH BANK LOW FLOW (SD 5-5) & CHECK DAMS (SD 5-4) @ MAX. 100m SPACING
- INDICATIVE MATERIAL STOCKPILE / FILL SORTING AREA
- INDICATIVE MATERIAL STOCKPILE (CONCRETE) / CRUSHING AREA
- EXTERNAL FLOW DIRECTION
- PROPOSED SEDIMENT BASIN DISCHARGE LOCATION
- SITE ENTRY POINT
- PROPOSED EARTH BANK HIGH FLOW FOR DIVERSION OF EXTERNAL CLEAN WATER (SD 5-6)
- BIODIVERSITY OFFSET AREAS

Site area	SB01 A	SB01 B	SB01 C	SB02 A	SB02 B	SB02 C	SB09 A	SB09 B	SB10 A	SB10 B	SB10 C	SB10 D
Total catchment area (ha)	13.01	9.43	9.92	8.95	7.02	6.03	7.10	5.60	2.28	3.17	3.32	1.48
Disturbed catchment area (ha)	13.01	9.43	9.92	8.95	7.02	6.03	7.10	5.60	2.28	3.17	3.32	1.48
Soil analysis												
% sand (faction 0.02 to 2.00 mm	20	20	20	20	20	20	20	20	20	20	20	20
% silt (fraction 0.002 to 0.02 mm)	40	40	40	40	40	40	40	40	40	40	40	40
% clay (fraction finer than 0.002 mm)	40	40	40	40	40	40	40	40	40	40	40	40
Dispersion percentage												
% of whole soil dispersible	0	0	0	0	0	0	0	0	0	0	0	0
Soil Texture Group	F	F	F	F	F	F	F	F	F	F	F	F
Rainfall data												
Design rainfall depth (days)	5	5	5	5	5	5	5	5	5	5	5	5
Design rainfall depth (percentile)	80	80	80	80	80	80	80	80	80	80	80	80
x-day, y-percentile rainfall event	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4
Rainfall intensity: 2-year, 6-hour storm	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
RUSLE Factors												
Rainfall erosivity (R-factor)	2540	2540	2540	2540	2540	2540	2540	2540	2540	2540	2540	2540
Soil erodibility (K-factor)	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
Slope length (m)	300	190	190	190	190	250	220	250	150	220	220	80
Slope gradient (%)	0.3	0.5	0.5	0.5	0.5	0.4	0.5	0.4	0.5	0.5	0.5	0.5
Length/gradient (LS-factor)	0.27	0.24	0.24	0.24	0.24	0.26	0.24	0.26	0.23	0.24	0.24	0.19
Erosion control practice (P-factor)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover (C-factor)	1	1	1	1	1	1	1	1	1	1	1	1
Calculations												
Soil loss (t/ha/yr)	43	38	38	38	38	41	38	41	36	38	38	30
Soil Loss Class	1	1	1	1	1	1	1	1	1	1	1	1
Soil loss (m3/ha/yr)	33	29	29	29	29	32	29	32	28	29	29	23
Sediment basin storage volume, m3	73	47	49	45	35	32	35	30	11	16	17	6

Site	Cv	Rx-day, y-%ile	Total catchment area (ha)	Settling zone volume (m3)	Sediment storage volume (m3)	Total basin volume (m3)
SB01A	0.50	24.4	13.01	1587	73	1660
SB01B	0.50	24.4	9.43	1150	47	1197
SB01C	0.50	24.4	9.92	1210	49	1259
SB02A	0.50	24.4	8.95	1092	45	1137
SB02B	0.50	24.4	7.02	856	35	891
SB02C	0.50	24.4	6.03	736	32	768
SB09A	0.50	24.4	7.10	866	35	901
SB09B	0.50	24.4	5.60	683	30	713
SB10A	0.50	24.4	2.28	278	11	289
SB10B	0.50	24.4	3.17	387	16	403
SB10C	0.50	24.4	3.32	405	17	422
SB10D	0.50	24.4	1.48	181	6	187

SEDIMENT BASIN SIZING SPREADSHEET:
F:\AA009335\3_SSS2\CV\CLC\A-STORMWATER\B34_SWMP\CONSTRUCTION SED BASIN CALCS\MPE STAGE 2 CONSTRUCTION - SED BASIN CALCS (DETAILED) - COMBINED.XLS

Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

0 50 100 150 200 250m
1 : 2500

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE — TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	1 : 2500	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1101-ErosionAndSedimentControlPlan.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: EROSION AND SEDIMENT CONTROL PLAN

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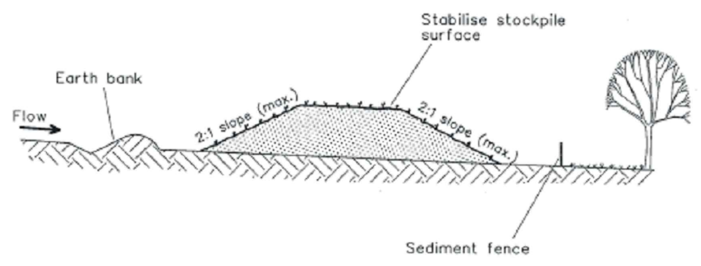
Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG-1101- Issue 01

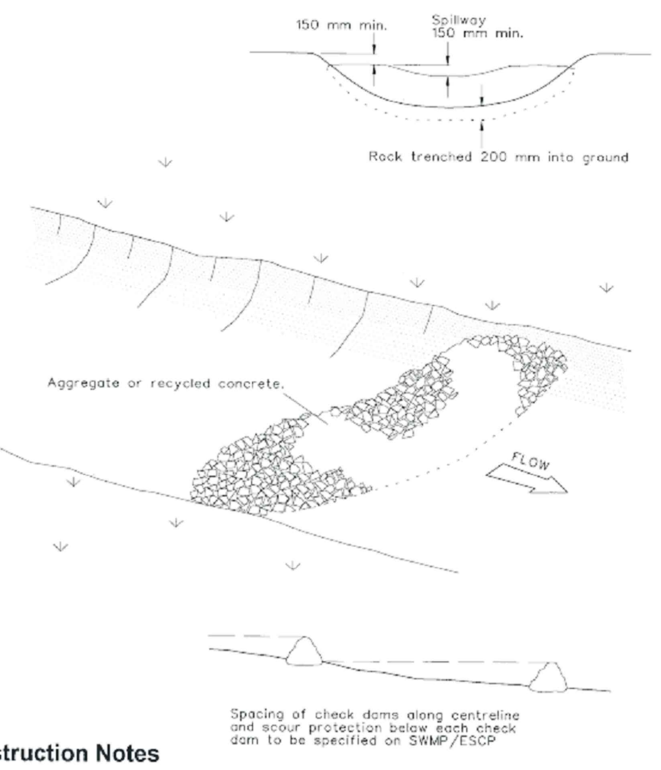
100mm on Original



Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

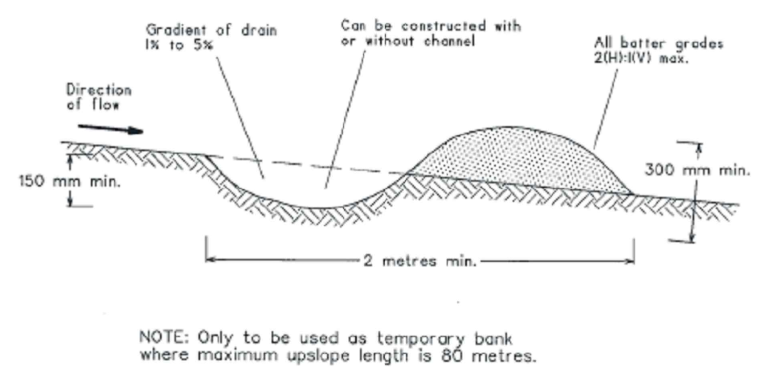
STOCKPILES (SD 4-1)



Construction Notes

1. Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.
2. Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.
3. Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.
4. Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

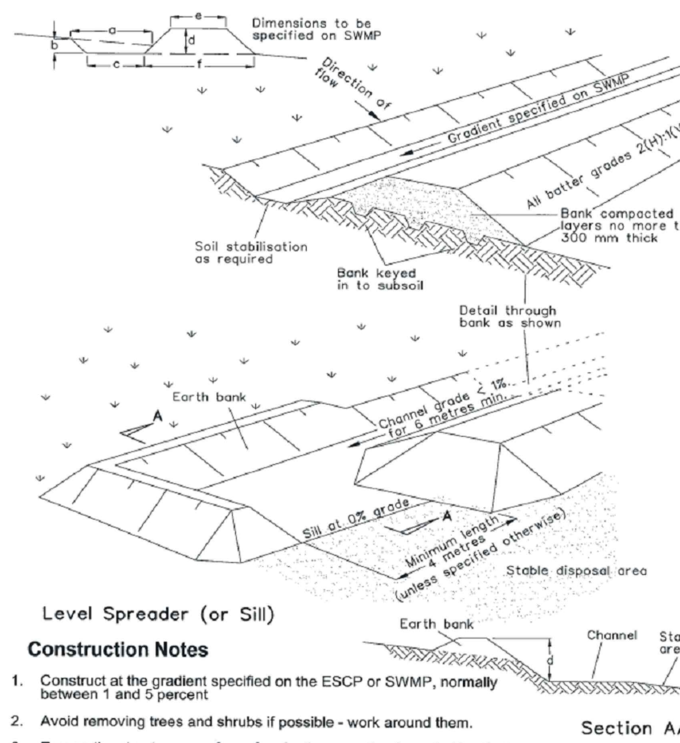
ROCK CHECK DAM (SD 5-4)



Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

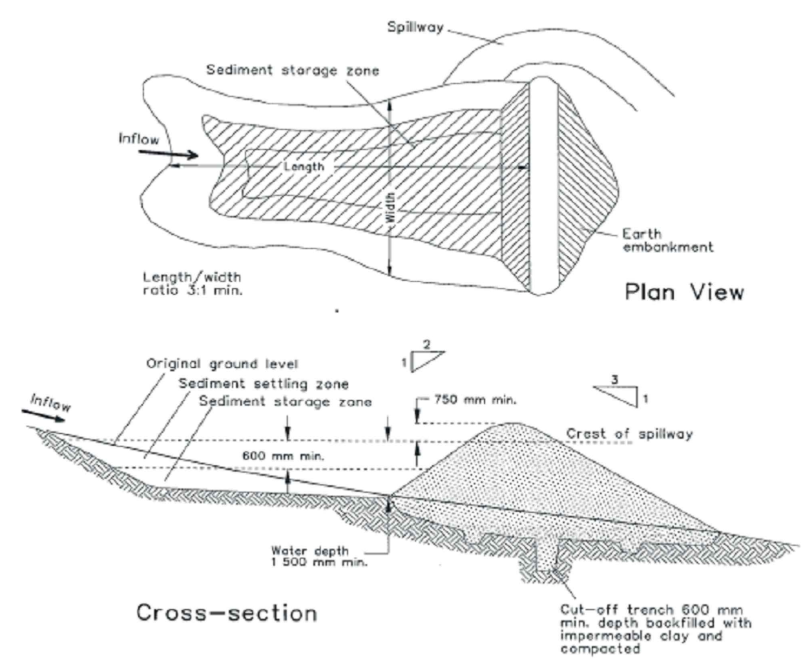
EARTH BANK LOW FLOW (SD 5-5)



Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

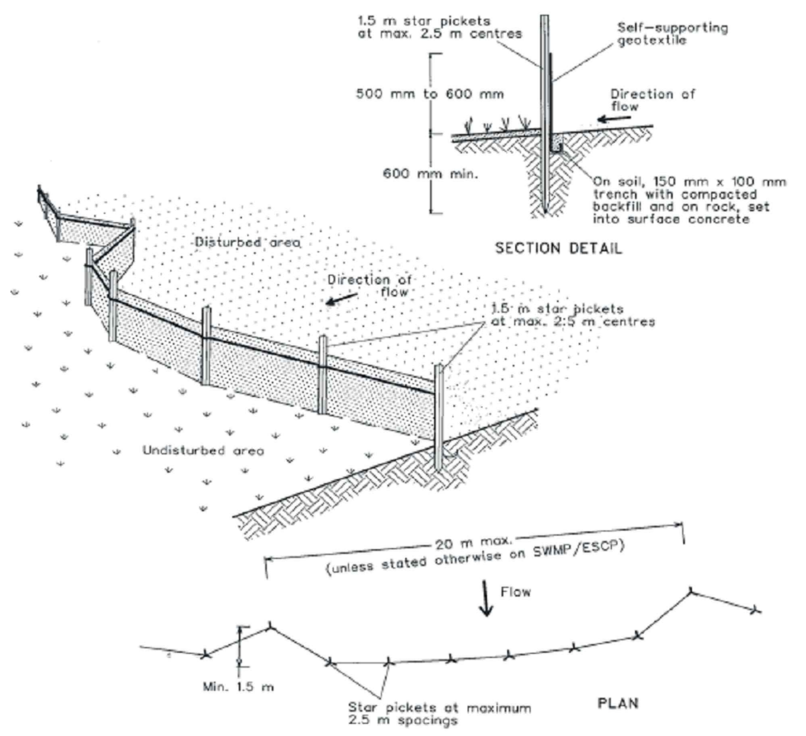
EARTH BANK HIGH FLOW (SD 5-6)



Construction Notes

1. Remove all vegetation and topsoil from under the dam wall and from within the storage area.
2. Construct a cut-off trench 500 mm deep and 1,200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
3. Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
4. Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
5. Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
6. Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
7. Construct the emergency spillway.
8. Rehabilitate the structure following the SWMP.

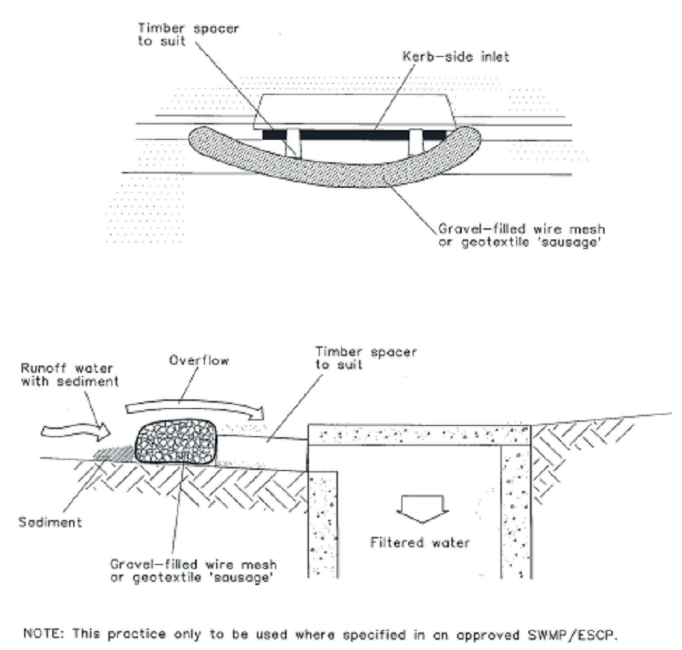
SEDIMENT BASIN (SD 6-4)



Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

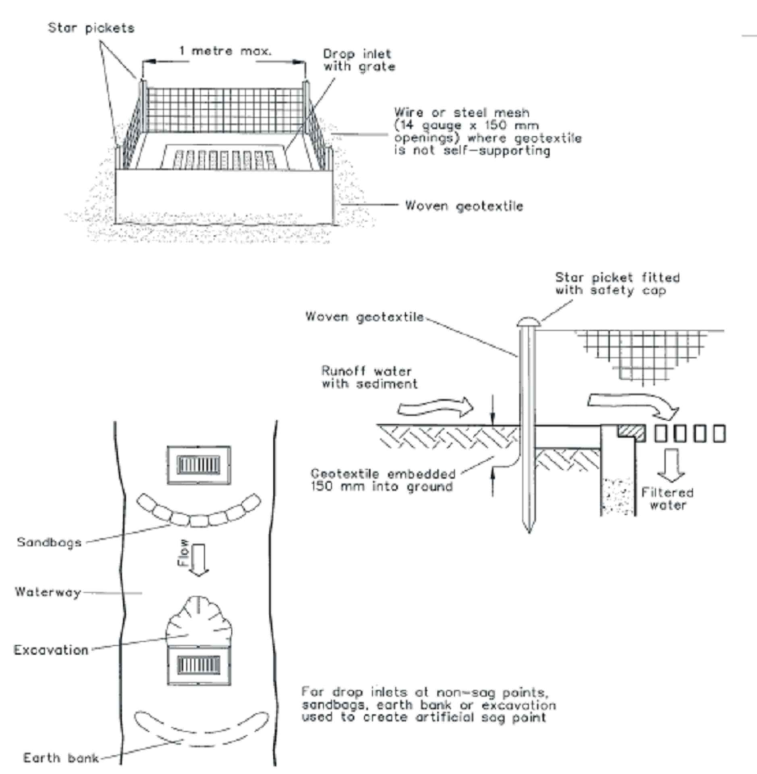
SEDIMENT FENCE (SD 6-8)



Construction Notes

1. Install filters to kerb inlets only at sag points.
2. Fabricate a sleeve made from geotextile or wire mesh longer than the length of the inlet pit and fill it with 25 mm to 50 mm gravel.
3. Form an elliptical cross-section about 150 mm high x 400 mm wide.
4. Place the filter at the opening leaving at least a 100-mm space between it and the kerb inlet. Maintain the opening with spacer blocks.
5. Form a seal with the kerb to prevent sediment bypassing the filter.
6. Sandbags filled with gravel can substitute for the mesh or geotextile providing they are placed so that they firmly abut each other and sediment-laden waters cannot pass between.

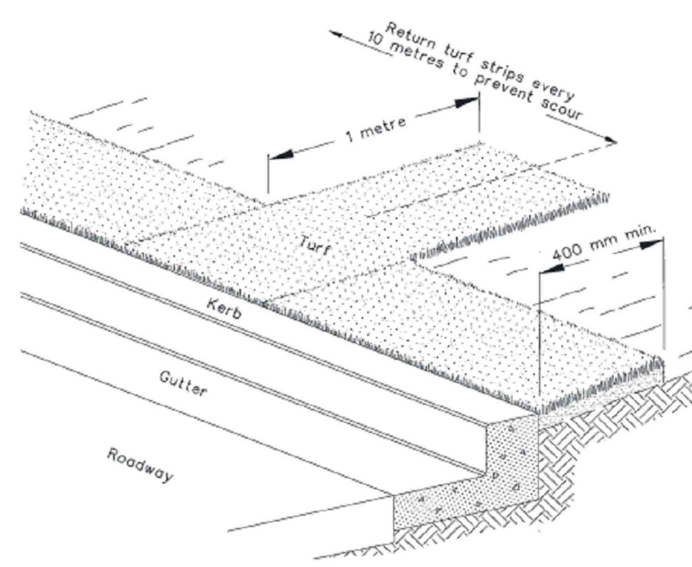
MESH AND GRAVEL INLET FILTER (SD 6-11)



Construction Notes

1. Fabricate a sediment barrier made from geotextile or straw bales.
2. Follow Standard Drawing 6-7 and Standard Drawing 6-8 for installation procedures for the straw bales or geofabric. Reduce the picket spacing to 1 metre centres.
3. In waterways, artificial sag points can be created with sandbags or earth banks as shown in the drawing.
4. Do not cover the inlet with geotextile unless the design is adequate to allow for all waters to bypass it.

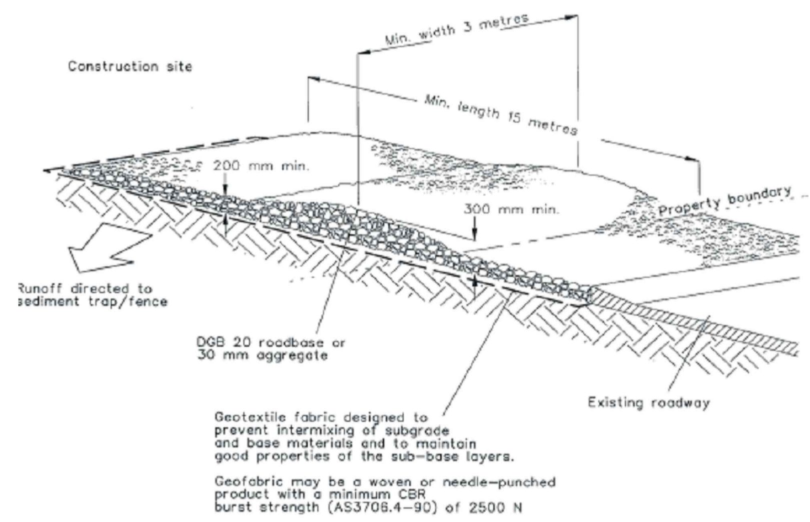
GEOTEXTILE INLET FILTER (SD 6-12)



Construction Notes

1. Install a 400-mm minimum wide roll of turf on the footpath next to the kerb and at the same level as the top of the kerb.
2. Lay 1.4 metre long turf strips normal to the kerb every 10 metres.
3. Rehabilitate disturbed soil behind the

KERBSIDE TURF STRIP (SD 6-13)



Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

STABILISED SITE ACCESS (SD 6-14)

EROSION & SEDIMENT CONTROL NOTES

GENERAL INSTRUCTIONS

1. THE EROSION AND SEDIMENT CONTROL SHOWN IN THESE DRAWINGS IS INDICATIVE FOR THE CONSTRUCTION AREA ONLY. THE SITE CONTRACTOR SHALL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE APPROPRIATE CONSIDERING ACTUAL SITE CONDITIONS AND CONSTRUCTION STAGING.
2. ALL WORK SHALL BE GENERALLY CARRIED OUT IN ACCORDANCE WITH
   a. LOCAL AUTHORITY REQUIREMENTS
   b. EPA REQUIREMENTS
   c. LANDCOM "MANAGING URBAN STORMWATER, SOILS AND CONSTRUCTION", 4th EDITION, MARCH 2004 ("BLUE BOOK")
   d. RELEVANT CONSTRUCTION AND ENVIRONMENT MANAGEMENT PLAN (CEMP)
   e. RELEVANT SOIL AND WATER MANAGEMENT PLAN (SWMP)
   f. RELEVANT EROSION AND SEDIMENT CONTROL PLAN (ESCP)
3. CONTRACTOR TO MAINTAIN THE EROSION CONTROL DEVICES TO THE SATISFACTION OF THE SUPERINTENDENT AND THE LOCAL AUTHORITY.
4. THE WATER IN THE SEDIMENT BASIN(S) SHALL BE LOWERED PERIODICALLY TO MAINTAIN THE MINIMUM STORAGE VOLUME REQUIRED FOR FINE SOILS.
5. AT ALL TIMES A WATER CART(S) SHALL BE MAINTAINED ON SITE TO:
   a. WATER THE AREAS OF HYDROMULCH
   b. CONTROL DUST
6. WATERING OF MULCH, DUST OR VEGETATION MUST BE KEPT TO THE MINIMUM REQUIRED TO ACHIEVE SPECIFIED OUTCOMES. IN NO CASE SHALL AREAS BE OVER WATERED TO SATURATION OR TO THE POINT WHERE WATER PONDS ON THE SURFACE.
7. STORMWATER IN THE SETTLING ZONE SHALL BE DRAINED OR PUMPED OUT WITHIN 2 DAYS FOLLOWING RAINFALL EVENT IF THE NOMINATED WATER QUALITY TARGETS CAN BE MET. THE LOWER LEVEL OF THE SETTLING ZONE SHALL BE IDENTIFIED WITH A PEG THAT SHOWS CLEARLY THE LEVEL TO WHICH DESIGN CAPACITY IS AVAILABLE.
8. STORED SEDIMENT SHALL NOT ENCROACH INTO SETTLING ZONE. SEDIMENT REMOVED FROM SEDIMENT BASIN SHALL BE DISPOSED OF IN PLACES THAT WILL NOT RESULT IN A FUTURE EROSION OR POLLUTION HAZARD.
   TEMPORARY SEDIMENT BASIN OUTLET PIPE SHALL BE CAPPED DURING CONSTRUCTION. AFTER CONSTRUCTION BASIN SHOULD BE CLEARED OF SEDIMENTS BEFORE OUTLET PIPE CAP IS REMOVED.
9. WHEN STORMWATER PITS ARE CONSTRUCTED, PREVENT SITE RUNOFF ENTERING UNLESS SEDIMENT FENCES ARE ERECTED AROUND PITS.
10. CONTRACTOR IS TO ENSURE ALL EROSION & SEDIMENT CONTROL DEVICES ARE MAINTAINED IN GOOD WORKING ORDER AND OPERATE EFFECTIVELY. REPAIRS AND OR MAINTENANCE SHALL BE UNDERTAKEN AS REQUIRED, PARTICULARLY FOLLOWING STORM EVENTS.

LAND DISTURBANCE

11. WHERE PRACTICAL, THE SOIL EROSION HAZARD ON THE SITE WILL BE KEPT AS LOW AS POSSIBLE. TO THIS END, WORKS SHOULD BE UNDERTAKEN IN THE FOLLOWING SEQUENCE:
   a. MAINTAIN EXISTING SECURITY / WIND FENCES INSTALLED AS PART OF THE ENABLING WORKS AND INSTALL NEW SECURITY / WIND FENCES AS SHOWN.
   b. MAINTAIN EXISTING SEDIMENT FENCES INSTALLED AS PART OF THE ENABLING WORKS AND INSTALL NEW SEDIMENT FENCES AS SHOWN.
   c. INSTALL SEDIMENT TRAPS AS SHOWN ON PLAN AND AS REQUIRED.
   d. UNDERTAKE SITE DEVELOPMENT WORKS IN ACCORDANCE WITH THE ENGINEERING PLANS. WHERE POSSIBLE, PHASE DEVELOPMENT SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF WORKABLE SIZE.
   e. DISTURBED AREAS TO BE STABILISED TO THE FOLLOWING STANDARDS:
      - EMBANKMENTS AND CREEKS - HYDRO MULCHED
      - SWALES - 100mm THICK MIN. TOPSOIL SEEDING.
      - VERGES - TURFED TO LANDSCAPE ARCHITECT'S SPECIFICATION.
      - DETENTION BASINS AND BATTERS - PROVIDE 100mm THICK MIN. TOPSOIL AND HYDRO MULCHED
12. SEED MIXTURES ARE TO BE APPROVED BY SUPERINTENDENT PRIOR TO SPRAYING. ALL GRASSED AREAS SHALL BE REGULARLY WATERED AND MAINTAINED UNTIL EXPIRATION OF THE MAINTENANCE PERIOD.

EROSION CONTROL

13. DURING WINDY WEATHER, LARGE, UNPROTECTED AREAS WILL BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER TO KEEP DUST UNDER CONTROL.
14. FINAL SITE LANDSCAPING WILL BE UNDERTAKEN AS SOON AS POSSIBLE AND WITHIN 10 WORKING DAYS FROM COMPLETION OF CONSTRUCTION ACTIVITIES.

SEDIMENT CONTROL

15. STOCKPILES WILL NOT BE LOCATED WITHIN 2 METRES OF HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS. WHERE THEY ARE BETWEEN 2 AND 5 METRES FROM SUCH AREAS, SPECIAL SEDIMENT CONTROL MEASURES SHOULD BE TAKEN TO MINIMISE POSSIBLE POLLUTION TO DOWNSLOPE WATERS, E.G. THROUGH INSTALLATION OF SEDIMENT FENCING.
16. WATER WILL BE PREVENTED FROM ENTERING THE PERMANENT DRAINAGE SYSTEM UNLESS IT IS RELATIVELY SEDIMENT FREE. I.E. THE CATCHMENT AREA HAS BEEN PERMANENTLY LANDSCAPED AND/OR ANY LIKELY SEDIMENT HAS BEEN FILTERED THROUGH AN APPROVED STRUCTURE.
17. TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE REHABILITATED/STABILISED.
18. ALL PROPOSED PITS TO HAVE GEOTEXTILE INLET FILTERS PRIOR TO PAVEMENT CONSTRUCTION. PROVIDE MESH AND GRAVEL INLET FILTER TO KERB INLET PITS ONCE PAVEMENT IS CONSTRUCTED.

OTHER MATERIALS

19. ACCEPTABLE RECEPTORS WILL BE PROVIDED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.
20. ANY EXISTING TREES WHICH FORM PART OF THE FINAL LANDSCAPING PLAN WILL BE PROTECTED FROM CONSTRUCTION ACTIVITIES IN ACCORDANCE WITH LANDSCAPE ARCHITECTS DETAILS.
21. ALL AREAS OF PUBLIC THOROUGHFARE MUST BE KEPT CLEAN AND FREE OF WATER RUNOFF, SEDIMENT AND CONSTRUCTION MATERIALS AT ALL TIMES. THIS INCLUDES AREAS OUTSIDE OF THE SITE BOUNDARY.
22. SITE SECURITY AND EROSION AND SEDIMENT CONTROL MEASURES MUST BE CHECKED AND DEEMED SAFE BY THE CIVIL WORKS CONTRACTOR PRIOR TO LEAVING THE SITE EACH DAY.

Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE
TACTICAL GROUP

Status	PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION		
Scales	N.T.S.	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	
Filename:	SSS2-ARC-CV-DWG-1102-ErosionAndSedimentControlDetails.dwg		

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: EROSION AND SEDIMENT CONTROL DETAILS

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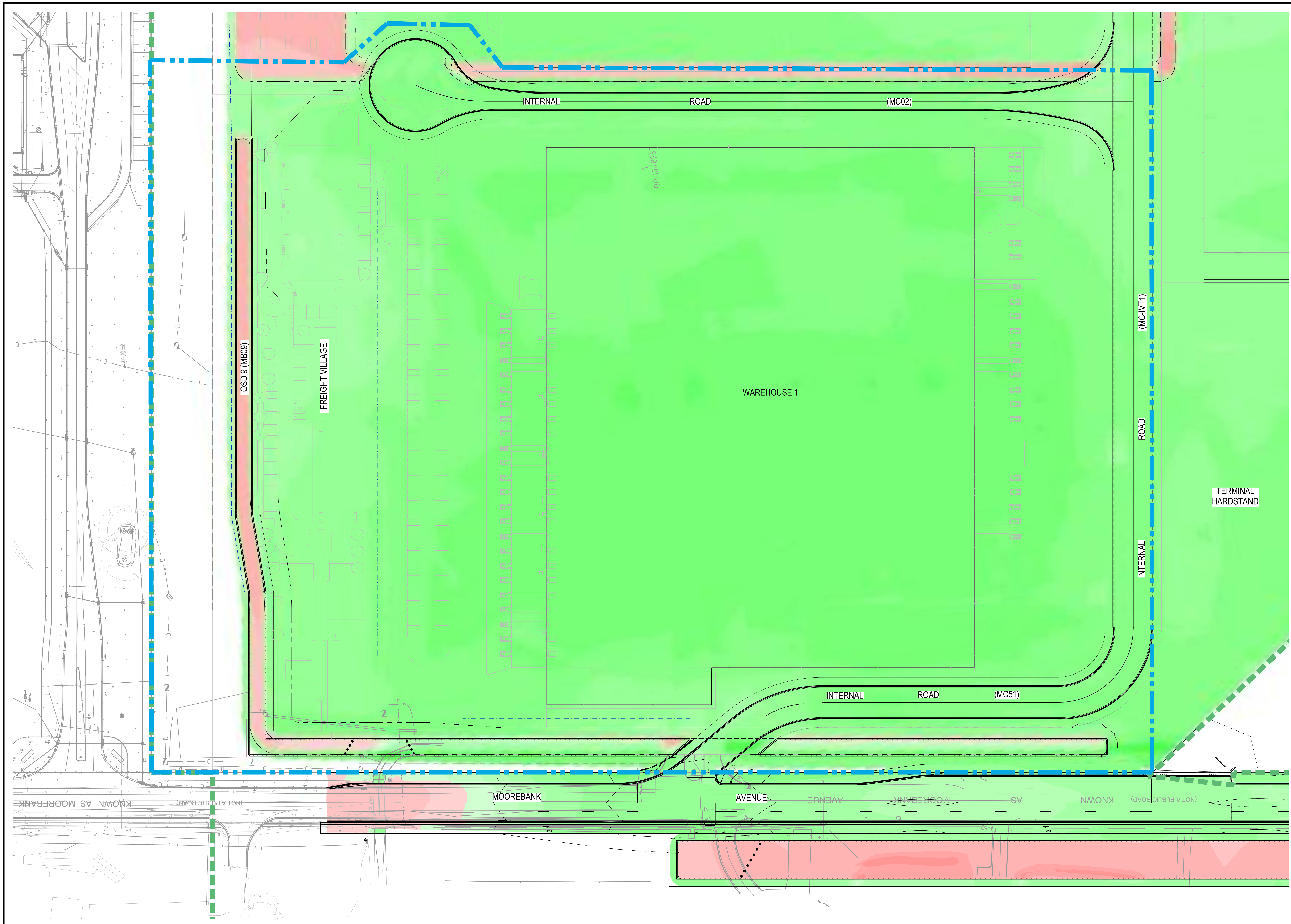
Project No. AA009335
Drawing No. SSS2 -ARC-CV-DWG-1102- Issue 01



LEGEND

MPE STAGE 2 APPROVAL BOUNDARY

WAREHOUSE 1 PRECINCT BOUNDARY

ASSUMPTIONS AND NOTES

1. HATCHING SHOWN REPRESENTS DEPTH RANGE BETWEEN THE STRIPPED EXISTING SURFACE AND THE DESIGN SURFACE (REFER TYPICAL EARTHWORKS SECTION).
2. NO ALLOWANCE HAS BEEN MADE FOR;
   - BULKING OR COMPACTION FACTORS
   - TRENCHING FOR UTILITIES (INC. STORMWATER, WATER, SEWER, ELECTRICAL AND COMMUNICATIONS)
3. VOLUMES HAVE BEEN PREPARED BASED ON CONCEPT GRADING SUBJECT TO REFINEMENT IN FUTURE DESIGN STAGES. REFER TO ARCHITECTS DRAWINGS FOR FINISHED LEVELS.
4. CONTOURS SHOWN REPRESENT THE BULK EARTHWORKS SURFACE LEVELS (± 500mm).

DEPTH RANGE LEGEND

DEPTH OF FILL: 999, 3.50, 3.00, 2.50, 2.00, 1.50, 1.00, 0.50, 0.00

DEPTH OF CUT: 0.50, 1.00, 1.50, 2.00, 2.50, 3.00, 3.50, 999

NOTES

1. ONLY WORKS CONTAINED WITHIN THE WAREHOUSE 1 PRECINCT BOUNDARY ARE CONSIDERED WITHIN THE MOOREBANK PRECINCT EAST STAGE 2 - WAREHOUSE 1 PRECINCT STORMWATER MANAGEMENT PLAN.

Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

0 15 30 45 60 75m

1 : 750

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE; TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	1 : 750
Original Size	A1
Height Datum	AHD
Grid	MGA
Filename:	SSS2-ARC-CV-DWG-1111-BulkEarthworksPlan.dwg

Current Issue Signatures: Drawn / Designed / Checked / Approved

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: BULK EARTHWORKS PLAN

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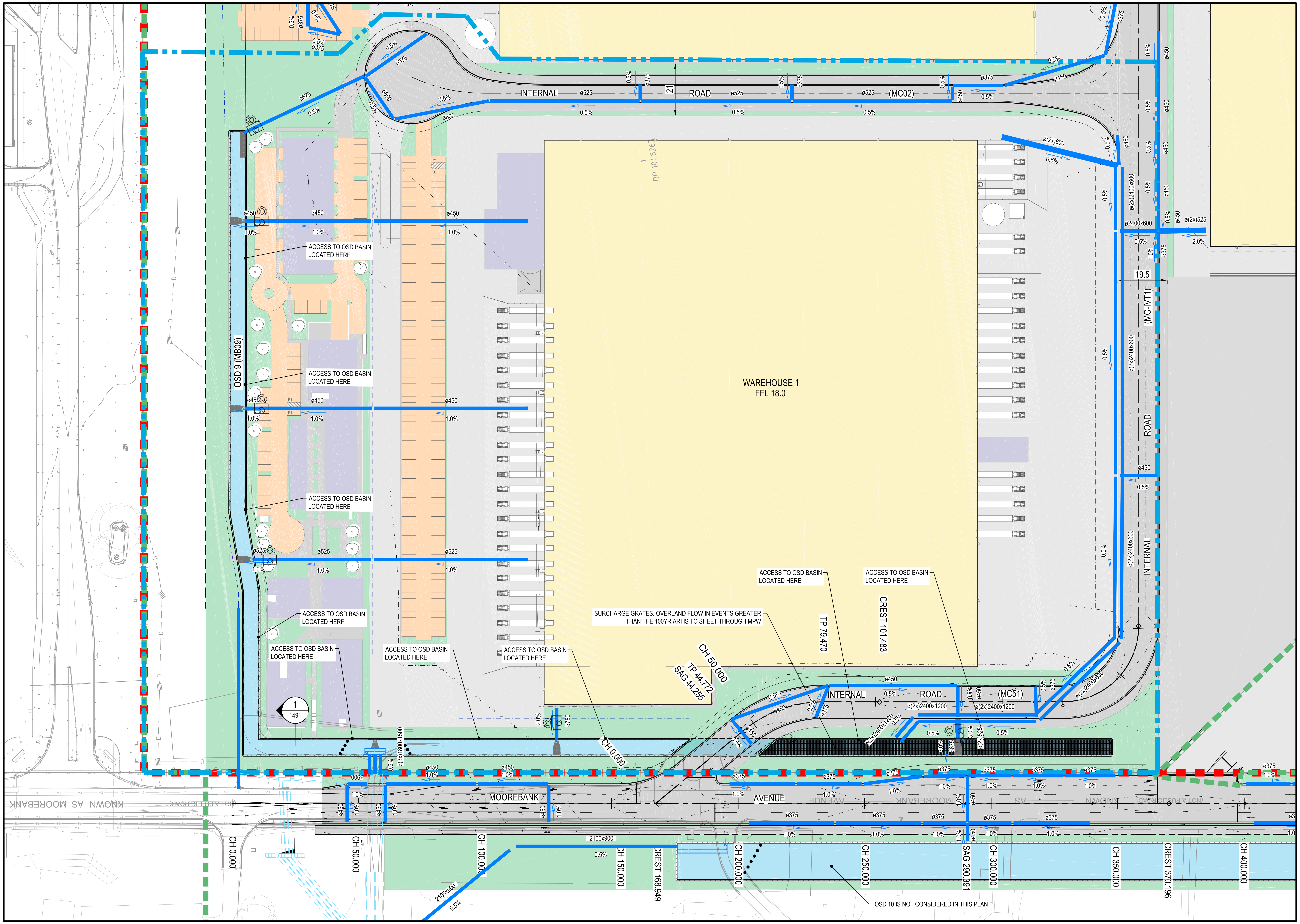
Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG-1111- Issue 01

100mm on Original

Date Plotted: 11 May 2018 - 03:29PM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1111-BulkEarthworksPlan.dwg V1



LEGEND

- MPE SITE BOUNDARY
- MPE STAGE 2 APPROVAL BOUNDARY
- WAREHOUSE 1 PRECINCT BOUNDARY
- EXISTING CONTOURS
- PROPOSED CONTOURS
- PROPOSED TRUNK STORMWATER DRAINAGE NETWORK
- PROPOSED TRUNK STORMWATER DRAINAGE NETWORK (BY OTHERS)
- PROPOSED UNDERGROUND ON SITE DETENTION TANK
- GROSS POLLUTANT TRAP

NOTES

1. REFER TO DRAWING SSS2-ARC-CV-DWG-1003 FOR TYPICAL ROAD CROSS SECTIONS.
2. ONLY WORKS CONTAINED WITHIN THE WAREHOUSE 1 PRECINCT BOUNDARY ARE CONSIDERED WITHIN THE MOOREBANK PRECINCT EAST STAGE 2 - WAREHOUSE 1 PRECINCT STORMWATER MANAGEMENT PLAN.
3. ROAD RESERVE TO BE USED AS CONTROLLED OVERLAND FLOW PATH. FULL ROAD RESERVE IS DEDICATED TO THIS PURPOSE IN EXTREME FLOOD EVENTS.

Issue	Description	Date
02	RESPONSE TO VERIFIERS COMMENTS	18/06/2018
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

0 15 30 45 60 75m
1 : 750

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE / TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	1 : 750	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1201-CivilAndStormwaterPlan.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: CIVIL AND STORMWATER PLAN

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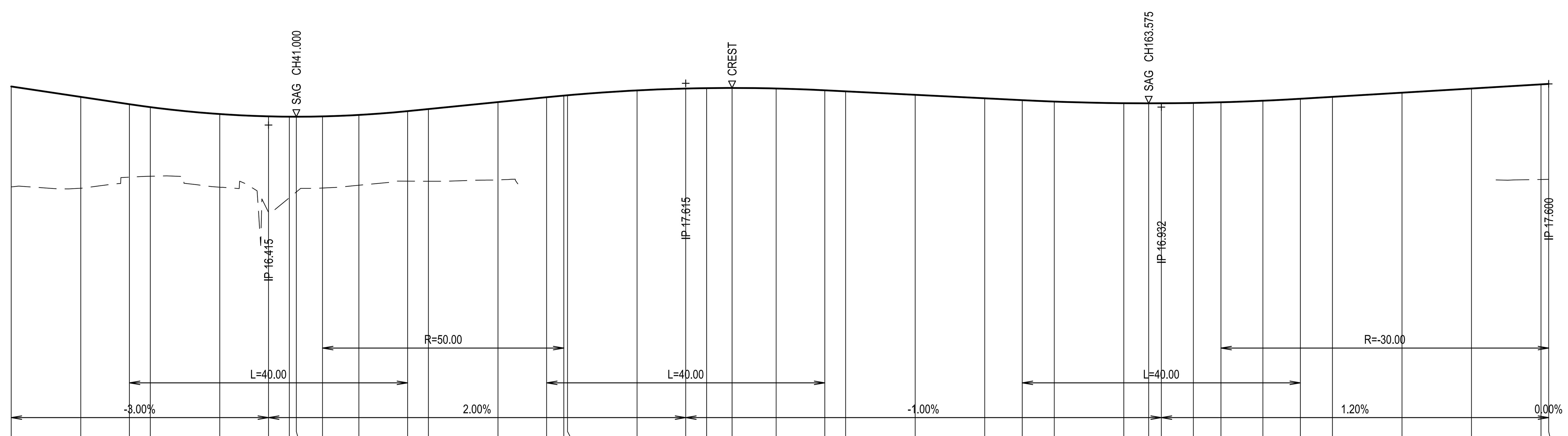
Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG- 1201- Issue 02



HORIZONTAL CURVES
VERTICAL CURVES
GRADIENT
DATUM RL 7.0

CHAINAGE	CONTROL STRING LEVEL	EXISTING LEVEL
0.000	17.525	14.64
10.000	17.225	14.60
17.000	17.015	14.92
20.000	16.931	14.94
30.000	16.731	14.63
37.000	16.665	13.91
40.000	16.656	14.33
41.000	16.655	14.49
44.772	16.664	14.60
50.000	16.706	14.68
57.000	16.815	14.80
60.000	16.876	14.80
70.000	17.076	14.84
77.000	17.215	
79.471	17.263	
80.000	17.272	
90.000	17.412	
97.000	17.465	
100.000	17.477	
103.667	17.482	
110.000	17.467	
117.000	17.415	
120.000	17.386	
130.000	17.285	
140.000	17.186	
145.393	17.132	
150.000	17.091	
160.000	17.044	
163.575	17.041	
165.393	17.042	
170.000	17.052	
173.973	17.070	
180.000	17.115	
185.393	17.172	
190.000	17.227	
200.000	17.347	
210.000	17.467	
220.000	17.587	14.85
221.097	17.600	14.85

MC51 LONGITUDINAL SECTION

SCALE 1:500 HORI.
1:100 VERT.

Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

0 10 20 30 40 50m
1 : 500

0 2 4 6 8 10m
1 : 100

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE
TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	AS SHOWN	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1211-RoadLongitudinalSections.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2
WAREHOUSE 1 PRECINCT

Title: ROAD LONGITUDINAL SECTIONS

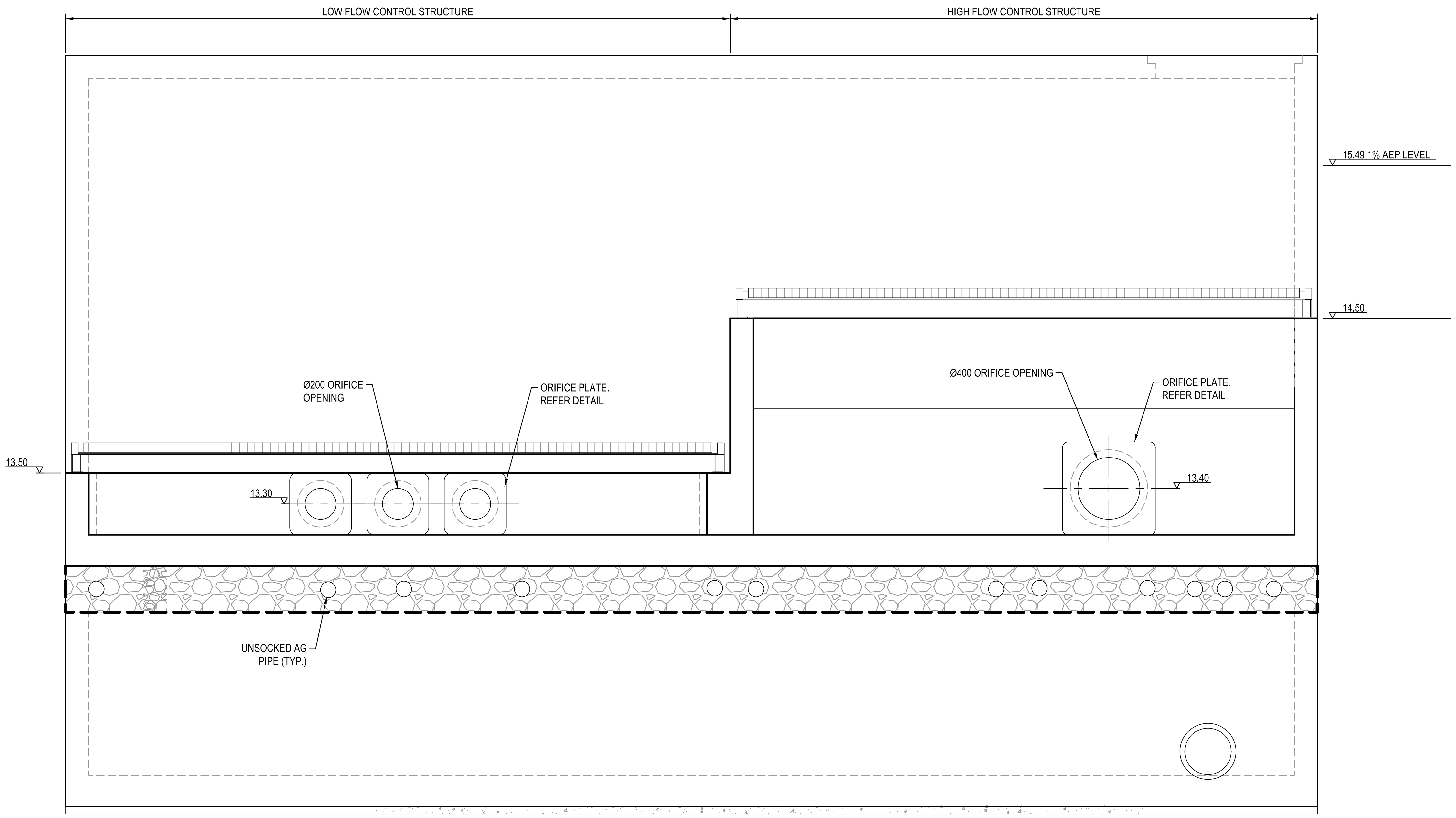
ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
ABN 76 104 485 289
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No. AA009335

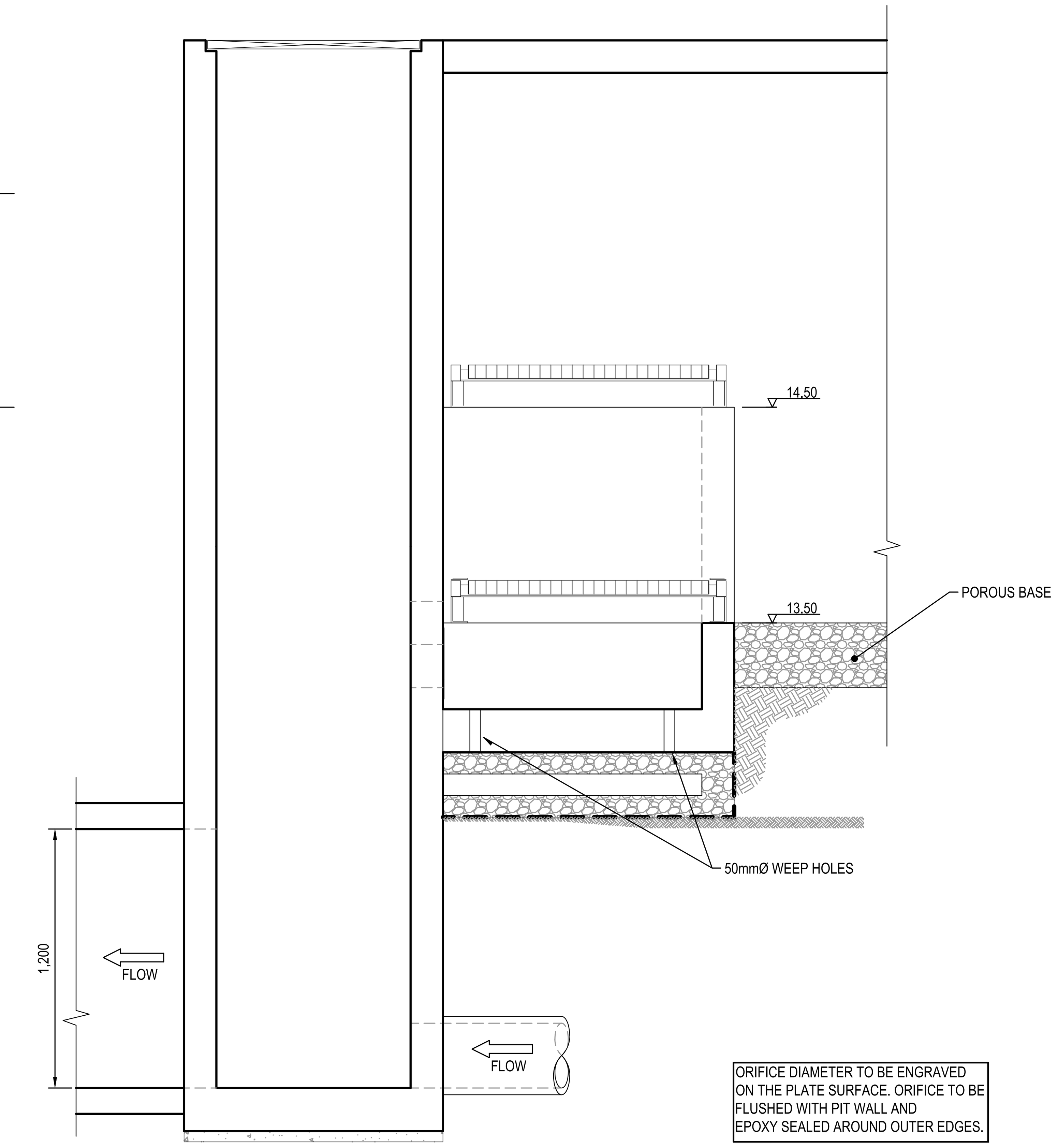
Drawing No. SSS2 -ARC-CV-DWG-1211- Issue 01

100mm on Original

Date Plotted: 11 May 2018 - 11:47AM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1211-RoadLongitudinalSections.dwg V1



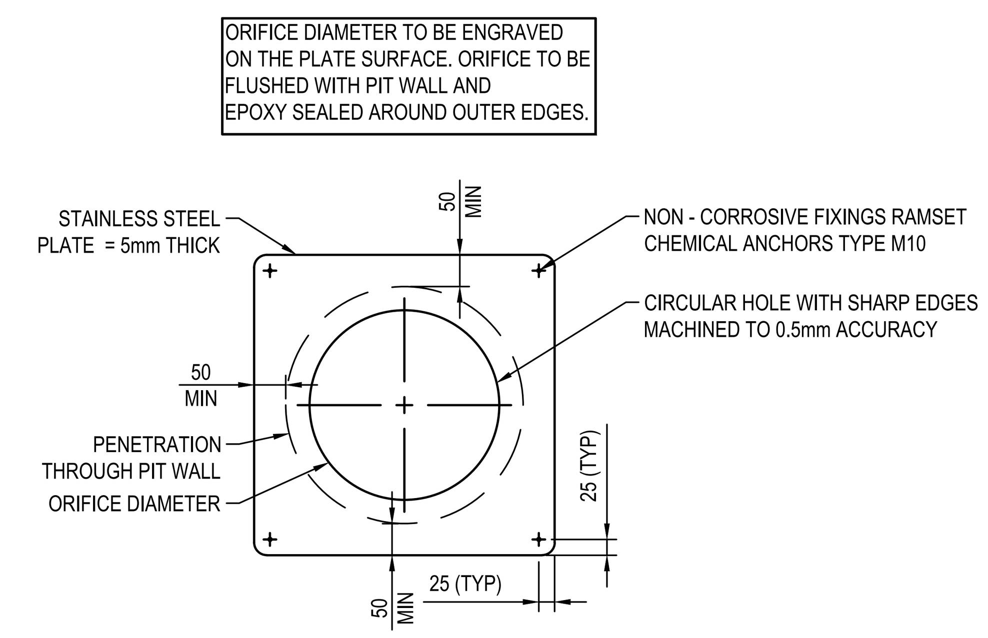
SECTION 1
1 : 20



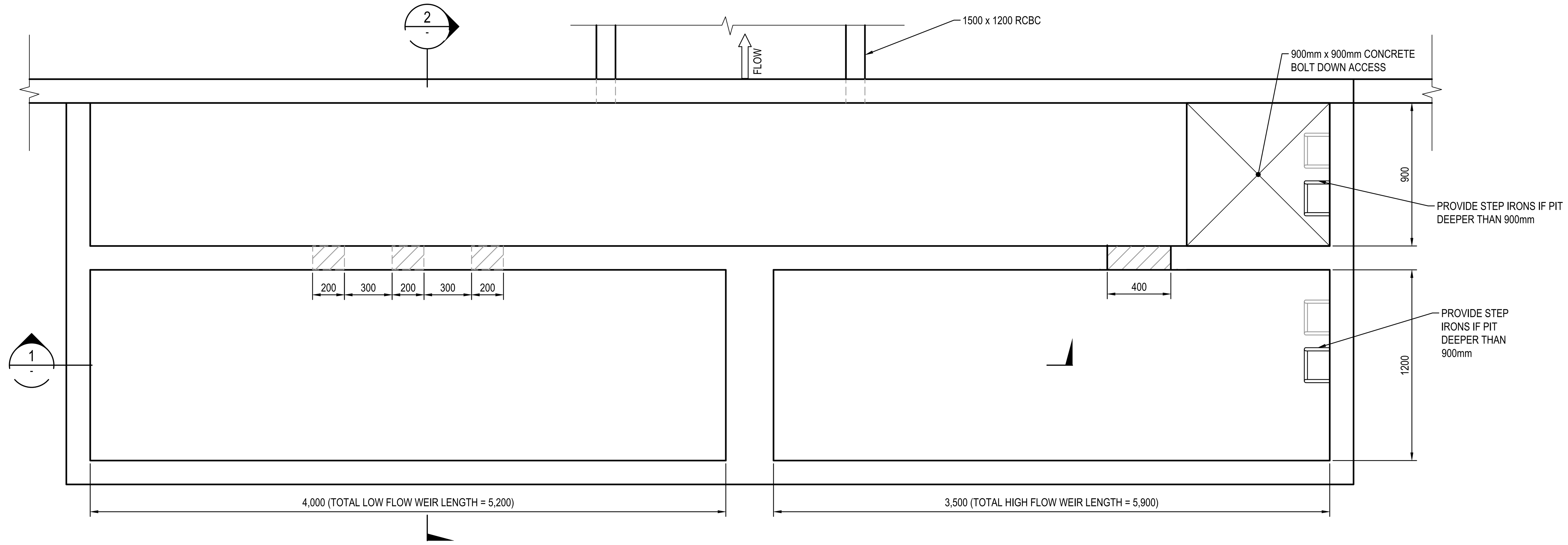
SECTION 2
1 : 20

NOTES:

TRASH SCREENS TO BE PROVIDED.



TYPICAL CIRCULAR ORIFICE PLATE DETAIL
SCALE 1 : 10



OSD BASIN OUTLET 9 PLAN - DETENTION CONTROL PIT
SCALE 1 : 20

Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

0 100 200 400 600 800 1000mm
1 : 10

0 500 1000 1500 2000mm
1 : 20

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE / TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales: AS SHOWN
Current Issue Signatures: Drawn / Designed / Checked / Approved
Original Size: A1
Height Datum: AHD
Grid: MGA
Filename: SSS2-ARC-CV-DWG-1411-StormwaterDrainageOSDOutlet09.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: STORMWATER DRAINAGE OSD OUTLET 09

ARCADIS
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NORTH SYDNEY NSW 2060
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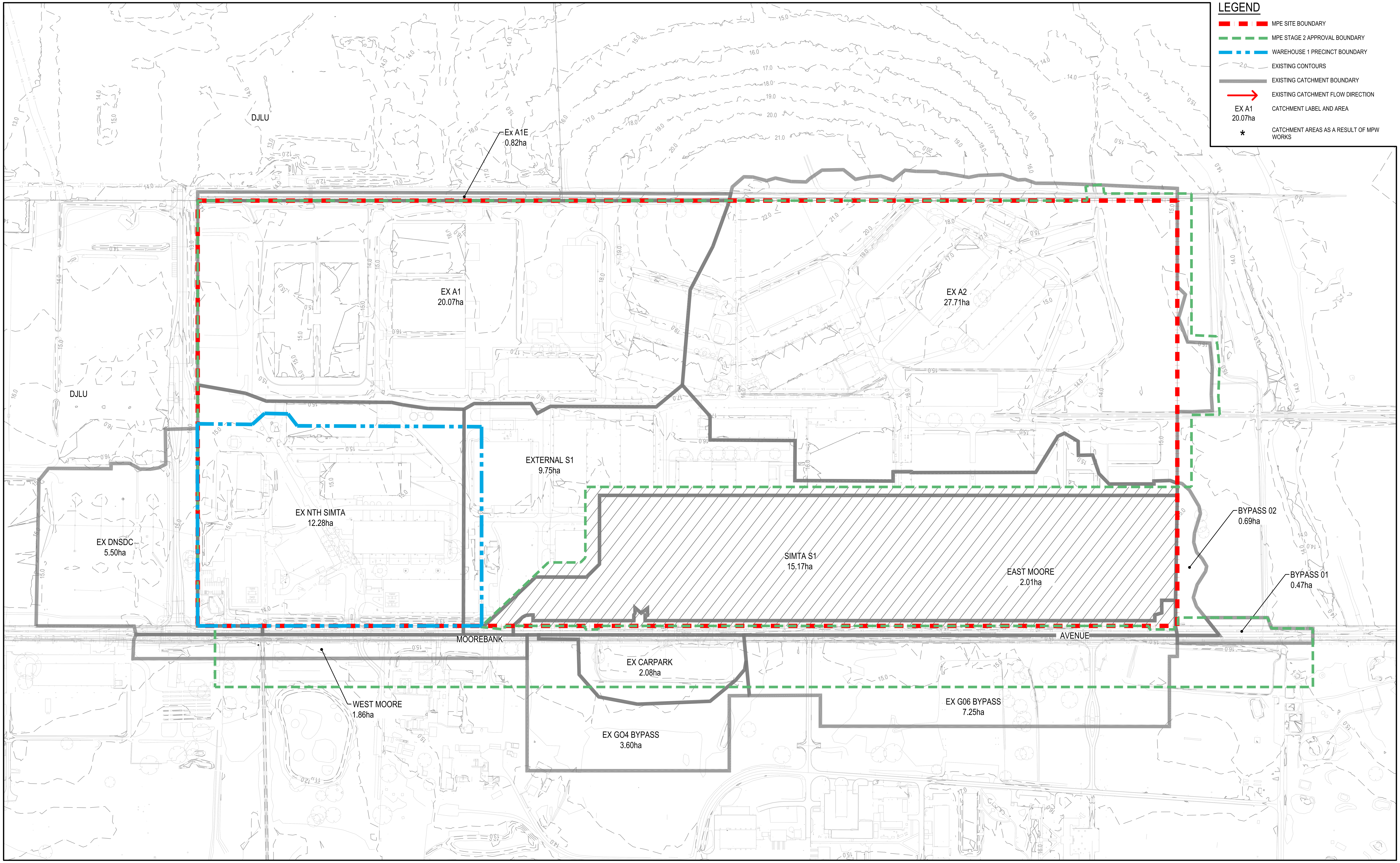
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No. AA009335
Drawing No. SSS2 -ARC-CV-DWG- 1411-
Issue 01

100mm on Original

Date Plotted: 11 May 2018 - 05:39PM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1411-StormwaterDrainageOSDOutlet09.dwg



Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - NORTH WEST AREA	11/05/2018

100mm on Original

0 50 100 150 200 250m
1 : 2500

Client
SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE
TACTICAL GROUP

Status
PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	1 : 2500	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1431-ExistingCatchmentPlan.dwg

Project
MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

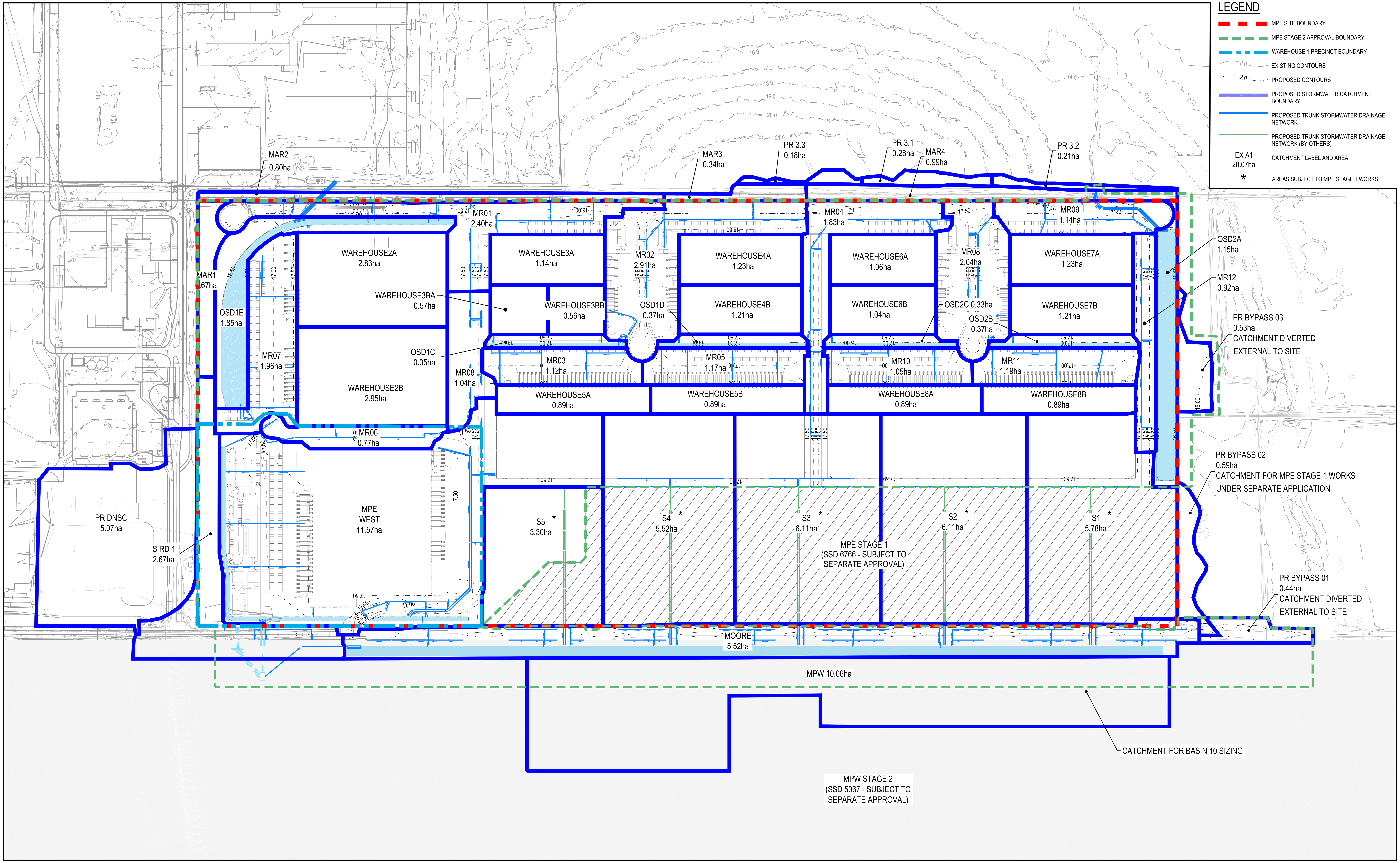
Title
EXISTING CATCHMENT PLAN

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
ABN 76 104 485 289
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG- 1431-
Issue 01

Date Plotted: 11 May 2018 - 03:56PM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1431-ExistingCatchmentPlan.dwg



Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

0 50 100 150 200 250m

1 : 2500

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE / TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	1 : 2500	Current Issue Signatures
		Drawn
Original Size	A1	Designed
Height Datum	AHD	Checked
Grid	MGA	Approved

Filename: SSS2-ARC-CV-DWG-1432-ProposedCatchmentPlan.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: PROPOSED CATCHMENT PLAN

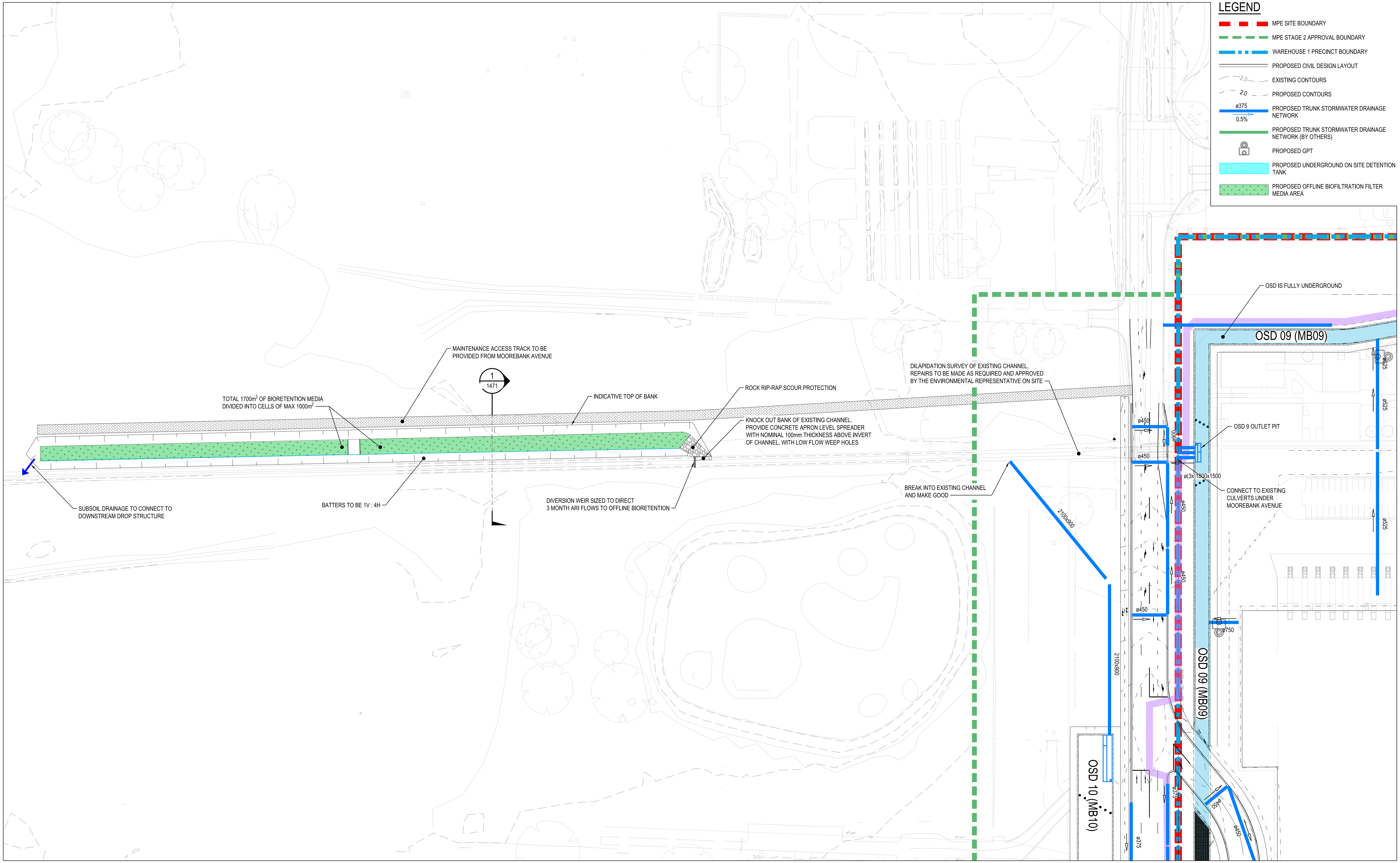
ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
ABN 76 104 485 289
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG- 1432- Issue 01

100mm on Original

Date Plotted: 11 May 2018 - 04:33PM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1432-ProposedCatchmentPlan.dwg V1



0 15 30 45 60 75m

1 : 750

Issue	Description	Date
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE — TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	1 : 750	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: STORMWATER DRAINAGE WATER QUALITY PLAN OSD 09

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
ABN 76 104 485 289
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

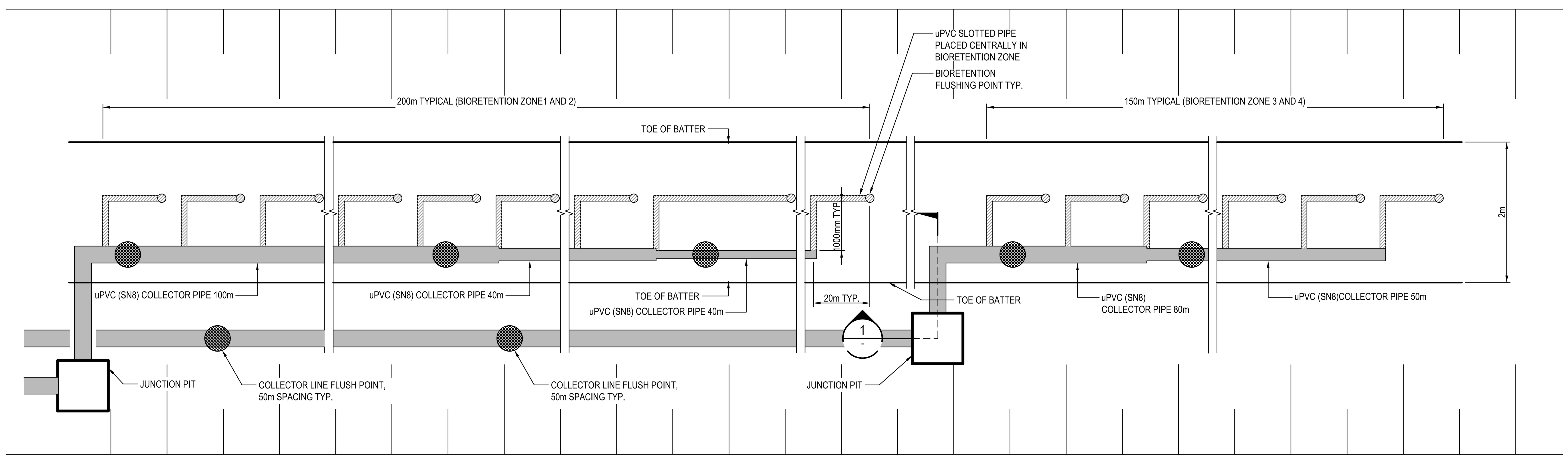
Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG- 1451- Issue 01

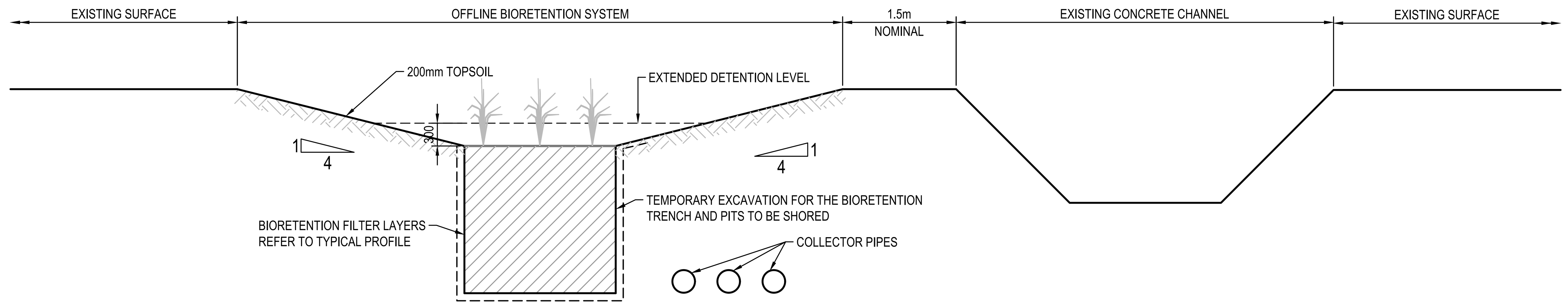
Filename: SSS2-ARC-CV-DWG-1451-StormwaterDrainageWaterQualityPlanOSD09.dwg

100mm on Original

Date Plotted: 11 May 2018 - 05:36PM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1451-StormwaterDrainageWaterQualityPlanOSD09.dwg V1

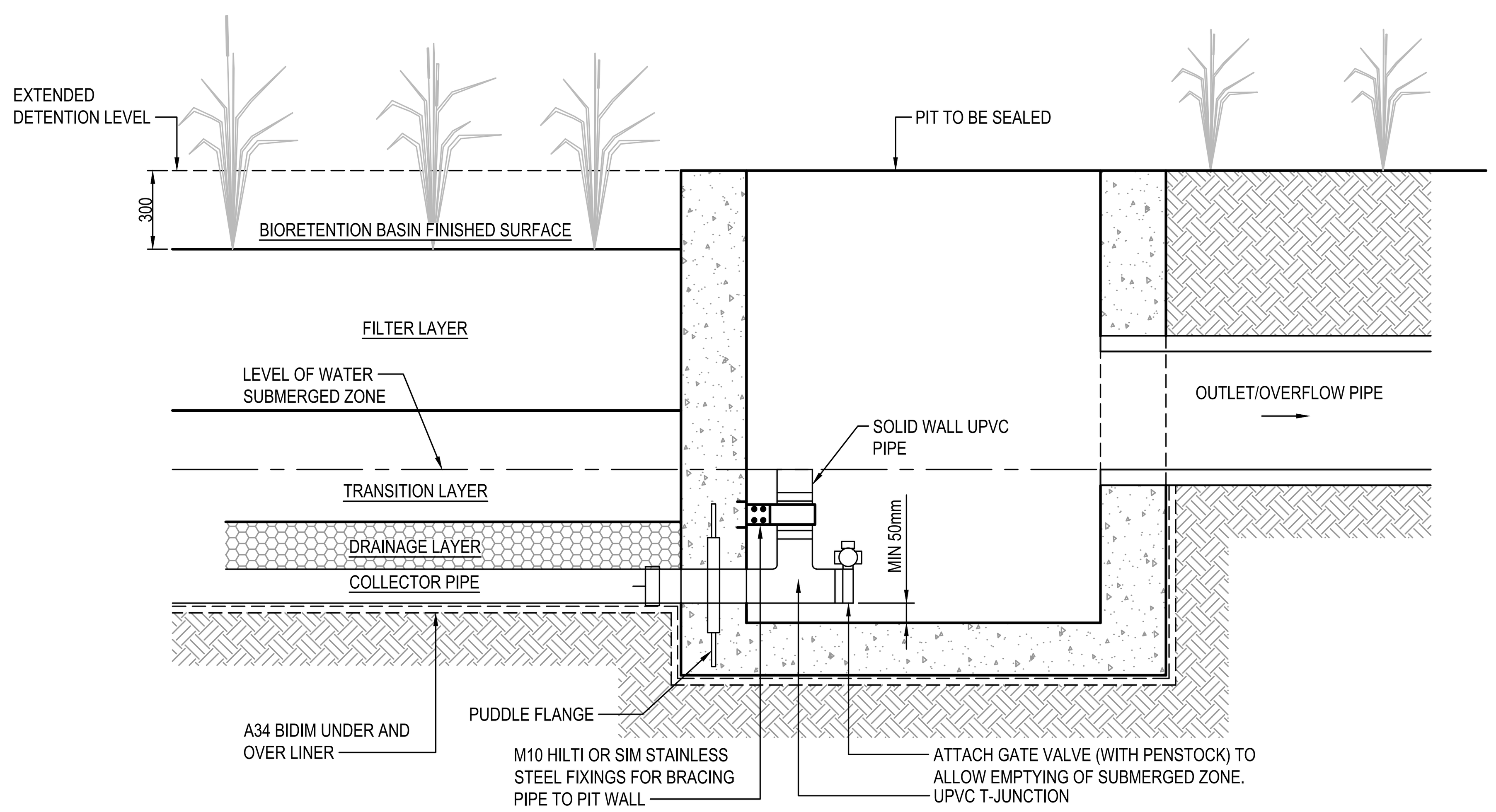


COLLECTOR PIPE CONFIGURATION PLAN
N.T.S.



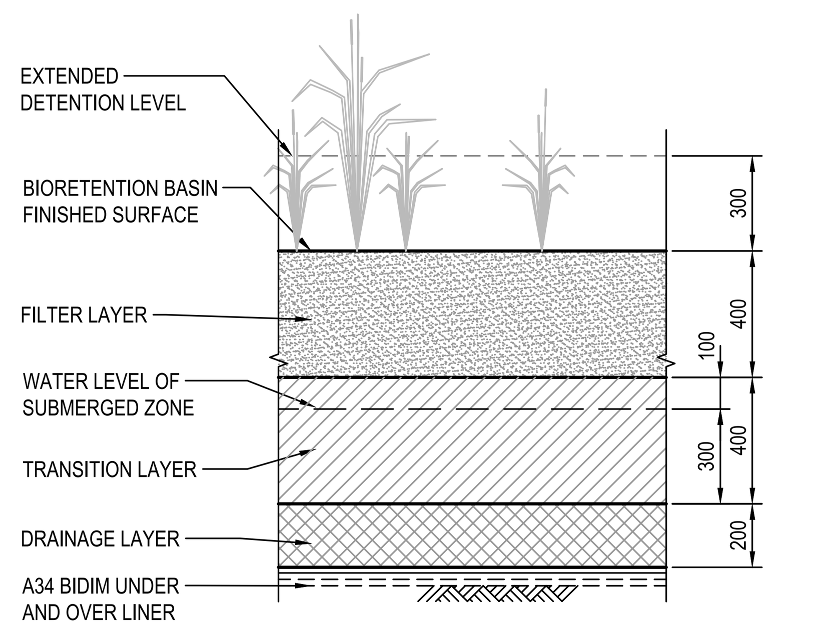
TYPICAL OFFLINE BIORETENTION SYSTEM

SECTION 1 / 1451
N.T.S.

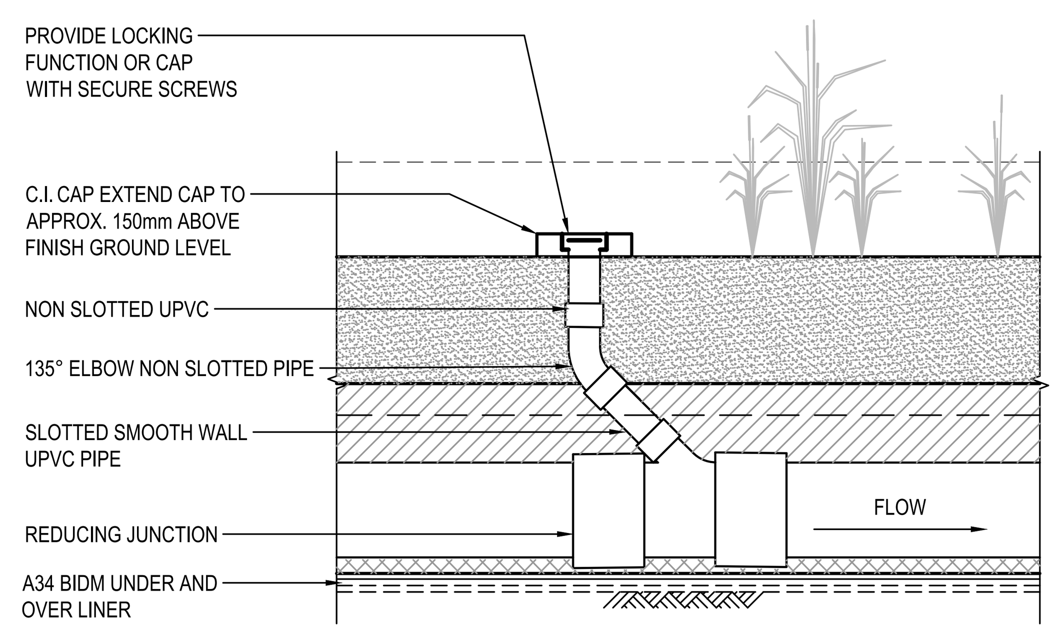


TYPICAL COLLECTOR LINE PIT

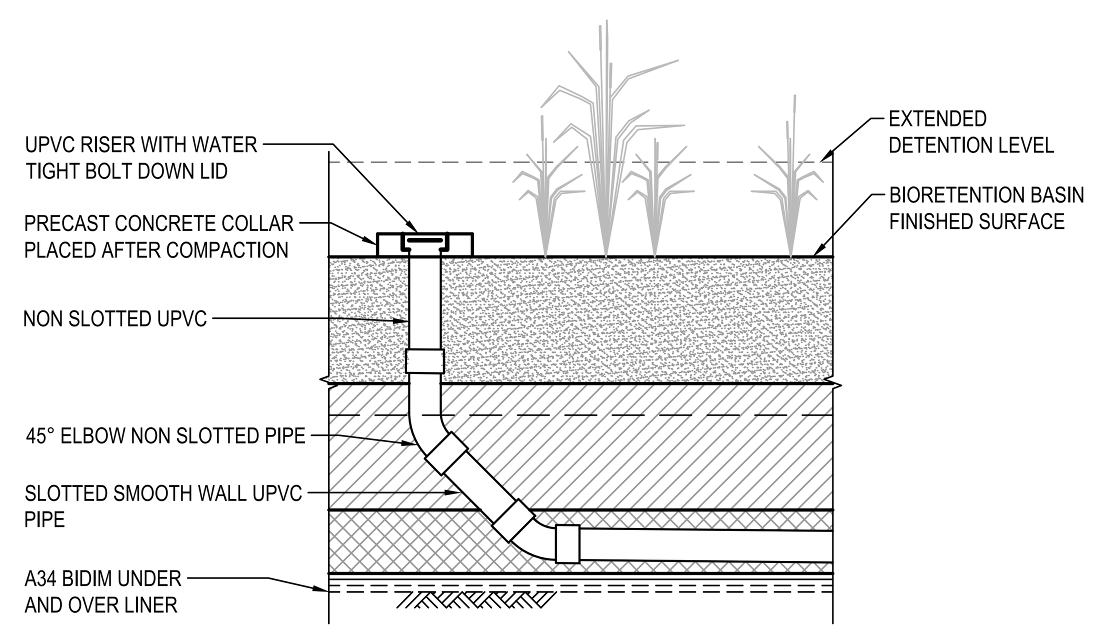
SECTION 1 / -
N.T.S.



TYPICAL BIORETENTION FILTER PROFILE
N.T.S.



COLLECTOR LINE FLUSHING POINT
N.T.S.



BIORETENTION FLUSHING POINT
N.T.S.

NOTES

1. REFER TO THE MOOREBANK PRECINCT EAST STAGE 2 - WAREHOUSE 1 PRECINCT STORMWATER MANAGEMENT PLAN (CHAPTERS 5 AND 6) FOR FURTHER DETAILS OF THE DESIGN AND MODELLING OF WATER QUALITY TREATMENT MEASURES.
2. ALL FILTER MEDIA USED IN STORMWATER TREATMENT MEASURES MUST:
   - BE LOAMY SAND WITH AN APPROXIMATELY HIGH PERMEABILITY UNDER COMPACTION AND MUST BE FREE OF RUBBISH, DELETERIOUS MATERIAL, TOXICANTS, DECLARED PLANTS AND LOCAL WEEDS AND MUST NOT BE HYDROPHOBIC.
   - HAVE A HYDRAULIC CONDUCTIVITY = 100-300mm/hr, AS MEASURED USING ASTM F1815-06 METHOD.
   - HAVE AN ORGANIC MATTER CONTENT LESS THAN 5% (w/w)

Issue	Description	Date
02	RESPONSE TO VERIFIERS COMMENTS	18/06/2018
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE / TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

		Current Issue Signatures	
Scales	N.T.S.	Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1471-StormwaterBioretentionTypicalDetails.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: STORMWATER BIORETENTION TYPICAL DETAILS

ARCADIS
Arcadis Australia Pacific Pty Limited
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NORTH SYDNEY NSW 2060
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Tel No: +61 2 8907 9000
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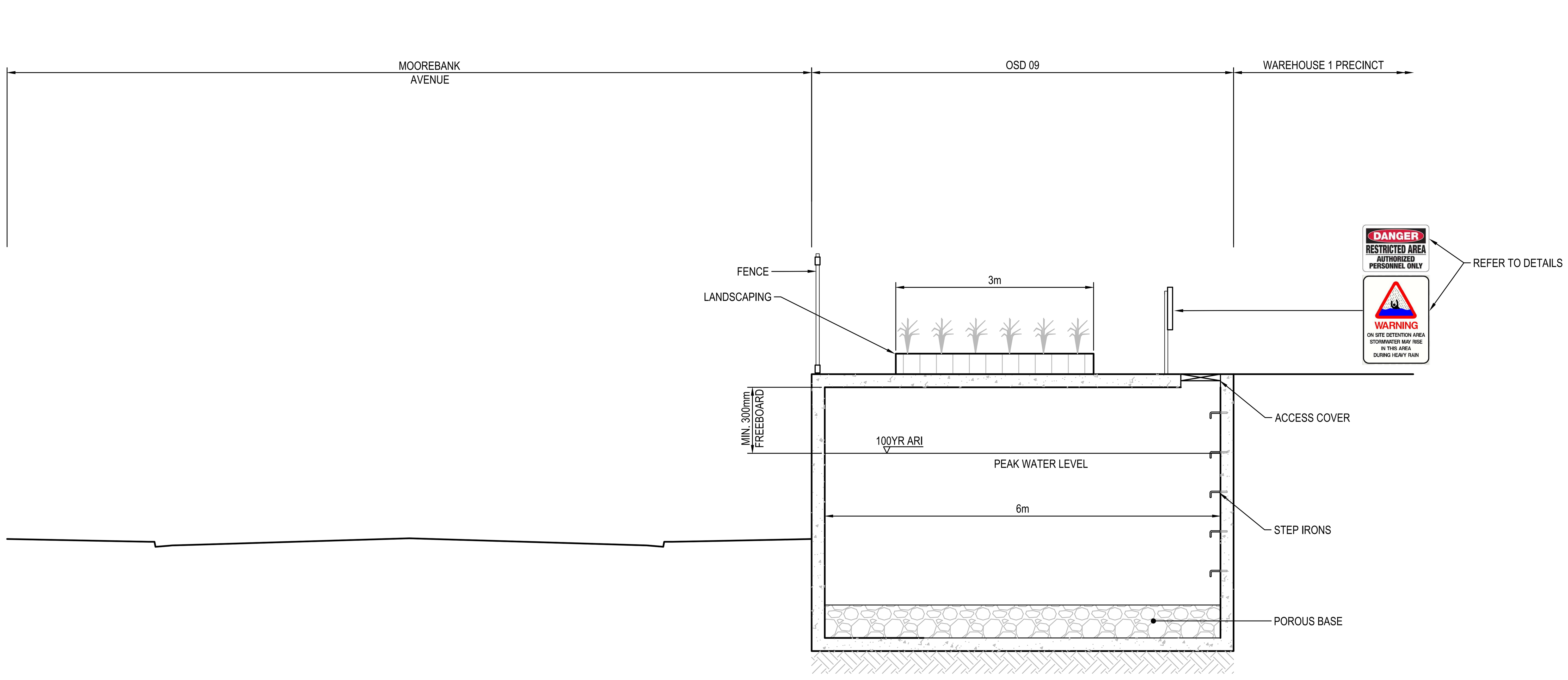
arcadis.com

Project No. AA009335
Drawing No. SSS2 -ARC-CV-DWG- 1471- Issue 02

100mm on Original

Date Plotted: 18 Jun 2018 - 03:27PM File Name: F:\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1471-StormwaterBioretentionTypicalDetails.dwg V1

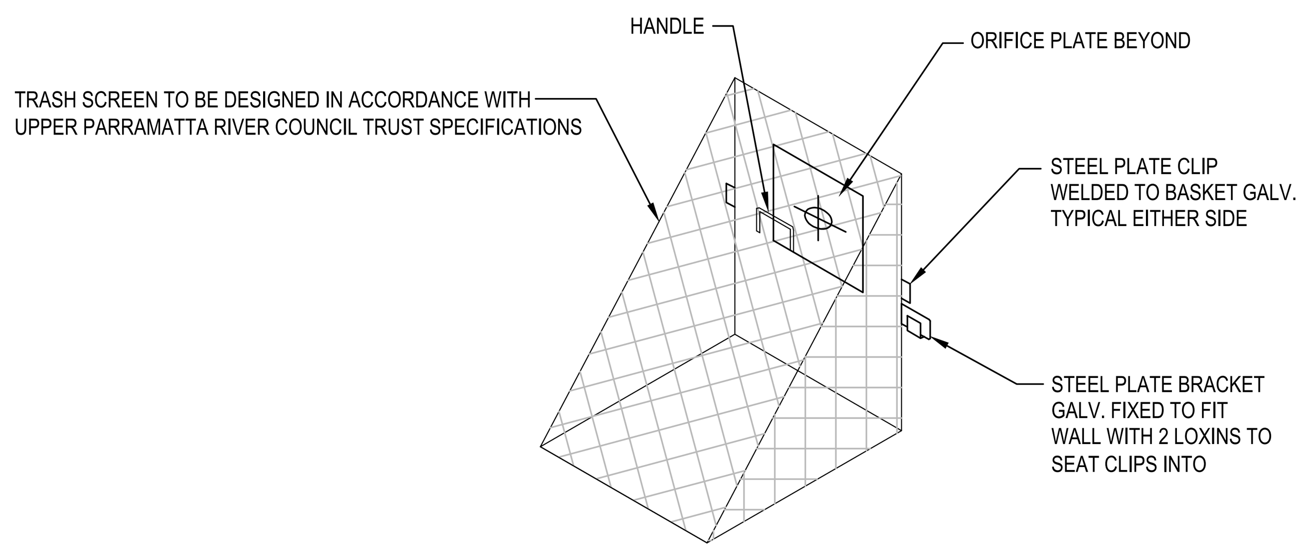


SECTION 1/1201
N.T.S

TYPICAL ON-SITE DETENTION AREA SIGN
SCALE : NTS
(SIGN TO COMPLY WITH AS 1319)

TYPICAL RESTRICTED AREA SIGN
SCALE : NTS
(SIGN TO COMPLY WITH AS 1319)

TYPICAL CONFINED SPACE SIGN
SCALE : NTS
(SIGN TO COMPLY WITH AS 1319)



TRASH SCREEN DETAIL
N.T.S

NOTES:
1. TRASH SCREEN TO BE IN FRONT OF ANY ORIFICE CONTROL
2. TRASH SCREEN AREA TO BE MINIMUM 20x ORIFICE AREA

Issue	Description	Date
02	RESPONSE TO VERIFIERS COMMENTS	18/06/2018
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018

100mm on Original

Client: SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE / TACTICAL GROUP

Status: PRELIMINARY ONLY
NOT TO BE USED FOR CONSTRUCTION

Scales	N.T.S.	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid	MGA	Approved	

Filename: SSS2-ARC-CV-DWG-1491-OSD09TypicalSectionAndDetails.dwg

Project: MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT

Title: OSD 09 TYPICAL SECTION AND DETAILS

ARCADIS
Arcadis Australia Pacific Pty Limited
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NORTH SYDNEY NSW 2060
ABN 76 104 485 289
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No. AA009335

Drawing No. SSS2 -ARC-CV-DWG- 1491- Issue 02

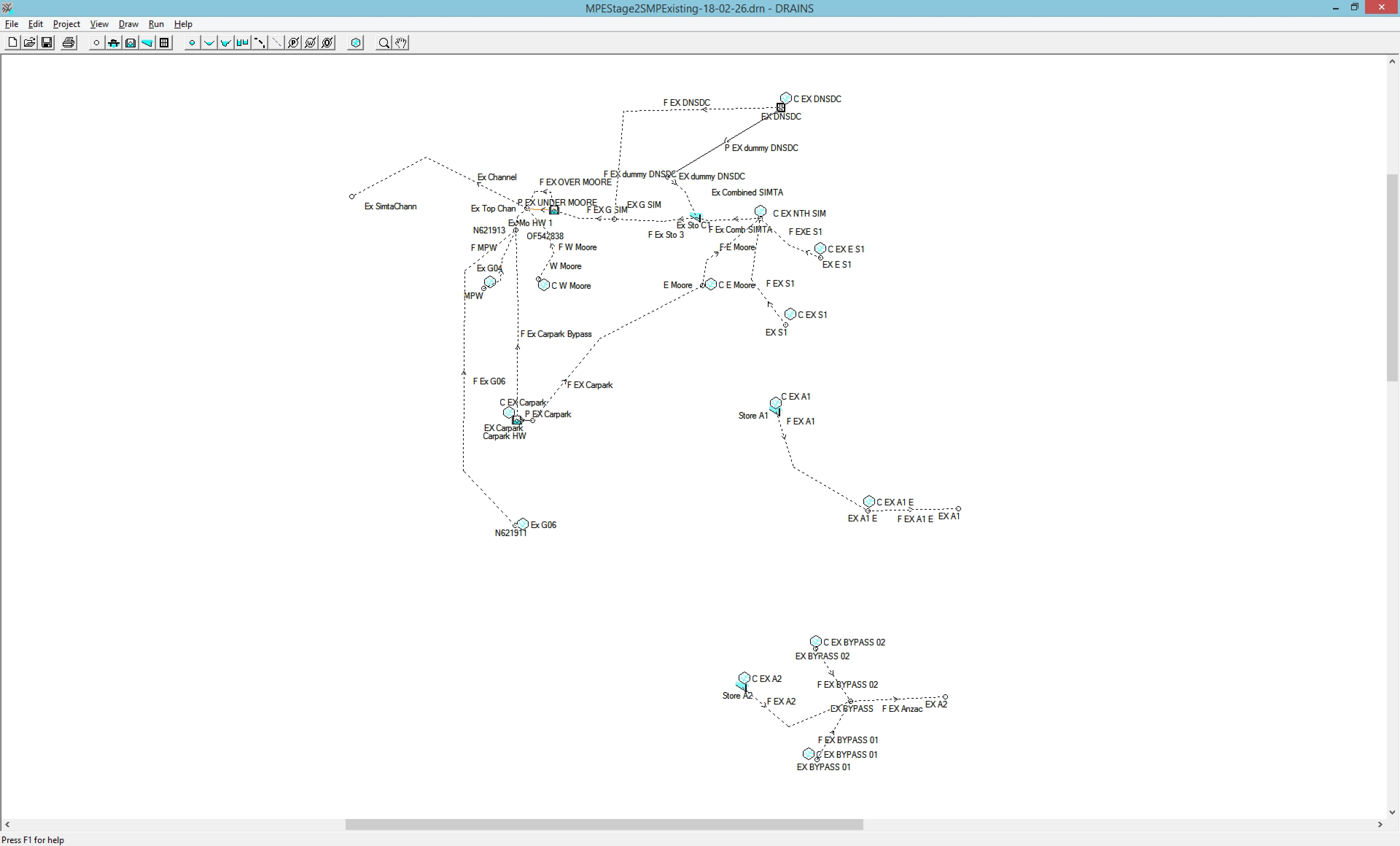
Date Plotted: 26 Jun 2018 - 03:13PM File Name: \\HC-AUS-NS-FS-01\jobs\AA009335\3_SSS2\CV\DWG\SSS2-ARC-CV-DWG-1491-OSD09TypicalSectionAndDetails.dwg V1

APPENDIX B

Existing Conditions Hydraulic Modelling

B.1 DRAINS Model Data

B.2 DRAINS Model Results



MPEStage2SMPExisting-18-02-26.drn - DRAINS
File Edit Project View Draw Run Help
F EX DNSDC
C EX DNSDC
EX DNSDC
P EX dummy DNSDC
F EX dummy DNSDC
EX dummy DNSDC
Ex Combined SIMTA
Ex Channel
F EX OVER MOORE
P EX UNDER MOORE
Ex SimtaChann
Ex Top Chan
F EX G SIM
EX G SIM
C EX NTH SIM
Ex Mo HW 1
Ex Sto C
F Ex Comb SIMTA
F EXE S1
N621913
OF542838
F Ex Sto 3
C EX E S1
EX E S1
F MPW
F W Moore
F E Moore
Ex G04
W Moore
MPW
C W Moore
E Moore
C E Moore
F EX S1
C EX S1
EX S1
F Ex Carpark Bypass
F Ex G06
F EX Carpark
C EX Carpark
P EX Carpark
EX Carpark
Carpark HW
C EX A1
Store A1
F EX A1
C EX A1 E
EX A1 E
F EX A1 E
EX A1
Ex G06
N621911
C EX BYPASS 02
EX BYPASS 02
C EX A2
F EX BYPASS 02
Store A2
F EX A2
EX BYPASS
F EX Anzac
EX A2
F EX BYPASS 01
C EX BYPASS 01
EX BYPASS 01
Press F1 for help

Job	MPE Stage 2	**Design**	J.Ko	**Office**	Sydney
	Stormwater Management Plan	**Date**	27/02/2018	**Job No**	AA009335
		Checked			
		Date	27/02/2018		

Calculation Sheet

MPE Stage 2

Stormwater Management Plan

DRAINS Data and Results

Existing Model

ARCADIS Design & Consultancy for natural and built assets

ARCADIS Design & Consultancy for natural and built assets

PROJECT MPE Stage 2
Stormwater Management Plan
TITLE DRAINS Data
Existing Model

JOB No AA009335
PREPARED [redacted] **DATE** 27/02/2018
CHECKED [redacted] **DATE** 27/02/2018

DATA

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Existing Model

PIT / NODE DETAILS			Version 13											
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
Ex SimtaChann	Node							0		305168.848	6241764.125		114765372	
Ex Combined SIMTA	Node					10		0		306099.406	6241715.299		66886585	
EX G SIM	Node							0		305766.982	6241713.173		66886579	
EX S1	Node							0		306156.768	6241471.509		66886570	
MPW	Node							0		305469.443	6241555.646		66418913	
EX DNSDC	OnGrade	Special	DNSDC		0	14		0	0	306147.208	6241966.259	No	66418895	1 x Ku
EX dummy DNSDC	Node					20		0		305887.086	6241810.04		65741985	
Ex Mo HW 1	Headwall				0.5	14.15		0		305631.329	6241733.293		66418818	
Ex Top Chan	Node					14.2		0		305567.275	6241737.155		66354021	
Carpark HW	Headwall				0.5	14.7		0		305545.963	6241255.103		66354014	
EX Carpark	Node					11		0		305581.482	6241255.103		65742025	
EX BYPASS	Node							0		306304.166	6240616.182		65742001	
EX A1 E	Node					10		0		306343.528	6241049.026		65741998	
E Moore	Node					10		0		305966.756	6241562.731		117904849	
EX E S1	Node					10		0		306237.255	6241625.573		117904865	
EX A1	Node					10		0		306549.618	6241054.559		119788497	
W Moore	Node					10		0		305593.511	6241576.725		121800214	
N621911	Node							0		305540.682	6241015.831		122115309	
N621913	Node					14.2		0		305542.149	6241687.452		122115325	
EX A2	Node							0		306519.939	6240625.864		123442724	
EX BYPASS 02	Node							0		306224.968	6240736.153		123442741	
EX BYPASS 01	Node							0		306228.925	6240483.309		123442744	

DETENTION BASIN DETAILS														
Name	Elev	Volume	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)
Store A2	13.24	0		None						306059.636	6240648.168	No		
	13.3	0.015												
	13.4	0.19												
	13.5	4.125												
	13.6	22.806												
	13.7	74.754												
	13.8	171.018												
	13.9	342.16												
	14	630.48												
	14.1	1118.78												
	14.2	1926.27												
	14.3	3160.4												
	14.4	4835.58												
	14.5	6964.12												
	14.6	9563.34												
	14.7	12682.6												
	14.8	16390.2												
	14.9	20816.7												
	15	25941.6												
	15.1	31774.6												
	15.2	38137.8												
	15.3	44975.1												
	15.4	52117.8												
	15.5	59590.3												
	15.6	67356.2												
	15.7	75203.2												
	15.8	83103.9												
	15.9	91063.6												
	16	99109.7												
	16	99109.7												
Store A1	12.65	0		None						306135.258	6241275.521	No		
	12.9	0.03												
	13	0.039												
	13.1	2.114												
	13.2	14.038												
	13.3	39.629												
	13.4	81.294												
	13.5	146.75												
	13.6	248.51												
	13.7	411.632												
	13.8	706.865												
	13.9	1251.34												
	14	2109.65												
	14.1	3230.35												
	14.2	4564.46												
	14.3	6071.14												
	14.4	7765.32												
	14.5	9687.54												
	14.6	11834.3												
	14.7	14174.2												
	14.8	16701.3												
	14.9	19417.7												
	15	22401.9												
Ex Sto C1	11.579	0		None						305953.478	6241715.708	No		
	12	2000												
	12.32	3640.5												
	12.43	4677												
	12.49	5700												
	12.52	5800												
	12.61	6000												
	12.65	7000												
	12.7	7300												
	13.07	10300												
	13.21	12000												
	14.315	16000												

SUB-CATCHMENT DETAILS														
Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %
C EX NTH SIM	Ex Combined SIMTA	12.28	60.7	39.3	0	12	15	0						
C EX S1	EX S1	15.17	60.9	39.1	0	15	20	0						
C EX DNSDC	EX DNSDC	5.5	82	18	0	5	5	0						
C EX Carpark	Carpark HW	2.08	61.2	38.8	0	5	5	0						
C EX A2	Store A2	27.71	33.4	66.6	0	14.5	24	0						
C EX A1	Store A1	20.07	50	50	0	14	15	0						
C EX A1 E	EX A1 E	0.82	50	50	0	5	7	0						
C E Moore	E Moore	2.01	80	20	0	5	20	0						
C EX E S1	EX E S1	9.75	60.9	39.1	0	15	20	0						
C W Moore	W Moore	1.86	50	50	0	5	20	0						
Ex G06	N621911	7.25	5	95	0	15	15	0						
C EX BYPASS 01	EX BYPASS 01	0.47	67	33	0	5	5	0						

Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
Ex G04	MPW	3.6	10	0.5	0.04	0		Moorebank RAFTS
C EX BYPASS 02	EX BYPASS 02	0.69	0	0.5	0.04	0		Moorebank RAFTS

PIPE DETAILS														
Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg
P EX dummy DNSDC	EX DNSDC	EX dummy DNSDC	10	10	9.9	1	RCP Class 2	600	600	0.3	New	1	EX DNSDC	0
P EX UNDER MOORE	Ex Mo HW 1	Ex Top Chan	18.15	11.58	11.4	0.99	Box Culverts	2W x 1.8H		0.3	Existing	2	Ex Mo HW 1	0
P EX Carpark	Carpark HW	EX Carpark	8.77	14.31	13.87	5.02	RCP Class 2	300	300	0.3	NewFixed	1	Carpark HW	0

DETAILS of SERVICES CROSSING PIPES										
Pipe	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	etc etc

CHANNEL DETAILS													
Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed

OVERFLOW ROUTE DETAILS														
Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %		id
F Ex Comb SIMTA	Ex Combined SIMTA	Ex Sto C1	0.1				Dummy used to model flow across road low points	0.3	0.3	0.6	1	0		66886586
F EX G SIM	EX G SIM	Ex Mo HW 1	0.1				Dummy used to model flow across road low points	0.3	0.3	0.6	1	0		66886581
F EX S1	EX S1	Ex Combined SIMTA	7				Dummy used to model flow across road low points	0.3	0.3	0.6	1	0		66886571
F MPW	MPW	N621913	4				West Moorebank	0.15	0.2	0.6	0.2	0		66418872
F EX DNSDC	EX DNSDC	EX G SIM	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		65742028
F EX dummy DNSDC	EX dummy DNSDC	Ex Sto C1	0.1				Dummy used to model flow across road low points	0.3	0.3	0.6	1	0		66418902
F EX OVER MOORE	Ex Mo HW 1	Ex Top Chan	0.1	14.15			Dummy used to model flow across road low points	0.3	0.3	0.6	1	0		66418832
Ex Channel	Ex Top Chan	Ex SimtaChann	5				Concrete Channel	0.3	0.3	0.6	0.1	100		65745589
F Ex Carpark Bypass	Carpark HW	N621913	10	0	20	1.6	West Moore CP	0.2	0.2	0.6	0.2	0		121800256
F EX Carpark	EX Carpark	E Moore	0.1				Dummy used to model flow across road low points	0.3	0.3	0.6	1	0		66418914
F EX A2	Store A2	EX BYPASS	0.1	13.24			Really Long Weir	0.3	0.3	0.6	1	0		65770283
F EX A1	Store A1	EX A1 E	0.1	12.65			Really Long Weir	0.3	0.3	0.6	1	0		65770282
F EX Anzac	EX BYPASS	EX A2	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		123442727
F EX A1 E	EX A1 E	EX A1	0.1				Dummy used to model flow across road low points	0.3	0.3	0.6	1	0		119788502
F Ex Sto 3	Ex Sto C1	EX G SIM	0.1	11.579			Really Long Weir	0.3	0.3	0.6	1	0		117017831
F E Moore	E Moore	Ex Combined SIMTA	15				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		117904855
F EXE S1	EX E S1	Ex Combined SIMTA	7				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		117904870
F W Moore	W Moore	Ex Top Chan	15				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		121800217
F Ex G06	N621911	N621913	20				West Moorebank	0.15	0.2	0.6	0.2	0		122115311
OF542838	N621913	Ex Top Chan	0.1				West Moorebank	0.15	0.2	0.6	0.2	0		122115331
F EX BYPASS 02	EX BYPASS 02	EX BYPASS	5				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		123442749
F EX BYPASS 01	EX BYPASS 01	EX BYPASS	5				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		123442753

PIPE COVER DETAILS					
Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)	
P EX dummy DNSDC	RCP Class 2	600	0.6	3.35	
P EX UNDER MOORE	Box Culverts	0	0.6	0.62	
P EX Carpark	RCP Class 2	300	0.6	-3.2	Unsafe

This model has no pipes with non-return valves

ARCADIS Design & Consultancy for natural and built assets

PROJECT	MPE Stage 2	**JOB No**	AA009335
	Stormwater Management Plan	**PREPARED** [redacted]	**DATE** 27/02/2018
TITLE	DRAINS Results	**CHECKED** [redacted]	**DATE** 27/02/2018
	Existing Model - 1 Year ARI		

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Existing Model

DRAINS results prepared from Version 2017.10

1 YEAR ARI

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
EX DNSDC	10.72		1.148		3.28	0	None
EX dummy DNSDC	10.48		0				
Ex Mo HW 1	12.13		2.755		2.02	0	None
Ex Top Chan	11.63		0.526				
Carpark HW	14.74		0.384		-0.04	0.284	Headwall height/system capacity
EX Carpark	11		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C EX NTH SIM	1.529	1.365	0.164	12	15	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C EX S1	1.637	1.491	0.151	15	20	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C EX DNSDC	1.148	1.047	0.101	5	5	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C EX Carpark	0.384	0.275	0.11	5	5	0	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
C EX A2	1.911	1.528	0.391	14.5	24	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C EX A1	2.033	1.696	0.34	14	15	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C EX A1 E	0.128	0.089	0.041	5	7	0	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
C E Moore	0.384	0.373	0.01	5	20	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C EX E S1	1.052	0.958	0.097	15	20	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C W Moore	0.24	0.216	0.024	5	20	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
Ex G06	0.403	0.055	0.363	15	15	0	AR&R 1 year, 1 hour storm, average 26.3 mm/h, Zone 1
C EX BYPASS 01	0.089	0.068	0.021	5	5	0	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1

Name	Max Flow (cu.m/s)	Due to Storm
Ex G04	0.146	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1
C EX BYPASS 02	0.027	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1

Outflow Volumes for Total Catchment (51.7 impervious + 57.6 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 15 minutes storm, av	14981.37	6913.01 (46.1%)	6524.75 (92.1%)	388.26 (4.9%)
AR&R 1 year, 25 minutes storm, av	19521.12	9866.17 (50.5%)	8657.45 (93.7%)	1208.72 (11.8%)
AR&R 1 year, 45 minutes storm, av	25544.08	13552.16 (53.1%)	11443.23 (94.7%)	2108.93 (15.7%)
AR&R 1 year, 1 hour storm, average	28782.73	15750.65 (54.7%)	12959.35 (95.2%)	2791.30 (18.4%)
AR&R 1 year, 1.5 hours storm, aver	33690.32	18364.44 (54.5%)	15269.41 (95.8%)	3095.03 (17.4%)
AR&R 1 year, 2 hours storm, averag	37457.06	20603.40 (55.0%)	17109.24 (96.6%)	3494.17 (17.7%)
AR&R 1 year, 3 hours storm, averag	43269.69	23477.55 (54.3%)	19910.25 (97.3%)	3567.31 (15.6%)
AR&R 1 year, 4.5 hours storm, aver	49844.43	26823.44 (53.8%)	23018.67 (97.6%)	3804.77 (14.5%)
AR&R 1 year, 6 hours storm, averag	55099.82	29672.24 (53.9%)	25513.38 (97.9%)	4158.86 (14.3%)
AR&R 1 year, 9 hours storm, averag	63523.78	35751.05 (56.3%)	29475.01 (98.1%)	6276.04 (18.8%)
AR&R 1 year, 12 hours storm, avera	70330.66	40272.32 (57.3%)	32710.09 (98.3%)	7562.23 (20.4%)
AR&R 1 year, 18 hours storm, avera	81245.73	42966.88 (52.9%)	37880.26 (98.6%)	5086.62 (11.9%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
P EX dummy DNSDC	1.152	4.07	10.725	10.5	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
P EX UNDER MOORE	2.755	3	11.81	11.63	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1
P EX Carpark	0.101	3.56	14.436	13.997	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
F Ex Comb SIMTA	4.05	4.05	0	0.155	0.21	34.98	1.37	AR&R 1 year, 1 hour storm, average 26.3 mm/h, Zone 1
F EX G SIM	2.755	2.755	0	0.132	0.16	30.49	1.24	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1
F EX S1	1.637	1.637	0	0.106	0.12	25.28	1.09	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MPW	0.146	0.146	0	0.112	0.03	20.37	0.27	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1
F EX DNSDC	0	0	0	0	0	0	0	
F EX dummy DNSDC	1.152	1.152	0	0.092	0.09	22.41	1	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F EX OVER MOORE	0	0	0	0	0	0	0	
Ex Channel	3.191	3.191	0	0.902	1.27	3.38	1.41	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F Ex Carpark Bypass	0.284	0.284	0	0.187	0.03	37.49	0.17	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F EX Carpark	0.101	0.101	0	0.035	0.02	10.91	0.51	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F EX A2	0.13	0.13	0	0.002	0	699.9	0.09	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1
F EX A1	2.003	2.003	0	0.009	0	699.9	0.3	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F EX Anzac	0.17	0.17	0	0.043	0.02	12.53	0.58	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F EX A1 E	2.104	2.104	0	0.118	0.14	27.62	1.16	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F Ex Sto 3	2.755	2.755	0	0.011	0	699.9	0.35	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1
F E Moore	0.484	0.484	0	0.064	0.05	16.84	0.79	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F EXE S1	1.052	1.052	0	0.089	0.09	21.87	0.96	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W Moore	0.24	0.24	0	0.049	0.03	13.79	0.64	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F Ex G06	0.403	0.403	0	0.136	0.04	46.24	0.29	AR&R 1 year, 1 hour storm, average 26.3 mm/h, Zone 1
OF542838	0.459	0.459	0	0.138	0.04	46.58	0.3	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1
F EX BYPASS 02	0.027	0.027	0	0.021	0.01	7.03	0.36	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1
F EX BYPASS 01	0.089	0.089	0	0.034	0.02	10.74	0.47	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Store A2	14.41	5146.5	0.13	0	0.13
Store A1	13.19	13	2.003	0	2.003
Ex Sto C1	12.35	3935.3	2.755	0	2.755

CONTINUITY CHECK for AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1				
Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Ex SimtaChann	21274.87	21274.87	0	0
Ex Combined SIMTA	16111.2	16111.29	0	0
EX G SIM	18774.99	18774.87	0	0
EX S1	5860.61	5860.61	0	0
MPW	976.02	976.02	0	0
EX DNSDC	2674.27	2674.35	0	0
EX dummy DNSDC	2674.35	2674.35	0	0
Ex Mo HW 1	18774.87	18779.92	0	0
Ex Top Chan	21275	21274.87	0	0
Carpark HW	806.65	806.66	0	0
EX Carpark	792.97	792.97	0	0
Store A2	7097.56	4595.81	2503.38	0
Store A1	6718.75	6718.81	0	0
EX BYPASS	4975.08	4968.43	0	0.1
EX A1 E	6993.37	6993.36	0	0
Ex Sto C1	18785.64	18774.99	10.71	0
E Moore	1751.22	1751.21	0	0
EX E S1	3766.7	3766.7	0	0
EX A1	6993.36	6993.36	0	0
W Moore	622.61	622.61	0	0
N621911	883.03	883.03	0	0
N621913	1872.73	1872.47	0	0
EX A2	4968.43	4968.43	0	0
EX BYPASS 02	184.1	184.1	0	0
EX BYPASS 01	195.17	195.17	0	0
Run Log for MPEStage2SMPExisting run at 14:52:38 on 27/2/2018				
No water upwelling from any pit. Freeboard was adequate at all pits.				
The maximum flow in these overflow routes is unsafe: F EX A1 E, F EXE S1, F E Moore, Ex Channel				

PROJECT MPE Stage 2 Stormwater Management Plan	**JOB No** AA009335	
TITLE DRAINS Results Existing Model - 10 Year ARI	**PREPARE**[redacted]	**DATE** 27/02/2018
	CHECKED [redacted]	**DATE** 27/02/2018

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Existing Model

DRAINS results prepared from Version 2017.10

10 YEAR ARI

PIT / NODE DETAILS — Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
EX DNSDC	11.29		2.228		2.71	0.118	Inlet Capacity
EX dummy DNSDC	10.48		0				
Ex Mo HW 1	12.88		6.215		1.27	0	None
Ex Top Chan	12.84		1.96				
Carpark HW	14.78		0.813		-0.08	0.708	Headwall height/system capacity
EX Carpark	11		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C EX NTH SIM	3.257	2.452	0.874	12	15	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
C EX S1	3.469	2.718	0.828	15	20	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
C EX DNSDC	2.228	1.882	0.346	5	5	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
C EX Carpark	0.813	0.531	0.282	5	5	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
C EX A2	5.123	2.358	2.854	14.5	24	0	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
C EX A1	4.763	3.09	1.816	14	15	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
C EX A1 E	0.3	0.171	0.129	5	7	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
C E Moore	0.721	0.671	0.056	5	20	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
C EX E S1	2.229	1.747	0.532	15	20	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
C W Moore	0.513	0.365	0.157	5	20	0	AR&R 10 year, 1.5 hours storm, average 37.4 mm/h, Zone 1
Ex G06	1.529	0.091	1.439	15	15	0	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
C EX BYPASS 01	0.186	0.131	0.054	5	5	0	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1

Name	Max Flow (cu.m/s)	Due to Storm
Ex G04	0.32	AR&R 10 year, 12 hours storm, average 10.2 mm/h, Zone 1
C EX BYPASS 02	0.06	AR&R 10 year, 12 hours storm, average 10.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (51.7 impervious + 57.6 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 15 minutes storm, a	26939.88	18052.21 (67.0%)	12148.82 (95.3%)	5903.39 (41.6%)
AR&R 10 year, 25 minutes storm, a	35067.91	24867.39 (70.9%)	15979.94 (96.3%)	8887.45 (48.1%)
AR&R 10 year, 45 minutes storm, a	46034.89	33456.16 (72.7%)	21163.30 (97.2%)	12292.85 (50.7%)
AR&R 10 year, 1 hour storm, averag	52026.89	38183.72 (73.4%)	23975.00 (97.4%)	14208.72 (51.8%)
AR&R 10 year, 1.5 hours storm, ave	61214.74	45170.66 (73.8%)	28389.08 (98.0%)	16781.58 (52.0%)
AR&R 10 year, 2 hours storm, avera	68338.52	50373.47 (73.7%)	31718.51 (98.1%)	18654.96 (51.8%)
AR&R 10 year, 3 hours storm, avera	79423.84	58681.38 (73.9%)	37029.09 (98.6%)	21652.30 (51.7%)
AR&R 10 year, 4.5 hours storm, ave	92111.65	67046.34 (72.8%)	43032.59 (98.8%)	24013.74 (49.5%)
AR&R 10 year, 6 hours storm, avera	102398.46	74029.39 (72.3%)	47889.38 (98.9%)	26140.01 (48.4%)
AR&R 10 year, 9 hours storm, avera	119191.73	83998.02 (70.5%)	55805.41 (99.0%)	28192.61 (44.9%)
AR&R 10 year, 12 hours storm, ave	133144.25	94187.88 (70.7%)	62423.26 (99.1%)	31764.62 (45.3%)
AR&R 10 year, 18 hours storm, ave	156110.72	104970.34 (67.2%)	73302.48 (99.3%)	31667.86 (38.5%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
P EX dummy DNSDC	2.117	7.49	11.291	10.5	AR&R 10 year, 1.5 hours storm, average 37.4 mm/h, Zone 1
P EX UNDER MOORE	6.227	1.2	12.879	12.84	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
P EX Carpark	0.106	3.6	14.44	14	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
F Ex Comb SIMTA	8.576	8.576	0	0.209	0.35	45.76	1.67	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
F EX G SIM	6.215	6.215	0	0.184	0.28	40.73	1.54	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
F EX S1	3.469	3.469	0	0.145	0.19	33.01	1.32	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
F MPW	0.32	0.32	0	0.132	0.03	45.79	0.26	AR&R 10 year, 12 hours storm, average 10.2 mm/h, Zone 1
F EX DNSDC	0.118	0.118	0	0.037	0.02	11.45	0.52	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
F EX dummy DNSDC	2.117	2.117	0	0.119	0.14	27.8	1.16	AR&R 10 year, 1.5 hours storm, average 37.4 mm/h, Zone 1
F EX OVER MOORE	0	0	0	0	0	0	0	
Ex Channel	8.115	8.115	0	1.476	2.65	4.46	1.8	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
F Ex Carpark Bypass	0.708	0.708	0	0.236	0.04	46.84	0.19	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
F EX Carpark	0.106	0.106	0	0.035	0.02	11.09	0.51	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
F EX A2	0.922	0.922	0	0.006	0	699.9	0.23	AR&R 10 year, 12 hours storm, average 10.2 mm/h, Zone 1
F EX A1	3.459	3.459	0	0.013	0	699.9	0.38	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
F EX Anzac	0.971	0.971	0	0.086	0.08	21.15	0.95	AR&R 10 year, 12 hours storm, average 10.2 mm/h, Zone 1
F EX A1 E	3.528	3.528	0	0.146	0.19	33.19	1.33	AR&R 10 year, 1 hour storm, average 47.6 mm/h, Zone 1
F Ex Sto 3	6.215	6.215	0	0.019	0.01	699.9	0.48	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
F E Moore	0.827	0.827	0	0.08	0.07	20.08	0.91	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
F EXE S1	2.229	2.229	0	0.121	0.14	28.16	1.18	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1
F W Moore	0.513	0.513	0	0.066	0.05	17.2	0.8	AR&R 10 year, 1.5 hours storm, average 37.4 mm/h, Zone 1
F Ex G06	1.529	1.529	0	0.173	0.08	50.75	0.47	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
OF542838	1.834	1.834	0	0.181	0.09	51.64	0.51	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
F EX BYPASS 02	0.06	0.06	0	0.029	0.01	9.73	0.42	AR&R 10 year, 12 hours storm, average 10.2 mm/h, Zone 1
F EX BYPASS 01	0.186	0.186	0	0.044	0.03	12.89	0.59	AR&R 10 year, 25 minutes storm, average 77.0 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Store A2	14.71	13133.7	0.922	0	0.922
Store A1	13.85	979.2	3.459	0	3.459
Ex Sto C1	12.72	7476.8	6.215	0	6.215

CONTINUITY CHECK for AR&R 10 year, 12 hours storm, average 10.2 mm/h, Zone 1				
Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Ex SimtaChann	53422.04	53422.04	0	0
Ex Combined SIMTA	38859.58	38859.43	0	0
EX G SIM	44835.55	44835.5	0	0
EX S1	14317.33	14317.33	0	0
MPW	3043.56	3043.56	0	0
EX DNSDC	5980.95	5981.01	0	0
EX dummy DNSDC	5981.01	5981.01	0	0
Ex Mo HW 1	44835.5	44284.74	0	1.2
Ex Top Chan	53422.04	53422.04	0	0
Carpark HW	1970.67	1970.71	0	0
EX Carpark	1602.87	1602.87	0	0
Store A2	20973.07	15626.8	5348.81	0
Store A1	17475.31	17475.22	0.14	0
EX BYPASS	16672.95	16662.9	0	0.1
EX A1 E	18190	18190.05	0	0
Ex Sto C1	44840.48	44835.55	4.91	0
E Moore	3759.91	3759.89	0	0
EX E S1	9201.93	9201.93	0	0
EX A1	18190.05	18190.05	0	0
W Moore	1618.14	1618.14	0	0
N621911	4108.02	4108.02	0	0
N621913	7519.4	7519.12	0	0
EX A2	16662.9	16662.9	0	0
EX BYPASS 02	582.51	582.51	0	0
EX BYPASS 01	463.64	463.64	0	0
Run Log for MPEStage2SMPExisting run at 14:44:03 on 27/2/2018				
No water upwelling from any pit. Freeboard was adequate at all pits.				
The maximum flow in these overflow routes is unsafe: F EX Anzac, F Ex Carpark Bypass, F W Moore, F EX A1 E, F EXE S1, F E Moore, Ex Channel				

ARCADIS Design & Consultancy for natural and built assets

PROJECT	MPE Stage 2	**JOB No**	AA009335
	Stormwater Management Plan	**PREPARED** [redacted]	**DATE** 27/02/2018
TITLE	DRAINS Results	**CHECKED** [redacted]	**DATE** 27/02/2018
	Existing Model - 100 Year ARI		

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Existing Model

DRAINS results prepared from Version 2017.10

100 YEAR ARI

PIT / NODE DETAILS (Version 8)

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
EX DNSDC	11.3		3.025		2.7	0.915	Inlet Capacity
EX dummy DNSDC	10.48		0				
Ex Mo HW 1	13.41		9.325		0.74	0	None
Ex Top Chan	13.36		3.303				
Carpark HW	14.8		1.111		-0.1	1.002	Headwall height/system capacity
EX Carpark	11		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C EX NTH SIM	4.647	3.305	1.496	12	15	0	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C EX S1	5.012	3.756	1.534	15	20	0	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C EX DNSDC	3.025	2.543	0.482	5	5	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C EX Carpark	1.111	0.718	0.393	5	5	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C EX A2	8.016	3.272	4.745	14.5	24	0	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
C EX A1	7.007	4.217	3.111	14	15	0	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C EX A1 E	0.41	0.231	0.179	5	7	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C E Moore	0.972	0.861	0.114	5	20	0	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
C EX E S1	3.222	2.414	0.986	15	20	0	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C W Moore	0.756	0.498	0.264	5	20	0	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
Ex G06	2.301	0.139	2.166	15	15	0	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
C EX BYPASS 01	0.253	0.178	0.076	5	5	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1

Name	Max Flow (cu.m/s)	Due to Storm
Ex G04	0.569	AR&R 100 year, 4.5 hours storm, average 27.8 mm/h, Zone 1
C EX BYPASS 02	0.105	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1

Outflow Volumes for Total Catchment (51.7 impervious + 57.6 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 15 minutes storm,	39319.95	30227.23 (76.9%)	18014.03 (96.8%)	12213.20 (58.9%)
AR&R 100 year, 25 minutes storm,	51150.07	40544.03 (79.3%)	23592.37 (97.5%)	16951.66 (62.9%)
AR&R 100 year, 45 minutes storm,	67292.32	54387.08 (80.8%)	31229.05 (98.1%)	23158.03 (65.3%)
AR&R 100 year, 1 hour storm, avera	76204.31	61996.05 (81.4%)	35445.88 (98.3%)	26550.18 (66.1%)
AR&R 100 year, 1.5 hours storm, av	89973.8	73597.06 (81.8%)	41980.68 (98.6%)	31616.38 (66.7%)
AR&R 100 year, 2 hours storm, ave	100713.14	82485.03 (81.9%)	47047.08 (98.7%)	35437.96 (66.8%)
AR&R 100 year, 3 hours storm, ave	117530.98	96157.11 (81.8%)	55045.71 (99.0%)	41111.40 (66.4%)
AR&R 100 year, 4.5 hours storm, av	136913.69	111087.52 (81.1%)	64215.78 (99.1%)	46871.73 (65.0%)
AR&R 100 year, 6 hours storm, ave	152734.58	122610.98 (80.3%)	71718.24 (99.3%)	50892.74 (63.2%)
AR&R 100 year, 9 hours storm, ave	178907.8	139900.69 (78.2%)	84116.76 (99.4%)	55783.93 (59.2%)
AR&R 100 year, 12 hours storm, av	200950.98	156249.20 (77.8%)	94498.16 (99.4%)	61751.05 (58.3%)
AR&R 100 year, 18 hours storm, av	238001.11	178856.81 (75.1%)	112039.45 (99.5%)	66817.38 (53.3%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
P EX dummy DNSDC	2.121	7.5	11.295	10.5	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
P EX UNDER MOORE	9.328	1.3	13.381	13.36	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
P EX Carpark	0.109	3.63	14.442	14.002	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
F Ex Comb SIMTA	12.554	12.554	-6.91168E+16	0.23	0.47	49.99	2.04	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F EX G SIM	9.325	9.325	-1.15086E+16	0.216	0.37	47.2	1.71	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F EX S1	5.012	5.012	-1.73493E+16	0.168	0.24	37.68	1.45	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F MPW	0.569	0.569	-1.0755E+15	0.142	0.05	47.03	0.33	AR&R 100 year, 4.5 hours storm, average 27.8 mm/h, Zone 1
F EX DNSDC	0.915	0.915	-3.58079E+15	0.084	0.08	20.79	0.93	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F EX dummy DNSDC	2.121	2.121	-1.40335E+15	0.119	0.14	27.8	1.16	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F EX OVER MOORE	0	0	-2.16101E+16	0	0	0	0	
Ex Channel	12.853	12.853	-4.5754E+16	1.8	3.66	6.98	2.04	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F Ex Carpark Bypass	1.002	1.002	-6.85345E+16	0.26	0.05	50.59	0.2	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F EX Carpark	0.109	0.109	-8.58801E+16	0.036	0.02	11.27	0.5	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F EX A2	3.028	3.028	-5.57834E+15	0.013	0	699.9	0.35	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F EX A1	3.888	3.888	-7.10457E+14	0.014	0.01	699.9	0.39	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F EX Anzac	3.168	3.168	-5.57581E+15	0.14	0.18	31.93	1.29	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F EX A1 E	4.013	4.013	-1.77702E+15	0.154	0.21	34.8	1.37	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F Ex Sto 3	9.325	9.325	-1.13424E+17	0.024	0.01	699.9	0.55	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F E Moore	1.08	1.08	-2.24434E+16	0.09	0.09	22.05	0.97	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
F EXE S1	3.222	3.222	-1.41639E+15	0.141	0.18	32.11	1.3	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F W Moore	0.756	0.756	-1.07324E+15	0.078	0.07	19.54	0.88	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
F Ex G06	2.301	2.301	-1.78004E+19	0.191	0.11	52.42	0.55	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
OF542838	3.081	3.081	-8.80914E+16	0.207	0.13	53.02	0.61	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F EX BYPASS 02	0.105	0.105	-2.95476E+19	0.035	0.02	11.09	0.51	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F EX BYPASS 01	0.253	0.253	-2.82135E+16	0.05	0.03	13.97	0.65	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Store A2	14.78	15690.6	3.028	0	3.028
Store A1	14.06	2829.6	3.888	0	3.888
Ex Sto C1	13.08	10417.9	9.325	0	9.325

CONTINUITY CHECK for AR&R 100 year, 4.5 hours storm, average 27.8 mm/h, Zone 1

Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Ex SimtaChann	62127.37	62127.37	0	0
Ex Combined SIMTA	43471.41	43471.37	0	0
EX G SIM	49805.36	49804.95	0	0
EX S1	16249.91	16249.91	0	0
MPW	3514.89	3514.89	0	0
EX DNSDC	6403.64	6406.42	0	0
EX dummy DNSDC	6406.42	6406.42	0	0
Ex Mo HW 1	49804.95	49797.71	0	0
Ex Top Chan	62127.68	62127.37	0	0
Carpark HW	2232.33	2232.53	0	0
EX Carpark	1309.04	1309.04	0	0
Store A2	26323.08	17526.18	8799.05	0
Store A1	20543.3	20650.04	0	-0.5
EX BYPASS	18702.5	18693.7	0	0
EX A1 E	21489.86	21489.79	0	0
Ex Sto C1	49877.79	49805.36	72.59	0
E Moore	3630.92	3630.92	0	0
EX E S1	10444.06	10444.06	0	0
EX A1	21489.79	21489.79	0	0
W Moore	1903.27	1903.27	0	0
N621911	5988.62	5988.62	0	0
N621913	10427	10426.68	0	0
EX A2	18693.7	18693.7	0	0
EX BYPASS 02	659.97	659.97	0	0
EX BYPASS 01	516.36	516.36	0	0

Run Log for MPEStage2SMPExisting run at 14:49:14 on 27/2/2018

No water upwelling from any pit. Freeboard was adequate at all pits.

The maximum flow in these overflow routes is unsafe: OF542838, F Ex G06, F Ex Carpark Bypass, Ex Channel

ARCADIS Design & Consultancy for natural and built assets

PROJECT MPE Stage 2
Stormwater Management Plan
TITLE DRAINS Results
Existing Model - PMP

JOB No AA009335
PREPARED [redacted] **DATE** 27/02/2018
CHECKED [redacted] **DATE** 27/02/2018

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Existing Model

DRAINS results prepared from Version 2017.10

PMP

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
EX DNSDC	11.4		13.498		2.6	11.388	Inlet Capacity
EX dummy DNSDC	10.48		0				
Ex Mo HW 1	14.48		53.912		-0.33	25.47	Headwall height/system capacity
Ex Top Chan	12.57		44.805				
Carpark HW	14.99		5.062		-0.29	4.928	Headwall height/system capacity
EX Carpark	11		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C EX NTH SIM	23.193	15.608	8.475	12	15	0	PMP - 15 Minutes
C EX S1	25.364	16.414	9.593	15	20	0	PMP - 30 Minutes
C EX DNSDC	13.498	11.219	2.357	5	5	0	PMP - 15 Minutes
C EX Carpark	5.062	3.167	1.921	5	5	0	PMP - 15 Minutes
C EX A2	40.765	16.489	27.786	14.5	24	0	PMP - 30 Minutes
C EX A1	36.519	19.472	17.622	14	15	0	PMP - 15 Minutes
C EX A1 E	1.896	1.02	0.94	5	7	0	PMP - 15 Minutes
C E Moore	4.229	4	0.529	5	20	0	PMP - 15 Minutes
C EX E S1	16.302	10.549	6.166	15	20	0	PMP - 30 Minutes
C W Moore	3.006	2.313	1.225	5	20	0	PMP - 15 Minutes
Ex G06	12.775	0.681	12.095	15	15	0	PMP - 15 Minutes
C EX BYPASS 01	1.146	0.783	0.369	5	5	0	PMP - 15 Minutes

Name	Max Flow (cu.m/s)	Due to Storm
Ex G04	4.492	PMP - 45 Minutes
C EX BYPASS 02	0.848	PMP - 45 Minutes

Outflow Volumes for Total Catchment (51.7 impervious + 57.6 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
PMP - 15 Minutes	185742.03	176281.56 (94.9%)	87256.76 (99.3%)	89024.80 (91.0%)
PMP - 30 Minutes	273150.06	261531.44 (95.7%)	128576.16 (99.5%)	132955.28 (92.4%)
PMP - 45 Minutes	338706.06	325492.63 (96.1%)	159617.77 (99.6%)	165874.84 (92.9%)
PMP - 60 Minutes	393244.97	378731.59 (96.3%)	185438.47 (99.7%)	193293.13 (93.3%)
PMP - 1.5 Hours	502505.03	485893.31 (96.7%)	237152.13 (99.8%)	248741.20 (93.9%)
PMP - 2 Hours	589730.88	571212.81 (96.9%)	278426.22 (99.8%)	292786.59 (94.2%)
PMP - 2.5 Hours	655560.13	635350.13 (96.9%)	309580.19 (99.8%)	325769.91 (94.3%)
PMP - 3 Hours	721389.19	699522.88 (97.0%)	340727.94 (99.8%)	358794.94 (94.4%)
PMP - 4 Hours	819450.06	794265.88 (96.9%)	387132.53 (99.9%)	407133.34 (94.3%)
PMP - 5 Hours	896478.38	868029.25 (96.8%)	423572.91 (99.9%)	444456.31 (94.1%)
PMP - 6 Hours	950835.31	919067.00 (96.7%)	449285.41 (99.9%)	469781.56 (93.8%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
P EX dummy DNSDC	2.184	7.72	11.401	10.5	PMP - 15 Minutes
P EX UNDER MOORE	28.442	6.08	12.75	12.57	PMP - 45 Minutes
P EX Carpark	0.133	3.83	14.479	14.018	PMP - 15 Minutes

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
F Ex Comb SIMTA	60.596	60.596	-6.91168E+16	0.23	2.27	49.99	9.86	PMP - 30 Minutes
F EX G SIM	53.912	53.912	-1.15086E+16	0.23	2.02	49.99	8.77	PMP - 45 Minutes
F EX S1	25.364	25.364	-1.73493E+16	0.23	0.95	49.99	4.13	PMP - 30 Minutes
F MPW	4.492	4.492	-1.0755E+15	0.232	0.16	53.81	0.71	PMP - 45 Minutes
F EX DNSDC	11.388	11.388	-3.58079E+15	0.23	0.43	49.99	1.85	PMP - 15 Minutes
F EX dummy DNSDC	2.184	2.184	-1.40335E+15	0.12	0.14	27.98	1.18	PMP - 15 Minutes
F EX OVER MOORE	25.47	25.47	-2.16101E+16	0.23	0.95	49.99	4.14	PMP - 45 Minutes
Ex Channel	74.033	74.033	-4.5754E+16	2.927	2.42	120.04	0.83	PMP - 45 Minutes
F Ex Carpark Bypass	4.928	4.928	-6.85345E+16	0.294	0.22	55.81	0.74	PMP - 15 Minutes
F EX Carpark	0.133	0.133	-8.58801E+16	0.039	0.02	11.81	0.54	PMP - 15 Minutes
F EX A2	16.958	16.958	-5.57834E+15	0.034	0.02	699.9	0.7	PMP - 2 Hours
F EX A1	8.295	8.295	-7.10457E+14	0.022	0.01	699.9	0.53	PMP - 3 Hours
F EX Anzac	17.771	17.771	-5.57581E+15	0.23	0.66	49.99	2.89	PMP - 2 Hours
F EX A1 E	8.671	8.671	-1.77702E+15	0.211	0.35	46.12	1.66	PMP - 3 Hours
F Ex Sto 3	51.598	51.598	-1.13424E+17	0.067	0.07	699.9	1.1	PMP - 30 Minutes
F E Moore	4.361	4.361	-2.24434E+16	0.159	0.22	35.88	1.4	PMP - 15 Minutes
F EXE S1	16.302	16.302	-1.41639E+15	0.23	0.61	49.99	2.65	PMP - 30 Minutes
F W Moore	3.006	3.006	-1.07324E+15	0.137	0.17	31.39	1.27	PMP - 15 Minutes
F Ex G06	12.775	12.775	-1.78004E+19	0.242	0.45	54.14	1.86	PMP - 15 Minutes
OF542838	17.719	17.719	-8.80914E+16	0.242	0.62	54.14	2.58	PMP - 30 Minutes
F EX BYPASS 02	0.848	0.848	-2.95476E+19	0.081	0.07	20.25	0.92	PMP - 45 Minutes
F EX BYPASS 01	1.146	1.146	-2.82135E+16	0.092	0.09	22.41	0.99	PMP - 15 Minutes

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Store A2	15.58	65633.1	16.958	0	16.958
Store A1	16.27	60243.7	8.295	0	8.295
Ex Sto C1	19	32953.1	51.598	0	51.598

CONTINUITY CHECK for PMP - 15 Minutes				
Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Ex SimtaChann	95400.35	95400.35	0	0
Ex Combined SIMTA	64333.87	64333.82	0	0
EX G SIM	72479.48	72472.7	0	0
EX S1	24802.52	24802.52	0	0
MPW	5320.33	5320.33	0	0
EX DNSDC	9178.01	9177	0	0
EX dummy DNSDC	2342.78	2342.78	0	0
Ex Mo HW 1	72472.7	72469.82	0	0
Ex Top Chan	95404.24	95400.35	0	0
Carpark HW	3419.83	3420.05	0	0
EX Carpark	142.11	142.11	0	0
Store A2	44134.44	31252.2	12884.84	0
Store A1	32576.55	32276.34	309.51	0
EX BYPASS	33032.95	33020.59	0	0
EX A1 E	33612.35	33575.72	0	0.1
Ex Sto C1	66676.62	65645.29	1033.06	0
E Moore	3482.43	3482.43	0	0
EX E S1	15940.97	15940.97	0	0
EX A1	33575.72	33575.72	0	0
W Moore	3012.51	3012.51	0	0
N621911	11331.58	11331.58	0	0
N621913	19929.85	19921.94	0	0
EX A2	33020.59	33020.59	0	0
EX BYPASS 02	1004.77	1004.77	0	0
EX BYPASS 01	775.97	775.97	0	0
Run Log for MPEStage2SMPExisting run at 14:45:41 on 27/2/2018				
The maximum water level in these storages exceeds the maximum elevation you specified: Ex Sto C1, Store A1.				
DRAINS has extrapolated the Elevation vs Storage table to a higher Elevation. Please provide accurate values for higher elevations.				
No water upwelling from any pit. Freeboard was adequate at all pits.				
The maximum flow in these overflow routes is unsafe: F EX Anzac, OF542838, F Ex G06, F Ex Carpark Bypass, F EX A1 E, F EXE S1, F EX DNSDC, Ex Channel, F EX OVER MOORE, F MPW, F EX S1, F EX G SIM, F Ex Comb SIMTA				

APPENDIX C

Developed Conditions Hydraulic Modelling

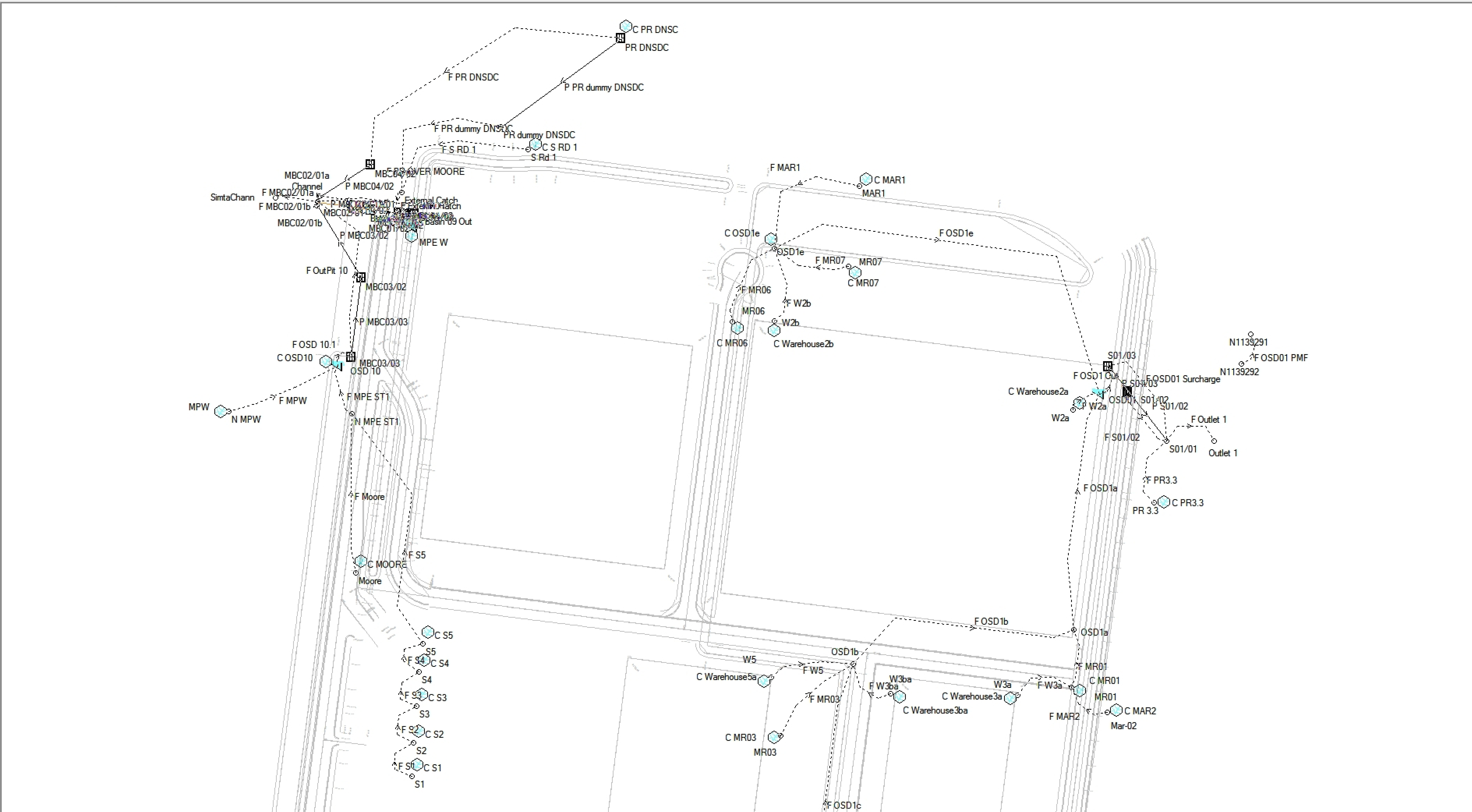
C.1 DRAINS Model Data

C.2 DRAINS Model Results

C.3 Orifice Calculations

MPEStage2SMPProposed-18-02-27.drn - DRAINS

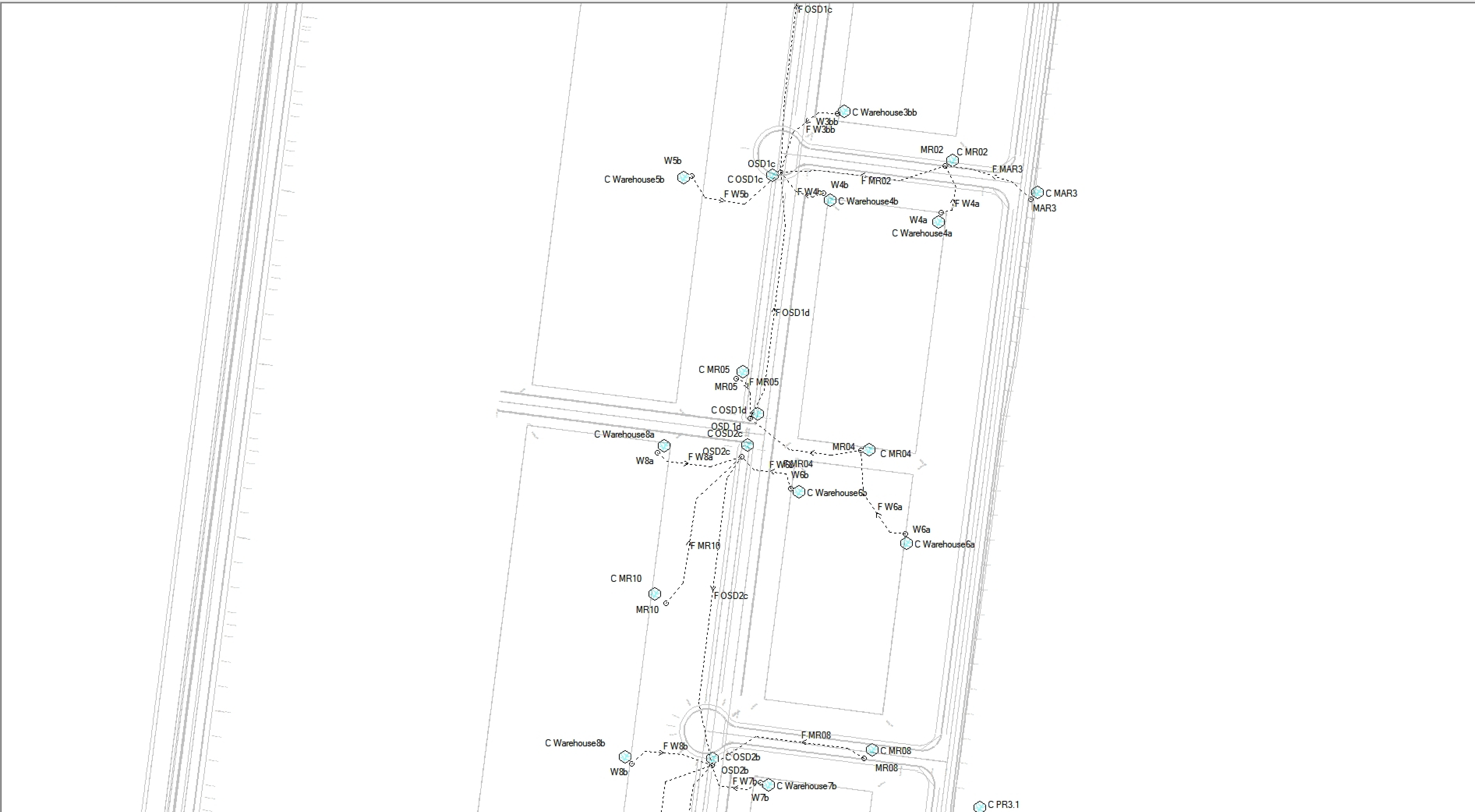
File Edit Project View Draw Run Help



Press F1 for help

MPEStage2SMPProposed-18-02-27.drn - DRAINS

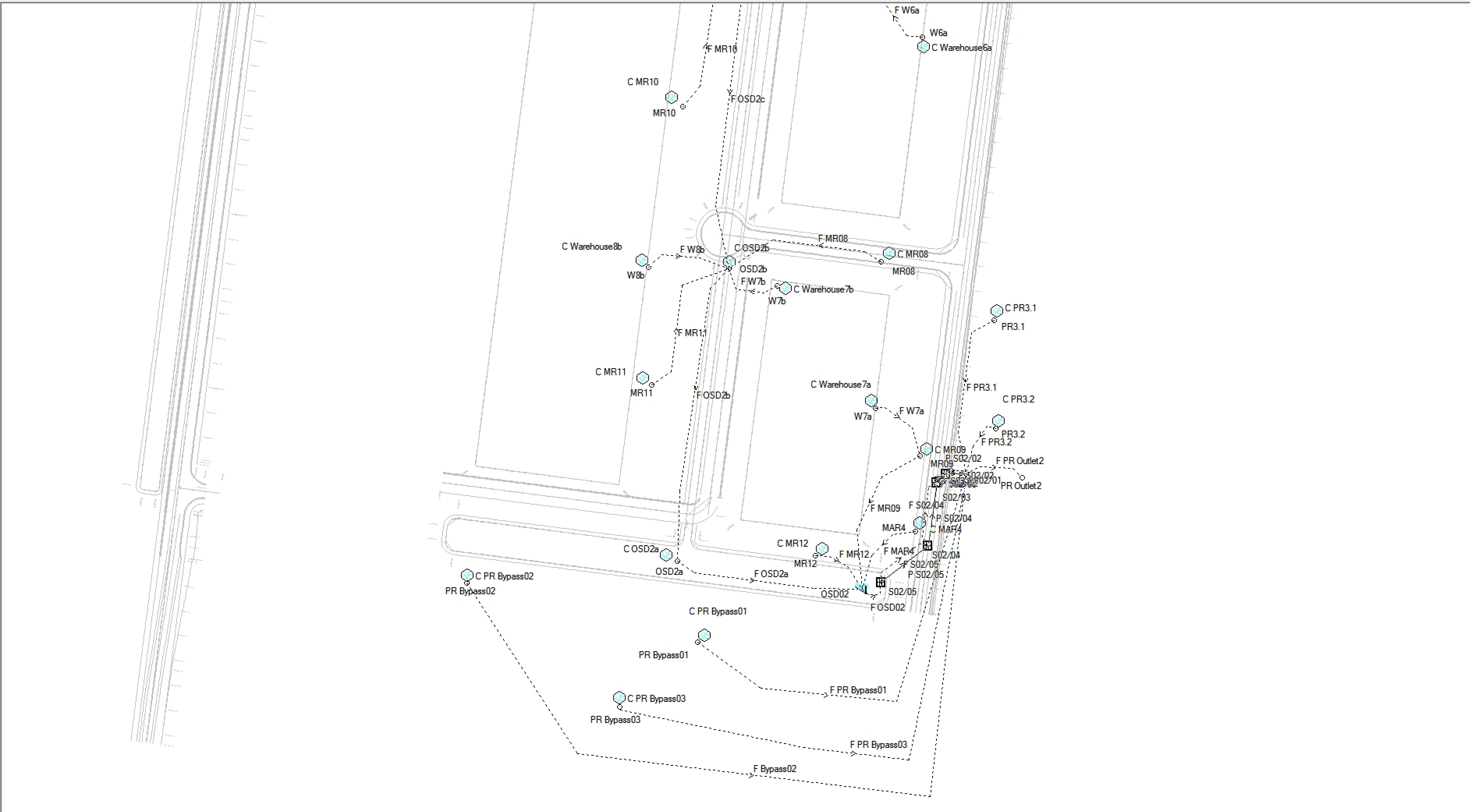
File Edit Project View Draw Run Help



Press F1 for help

MPEStage2SMPProposed-18-02-27.drn - DRAINS

File Edit Project View Draw Run Help



Press F1 for help.

Job	MPE Stage 2	**Design**	J.Ko	**Office**	Sydney
	Stormwater Management Plan	**Date**	27/02/2018	**Job No**	AA009335
		Checked	[redacted]		
		Date	27/02/2018		

Calculation Sheet

MPE Stage 2

Stormwater Management Plan

DRAINS Data and Results

Proposed Model

ARCADIS Design & Consultancy for natural and built assets

ARCADIS Design & Consultancy for natural and built assets

PROJECT MPE Stage 2
Stormwater Management Plan
TITLE DRAINS Data
Proposed Model

JOB No AA009335
PREPARED [redacted]
CHECKED [redacted]

DATE 27/02/2018
DATE 27/02/2018

DATA

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

PIT / NODE DETAILS			Version 13											
Name	Type	Family	Size	Ponding	Pressure	Surface	Max Pond	Base	Blocking	x	y	Bolt-down	id	Part Full
				Volume	Change	Elev (m)	Depth (m)	Inflow	Factor			lid		Shock Loss
				(cu.m)	Coeff. Ku			(cu.m/s)						
SimtaChann	Node							0		308022.439	6241705.452		65741915	
PR DNSDC	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		0	14		0	0	308299.167	6241833.058	No	66418895	1 x Ku
PR dummy DNSDC	Node					20		0		308202.757	6241762.019		65741985	
S5	Node					17		0		308140.506	6241348.333		103017775	
Moore	Node					17		0		308086.876	6241405.164		103017780	
S Rd 1	Node					10		0		308224.615	6241744.187		115088999	
N MPE ST1	Node					10		0		308083.764	6241532.7		116991893	
S4	Node					17		0		308137.304	6241325.92		118729372	
S3	Node					17		0		308135.703	6241298.706		118729400	
S2	Node					17		0		308133.302	6241269.089		118729401	
S1	Node					17		0		308131.701	6241242.675		118729402	
N MPW	Node					17		0		307985.221	6241534.515		119934479	
MB09	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		0.5	16.5		0	0	308133.767	6241692.068	No	396247125	1 x Ku
MBC01/02	OnGrade	Nodes	Stub Connection		0	16.6		0	0	308126.289	6241693.024	Yes	396247126	1 x Ku
MBC01/01A	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		2.5	16.6		0	0	308120.974	6241693.466	No	397043536	1 x Ku
MBC01/01	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		0.3	16.6		0	0	308098.999	6241696.335	No	397043602	1 x Ku
MBC02/01	Node					16.6		0		308056.135	6241701.983		396247151	
MBC04/02	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		2.5	13		0	0	308098.807	6241732.481	No	396247157	1 x Ku
MBC02/01a	Node					16.6		0		308057.753	6241706.51		397043634	
MBC03/03	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		0.5	17.5		0	0	308082.833	6241578.206	No	396247176	1 x Ku
MBC03/02	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		1	14.752		0	0	308090.977	6241641.979	No	396247177	1 x Ku
MBC02/01b	Node					16.6		0		308055.809	6241699.301		397043635	
S01/03	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		0.5	17.2		0	0	308689.072	6241570.82	No	396247203	1 x Ku
S01/02	OnGrade	Nodes	Stub Connection		0.2	17.905		0	0	308704.818	6241550.713	Yes	396247204	1 x Ku
S01/01	Node					12.65		0		308735.957	6241510.95		396247205	
S02/05	OnGrade	Surface Inlet Pits	Unlimited Entry Pit		0.5	17.5		0	0	308516.559	6240363.441	No	396247210	1 x Ku
S02/04	OnGrade	Junction Pits	Junction Pit 1200x1200		0.6	17.572		0	0	308554.406	6240392.697	No	396247211	1 x Ku
S02/03	OnGrade	Junction Pits	Junction Pit 1200x1200		0.6	17.31		0	0	308561.107	6240443.126	No	396247212	1 x Ku
S02/02	OnGrade	Junction Pits	Junction Pit 1200x1200		0.6	17.06		0	0	308568.466	6240450.119	No	396247213	1 x Ku
S02/01	Node					14.12		0		308584.79	6240450.133		396247214	
Outlet 1	Node							0		308773.681	6241510.861		396311066	
PR 3.3	Node							0		308725.889	6241461.157		396311070	
PR Bypass02	Node							0		308185.583	6240362.301		396311078	
PR Bypass03	Node							0		308307.512	6240263.228		396311089	
PR Bypass01	Node							0		308369.91	6240315.227		396311099	
PR3.1	Node							0		308607.124	6240572.933		396311110	
PR3.2	Node							0		308608.518	6240486.15		396311116	
PR Outlet2	Node							0		308629.627	6240447.119		396311123	
N1139291	Node							0		308803.025	6241595.923		396473222	
N1139292	Node							0		308795.454	6241572.452		396473223	
W2a	Node							0		308660.811	6241535.581		396598287	
MR01	Node							0		308659.924	6241313.317		396598291	
W3a	Node							0		308616.429	6241307.198		396598299	
OSD1b	Node							0		308485.112	6241332.407		396598306	
OSD1c	Node							0		308450.257	6241088.801		396598310	
MR02	Node							0		308581.655	6241094.011		396598314	
W3ba	Node							0		308514.702	6241308.736		396598327	
MR03	Node							0		308426.911	6241274.891		396598333	
W3bb	Node							0		308495.474	6241135.525		396598356	
W5	Node							0		308419.528	6241321.91		396598374	
OSD1a	Node							0		308661.269	6241359.725		396598386	
OSD 1d	Node							0		308425.765	6240891.543		396598413	
MR04	Node							0		308514.475	6240866.257		396598427	
W4a	Node							0		308578.712	6241056.723		396598433	
W6a	Node							0		308549.96	6240799.188		396598455	
W4b	Node							0		308484.265	6241071.786		396598463	
W5b	Node							0		308379.135	6241086.07		396598469	
MR05	Node							0		308414.531	6240923.725		396598476	
OSD1e	Node							0		308421.771	6241664.827		396598480	
MR06	Node							0		308388.536	6241606.307		396598487	
W2b	Node							0		308422.232	6241606.69		396598497	
MR07	Node							0		308481.501	6241650.651		396598504	
MAR1	Node							0		308490.138	6241714.963		396598516	
MAR2	Node							0		308688.127	6241293.252		396598526	
MAR3	Node							0		308650.342	6241066.758		396598535	
OSD2a	Node							0		308354.217	6240380.164		396618144	
OSD2b	Node							0		308395.319	6240614.025		396618153	
OSD2c	Node							0		308418.765	6240861.451		396618162	
W6b	Node							0		308458.016	6240835.284		396618169	
W7a	Node							0		308512.43	6240502.114		396618175	
W7b	Node							0		308433.866	6240600.46		396618179	
W8a	Node							0		308351.112	6240864.395		396618186	
W8b	Node							0		308330.614	6240615.382		396618190	
MR08	Node							0		308516.826	6240619.536		396618199	
MR09	Node							0		308548.039	6240464.245		396618207	
MR10	Node							0		308358.286	6240743.978		396618219	
MR11	Node							0		308333.447	6240520.86		396618231	
MR12	Node							0		308464.231	6240384.228		396618239	
MAR4	Node							0		308544.04	6240403.854		396757067	
External Catch	Node							0		308123.606	6241709.885		397054278	

DETENTION BASIN DETAILS														
Name	Elev	Volume	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)
Basin 09	13.5	0		None						308132.457	6241681.699	No		
	14.5	3500												
	15.5	7000												
	16.5	10500												
OSD 10	13.8	0		None						308072.717	6241570.761	No		
	14.8	14950												
	15.8	29900												
	16.8	44850												
OSD01	14	0		None						308682.29	6241548.283	No		
	15	14320												
	16	28640												
	17	42960												
	18	57280												
OSD02	15	0		None						308502.086	6240357.446	No		
	16	12010												
	17	24020												
	18	36030												

SUB-CATCHMENT DETAILS														
Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp
	Node	Area	Area	Area	Area	Time	Time	Time	Length	Length	Length	Slope(%)	Slope	Slope
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%
MPE W	Basin 09	11.57	100	0	0	5	0	0						
C PR DNSC	PR DNSDC	5.07	82	18	0	5	5	0						
C S5	S5	3.3	100	0	0	5	10	0						
C MOORE	Moore	3.16	100	0	0	5	10	0						
C S RD 1	S Rd 1	2.67	100	0	0	5	12	0						
C S4	S4	5.52	100	0	0	5	10	0						
C S3	S3	6.11	100	0	0	5	10	0						
C S2	S2	6.11	100	0	0	5	10	0						
C S1	S1	5.78	100	0	0	5	10	0						
MPW	N MPW	10.06	100	0	0	5	10	0						
C OSD10	OSD 10	2.36	100	0	0	5	8	0						
C PR3.3	PR 3.3	0.18	20	80	0	10	12	0						
C PR Bypass01	PR Bypass01	0.44	67	33	0	5	5	0						
C Warehouse2a	W2a	2.83	100	0	0	5	0	0						
C MR01	MR01	2.4	100	0	0	5	8	0						
C Warehouse3a	W3a	1.14	100	0	0	5	0	0						
C OSD1c	OSD1c	0.35	100	0	0	5	10	0						
C MR02	MR02	2.91	100	0	0	5	8	0						
C Warehouse3ba	W3ba	0.57	100	0	0	5	0	0						
C MR03	MR03	1.12	100	0	0	5	8	0						
C Warehouse3bb	W3bb	0.56	100	0	0	5	0	0						
C Warehouse5a	W5	0.89	100	0	0	5	0	0						
C OSD1d	OSD 1d	0.37	100	0	0	5	10	0						
C MR04	MR04	1.83	100	0	0	5	8	0						
C Warehouse4a	W4a	1.23	100	0	0	5	0	0						
C Warehouse6a	W6a	1.06	100	0	0	5	0	0						
C Warehouse4b	W4b	1.21	100	0	0	5	0	0						
C Warehouse5b	W5b	0.89	100	0	0	5	0	0						
C MR05	MR05	1.17	100	0	0	5	8	0						
C OSD1e	OSD1e	1.85	100	0	0	5	8	0						
C MR06	MR06	1.81	100	0	0	5	8	0						
C Warehouse2b	W2b	2.95	100	0	0	5	0	0						
C MR07	MR07	1.96	100	0	0	5	8	0						
C MAR1	MAR1	0.67	100	0	0	5	8	0						
C MAR2	MAR2	0.8	100	0	0	5	8	0						
C MAR3	MAR3	0.34	100	0	0	5	8	0						
C OSD2a	OSD2a	1.15	100	0	0	5	10	0						
C OSD2b	OSD2b	0.37	100	0	0	5	10	0						
C OSD2c	OSD2c	0.33	100	0	0	5	10	0						
C Warehouse6b	W6b	1.04	100	0	0	5	0	0						
C Warehouse7a	W7a	1.23	100	0	0	5	0	0						
C Warehouse7b	W7b	1.21	100	0	0	5	0	0						
C Warehouse8a	W8a	0.89	100	0	0	5	0	0						
C Warehouse8b	W8b	0.89	100	0	0	5	0	0						
C MR08	MR08	2.04	100	0	0	5	8	0						
C MR09	MR09	1.14	100	0	0	5	8	0						
C MR10	MR10	1.05	100	0	0	5	8	0						
C MR11	MR11	1.19	100	0	0	5	8	0						
C MR12	MR12	0.92	100	0	0	5	8	0						
C MAR4	MAR4	0.99	100	0	0	5	0	0						
Name	Pit or	Total	Impervious	Avg	Mannings	Time lag	Rainfall	Hydrological						
	Node	Area	Area	Slope(%)	n	(mins)	Multiplier	Model						
C PR Bypass02	PR Bypass02	0.59	0	0.2	0.06	0		Moorebank RAFTS						
C PR Bypass03	PR Bypass03	0.53	0	0.3	0.06	0		Moorebank RAFTS						
C PR3.1	PR3.1	0.28	0	2	0.07	0		Moorebank RAFTS						
C PR3.2	PR3.2	0.21	0	2	0.07	0		Moorebank RAFTS						
PIPE DETAILS														
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pipes	Chg From	At Chg
			(m)	(m)	(m)	(%)		(mm)	(mm)					
P PR dummy DNSDC	PR DNSDC	PR dummy DNSDC	10	10	9.9	1	RCP Class 2	600	600	0.6	New	1	PR DNSDC	0
P S09/02	MB09	MBC01/02	6.5	11.702	11.669	0.51	Box Culverts	1.8W x 1.5H		0.6	NewFixed	3	MB09	0
P MBC01/02	MBC01/02	MBC01/01A	5	11.669	11.651	0.36	Box Culverts	1.8W x 1.5H		0.6	NewFixed	3	MBC01/02	0
P MBC01/01A	MBC01/01A	MBC01/01	24.634	11.631	11.417	0.87	Box Culverts	1.8W x 1.5H		0.6	NewFixed	3	MBC01/01A	0
MBC02/02	MBC01/01	MBC02/01	20.4	10.692	10.431	1.28	Box Culverts	3.6W x 3.375H		0.3	Existing	2	MBC01/01	0
P MBC04/02	MBC04/02	MBC02/01a	50.037	10.752	10.5	0.5	Box Culverts	1.2W x 0.9H		0.6	NewFixed	4	MBC04/02	0
P MBC03/03	MBC03/03	MBC03/02	64.291	12.05	11.29	1.18	Box Culverts	2.1W x 0.9H		0.6	NewFixed	1	MBC03/03	0
P MBC03/02	MBC03/02	MBC02/01b	66.888	11.29	10.5	1.18	Box Culverts	2.1W x 0.9H		0.6	NewFixed	1	MBC03/02	0
P S01/03	S01/03	S01/02	25.538	12.45	12.323	0.5	Box Culverts	1.2W x 0.6H		0.6	NewFixed	4	S01/03	0
P S01/02	S01/02	S01/01	50.505	12.303	12.05	0.5	Box Culverts	1.2W x 0.6H		0.6	NewFixed	4	S01/02	0
P S02/05	S02/05	S02/04	47.836	13.846	13.607	0.5	Box Culverts	1.5W x 0.9H		0.6	NewFixed	3	S02/05	0
P S02/04	S02/04	S02/03	50.872	13.607	13.352	0.5	Box Culverts	1.5W x 0.9H		0.6	NewFixed	3	S02/04	0
P S02/03	S02/03	S02/02	10.152	13.352	13.302	0.49	Box Culverts	1.5W x 0.9H		0.6	NewFixed	3	S02/03	0
P S02/02	S02/02	S02/01	16.324	13.302	13.22	0.5	Box Culverts	1.5W x 0.9H		0.6	NewFixed	3	S02/02	0
DETAILS of SERVICES CROSSING PIPES														
Pipe	Chg	Bottom	Height of Service	Chg	Bottom	Height of Service	Chg	Bottom	Height of Service	etc				
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc				
CHANNEL DETAILS														
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Width	L.B. Slope	R.B. Slope	Manning	Depth	Roofed	
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)		

OVERFLOW ROUTE DETAILS														
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Depth	SafeDepth	Safe	Bed	D/S Area		id
			Time	Level	Length	Coeff. C	Section	Major Storms	Minor Storms	DxV	Slope	Contributing		
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%		
Basin 09 Out	Basin 09	MB09	0.1	13.5			Dummy for OSD Weirs	1	1	1	1	0		365435465
F PR DNSDC	PR DNSDC	MBC04/02	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		65742028
F PR dummy DNSDC	PR dummy DNSDC	External Catch	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		66418902
F S5	S5	N MPE ST1	8				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		103017786
F Moore	Moore	N MPE ST1	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		103017785
F S RD 1	S Rd 1	External Catch	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		115089004
F MPE ST1	N MPE ST1	OSD 10	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		66886581
F S4	S4	S5	4				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		118729374
F S3	S3	S4	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		118729376
F S2	S2	S3	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		118729382
F S1	S1	S2	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		118729389
F MPW	N MPW	OSD 10	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		119934499
F OSD 10.1	OSD 10	MBC03/03	0.1	13.8			Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		392918133
F PR OVER MOORE	MB09	MBC02/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		66418832
F MBC01/02	MBC01/02	MBC01/01A	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397059610
F MBC01/01A	MBC01/01A	MBC01/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397059606
F MBC01/01	MBC01/01	MBC02/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397043596
Channel	MBC02/01	SimtaChann	5				Concrete Channel	0.2	0.15	0.4	1	0		65745589
F MBC02/01a	MBC02/01a	MBC02/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397043638
F OutPit 10	MBC03/03	MBC02/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		119491597
F MBC02/01b	MBC02/01b	MBC02/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397043639
F OSD01 Surcharge	S01/03	S01/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396467363
F S01/02	S01/02	S01/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397064959
F Outlet 1	S01/01	Outlet 1	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396311065
F S02/05	S02/05	S02/04	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397064967
F S02/04	S02/04	S02/03	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397064968
F S02/03	S02/03	S02/02	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397064969
F S02/02	S02/02	S02/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397064970
F PR Outlet2	S02/01	PR Outlet2	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396311122
F OSD1 Out	OSD01	S01/03	0.1	14			Dummy for OSD Weirs	1	1	1	1	0		396247221
F OSD02	OSD02	S02/05	0.1	15			Dummy for OSD Weirs	1	1	1	1	0		396247245
F PR3.3	PR 3.3	S01/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396311069
F Bypass02	PR Bypass02	S02/01	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396311080
F PR Bypass03	PR Bypass03	S02/01	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396311091
F PR Bypass01	PR Bypass01	S02/01	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396311101
F PR3.1	PR3.1	S02/01	3				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396311112
F PR3.2	PR3.2	S02/01	1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396311115
F OSD01 PMF	N1139292	N1139291	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396473209
F W2a	W2a	OSD01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598411
F MR01	MR01	OSD1a	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598529
F W3a	W3a	MR01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598301
F OSD1b	OSD1b	OSD1a	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598340
F OSD1c	OSD1c	OSD1b	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598318
F MR02	MR02	OSD1c	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598322
F W3ba	W3ba	OSD1b	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598329
F MR03	MR03	OSD1b	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598335
F W3bb	W3bb	OSD1c	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598358
F W5	W5	OSD1b	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598376
F OSD1a	OSD1a	OSD01	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598294
F OSD1d	OSD 1d	OSD1c	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598422
F MR04	MR04	OSD 1d	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598428
F W4a	W4a	MR02	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598443
F W6a	W6a	MR04	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598457
F W4b	W4b	OSD1c	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598464
F W5b	W5b	OSD1c	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598471
F MR05	MR05	OSD 1d	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598478
F OSD1e	OSD1e	OSD01	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598509
F MR06	MR06	OSD1e	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598490
F W2b	W2b	OSD1e	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598499
F MR07	MR07	OSD1e	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598506
F MAR1	MAR1	OSD1e	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598518
F MAR2	MAR2	MR01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598523
F MAR3	MAR3	MR02	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396598537
F OSD2a	OSD2a	OSD02	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618149
F OSD2b	OSD2b	OSD2a	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618155
F OSD2c	OSD2c	OSD2b	5				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618160
F W6b	W6b	OSD2c	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618171
F W7a	W7a	MR09	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618209
F W7b	W7b	OSD2b	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618243
F W8a	W8a	OSD2c	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618194
F W8b	W8b	OSD2b	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618192
F MR08	MR08	OSD2b	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618203
F MR09	MR09	OSD02	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618212
F MR10	MR10	OSD2c	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618221
F MR11	MR11	OSD2b	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618234
F MR12	MR12	OSD02	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396618241
F MAR4	MAR4	OSD02	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		396757070
F External Catch	External Catch	MBC01/01A	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0		397054279

PIPE COVER DETAILS					
Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)	
P PR dummy DNSDC	RCP Class 2	600	0.6	3.35	
P S09/02	Box Culverts	0	0.6	-1.57	Unsafe
P MBC01/02	Box Culverts	0	0.6	-1.78	Unsafe
P MBC01/01A	Box Culverts	0	0.6	-1.63	Unsafe
MBC02/02	Box Culverts	0	0.6	2.33	
P MBC04/02	Box Culverts	0	0.6	1.3	
P MBC03/03	Box Culverts	0	0.6	1.3	
P MBC03/02	Box Culverts	0	0.6	1.26	
P S01/03	Box Culverts	0	0.6	0.6	
P S01/02	Box Culverts	0	0.6	-0.66	Unsafe
P S02/05	Box Culverts	0	0.6	-0.45	Unsafe
P S02/04	Box Culverts	0	0.6	2.95	
P S02/03	Box Culverts	0	0.6	2.75	
P S02/02	Box Culverts	0	0.6	-0.58	Unsafe

This model has no pipes with non-return valves

PROJECT	MPE Stage 2
	Stormwater Management Plan
TITLE	DRAINS Results
	Proposed Model - 1 Year ARI

JOB No	AA009335		
PREPARED	J[redacted]	**DATE**	27/02/2018
CHECKED	[redacted]	**DATE**	27/02/2018

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

DRAINS results prepared from Version 2017.10

1 YEAR ARI

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
PR DNSDC	10.72		1.058		3.28	0	None
PR dummy DNSDC	10.48		0				
MB09	11.93		0.249		4.57	0	None
MBC01/02	11.93		0		4.67	0	None
MBC01/01A	11.93		1.673		4.67	0	None
MBC01/01	10.85		0		5.75	0	None
MBC02/01	10.54		1.731				
MBC04/02	10.75		0		2.25		None
MBC02/01a	10.5		0				
MBC03/03	12.42		1.731		5.08	0	None
MBC03/02	11.72		0		3.03		None
MBC02/01b	10.74		0				
S01/03	12.6		0.796		4.6	0	None
S01/02	12.44		0		5.47	0	None
S01/01	12.17		0.014				
S02/05	13.87		0.058		3.63	0	None
S02/04	13.63		0		3.94	0	None
S02/03	13.38		0		3.93	0	None
S02/02	13.33		0		3.73	0	None
S02/01	13.24		0.083				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
MPE W	2.687	2.687	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C PR DNSC	1.058	0.966	0.093	5	5	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C S5	0.766	0.766	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MOORE	0.734	0.734	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C S RD 1	0.62	0.62	0	5	12	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C S4	1.282	1.282	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C S3	1.419	1.419	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C S2	1.419	1.419	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C S1	1.342	1.342	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
MPW	2.336	2.336	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C OSD10	0.548	0.548	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C PR3.3	0.014	0.006	0.009	10	12	0	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
C PR Bypass01	0.083	0.064	0.02	5	5	0	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
C Warehouse2a	0.657	0.657	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR01	0.557	0.557	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse3a	0.265	0.265	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C OSD1c	0.081	0.081	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR02	0.676	0.676	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse3ba	0.132	0.132	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR03	0.26	0.26	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse3bb	0.13	0.13	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse5a	0.207	0.207	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C OSD1d	0.086	0.086	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR04	0.425	0.425	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse4a	0.286	0.286	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse6a	0.246	0.246	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse4b	0.281	0.281	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse5b	0.207	0.207	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR05	0.272	0.272	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C OSD1e	0.43	0.43	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR06	0.42	0.42	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse2b	0.685	0.685	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR07	0.455	0.455	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MAR1	0.156	0.156	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MAR2	0.186	0.186	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MAR3	0.079	0.079	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C OSD2a	0.267	0.267	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C OSD2b	0.086	0.086	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C OSD2c	0.077	0.077	0	5	10	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse6b	0.242	0.242	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse7a	0.286	0.286	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse7b	0.281	0.281	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse8a	0.207	0.207	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C Warehouse8b	0.207	0.207	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR08	0.474	0.474	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR09	0.265	0.265	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR10	0.244	0.244	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR11	0.276	0.276	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MR12	0.214	0.214	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
C MAR4	0.23	0.23	0	5	0	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1

Name	Max Flow (cu.m/s)	Due to Storm
C PR Bypass02	0.01	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1
C PR Bypass03	0.011	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1
C PR3.1	0.013	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1
C PR3.2	0.01	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1

Outflow Volumes for Total Catchment (106 impervious + 2.81 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 15 minutes storm, av	14982.75	13550.43 (90.4%)	13532.47 (92.7%)	17.96 (4.7%)
AR&R 1 year, 25 minutes storm, av	19523.75	17991.72 (92.2%)	17956.63 (94.4%)	35.09 (7.0%)
AR&R 1 year, 45 minutes storm, av	25550.18	23875.90 (93.4%)	23782.95 (95.5%)	92.95 (14.1%)
AR&R 1 year, 1 hour storm, average	28790.63	27044.83 (93.9%)	26902.43 (95.9%)	142.40 (19.2%)
AR&R 1 year, 1.5 hours storm, aver	33700.48	31832.01 (94.5%)	31633.62 (96.3%)	198.40 (22.9%)
AR&R 1 year, 2 hours storm, averag	37470.98	35569.89 (94.9%)	35322.55 (96.8%)	247.35 (25.7%)
AR&R 1 year, 3 hours storm, averag	43281.56	41239.71 (95.3%)	40944.10 (97.1%)	295.62 (26.5%)
AR&R 1 year, 4.5 hours storm, aver	49858.1	47763.84 (95.8%)	47410.88 (97.6%)	352.97 (27.5%)
AR&R 1 year, 6 hours storm, averag	55120.41	53036.83 (96.2%)	52631.50 (98.0%)	405.33 (28.6%)
AR&R 1 year, 9 hours storm, averag	63552.13	61347.44 (96.5%)	60813.77 (98.2%)	533.67 (32.6%)
AR&R 1 year, 12 hours storm, avera	70366.37	68076.26 (96.7%)	67426.52 (98.4%)	649.75 (35.9%)
AR&R 1 year, 18 hours storm, avera	81289.9	78764.23 (96.9%)	78185.45 (98.7%)	578.78 (27.7%)

PIPE DETAILS					
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
P PR dummy DNSDC	1.062	3.77	10.72	10.49	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
P S09/02	0.25	0.2	11.93	11.928	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
P MBC01/02	0.282	0.2	11.928	11.928	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
P MBC01/01A	1.821	2.42	11.77	11.577	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
MBC02/02	1.82	2.24	10.805	10.544	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
P MBC04/02	0	0	10.752	10.5	AR&R 1 year, 15 minutes storm, average 54.8 mm/h, Zone 1
P MBC03/03	1.731	3.38	12.294	11.721	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1
P MBC03/02	1.731	3.38	11.534	10.744	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1
P S01/03	0.796	1.4	12.569	12.442	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1
P S01/02	0.796	1.4	12.421	12.169	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1
P S02/05	0.06	0.63	13.867	13.633	AR&R 1 year, 18 hours storm, average 4.1 mm/h, Zone 1
P S02/04	0.058	0.64	13.627	13.378	AR&R 1 year, 18 hours storm, average 4.1 mm/h, Zone 1
P S02/03	0.058	0.63	13.373	13.327	AR&R 1 year, 18 hours storm, average 4.1 mm/h, Zone 1
P S02/02	0.058	0.64	13.322	13.245	AR&R 1 year, 18 hours storm, average 4.1 mm/h, Zone 1

CHANNEL DETAILS					
Name	Max Q	Max V			Due to Storm
	(cu.m/s)	(m/s)			

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
Basin 09 Out	0.249	0.249	0	0.003	0	499.9	0.15	AR&R 1 year, 3 hours storm, average 13.2 mm/h, Zone 1
F PR DNSDC	0	0	0	0	0	0	0	
F PR dummy DNSDC	1.062	1.062	0	0.082	0.09	20.43	1.13	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F S5	3.488	3.488	0	0.135	0.2	31.03	1.51	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F Moore	0.734	0.734	0	0.07	0.07	18.1	1.02	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F S RD 1	0.62	0.62	0	0.066	0.06	17.2	0.97	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MPE ST1	3.648	3.648	0	0.138	0.21	31.57	1.53	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F S4	3.215	3.215	0	0.131	0.19	30.13	1.48	AR&R 1 year, 1 hour storm, average 26.3 mm/h, Zone 1
F S3	2.882	2.882	0	0.125	0.18	29.06	1.43	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F S2	2.375	2.375	0	0.115	0.16	27.08	1.37	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F S1	1.342	1.342	0	0.091	0.11	22.23	1.18	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MPW	2.336	2.336	0	0.115	0.16	26.9	1.37	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD 10.1	1.731	1.731	0	0.101	0.13	24.21	1.27	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1
F PR OVER MOORE	0	0	0	0	0	0	0	
F MBC01/02	0	0	0	0	0	0	0	
F MBC01/01A	0	0	3.995	0	0	0	0	
F MBC01/01	0	0	3.766	0	0	0	0	
Channel	2.3	2.3	0	0.394	1.14	2.42	2.9	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1
F MBC02/01a	0	0	4.139	0	0	0	0	
F OutPit 10	0	0	0	0	0	0	0	
F MBC02/01b	1.731	1.731	4.248	0.101	0.13	24.21	1.27	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1
F OSD01 Surcharge	0	0	0	0	0	0	0	
F S01/02	0	0	0	0	0	0	0	
F Outlet 1	0.797	0.797	0	0.073	0.08	18.64	1.04	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1
F S02/05	0	0	4.13	0	0	0	0	
F S02/04	0	0	4.254	0	0	0	0	
F S02/03	0	0	3.937	0	0	0	0	
F S02/02	0	0	4.182	0	0	0	0	
F PR Outlet2	0.119	0.119	0	0.035	0.02	10.91	0.6	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F OSD1 Out	0.796	0.796	0	0.006	0	499.9	0.25	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1
F OSD02	0.058	0.058	0	0.002	0	499.9	0.08	AR&R 1 year, 18 hours storm, average 4.1 mm/h, Zone 1
F PR3.3	0.014	0.014	0	0.016	0.01	5.24	0.34	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F Bypass02	0.01	0.01	0	0.014	0	4.64	0.32	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1
F PR Bypass03	0.011	0.011	0	0.015	0	4.94	0.31	AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1
F PR Bypass01	0.083	0.083	0	0.031	0.02	10.2	0.52	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1
F PR3.1	0.013	0.013	0	0.016	0.01	5.24	0.32	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1
F PR3.2	0.01	0.01	0	0.014	0	4.64	0.32	AR&R 1 year, 12 hours storm, average 5.4 mm/h, Zone 1
F OSD01 PMF	0	0	0	0	0	0	0	
F W2a	0.657	0.657	0	0.068	0.07	17.56	0.98	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR01	1.003	1.003	0	0.08	0.09	20.08	1.11	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W3a	0.265	0.265	0	0.047	0.04	13.43	0.75	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD1b	2.602	2.602	0	0.12	0.17	27.98	1.4	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD1c	2.464	2.464	0	0.117	0.16	27.44	1.38	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR02	1.036	1.036	0	0.081	0.09	20.25	1.12	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W3ba	0.132	0.132	0	0.036	0.02	11.27	0.61	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR03	0.26	0.26	0	0.046	0.04	13.25	0.77	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W3bb	0.13	0.13	0	0.036	0.02	11.27	0.6	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W5	0.207	0.207	0	0.043	0.03	12.53	0.71	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD1a	2.778	2.778	0	0.123	0.18	28.7	1.42	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD1d	1.023	1.023	0	0.081	0.09	20.25	1.11	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR04	0.668	0.668	0	0.068	0.07	17.56	1	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W4a	0.286	0.286	0	0.048	0.04	13.61	0.79	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W6a	0.246	0.246	0	0.045	0.03	13.07	0.75	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W4b	0.281	0.281	0	0.048	0.04	13.61	0.77	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W5b	0.207	0.207	0	0.043	0.03	12.53	0.71	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR05	0.272	0.272	0	0.047	0.04	13.43	0.77	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD1e	2.133	2.133	0	0.11	0.15	26	1.34	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR06	0.42	0.42	0	0.056	0.05	15.23	0.88	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W2b	0.685	0.685	0	0.069	0.07	17.74	1	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR07	0.455	0.455	0	0.058	0.05	15.58	0.9	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MAR1	0.156	0.156	0	0.038	0.02	11.63	0.65	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MAR2	0.186	0.186	0	0.041	0.03	12.17	0.69	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MAR3	0.079	0.079	0	0.03	0.02	10.02	0.52	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD2a	1.93	1.93	0	0.106	0.14	25.1	1.31	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD2b	1.87	1.87	0	0.105	0.13	24.92	1.29	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F OSD2c	0.766	0.766	0	0.072	0.07	18.46	1.02	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W6b	0.242	0.242	0	0.045	0.03	13.07	0.74	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W7a	0.286	0.286	4.185	0.048	0.04	13.61	0.79	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W7b	0.281	0.281	0	0.048	0.04	13.61	0.77	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W8a	0.207	0.207	0	0.043	0.03	12.53	0.71	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F W8b	0.207	0.207	0	0.043	0.03	12.53	0.71	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR08	0.474	0.474	4.182	0.059	0.05	15.76	0.91	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR09	0.547	0.547	0	0.062	0.06	16.48	0.94	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR10	0.244	0.244	0	0.045	0.03	13.07	0.75	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR11	0.276	0.276	4.42	0.048	0.04	13.61	0.76	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MR12	0.214	0.214	4.135	0.044	0.03	12.71	0.7	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F MAR4	0.23	0.23	4.155	0.044	0.03	12.89	0.73	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1
F External Catch	1.673	1.673	0	0.1	0.12	24.03	1.25	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1

DETENTION BASIN DETAILS					
Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
Basin 09	14.23	2541.8	0.249	0	0.249
OSD 10	14.29	7359.1	1.731	0	1.731
OSD01	14.79	11381.1	0.796	0	0.796
OSD02	15.66	7936.2	0.058	0	0.058

CONTINUITY CHECK for AR&R 1 year, 9 hours storm, average 6.5 mm/h, Zone 1				
Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Basin 09	6612.23	6609.06	3.21	0
SimtaChann	34345.67	34345.67	0	0
PR DNSDC	2465.66	2465.74	0	0
PR dummy DNSDC	2465.74	2465.74	0	0
S5	15327.63	15327.63	0	0
Moore	1805.94	1805.94	0	0
S Rd 1	1525.91	1525.91	0	0
N MPE ST1	17133.47	17133.56	0	0
S4	13441.75	13441.7	0	0
S3	10287.02	10287.01	0	0
S2	6795.17	6795.13	0	0
S1	3303.27	3303.27	0	0
N MPW	5749.3	5749.3	0	0
OSD 10	24231.4	23762.76	469.4	0
MB09	6609.06	6608.19	0	0
MBC01/02	6608.19	6610.36	0	0
MBC01/01A	10601.95	10558.85	0	0.4
MBC01/01	10558.85	10595.72	0	-0.3
MBC02/01	34348.02	34345.67	0	0
MBC04/02	0	0	0	0
MBC02/01a	0	0	0	0
MBC03/03	23762.76	23766.93	0	0
MBC03/02	23766.93	23753.46	0	0.1
MBC02/01b	23753.46	23752.3	0	0
S01/03	11367.3	11348.34	0	0.2
S01/02	11348.34	11340.27	0	0.1
S01/01	11374.98	11368.76	0	0.1
S02/05	2420.41	2411.86	0	0.4
S02/04	2411.86	2406.64	0	0.2
S02/03	2406.64	2401.98	0	0.2
S02/02	2401.98	2399.86	0	0.1
S02/01	2960.27	2957.8	0	0.1
OSD01	17665	11367.3	6300.89	0
OSD02	8252.45	2420.41	5832.99	0
Outlet 1	11368.76	11368.76	0	0
PR 3.3	34.72	34.72	0	0
PR Bypass02	128.48	128.48	0	0
PR Bypass03	121.98	121.98	0	0
PR Bypass01	182.75	182.75	0	0
PR3.1	72.56	72.56	0	0
PR3.2	54.64	54.64	0	0
PR Outlet2	2957.8	2957.8	0	0
N1139291	0	0	0	0
N1139292	0	0	0	0
W2a	1617.34	1617.34	0	0
MR01	2480.3	2480.32	0	0
W3a	651.51	651.51	0	0
OSD1b	8286.77	8286.76	0	0
OSD1c	6812.21	6812.29	0	0
MR02	2560.33	2560.33	0	0
W3ba	325.75	325.75	0	0
MR03	640.08	640.08	0	0
W3bb	320.04	320.04	0	0
W5	508.64	508.64	0	0
OSD1a	10767.03	10767.05	0	0
OSD 1d	2531.74	2531.75	0	0
MR04	1651.64	1651.63	0	0
W4a	702.95	702.95	0	0
W6a	605.79	605.79	0	0
W4b	691.52	691.52	0	0
W5b	508.64	508.64	0	0
MR05	668.66	668.66	0	0
OSD1e	5280.71	5280.65	0	0
MR06	1034.42	1034.42	0	0
W2b	1685.92	1685.92	0	0
MR07	1120.14	1120.14	0	0
MAR1	382.91	382.91	0	0
MAR2	457.2	457.2	0	0
MAR3	194.31	194.31	0	0
OSD2a	5806.49	5806.42	0	0
OSD2b	5149.19	5149.21	0	0
OSD2c	1891.67	1891.67	0	0
W6b	594.36	594.36	0	0
W7a	702.95	702.95	0	0
W7b	691.52	691.52	0	0
W8a	508.64	508.64	0	0
W8b	508.64	508.64	0	0
MR08	1165.86	1165.86	0	0
MR09	1354.45	1354.46	0	0
MR10	600.07	600.07	0	0
MR11	680.09	680.09	0	0
MR12	525.78	525.78	0	0
MAR4	565.79	565.79	0	0
External Catch	3991.63	3991.64	0	0

Run Log for MPEStage2SMPProposed run at 15:11:00 on 27/2/2018

No water upwelling from any pit. Freeboard was adequate at all pits.

The maximum flow in these overflow routes is unsafe: Channel

These overflow routes carried water uphill (adding energy): F OSD02, F OSD1 Out, F OSD 10.1, Basin 09 Out.

These results may be invalid. You should check for water flowing round in circles (e.g. negative flow in adjacent pipes) at these locations. You may need to reformulate the model.

ARCADIS Design & Consultancy for natural and built assets

PROJECT MPE Stage 2
Stormwater Management Plan
TITLE DRAINS Results
Proposed Model - 10 Year ARI

JOB No AA009335
PREPARED [redacted] **DATE** 27/02/2018
CHECKED [redacted] **DATE** 27/02/2018

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

DRAINS results prepared from Version 2017.10

10 YEAR ARI

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
PR DNSDC	11.37		2.055		2.63	0	None
PR dummy DNSDC	10.48		0				
MB09	12.08		0.737		4.42	0	None
MBC01/02	12.08		0		4.52	0	None
MBC01/01A	12.08		3.161		4.52	0	None
MBC01/01	10.92		0		5.68	0	None
MBC02/01	10.6		2.345				
MBC04/02	10.75		0		2.25		None
MBC02/01a	10.5		0				
MBC03/03	12.5		2.345		5	0	None
MBC03/02	11.82		0		2.94		None
MBC02/01b	10.8		0				
S01/03	12.7		1.713		4.5	0	None
S01/02	12.52		0		5.38	0	None
S01/01	12.25		0.046				
S02/05	13.97		0.568		3.53	0	None
S02/04	13.74		0		3.84	0	None
S02/03	13.48		0		3.83	0	None
S02/02	13.43		0		3.63	0	None
S02/01	13.32		0.212				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
MPE W	4.83	4.83	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C PR DNSC	2.055	1.735	0.319	5	5	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C S5	1.377	1.377	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MOORE	1.319	1.319	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C S RD 1	1.115	1.115	0	5	12	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C S4	2.304	2.304	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C S3	2.55	2.55	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C S2	2.55	2.55	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C S1	2.413	2.413	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
MPW	4.199	4.199	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C OSD10	0.985	0.985	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C PR3.3	0.046	0.011	0.035	10	12	0	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
C PR Bypass01	0.174	0.123	0.051	5	5	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse2a	1.181	1.181	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR01	1.002	1.002	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse3a	0.476	0.476	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C OSD1c	0.146	0.146	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR02	1.215	1.215	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse3ba	0.238	0.238	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR03	0.468	0.468	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse3bb	0.234	0.234	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse5a	0.372	0.372	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C OSD1d	0.154	0.154	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR04	0.764	0.764	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse4a	0.513	0.513	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse6a	0.442	0.442	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse4b	0.505	0.505	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse5b	0.372	0.372	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR05	0.488	0.488	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C OSD1e	0.772	0.772	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR06	0.756	0.756	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse2b	1.231	1.231	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR07	0.818	0.818	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MAR1	0.28	0.28	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MAR2	0.334	0.334	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MAR3	0.142	0.142	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C OSD2a	0.48	0.48	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C OSD2b	0.154	0.154	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C OSD2c	0.138	0.138	0	5	10	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse6b	0.434	0.434	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse7a	0.513	0.513	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse7b	0.505	0.505	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse8a	0.372	0.372	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C Warehouse8b	0.372	0.372	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR08	0.852	0.852	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR09	0.476	0.476	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR10	0.438	0.438	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR11	0.497	0.497	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MR12	0.384	0.384	0	5	8	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
C MAR4	0.413	0.413	0	5	0	0	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1

Name	Max Flow (cu.m/s)	Due to Storm
C PR Bypass02	0.036	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1
C PR Bypass03	0.037	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1
C PR3.1	0.034	AR&R 10 year, 4.5 hours storm, average 18.7 mm/h, Zone 1
C PR3.2	0.026	AR&R 10 year, 4.5 hours storm, average 18.7 mm/h, Zone 1

Outflow Volumes for Total Catchment (106 impervious + 2.81 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 15 minutes storm, a	26963.67	25369.66 (94.1%)	25155.04 (95.8%)	214.62 (30.9%)
AR&R 10 year, 25 minutes storm, a	35091.2	33436.20 (95.3%)	33053.46 (96.7%)	382.73 (42.4%)
AR&R 10 year, 45 minutes storm, a	46053.9	44315.46 (96.2%)	43715.23 (97.4%)	600.24 (50.7%)
AR&R 10 year, 1 hour storm, averag	52042.07	50275.83 (96.6%)	49559.74 (97.7%)	716.08 (53.5%)
AR&R 10 year, 1.5 hours storm, ave	61224.25	59390.64 (97.0%)	58508.59 (98.1%)	882.05 (56.0%)
AR&R 10 year, 2 hours storm, avera	68336.31	66482.25 (97.3%)	65471.96 (98.3%)	1010.29 (57.5%)
AR&R 10 year, 3 hours storm, avera	79421.05	77483.23 (97.6%)	76290.67 (98.6%)	1192.56 (58.4%)
AR&R 10 year, 4.5 hours storm, ave	92095.93	90026.05 (97.8%)	88644.44 (98.8%)	1381.61 (58.3%)
AR&R 10 year, 6 hours storm, avera	102361.01	100184.09 (97.9%)	98651.72 (98.9%)	1532.38 (58.2%)
AR&R 10 year, 9 hours storm, avera	119153.4	116743.81 (98.0%)	115012.77 (99.1%)	1731.04 (56.5%)
AR&R 10 year, 12 hours storm, ave	133087.89	130458.03 (98.0%)	128489.84 (99.1%)	1968.19 (57.5%)
AR&R 10 year, 18 hours storm, ave	156022.41	153017.72 (98.1%)	150925.06 (99.3%)	2092.66 (52.1%)

PIPE DETAILS								
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm			
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)				
P PR dummy DNSDC	2.059	7.28	11.372	10.5	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
P S09/02	0.739	0.36	12.081	12.08	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1			
P MBC01/02	0.745	0.34	12.08	12.079	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1			
P MBC01/01A	3.348	2.93	11.843	11.654	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
MBC02/02	3.35	2.83	10.856	10.595	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
P MBC04/02	0	0	10.752	10.5	AR&R 10 year, 15 minutes storm, average 98.7 mm/h, Zone 1			
P MBC03/03	2.345	3.76	12.347	11.817	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1			
P MBC03/02	2.345	3.76	11.587	10.799	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1			
P S01/03	1.713	1.82	12.646	12.525	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1			
P S01/02	1.713	1.83	12.498	12.248	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1			
P S02/05	0.568	1.26	13.946	13.736	AR&R 10 year, 12 hours storm, average 10.1 mm/h, Zone 1			
P S02/04	0.568	1.26	13.707	13.482	AR&R 10 year, 12 hours storm, average 10.1 mm/h, Zone 1			
P S02/03	0.568	1.25	13.453	13.431	AR&R 10 year, 12 hours storm, average 10.1 mm/h, Zone 1			
P S02/02	0.568	1.26	13.402	13.32	AR&R 10 year, 12 hours storm, average 10.1 mm/h, Zone 1			
CHANNEL DETAILS								
Name	Max Q	Max V			Due to Storm			
	(cu.m/s)	(m/s)						
OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
Basin 09 Out	0.737	0.737	0	0.006	0	499.9	0.23	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1
F PR DNSDC	0	0	0	0	0	0	0	
F PR dummy DNSDC	2.059	2.059	0	0.109	0.14	25.82	1.31	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F S5	6.336	6.336	0	0.173	0.3	38.57	1.75	AR&R 10 year, 1.5 hours storm, average 37.3 mm/h, Zone 1
F Moore	1.319	1.319	0	0.09	0.11	22.05	1.18	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F S RD 1	1.115	1.115	0	0.084	0.1	20.79	1.14	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MPE ST1	6.628	6.628	0	0.176	0.31	39.11	1.78	AR&R 10 year, 1.5 hours storm, average 37.3 mm/h, Zone 1
F S4	5.83	5.83	0	0.167	0.29	37.32	1.72	AR&R 10 year, 1.5 hours storm, average 37.3 mm/h, Zone 1
F S3	5.264	5.264	0	0.16	0.27	36.06	1.67	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F S2	4.269	4.269	0	0.147	0.23	33.37	1.59	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F S1	2.413	2.413	0	0.116	0.16	27.26	1.37	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MPW	4.199	4.199	0	0.146	0.23	33.19	1.58	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD 10.1	2.345	2.345	0	0.115	0.16	26.9	1.37	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
F PR OVER MOORE	0	0	0	0	0	0	0	
F MBC01/02	0	0	0	0	0	0	0	
F MBC01/01A	0	0	3.995	0	0	0	0	
F MBC01/01	0	0	3.766	0	0	0	0	
Channel	4.618	4.618	0	0.585	2.1	2.78	3.58	AR&R 10 year, 1.5 hours storm, average 37.3 mm/h, Zone 1
F MBC02/01a	0	0	4.139	0	0	0	0	
F OutPit 10	0	0	0	0	0	0	0	
F MBC02/01b	2.345	2.345	4.248	0.115	0.16	26.9	1.37	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
F OSD01 Surcharge	0	0	0	0	0	0	0	
F S01/02	0	0	0	0	0	0	0	
F Outlet 1	1.718	1.718	0	0.101	0.13	24.21	1.26	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1
F S02/05	0	0	4.13	0	0	0	0	
F S02/04	0	0	4.254	0	0	0	0	
F S02/03	0	0	3.937	0	0	0	0	
F S02/02	0	0	4.182	0	0	0	0	
F PR Outlet2	0.645	0.645	0	0.067	0.07	17.38	0.98	AR&R 10 year, 12 hours storm, average 10.1 mm/h, Zone 1
F OSD1 Out	1.713	1.713	0	0.011	0	499.9	0.32	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1
F OSD02	0.568	0.568	0	0.005	0	499.9	0.22	AR&R 10 year, 12 hours storm, average 10.1 mm/h, Zone 1
F PR3.3	0.046	0.046	0	0.025	0.01	8.23	0.45	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1
F Bypass02	0.036	0.036	0	0.023	0.01	7.63	0.41	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1
F PR Bypass03	0.037	0.037	0	0.023	0.01	7.63	0.42	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1
F PR Bypass01	0.174	0.174	0	0.04	0.03	11.99	0.67	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F PR3.1	0.034	0.034	0	0.022	0.01	7.33	0.42	AR&R 10 year, 4.5 hours storm, average 18.7 mm/h, Zone 1
F PR3.2	0.026	0.026	0	0.02	0.01	6.74	0.38	AR&R 10 year, 4.5 hours storm, average 18.7 mm/h, Zone 1
F OSD01 PMF	0	0	0	0	0	0	0	
F W2a	1.181	1.181	0	0.087	0.1	21.33	1.14	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR01	1.802	1.802	0	0.103	0.13	24.57	1.28	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W3a	0.476	0.476	0	0.06	0.05	15.94	0.89	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD1b	4.676	4.676	0	0.152	0.25	34.44	1.63	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD1c	4.428	4.428	0	0.15	0.24	33.9	1.6	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR02	1.863	1.863	0	0.105	0.13	24.92	1.28	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W3ba	0.238	0.238	0	0.045	0.03	13.07	0.73	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR03	0.468	0.468	0	0.059	0.05	15.76	0.9	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W3bb	0.234	0.234	0	0.044	0.03	12.89	0.74	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W5	0.372	0.372	0	0.053	0.05	14.69	0.85	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD1a	4.994	4.994	0	0.157	0.26	35.34	1.65	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD1d	1.839	1.839	0	0.104	0.13	24.74	1.29	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR04	1.201	1.201	0	0.087	0.1	21.33	1.16	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W4a	0.513	0.513	0	0.062	0.06	16.3	0.91	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W6a	0.442	0.442	0	0.058	0.05	15.58	0.87	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W4b	0.505	0.505	0	0.061	0.06	16.12	0.92	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W5b	0.372	0.372	0	0.053	0.05	14.69	0.85	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR05	0.488	0.488	0	0.06	0.05	15.94	0.91	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD1e	3.833	3.833	0	0.141	0.22	32.11	1.55	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR06	0.756	0.756	0	0.071	0.07	18.28	1.03	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W2b	1.231	1.231	0	0.088	0.1	21.51	1.17	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR07	0.818	0.818	0	0.074	0.08	18.82	1.04	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MAR1	0.28	0.28	0	0.048	0.04	13.61	0.77	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MAR2	0.334	0.334	0	0.052	0.04	14.33	0.81	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MAR3	0.142	0.142	0	0.037	0.02	11.45	0.62	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD2a	3.469	3.469	0	0.135	0.2	31.03	1.5	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD2b	3.36	3.36	0	0.133	0.2	30.67	1.49	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F OSD2c	1.377	1.377	0	0.092	0.11	22.41	1.19	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W6b	0.434	0.434	0	0.057	0.05	15.41	0.88	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W7a	0.513	0.513	4.185	0.062	0.06	16.3	0.91	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W7b	0.505	0.505	0	0.061	0.06	16.12	0.92	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W8a	0.372	0.372	0	0.053	0.05	14.69	0.85	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F W8b	0.372	0.372	0	0.053	0.05	14.69	0.85	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR08	0.852	0.852	4.182	0.075	0.08	19	1.06	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR09	0.983	0.983	0	0.08	0.09	20.08	1.08	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR10	0.438	0.438	0	0.057	0.05	15.41	0.89	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR11	0.497	0.497	4.42	0.061	0.05	16.12	0.9	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MR12	0.384	0.384	4.135	0.054	0.05	14.87	0.85	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F MAR4	0.413	0.413	4.155	0.056	0.05	15.23	0.86	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
F External Catch	3.161	3.161	0	0.13	0.19	29.95	1.48	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q	Max Q	Max Q			
			Total	Low Level	High Level			
Basin 09	14.85	4717.7	0.737	0	0.737			
OSD 10	14.8	15005.1	2.345	0	2.345			
OSD01	15.17	16713.8	1.713	0	1.713			
OSD02	16.09	13031.5	0.568	0	0.568			

CONTINUITY CHECK for AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1				
Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Basin 09	12498.52	12482.19	16.36	0
SimtaChann	65539.06	65539.06	0	0
PR DNSDC	4923.48	4923.54	0	0
PR dummy DNSDC	4923.54	4923.54	0	0
S5	28972.28	28972.29	0	0
Moore	3413.58	3413.58	0	0
S Rd 1	2884.26	2884.26	0	0
N MPE ST1	32385.89	32385.89	0	0
S4	25407.53	25407.49	0	0
S3	19444.61	19444.44	0	0
S2	12844.2	12844.18	0	0
S1	6243.83	6243.83	0	0
N MPW	10867.29	10867.29	0	0
OSD 10	45802.69	45269.8	533.51	0
MB09	12482.19	12482.87	0	0
MBC01/02	12482.87	12476.4	0	0.1
MBC01/01A	20284.26	20296.54	0	-0.1
MBC01/01	20296.54	20283.92	0	0.1
MBC02/01	65542.17	65539.06	0	0
MBC04/02	0	0	0	0
MBC02/01a	0	0	0	0
MBC03/03	45269.8	45271.78	0	0
MBC03/02	45271.78	45259.68	0	0
MBC02/01b	45259.68	45258.24	0	0
S01/03	26747.14	26728.02	0	0.1
S01/02	26728.02	26720.3	0	0
S01/01	26827.31	26820.96	0	0
S02/05	4716.94	4709.13	0	0.2
S02/04	4709.13	4700.71	0	0.2
S02/03	4700.71	4694.9	0	0.1
S02/02	4694.9	4694.01	0	0
S02/01	6230.77	6227.79	0	0
OSD01	33390.54	26747.14	6646.53	0
OSD02	15598.8	4716.94	10883.06	0
Outlet 1	26820.96	26820.96	0	0
PR 3.3	107	107	0	0
PR Bypass02	416.55	416.55	0	0
PR Bypass03	379.86	379.86	0	0
PR Bypass01	387.27	387.27	0	0
PR3.1	201.71	201.71	0	0
PR3.2	151.38	151.38	0	0
PR Outlet2	6227.79	6227.79	0	0
N1139291	0	0	0	0
N1139292	0	0	0	0
W2a	3057.11	3057.11	0	0
MR01	4688.27	4688.28	0	0
W3a	1231.49	1231.49	0	0
OSD1b	15663.55	15663.62	0	0
OSD1c	12876.6	12876.52	0	0
MR02	4839.5	4839.5	0	0
W3ba	615.74	615.74	0	0
MR03	1209.88	1209.88	0	0
W3bb	604.94	604.94	0	0
W5	961.42	961.42	0	0
OSD1a	20351.85	20351.93	0	0
OSD 1d	4785.51	4785.5	0	0
MR04	3121.92	3121.92	0	0
W4a	1328.71	1328.71	0	0
W6a	1145.07	1145.07	0	0
W4b	1307.1	1307.1	0	0
W5b	961.42	961.42	0	0
MR05	1263.89	1263.89	0	0
OSD1e	9981.52	9981.54	0	0
MR06	1955.25	1955.25	0	0
W2b	3186.73	3186.73	0	0
MR07	2117.29	2117.29	0	0
MAR1	723.77	723.77	0	0
MAR2	864.19	864.19	0	0
MAR3	367.29	367.29	0	0
OSD2a	10975.27	10975.36	0	0
OSD2b	9733.02	9733.03	0	0
OSD2c	3575.64	3575.63	0	0
W6b	1123.46	1123.46	0	0
W7a	1328.71	1328.71	0	0
W7b	1307.1	1307.1	0	0
W8a	961.42	961.42	0	0
W8b	961.42	961.42	0	0
MR08	2203.71	2203.71	0	0
MR09	2560.19	2560.19	0	0
MR10	1134.27	1134.27	0	0
MR11	1285.5	1285.5	0	0
MR12	993.83	993.83	0	0
MAR4	1069.45	1069.45	0	0
External Catch	7807.83	7807.79	0	0

Run Log for MPEStage2SMPProposed run at 15:07:24 on 27/2/2018

No water upwelling from any pit. Freeboard was adequate at all pits.
The maximum flow in these overflow routes is unsafe: F OSD1b, F OSD1a, F S4, F S3, F S5, F MPE ST1, Channel
These overflow routes carried water uphill (adding energy): F OSD02, F OSD1 Out, F OSD 10.1, Basin 09 Out.
These results may be invalid. You should check for water flowing round in circles (e.g. negative flow in adjacent pipes) at these locations. You may need to reformulate the model.

ARCADIS Design & Consultancy for natural and built assets

PROJECT MPE Stage 2
Stormwater Management Plan
TITLE DRAINS Results
Proposed Model - 100 Year ARI

JOB No AA009335
PREPARED [redacted] **DATE** 27/02/2018
CHECKED [redacted] **DATE** 27/02/2018

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

DRAINS results prepared from Version 2017.10

100 YEAR ARI

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond	Max Surface	Max Pond	Min	Overflow	Constraint
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)	
			(cu.m/s)	(cu.m)	(m)		
PR DNSDC	12.12		2.789		1.88	0	None
PR dummy DNSDC	10.48		0				
MB09	12.2		0.88		4.3	0	None
MBC01/02	12.19		0		4.41	0	None
MBC01/01A	12.19		4.283		4.41	0	None
MBC01/01	10.98		0		5.62	0	None
MBC02/01	10.63		2.872				
MBC04/02	10.75		0		2.25		None
MBC02/01a	10.5		0				
MBC03/03	12.57		2.872		4.93	0	None
MBC03/02	11.89		0		2.86		None
MBC02/01b	10.84		0				
S01/03	12.72		1.963		4.48	0	None
S01/02	12.55		0		5.36	0	None
S01/01	12.26		0.068				
S02/05	14.09		1.522		3.41	0	None
S02/04	13.85		0		3.72	0	None
S02/03	13.62		0		3.69	0	None
S02/02	13.55		0		3.51	0	None
S02/01	13.41		0.351				

SUB-CATCHMENT DETAILS							
Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm
	Flow Q	Max Q	Max Q	Tc	Tc	Tc	
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)	
MPE W	6.525	6.525	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C PR DNSC	2.789	2.345	0.445	5	5	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C S5	1.861	1.861	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MOORE	1.782	1.782	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C S RD 1	1.506	1.506	0	5	12	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C S4	3.113	3.113	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C S3	3.446	3.446	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C S2	3.446	3.446	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C S1	3.26	3.26	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
MPW	5.673	5.673	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C OSD10	1.331	1.331	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C PR3.3	0.068	0.017	0.052	10	12	0	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C PR Bypass01	0.237	0.166	0.071	5	5	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse2a	1.596	1.596	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR01	1.353	1.353	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse3a	0.643	0.643	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C OSD1c	0.197	0.197	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR02	1.641	1.641	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse3ba	0.321	0.321	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR03	0.632	0.632	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse3bb	0.316	0.316	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse5a	0.502	0.502	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C OSD1d	0.209	0.209	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR04	1.032	1.032	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse4a	0.694	0.694	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse6a	0.598	0.598	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse4b	0.682	0.682	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse5b	0.502	0.502	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR05	0.66	0.66	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C OSD1e	1.043	1.043	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR06	1.021	1.021	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse2b	1.664	1.664	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR07	1.105	1.105	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MAR1	0.378	0.378	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MAR2	0.451	0.451	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MAR3	0.192	0.192	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C OSD2a	0.649	0.649	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C OSD2b	0.209	0.209	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C OSD2c	0.186	0.186	0	5	10	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse6b	0.587	0.587	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse7a	0.694	0.694	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse7b	0.682	0.682	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse8a	0.502	0.502	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C Warehouse8b	0.502	0.502	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR08	1.15	1.15	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR09	0.643	0.643	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR10	0.592	0.592	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR11	0.671	0.671	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MR12	0.519	0.519	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
C MAR4	0.558	0.558	0	5	0	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1

Name	Max	Due to Storm
	Flow	
	(cu.m/s)	
C PR Bypass02	0.057	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
C PR Bypass03	0.058	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
C PR3.1	0.061	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
C PR3.2	0.049	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1

Outflow Volumes for Total Catchment (106 impervious + 2.81 pervious = 109 total ha)

Storm	Total Rainfall	Total Runoff	Impervious Runoff	Pervious Runoff
	cu.m	cu.m (Runoff %)	cu.m (Runoff %)	cu.m (Runoff %)
AR&R 100 year, 15 minutes storm,	39340.76	37712.86 (95.9%)	37184.84 (97.0%)	528.01 (52.2%)
AR&R 100 year, 25 minutes storm,	51171.39	49467.88 (96.7%)	48677.62 (97.6%)	790.26 (60.0%)
AR&R 100 year, 45 minutes storm,	67314.45	65538.19 (97.4%)	64398.68 (98.2%)	1139.51 (65.8%)
AR&R 100 year, 1 hour storm, avera	76225.23	74428.66 (97.6%)	73099.52 (98.4%)	1329.13 (67.8%)
AR&R 100 year, 1.5 hours storm, av	89990.3	88155.49 (98.0%)	86541.84 (98.7%)	1613.65 (69.7%)
AR&R 100 year, 2 hours storm, ave	100725.3	98855.24 (98.1%)	97020.48 (98.9%)	1834.76 (70.8%)
AR&R 100 year, 3 hours storm, ave	117535.91	115574.91 (98.3%)	113418.99 (99.0%)	2155.92 (71.3%)
AR&R 100 year, 4.5 hours storm, av	136910.31	134819.55 (98.5%)	132310.00 (99.2%)	2509.55 (71.2%)
AR&R 100 year, 6 hours storm, ave	152716.36	150485.27 (98.5%)	147710.95 (99.3%)	2774.31 (70.6%)
AR&R 100 year, 9 hours storm, ave	178880.39	176291.19 (98.6%)	173144.75 (99.3%)	3146.43 (68.4%)
AR&R 100 year, 12 hours storm, av	200891.41	198091.50 (98.6%)	194583.48 (99.4%)	3508.01 (67.9%)
AR&R 100 year, 18 hours storm, av	237902.48	234702.50 (98.7%)	230752.30 (99.6%)	3950.20 (64.5%)

PIPE DETAILS					
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
P PR dummy DNSDC	2.794	9.88	12.122	10.5	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
P S09/02	0.883	0.33	12.196	12.195	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
P MBC01/02	0.89	0.31	12.195	12.193	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
P MBC01/01A	4.736	3.3	11.897	11.713	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
MBC02/02	4.693	3.22	10.895	10.634	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
P MBC04/02	0	0	10.752	10.5	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
P MBC03/03	2.872	4.03	12.39	11.893	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
P MBC03/02	2.872	4.03	11.63	10.842	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
P S01/03	1.963	1.91	12.664	12.546	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
P S01/02	1.963	1.91	12.517	12.266	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
P S02/05	1.522	1.8	14.034	13.853	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
P S02/04	1.522	1.8	13.795	13.617	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
P S02/03	1.522	1.58	13.567	13.548	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
P S02/02	1.522	1.8	13.49	13.408	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1

CHANNEL DETAILS			
Name	Max Q	Max V	Due to Storm
	(cu.m/s)	(m/s)	

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
Basin 09 Out	0.88	0.88	-1.73493E+16	0.007	0	499.9	0.25	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F PR DNSDC	0	0	-7.10134E+15	0	0	0	0	
F PR dummy DNSDC	2.794	2.794	6602304	0.123	0.18	28.7	1.43	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F S5	8.862	8.862	-1.0755E+15	0.198	0.38	43.6	1.9	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
F Moore	1.782	1.782	-5.57834E+15	0.102	0.13	24.39	1.29	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F S RD 1	1.506	1.506	6601280	0.096	0.12	23.13	1.22	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MPE ST1	9.299	9.299	-1.40335E+15	0.202	0.39	44.32	1.93	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
F S4	8.213	8.213	-7.10457E+14	0.192	0.36	42.35	1.87	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F S3	7.281	7.281	-8.58801E+16	0.183	0.33	40.55	1.82	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F S2	5.669	5.669	-1.15086E+16	0.165	0.28	36.96	1.71	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F S1	3.26	3.26	-3.58079E+15	0.132	0.2	30.31	1.48	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MPW	5.673	5.673	-2.16101E+16	0.165	0.28	36.96	1.71	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F OSD 10.1	2.872	2.872	2300891136	0.124	0.18	28.88	1.45	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F PR OVER MOORE	0	0	2300194816	0	0	0	0	
F MBC01/02	0	0	0	0	0	0	0	
F MBC01/01A	0	0	6.85709E+15	0	0	0	0	
F MBC01/01	0	0	-1.66486E+22	0	0	0	0	
Channel	6.461	6.461	0	0.706	2.78	3.01	3.94	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
F MBC02/01a	0	0	4.32369E+30	0	0	0	0	
F OutPit 10	0	0	-4.5754E+16	0	0	0	0	
F MBC02/01b	2.872	2.872	0	0.124	0.18	28.88	1.45	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F OSD01 Surcharge	0	0	6570816	0	0	0	0	
F S01/02	0	0	-3.57496E+19	0	0	0	0	
F Outlet 1	1.971	1.971	6596832	0.106	0.14	25.28	1.32	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F S02/05	0	0	0	0	0	0	0	
F S02/04	0	0	-7.2349E+13	0	0	0	0	
F S02/03	0	0	0	0	0	0	0	
F S02/02	0	0	-9.66836E+29	0	0	0	0	
F PR Outlet2	1.732	1.732	6588512	0.101	0.13	24.21	1.27	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F OSD1 Out	1.963	1.963	0	0.011	0	499.9	0.35	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F OSD02	1.522	1.522	0	0.01	0	499.9	0.3	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F PR3.3	0.068	0.068	0	0.029	0.01	9.73	0.48	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F Bypass02	0.057	0.057	6600064	0.026	0.01	8.83	0.49	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F PR Bypass03	0.058	0.058	2304024576	0.027	0.01	9.13	0.46	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F PR Bypass01	0.237	0.237	2303328256	0.045	0.03	13.07	0.72	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F PR3.1	0.061	0.061	0	0.027	0.01	9.13	0.49	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F PR3.2	0.049	0.049	0	0.026	0.01	8.53	0.45	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F OSD01 PMF	0	0	2300928000	0	0	0	0	
F W2a	1.596	1.596	0	0.097	0.12	23.49	1.25	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR01	2.434	2.434	432998912	0.116	0.16	27.26	1.39	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W3a	0.643	0.643	6571904	0.067	0.07	17.38	0.98	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F OSD1b	6.377	6.377	6584224	0.173	0.3	38.57	1.76	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F OSD1c	5.861	5.861	0	0.167	0.29	37.5	1.72	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F MR02	2.516	2.516	2306461696	0.118	0.16	27.62	1.39	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W3ba	0.321	0.321	2307153920	0.051	0.04	14.15	0.8	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR03	0.632	0.632	0	0.067	0.06	17.38	0.96	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W3bb	0.316	0.316	432631808	0.051	0.04	14.15	0.79	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W5	0.502	0.502	15331164160	0.061	0.06	16.12	0.91	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F OSD1a	6.965	6.965	2305765376	0.179	0.32	39.83	1.8	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F OSD1d	2.486	2.486	15337455616	0.117	0.16	27.44	1.4	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR04	1.623	1.623	-8.07955E+15	0.098	0.12	23.67	1.25	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W4a	0.694	0.694	432694272	0.07	0.07	17.92	0.99	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W6a	0.598	0.598	0	0.065	0.06	17.02	0.96	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W4b	0.682	0.682	0	0.069	0.07	17.74	0.99	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W5b	0.502	0.502	42723508224	0.061	0.06	16.12	0.91	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR05	0.66	0.66	42709614592	0.068	0.07	17.56	0.98	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F OSD1e	5.187	5.187	0	0.159	0.27	35.88	1.66	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR06	1.021	1.021	432389632	0.081	0.09	20.25	1.1	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W2b	1.664	1.664	432302592	0.099	0.12	23.85	1.26	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR07	1.105	1.105	433085952	0.084	0.09	20.79	1.13	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MAR1	0.378	0.378	432781312	0.054	0.05	14.87	0.83	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MAR2	0.451	0.451	15325921280	0.058	0.05	15.58	0.89	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MAR3	0.192	0.192	15304163328	0.042	0.03	12.35	0.68	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F OSD2a	4.65	4.65	0	0.152	0.25	34.44	1.62	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F OSD2b	4.445	4.445	432885760	0.15	0.24	33.9	1.6	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F OSD2c	1.862	1.862	15327559680	0.105	0.13	24.92	1.28	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W6b	0.587	0.587	0	0.064	0.06	16.84	0.96	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W7a	0.694	0.694	0	0.07	0.07	17.92	0.99	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W7b	0.682	0.682	0	0.069	0.07	17.74	0.99	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W8a	0.502	0.502	15318253568	0.061	0.06	16.12	0.91	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F W8b	0.502	0.502	0	0.061	0.06	16.12	0.91	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR08	1.15	1.15	0	0.086	0.1	21.15	1.13	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR09	1.328	1.328	-6.96678E+15	0.09	0.11	22.05	1.19	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR10	0.592	0.592	-1.10347E+17	0.065	0.06	17.02	0.95	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR11	0.671	0.671	7.46293E+26	0.069	0.07	17.74	0.98	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MR12	0.519	0.519	-1.82561E+12	0.062	0.06	16.3	0.92	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F MAR4	0.558	0.558	-1.92207E+31	0.063	0.06	16.66	0.94	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1
F External Catch	4.283	4.283	0	0.147	0.23	33.37	1.6	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1

DETENTION BASIN DETAILS					
Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
Basin 09	15.49	6948.3	0.88	0	0.88
OSD 10	15.37	23485.6	2.872	0	2.872
OSD01	15.56	22337.8	1.963	0	1.963
OSD02	16.18	14183.9	1.522	0	1.522

CONTINUITY CHECK for AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1				
Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Basin 09	18821.5	18790.96	30.68	0
SimtaChann	99027.36	99027.36	0	0
PR DNSDC	7629.11	7630.96	0	0
PR dummy DNSDC	7630.96	7630.96	0	0
S5	43629.53	43629.46	0	0
Moore	5140.56	5140.56	0	0
S Rd 1	4343.41	4343.41	0	0
N MPE ST1	48769.47	48769.97	0	0
S4	38260.96	38261.23	0	0
S3	29281.61	29281.53	0	0
S2	19342.24	19342.01	0	0
S1	9402.55	9402.55	0	0
N MPW	16365.14	16365.14	0	0
OSD 10	68973.5	68276.45	698.81	0
MB09	18790.96	18791.35	0	0
MBC01/02	18791.35	18784.69	0	0
MBC01/01A	30759.12	30498.06	0	0.8
MBC01/01	30498.06	30769.58	0	-0.9
MBC02/01	99032.23	99027.36	0	0
MBC04/02	0	0	0	0
MBC02/01a	0	0	0	0
MBC03/03	68276.45	68277.02	0	0
MBC03/02	68277.02	68264.73	0	0
MBC02/01b	68264.73	68262.52	0	0
S01/03	43206.22	43186.39	0	0
S01/02	43186.39	43180.1	0	0
S01/01	43375.24	43368.74	0	0
S02/05	12543.8	12538.11	0	0
S02/04	12538.11	12530.81	0	0.1
S02/03	12530.81	12527.24	0	0
S02/02	12527.24	12523.94	0	0
S02/01	15078.77	15075.8	0	0
OSD01	50282.9	43206.22	7079.84	0
OSD02	23490.22	12543.8	10947.66	0
Outlet 1	43368.74	43368.74	0	0
PR 3.3	195.14	195.14	0	0
PR Bypass02	661.95	661.95	0	0
PR Bypass03	661.21	661.21	0	0
PR Bypass01	617.36	617.36	0	0
PR3.1	351	351	0	0
PR3.2	263.33	263.33	0	0
PR Outlet2	15075.8	15075.8	0	0
N1139291	0	0	0	0
N1139292	0	0	0	0
W2a	4603.68	4603.68	0	0
MR01	7060.11	7060.1	0	0
W3a	1854.49	1854.49	0	0
OSD1b	23587.86	23587.88	0	0
OSD1c	19391.01	19390.9	0	0
MR02	7287.88	7287.81	0	0
W3ba	927.25	927.25	0	0
MR03	1821.95	1821.95	0	0
W3bb	910.98	910.98	0	0
W5	1447.81	1447.81	0	0
OSD1a	30647.95	30648	0	0
OSD 1d	7206.5	7206.53	0	0
MR04	4701.29	4701.28	0	0
W4a	2000.91	2000.91	0	0
W6a	1724.36	1724.36	0	0
W4b	1968.35	1968.35	0	0
W5b	1447.81	1447.81	0	0
MR05	1903.29	1903.29	0	0
OSD1e	15031.13	15031.19	0	0
MR06	2944.42	2944.42	0	0
W2b	4798.93	4798.93	0	0
MR07	3188.43	3188.43	0	0
MAR1	1089.92	1089.92	0	0
MAR2	1301.41	1301.41	0	0
MAR3	553.09	553.09	0	0
OSD2a	16527.79	16527.83	0	0
OSD2b	14656.92	14657.06	0	0
OSD2c	5384.56	5384.53	0	0
W6b	1691.82	1691.82	0	0
W7a	2000.91	2000.91	0	0
W7b	1968.35	1968.35	0	0
W8a	1447.81	1447.81	0	0
W8b	1447.81	1447.81	0	0
MR08	3318.59	3318.59	0	0
MR09	3855.42	3855.39	0	0
MR10	1708.08	1708.08	0	0
MR11	1935.83	1935.83	0	0
MR12	1496.61	1496.61	0	0
MAR4	1610.48	1610.48	0	0
External Catch	11974.37	11974.32	0	0

Run Log for MPEStage2SMPProposed run at 15:08:44 on 27/2/2018

No water upwelling from any pit. Freeboard was adequate at all pits.

The maximum flow in these overflow routes is unsafe: F MPE ST1, Channel

These overflow routes carried water uphill (adding energy): F OSD02, F OSD1 Out, F OSD 10.1, Basin 09 Out.

These results may be invalid. You should check for water flowing round in circles (e.g. negative flow in adjacent pipes) at these locations. You may need to reformulate the model.

PROJECT	MPE Stage 2
	Stormwater Management Plan
TITLE	DRAINS Results
	Proposed Model - 100 Year ARI + 10% Climate Change

JOB No	AA009335		
PREPARED	[redacted]	**DATE**	27/02/2018
CHECKED	[redacted]	**DATE**	27/02/2018

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

100 YEAR ARI + 10% CC

DRAINS results prepared from Version 2017.10

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond	Max Surface	Max Pond	Min	Overflow	Constraint
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)	
			(cu.m/s)	(cu.m)	(m)		
PR DNSDC	12.47		3.074		1.53	0	None
PR dummy DNSDC	10.48		0				
MB09	12.23		0.916		4.27	0	None
MBC01/02	12.23		0		4.37	0	None
MBC01/01A	12.23		4.717		4.37	0	None
MBC01/01	10.99		0		5.61	0	None
MBC02/01	10.65		3.03				
MBC04/02	10.75		0		2.25		None
MBC02/01a	10.5		0				
MBC03/03	12.59		3.03		4.91	0	None
MBC03/02	11.91		0		2.84		None
MBC02/01b	10.85		0				
S01/03	12.73		2.047		4.47	0	None
S01/02	12.55		0		5.35	0	None
S01/01	12.27		0.077				
S02/05	14.11		1.726		3.39	0	None
S02/04	13.87		0		3.7	0	None
S02/03	13.64		0		3.67	0	None
S02/02	13.57		0		3.49	0	None
S02/01	13.42		0.405				

SUB-CATCHMENT DETAILS							
Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm
	Flow Q	Max Q	Max Q	Tc	Tc	Tc	
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)	
MPE W	7.176	7.176	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C PR DNSC	3.074	2.578	0.496	5	5	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C S5	2.047	2.047	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MOORE	1.96	1.96	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C S RD 1	1.656	1.656	0	5	12	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C S4	3.423	3.423	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C S3	3.789	3.789	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C S2	3.789	3.789	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C S1	3.585	3.585	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
MPW	6.239	6.239	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C OSD10	1.464	1.464	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C PR3.3	0.077	0.019	0.059	10	12	0	100 year +10% CC, 25 minutes storm, average 124 mm/h, Zone 1
C PR Bypass01	0.262	0.183	0.079	5	5	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse2a	1.755	1.755	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR01	1.488	1.488	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse3a	0.707	0.707	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C OSD1c	0.217	0.217	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR02	1.805	1.805	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse3ba	0.354	0.354	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR03	0.695	0.695	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse3bb	0.347	0.347	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse5a	0.552	0.552	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C OSD1d	0.229	0.229	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR04	1.135	1.135	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse4a	0.763	0.763	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse6a	0.657	0.657	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse4b	0.75	0.75	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse5b	0.552	0.552	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR05	0.726	0.726	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C OSD1e	1.147	1.147	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR06	1.123	1.123	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse2b	1.83	1.83	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR07	1.216	1.216	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MAR1	0.416	0.416	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MAR2	0.496	0.496	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MAR3	0.211	0.211	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C OSD2a	0.713	0.713	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C OSD2b	0.229	0.229	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C OSD2c	0.205	0.205	0	5	10	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse6b	0.645	0.645	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse7a	0.763	0.763	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse7b	0.75	0.75	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse8a	0.552	0.552	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C Warehouse8b	0.552	0.552	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR08	1.265	1.265	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR09	0.707	0.707	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR10	0.651	0.651	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR11	0.738	0.738	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MR12	0.571	0.571	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
C MAR4	0.614	0.614	0	5	0	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1

Name	Max	Due to Storm
	Flow	
	(cu.m/s)	
C PR Bypass02	0.065	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
C PR Bypass03	0.066	100 year +10% CC, 6 hours storm, average 25.6 mm/h, Zone 1
C PR3.1	0.073	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1
C PR3.2	0.058	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1

Outflow Volumes for Total Catchment (106 impervious + 2.81 pervious = 109 total ha)

Storm	Total Rainfall	Total Runoff	Impervious Runoff	Pervious Runoff
	cu.m	cu.m (Runoff %)	cu.m (Runoff %)	cu.m (Runoff %)
100 year +10% CC, 15 minutes stor	43264.27	41625.51 (96.2%)	40997.57 (97.3%)	627.95 (56.4%)
100 year +10% CC, 25 minutes stor	56281.61	54566.10 (97.0%)	53645.46 (97.8%)	920.64 (63.6%)
100 year +10% CC, 45 minutes stor	74042.16	72260.31 (97.6%)	70948.49 (98.4%)	1311.82 (68.9%)
100 year +10% CC, 1 hour storm, a	83846.38	82045.62 (97.9%)	80521.37 (98.6%)	1524.25 (70.7%)
100 year +10% CC, 1.5 hours storm	99001.27	97163.45 (98.1%)	95319.01 (98.8%)	1844.45 (72.4%)
100 year +10% CC, 2 hours storm,	110813.67	108940.16 (98.3%)	106847.37 (99.0%)	2092.80 (73.4%)
100 year +10% CC, 3 hours storm,	129317.38	127350.42 (98.5%)	124894.20 (99.1%)	2456.22 (73.8%)
100 year +10% CC, 4.5 hours storm	150639.89	148546.81 (98.6%)	145686.55 (99.3%)	2860.26 (73.8%)
100 year +10% CC, 6 hours storm,	168049.78	165810.41 (98.7%)	162649.06 (99.3%)	3161.34 (73.1%)
100 year +10% CC, 9 hours storm,	196864.06	194330.80 (98.7%)	190734.56 (99.4%)	3596.23 (71.0%)
100 year +10% CC, 12 hours storm	221110.05	218236.39 (98.7%)	214244.53 (99.5%)	3991.85 (70.2%)
100 year +10% CC, 18 hours storm	261869.73	258635.91 (98.8%)	254106.80 (99.6%)	4529.11 (67.2%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
P PR dummy DNSDC	3.08	10.89	12.473	10.5	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
P S09/02	0.919	0.32	12.232	12.23	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
P MBC01/02	0.926	0.31	12.23	12.228	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
P MBC01/01A	5.175	3.4	11.913	11.73	100 year +10% CC, 1.5 hours storm, average 60.4 mm/h, Zone 1
MBC02/02	5.142	3.33	10.907	10.646	100 year +10% CC, 1.5 hours storm, average 60.4 mm/h, Zone 1
P MBC04/02	0	0	10.752	10.5	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
P MBC03/03	3.03	4.1	12.402	11.914	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1
P MBC03/02	3.03	4.1	11.642	10.854	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1
P S01/03	2.047	1.94	12.67	12.553	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
P S01/02	2.047	1.94	12.523	12.272	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
P S02/05	1.726	1.88	14.05	13.874	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
P S02/04	1.726	1.88	13.811	13.641	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
P S02/03	1.726	1.63	13.588	13.569	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
P S02/02	1.726	1.88	13.506	13.424	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V			Due to Storm
	(cu.m/s)	(m/s)			

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
Basin 09 Out	0.916	0.916	-1.73493E+16	0.007	0	499.9	0.26	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
F PR DNSDC	0	0	-7.10134E+15	0	0	0	0	
F PR dummy DNSDC	3.08	3.08	6602304	0.129	0.19	29.77	1.46	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F S5	9.748	9.748	-1.0755E+15	0.206	0.4	45.22	1.94	100 year +10% CC, 1.5 hours storm, average 60.4 mm/h, Zone 1
F Moore	1.96	1.96	-5.57834E+15	0.106	0.14	25.28	1.31	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F S RD 1	1.656	1.656	6601280	0.099	0.12	23.85	1.25	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MPE ST1	10.229	10.229	-1.40335E+15	0.21	0.41	45.94	1.98	100 year +10% CC, 1.5 hours storm, average 60.4 mm/h, Zone 1
F S4	9.037	9.037	-7.10457E+14	0.2	0.38	43.96	1.91	100 year +10% CC, 25 minutes storm, average 124 mm/h, Zone 1
F S3	8.01	8.01	-8.58801E+16	0.19	0.35	41.99	1.86	100 year +10% CC, 25 minutes storm, average 124 mm/h, Zone 1
F S2	6.235	6.235	-1.15086E+16	0.172	0.3	38.4	1.74	100 year +10% CC, 25 minutes storm, average 124 mm/h, Zone 1
F S1	3.585	3.585	-3.58079E+15	0.137	0.21	31.39	1.52	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MPW	6.239	6.239	-2.16101E+16	0.172	0.3	38.4	1.74	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F OSD 10.1	3.03	3.03	2300891136	0.128	0.19	29.59	1.45	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1
F PR OVER MOORE	0	0	2300194816	0	0	0	0	
F MBC01/02	0	0	0	0	0	0	0	
F MBC01/01A	0	0	6.85709E+15	0	0	0	0	
F MBC01/01	0	0	-1.66486E+22	0	0	0	0	
Channel	6.979	6.979	0	0.737	2.97	3.07	4.02	100 year +10% CC, 1.5 hours storm, average 60.4 mm/h, Zone 1
F MBC02/01a	0	0	4.32369E+30	0	0	0	0	
F OutPit 10	0	0	-4.5754E+16	0	0	0	0	
F MBC02/01b	3.03	3.03	0	0.128	0.19	29.59	1.45	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1
F OSD01 Surcharge	0	0	6570816	0	0	0	0	
F S01/02	0	0	-3.57496E+19	0	0	0	0	
F Outlet 1	2.056	2.056	6596832	0.108	0.14	25.64	1.33	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
F S02/05	0	0	0	0	0	0	0	
F S02/04	0	0	-7.2349E+13	0	0	0	0	
F S02/03	0	0	0	0	0	0	0	
F S02/02	0	0	-9.66836E+29	0	0	0	0	
F PR Outlet2	1.985	1.985	6588512	0.107	0.14	25.46	1.31	100 year +10% CC, 12 hours storm, average 16.9 mm/h, Zone 1
F OSD1 Out	2.047	2.047	0	0.012	0	499.9	0.34	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
F OSD02	1.726	1.726	0	0.011	0	499.9	0.32	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
F PR3.3	0.077	0.077	0	0.03	0.02	10.02	0.51	100 year +10% CC, 25 minutes storm, average 124 mm/h, Zone 1
F Bypass02	0.065	0.065	6600064	0.028	0.01	9.43	0.49	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1
F PR Bypass03	0.066	0.066	2304024576	0.028	0.01	9.43	0.49	100 year +10% CC, 6 hours storm, average 25.6 mm/h, Zone 1
F PR Bypass01	0.262	0.262	2303328256	0.047	0.04	13.43	0.75	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F PR3.1	0.073	0.073	0	0.029	0.01	9.73	0.51	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1
F PR3.2	0.058	0.058	0	0.027	0.01	9.13	0.46	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1
F OSD01 PMF	0	0	2300928000	0	0	0	0	
F W2a	1.755	1.755	0	0.102	0.13	24.39	1.27	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR01	2.677	2.677	432998912	0.121	0.17	28.16	1.42	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W3a	0.707	0.707	6571904	0.07	0.07	17.92	1.01	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F OSD1b	7.028	7.028	6584224	0.18	0.32	40.01	1.8	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F OSD1c	6.446	6.446	0	0.174	0.31	38.75	1.76	100 year +10% CC, 25 minutes storm, average 124 mm/h, Zone 1
F MR02	2.767	2.767	2306461696	0.123	0.18	28.52	1.43	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W3ba	0.354	0.354	2307153920	0.053	0.04	14.51	0.83	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR03	0.695	0.695	0	0.07	0.07	17.92	0.99	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W3bb	0.347	0.347	432631808	0.053	0.04	14.51	0.82	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W5	0.552	0.552	15331164160	0.063	0.06	16.66	0.93	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F OSD1a	7.661	7.661	2305765376	0.186	0.34	41.27	1.84	100 year +10% CC, 25 minutes storm, average 124 mm/h, Zone 1
F OSD1d	2.734	2.734	15337455616	0.123	0.17	28.52	1.41	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR04	1.785	1.785	-8.07955E+15	0.103	0.13	24.57	1.27	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W4a	0.763	0.763	432694272	0.072	0.07	18.46	1.01	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W6a	0.657	0.657	0	0.068	0.07	17.56	0.98	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W4b	0.75	0.75	0	0.071	0.07	18.28	1.02	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W5b	0.552	0.552	42723508224	0.063	0.06	16.66	0.93	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR05	0.726	0.726	42709614592	0.07	0.07	18.1	1.01	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F OSD1e	5.704	5.704	0	0.166	0.28	37.14	1.7	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR06	1.123	1.123	432389632	0.085	0.1	20.97	1.12	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W2b	1.83	1.83	432302592	0.104	0.13	24.74	1.28	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR07	1.216	1.216	433085952	0.088	0.1	21.51	1.15	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MAR1	0.416	0.416	432781312	0.056	0.05	15.23	0.87	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MAR2	0.496	0.496	15325921280	0.061	0.05	16.12	0.9	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MAR3	0.211	0.211	15304163328	0.043	0.03	12.53	0.72	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F OSD2a	5.124	5.124	0	0.159	0.26	35.7	1.66	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F OSD2b	4.889	4.889	432885760	0.155	0.26	34.98	1.65	100 year +10% CC, 25 minutes storm, average 124 mm/h, Zone 1
F OSD2c	2.048	2.048	15327559680	0.108	0.14	25.64	1.33	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W6b	0.645	0.645	0	0.067	0.07	17.38	0.98	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W7a	0.763	0.763	0	0.072	0.07	18.46	1.01	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W7b	0.75	0.75	0	0.071	0.07	18.28	1.02	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W8a	0.552	0.552	15318253568	0.063	0.06	16.66	0.93	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F W8b	0.552	0.552	0	0.063	0.06	16.66	0.93	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR08	1.265	1.265	0	0.088	0.1	21.69	1.18	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR09	1.461	1.461	-6.96678E+15	0.094	0.11	22.77	1.22	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR10	0.651	0.651	-1.10347E+17	0.068	0.07	17.56	0.97	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR11	0.738	0.738	7.46293E+26	0.071	0.07	18.28	1	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MR12	0.571	0.571	-1.82561E+12	0.064	0.06	16.84	0.94	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F MAR4	0.614	0.614	-1.92207E+31	0.066	0.06	17.2	0.96	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1
F External Catch	4.717	4.717	0	0.153	0.25	34.62	1.63	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
Basin 09	15.66	7572.2	0.916	0	0.916
OSD 10	15.56	26363.7	3.03	0	3.03
OSD01	15.7	24411.8	2.047	0	2.047
OSD02	16.22	14636	1.726	0	1.726

CONTINUITY CHECK for 100 year +10% CC, 6 hours storm, average 25.6 mm/h, Zone 1				
Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Basin 09	17674.9	17191.61	485.99	0
SimtaChann	91373.6	91373.6	0	0
PR DNSDC	7269.43	7269.1	0	0
PR dummy DNSDC	7269.1	7269.1	0	0
S5	40971.76	40971.62	0	0
Moore	4827.38	4827.38	0	0
S Rd 1	4078.83	4078.83	0	0
N MPE ST1	45799.03	45798.95	0	0
S4	35930.36	35930.26	0	0
S3	27497.8	27497.64	0	0
S2	18163.76	18163.77	0	0
S1	8829.84	8829.84	0	0
N MPW	15368.21	15368.21	0	0
OSD 10	64772.3	62915.44	1860.64	0
MB09	17191.61	17172.7	0	0.1
MBC01/02	17172.7	17159.19	0	0.1
MBC01/01A	28507.18	28752.42	0	-0.9
MBC01/01	28752.42	28518.46	0	0.8
MBC02/01	91393.98	91373.6	0	0
MBC04/02	0	0	0	0
MBC02/01a	0	0	0	0
MBC03/03	62915.44	62903.67	0	0
MBC03/02	62903.67	62883.03	0	0
MBC02/01b	62883.03	62875.55	0	0
S01/03	38564.16	38542.93	0	0.1
S01/02	38542.93	38535.32	0	0
S01/01	38735.23	38728.21	0	0
S02/05	10693.94	10683.04	0	0.1
S02/04	10683.04	10677.65	0	0.1
S02/03	10677.65	10670.57	0	0.1
S02/02	10670.57	10669.59	0	0
S02/01	13205.89	13202.87	0	0
OSD01	47219.65	38564.16	8659.05	0
OSD02	22059.24	10693.94	11366.53	0
Outlet 1	38728.21	38728.21	0	0
PR 3.3	199.89	199.89	0	0
PR Bypass02	704.81	704.81	0	0
PR Bypass03	637.89	637.89	0	0
PR Bypass01	596.47	596.47	0	0
PR3.1	341.14	341.14	0	0
PR3.2	255.97	255.97	0	0
PR Outlet2	13202.87	13202.87	0	0
N1139291	0	0	0	0
N1139292	0	0	0	0
W2a	4323.25	4323.25	0	0
MR01	6630.02	6629.97	0	0
W3a	1741.52	1741.52	0	0
OSD1b	22150.9	22150.95	0	0
OSD1c	18209.63	18209.62	0	0
MR02	6843.92	6843.87	0	0
W3ba	870.76	870.76	0	0
MR03	1710.97	1710.97	0	0
W3bb	855.48	855.48	0	0
W5	1359.61	1359.61	0	0
OSD1a	28780.89	28780.82	0	0
OSD 1d	6767.46	6767.5	0	0
MR04	4414.91	4414.92	0	0
W4a	1879.02	1879.02	0	0
W6a	1619.3	1619.3	0	0
W4b	1848.46	1848.46	0	0
W5b	1359.61	1359.61	0	0
MR05	1787.35	1787.35	0	0
OSD1e	14115.38	14115.53	0	0
MR06	2765.05	2765.05	0	0
W2b	4506.58	4506.58	0	0
MR07	2994.19	2994.19	0	0
MAR1	1023.52	1023.52	0	0
MAR2	1222.12	1222.12	0	0
MAR3	519.4	519.4	0	0
OSD2a	15520.91	15520.94	0	0
OSD2b	13764.07	13764.1	0	0
OSD2c	5056.53	5056.53	0	0
W6b	1588.76	1588.76	0	0
W7a	1879.02	1879.02	0	0
W7b	1848.46	1848.46	0	0
W8a	1359.61	1359.61	0	0
W8b	1359.61	1359.61	0	0
MR08	3116.4	3116.4	0	0
MR09	3620.54	3620.53	0	0
MR10	1604.05	1604.05	0	0
MR11	1817.9	1817.9	0	0
MR12	1405.43	1405.43	0	0
MAR4	1512.38	1512.38	0	0
External Catch	11347.88	11347.9	0	0

Run Log for MPEStage2SMPProposed run at 15:12:27 on 27/2/2018

No water upwelling from any pit. Freeboard was adequate at all pits.
The maximum flow in these overflow routes is unsafe: F S5, F MPE ST1, Channel
These overflow routes carried water uphill (adding energy): F OSD02, F OSD1 Out, F OSD 10.1, Basin 09 Out.
These results may be invalid. You should check for water flowing round in circles (e.g. negative flow in adjacent pipes) at these locations. You may need to reformulate the model.

ARCADIS Design & Consultancy for natural and built assets

PROJECT MPE Stage 2
Stormwater Management Plan
TITLE DRAINS Results
Proposed Model - PMP

JOB No AA009335
PREPARED [redacted] **DATE** 27/02/2018
CHECKED [redacted] **DATE** 27/02/2018

DRAINS File Path:	
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64.bit) - 9 August 2017
Modeller's Name:	
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

DRAINS results prepared from Version 2017.10

PMP

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
PR DNSDC	14		12.443		0	8.398	Outlet System
PR dummy DNSDC	10.48		0				
MB09	12.61		23.715		3.89	18.715	Inlet Capacity
MBC01/02	12.56		0		4.04	0	None
MBC01/01A	12.56		10.689		4.04	5.689	Inlet Capacity
MBC01/01	11.29		5.689		5.31	0.689	Inlet Capacity
MBC02/01	10.85		62.652				
MBC04/02	11.44		8.398		1.56		None
MBC02/01a	10.93		0				
MBC03/03	12.82		53.834		4.68	48.834	Inlet Capacity
MBC03/02	12.2		0		2.55		None
MBC02/01b	11.06		0				
S01/03	12.97		42.568		4.23	37.568	Inlet Capacity
S01/02	12.78		0		5.13	0	None
S01/01	12.47		37.726				
S02/05	14.41		10.786		3.09	5.786	Inlet Capacity
S02/04	14.2		5.786		3.37	5.786	Inlet Capacity
S02/03	13.97		5.786		3.34	5.786	Inlet Capacity
S02/02	13.85		5.786		3.21	5.786	Inlet Capacity
S02/01	13.64		7.302				

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
MPE W	28.782	28.782	0	5	0	0	PMP - 15 Minutes
C PR DNSC	12.443	10.342	2.172	5	5	0	PMP - 15 Minutes
C S5	8.209	8.209	0	5	10	0	PMP - 15 Minutes
C MOORE	7.861	7.861	0	5	10	0	PMP - 15 Minutes
C S RD 1	6.642	6.642	0	5	12	0	PMP - 15 Minutes
C S4	13.732	13.732	0	5	10	0	PMP - 15 Minutes
C S3	15.199	15.199	0	5	10	0	PMP - 15 Minutes
C S2	15.199	15.199	0	5	10	0	PMP - 15 Minutes
C S1	14.378	14.378	0	5	10	0	PMP - 15 Minutes
MPW	25.025	25.025	0	5	10	0	PMP - 15 Minutes
C OSD10	5.871	5.871	0	5	8	0	PMP - 15 Minutes
C PR3.3	0.357	0.083	0.285	10	12	0	PMP - 15 Minutes
C PR Bypass01	1.073	0.733	0.346	5	5	0	PMP - 15 Minutes
C Warehouse2a	7.04	7.04	0	5	0	0	PMP - 15 Minutes
C MR01	5.97	5.97	0	5	8	0	PMP - 15 Minutes
C Warehouse3a	2.836	2.836	0	5	0	0	PMP - 15 Minutes
C OSD1c	0.871	0.871	0	5	10	0	PMP - 15 Minutes
C MR02	7.239	7.239	0	5	8	0	PMP - 15 Minutes
C Warehouse3ba	1.418	1.418	0	5	0	0	PMP - 15 Minutes
C MR03	2.786	2.786	0	5	8	0	PMP - 15 Minutes
C Warehouse3bb	1.393	1.393	0	5	0	0	PMP - 15 Minutes
C Warehouse5a	2.214	2.214	0	5	0	0	PMP - 15 Minutes
C OSD1d	0.92	0.92	0	5	10	0	PMP - 15 Minutes
C MR04	4.552	4.552	0	5	8	0	PMP - 15 Minutes
C Warehouse4a	3.06	3.06	0	5	0	0	PMP - 15 Minutes
C Warehouse6a	2.637	2.637	0	5	0	0	PMP - 15 Minutes
C Warehouse4b	3.01	3.01	0	5	0	0	PMP - 15 Minutes
C Warehouse5b	2.214	2.214	0	5	0	0	PMP - 15 Minutes
C MR05	2.911	2.911	0	5	8	0	PMP - 15 Minutes
C OSD1e	4.602	4.602	0	5	8	0	PMP - 15 Minutes
C MR06	4.503	4.503	0	5	8	0	PMP - 15 Minutes
C Warehouse2b	7.338	7.338	0	5	0	0	PMP - 15 Minutes
C MR07	4.876	4.876	0	5	8	0	PMP - 15 Minutes
C MAR1	1.667	1.667	0	5	8	0	PMP - 15 Minutes
C MAR2	1.99	1.99	0	5	8	0	PMP - 15 Minutes
C MAR3	0.846	0.846	0	5	8	0	PMP - 15 Minutes
C OSD2a	2.861	2.861	0	5	10	0	PMP - 15 Minutes
C OSD2b	0.92	0.92	0	5	10	0	PMP - 15 Minutes
C OSD2c	0.821	0.821	0	5	10	0	PMP - 15 Minutes
C Warehouse6b	2.587	2.587	0	5	0	0	PMP - 15 Minutes
C Warehouse7a	3.06	3.06	0	5	0	0	PMP - 15 Minutes
C Warehouse7b	3.01	3.01	0	5	0	0	PMP - 15 Minutes
C Warehouse8a	2.214	2.214	0	5	0	0	PMP - 15 Minutes
C Warehouse8b	2.214	2.214	0	5	0	0	PMP - 15 Minutes
C MR08	5.075	5.075	0	5	8	0	PMP - 15 Minutes
C MR09	2.836	2.836	0	5	8	0	PMP - 15 Minutes
C MR10	2.612	2.612	0	5	8	0	PMP - 15 Minutes
C MR11	2.96	2.96	0	5	8	0	PMP - 15 Minutes
C MR12	2.289	2.289	0	5	8	0	PMP - 15 Minutes
C MAR4	2.463	2.463	0	5	0	0	PMP - 15 Minutes

Name	Max Flow (cu.m/s)	Due to Storm
C PR Bypass02	0.515	PMP - 1.5 Hours
C PR Bypass03	0.505	PMP - 1.5 Hours
C PR3.1	0.431	PMP - 30 Minutes
C PR3.2	0.329	PMP - 30 Minutes

Outflow Volumes for Total Catchment (106 impervious + 2.81 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
PMP - 15 Minutes	185793	184027.28 (99.0%)	179758.08 (99.3%)	4269.21 (89.3%)
PMP - 30 Minutes	273225	271342.56 (99.3%)	264879.69 (99.5%)	6462.88 (91.9%)
PMP - 45 Minutes	338799	336917.41 (99.4%)	328813.00 (99.6%)	8104.40 (93.0%)
PMP - 60 Minutes	393352.88	391474.09 (99.5%)	382004.38 (99.7%)	9469.71 (93.6%)
PMP - 1.5 Hours	502642.94	500736.81 (99.6%)	488522.06 (99.8%)	12214.75 (94.5%)
PMP - 2 Hours	589892.75	587944.38 (99.7%)	573563.13 (99.8%)	14381.23 (94.8%)
PMP - 2.5 Hours	655740	653768.88 (99.7%)	637745.88 (99.8%)	16022.99 (95.0%)
PMP - 3 Hours	721587.19	719576.00 (99.7%)	701912.88 (99.8%)	17663.15 (95.1%)
PMP - 4 Hours	819674.94	817590.56 (99.7%)	797513.25 (99.9%)	20077.33 (95.2%)
PMP - 5 Hours	896724.38	894530.88 (99.8%)	872577.75 (99.9%)	21953.14 (95.2%)
PMP - 6 Hours	951096.25	948729.38 (99.8%)	925491.00 (99.9%)	23238.37 (95.0%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
P PR dummy DNSDC	4.084	14.44	14	10.5	PMP - 2.5 Hours
P S09/02	5.894	1.24	12.586	12.564	PMP - 15 Minutes
P MBC01/02	5.758	1.19	12.564	12.562	PMP - 15 Minutes
P MBC01/01A	10.192	4.32	12.068	11.914	PMP - 2 Hours
MBC02/02	14.815	4.88	11.114	10.853	PMP - 15 Minutes
P MBC04/02	5.168	2.62	11.163	10.935	PMP - 15 Minutes
P MBC03/03	5.218	4.83	12.565	12.201	PMP - 45 Minutes
P MBC03/02	5.587	4.77	11.86	11.058	PMP - 45 Minutes
P S01/03	5.065	2.63	12.851	12.778	PMP - 15 Minutes
P S01/02	5.201	2.55	12.731	12.474	PMP - 15 Minutes
P S02/05	5.115	2.41	14.319	14.201	PMP - 30 Minutes
P S02/04	5.109	2.33	14.095	13.974	PMP - 30 Minutes
P S02/03	5.105	2.18	13.872	13.855	PMP - 30 Minutes
P S02/02	5.093	2.67	13.726	13.644	PMP - 30 Minutes

CHANNEL DETAILS

Name	Max Q	Max V	Due to Storm
	(cu.m/s)	(m/s)	

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
Basin 09 Out	23.715	23.715	-1.73493E+16	0.052	0.05	499.9	0.92	PMP - 15 Minutes
F PR DNSDC	8.398	8.398	-7.10134E+15	0.194	0.36	42.71	1.88	PMP - 15 Minutes
F PR dummy DNSDC	4.084	4.084	6602304	0.144	0.23	32.83	1.57	PMP - 2.5 Hours
F S5	43.457	43.457	-1.0755E+15	0.23	1.63	49.99	7.07	PMP - 30 Minutes
F Moore	7.861	7.861	-5.57834E+15	0.189	0.35	41.81	1.84	PMP - 15 Minutes
F S RD 1	6.642	6.642	6601280	0.176	0.31	39.29	1.77	PMP - 15 Minutes
F MPE ST1	44.278	44.278	-1.40335E+15	0.23	1.66	49.99	7.2	PMP - 30 Minutes
F S4	39.992	39.992	-7.10457E+14	0.23	1.5	49.99	6.51	PMP - 30 Minutes
F S3	33.22	33.22	-8.58801E+16	0.23	1.24	49.99	5.4	PMP - 15 Minutes
F S2	27.255	27.255	-1.15086E+16	0.23	1.02	49.99	4.43	PMP - 15 Minutes
F S1	14.378	14.378	-3.58079E+15	0.23	0.54	49.99	2.34	PMP - 15 Minutes
F MPW	25.025	25.025	-2.16101E+16	0.23	0.94	49.99	4.07	PMP - 15 Minutes
F OSD 10.1	53.834	53.834	2300891136	0.23	2.01	49.99	8.76	PMP - 45 Minutes
F PR OVER MOORE	18.715	18.715	2300194816	0.23	0.7	49.99	3.04	PMP - 15 Minutes
F MBC01/02	0	0	0	0	0	0	0	
F MBC01/01A	5.689	5.689	6.85709E+15	0.166	0.28	37.14	1.7	PMP - 15 Minutes
F MBC01/01	0.689	0.689	-1.66486E+22	0.069	0.07	17.74	1	PMP - 15 Minutes
Channel	74.264	74.264	0	2.303	10.32	68.61	4.48	PMP - 45 Minutes
F MBC02/01a	5.168	5.168	4.32369E+30	0.159	0.27	35.7	1.67	PMP - 15 Minutes
F OutPit 10	48.834	48.834	-4.5754E+16	0.23	1.83	49.99	7.94	PMP - 45 Minutes
F MBC02/01b	5.587	5.587	0	0.164	0.28	36.78	1.7	PMP - 45 Minutes
F OSD01 Surcharge	37.568	37.568	6570816	0.23	1.41	49.99	6.11	PMP - 30 Minutes
F S01/02	0	0	-3.57496E+19	0	0	0	0	
F Outlet 1	42.726	42.726	6596832	0.23	1.6	49.99	6.95	PMP - 30 Minutes
F S02/05	5.786	5.786	0	0.167	0.29	37.32	1.71	PMP - 2 Hours
F S02/04	5.786	5.786	-7.2349E+13	0.167	0.29	37.32	1.71	PMP - 2 Hours
F S02/03	5.786	5.786	0	0.167	0.29	37.32	1.71	PMP - 2 Hours
F S02/02	5.786	5.786	-9.66836E+29	0.167	0.29	37.32	1.71	PMP - 2 Hours
F PR Outlet2	12.386	12.386	6588512	0.227	0.47	49.35	2.07	PMP - 1.5 Hours
F OSD1 Out	42.568	42.568	0	0.073	0.09	499.9	1.17	PMP - 30 Minutes
F OSD02	10.786	10.786	0	0.032	0.02	499.9	0.67	PMP - 2 Hours
F PR3.3	0.357	0.357	0	0.053	0.04	14.51	0.84	PMP - 15 Minutes
F Bypass02	0.515	0.515	6600064	0.062	0.06	16.3	0.91	PMP - 1.5 Hours
F PR Bypass03	0.505	0.505	2304024576	0.061	0.06	16.12	0.92	PMP - 1.5 Hours
F PR Bypass01	1.073	1.073	2303328256	0.083	0.09	20.61	1.11	PMP - 15 Minutes
F PR3.1	0.431	0.431	0	0.057	0.05	15.41	0.87	PMP - 30 Minutes
F PR3.2	0.329	0.329	0	0.051	0.04	14.15	0.82	PMP - 30 Minutes
F OSD01 PMF	0	0	2300928000	0	0	0	0	
F W2a	7.04	7.04	0	0.18	0.32	40.01	1.8	PMP - 15 Minutes
F MR01	10.763	10.763	432998912	0.214	0.43	46.84	2	PMP - 15 Minutes
F W3a	2.836	2.836	6571904	0.124	0.18	28.88	1.43	PMP - 15 Minutes
F OSD1b	29.314	29.314	6584224	0.23	1.1	49.99	4.77	PMP - 15 Minutes
F OSD1c	26.789	26.789	0	0.23	1	49.99	4.36	PMP - 15 Minutes
F MR02	11.105	11.105	2306461696	0.217	0.44	47.38	2.01	PMP - 15 Minutes
F W3ba	1.418	1.418	2307153920	0.093	0.11	22.59	1.21	PMP - 15 Minutes
F MR03	2.786	2.786	0	0.123	0.18	28.7	1.42	PMP - 15 Minutes
F W3bb	1.393	1.393	432631808	0.092	0.11	22.41	1.21	PMP - 15 Minutes
F W5	2.214	2.214	15331164160	0.112	0.15	26.36	1.35	PMP - 15 Minutes
F OSD1a	32.886	32.886	2305765376	0.23	1.23	49.99	5.35	PMP - 30 Minutes
F OSD1d	10.969	10.969	15337455616	0.216	0.43	47.2	2.01	PMP - 15 Minutes
F MR04	7.164	7.164	-8.07955E+15	0.182	0.33	40.37	1.8	PMP - 15 Minutes
F W4a	3.06	3.06	432694272	0.128	0.19	29.59	1.46	PMP - 15 Minutes
F W6a	2.637	2.637	0	0.121	0.17	28.16	1.4	PMP - 15 Minutes
F W4b	3.01	3.01	0	0.127	0.19	29.41	1.46	PMP - 15 Minutes
F W5b	2.214	2.214	42723508224	0.112	0.15	26.36	1.35	PMP - 15 Minutes
F MR05	2.911	2.911	42709614592	0.125	0.18	29.06	1.45	PMP - 15 Minutes
F OSD1e	22.96	22.96	0	0.23	0.86	49.99	3.73	PMP - 15 Minutes
F MR06	4.503	4.503	432389632	0.15	0.24	34.08	1.61	PMP - 15 Minutes
F W2b	7.338	7.338	432302592	0.184	0.33	40.73	1.81	PMP - 15 Minutes
F MR07	4.876	4.876	433085952	0.155	0.26	34.98	1.65	PMP - 15 Minutes
F MAR1	1.667	1.667	432781312	0.099	0.13	23.85	1.26	PMP - 15 Minutes
F MAR2	1.99	1.99	15325921280	0.107	0.14	25.46	1.31	PMP - 15 Minutes
F MAR3	0.846	0.846	15304163328	0.075	0.08	19	1.05	PMP - 15 Minutes
F OSD2a	21.362	21.362	0	0.23	0.8	49.99	3.47	PMP - 15 Minutes
F OSD2b	20.278	20.278	432885760	0.23	0.76	49.99	3.3	PMP - 15 Minutes
F OSD2c	8.229	8.229	15327559680	0.192	0.36	42.35	1.88	PMP - 15 Minutes
F W6b	2.587	2.587	0	0.12	0.17	27.98	1.39	PMP - 15 Minutes
F W7a	3.06	3.06	0	0.128	0.19	29.59	1.46	PMP - 15 Minutes
F W7b	3.01	3.01	0	0.127	0.19	29.41	1.46	PMP - 15 Minutes
F W8a	2.214	2.214	15318253568	0.112	0.15	26.36	1.35	PMP - 15 Minutes
F W8b	2.214	2.214	0	0.112	0.15	26.36	1.35	PMP - 15 Minutes
F MR08	5.075	5.075	0	0.158	0.26	35.52	1.66	PMP - 15 Minutes
F MR09	5.88	5.88	-6.96678E+15	0.167	0.29	37.5	1.72	PMP - 15 Minutes
F MR10	2.612	2.612	-1.10347E+17	0.12	0.17	27.98	1.41	PMP - 15 Minutes
F MR11	2.96	2.96	7.46293E+26	0.126	0.18	29.24	1.45	PMP - 15 Minutes
F MR12	2.289	2.289	-1.82561E+12	0.114	0.15	26.72	1.36	PMP - 15 Minutes
F MAR4	2.463	2.463	-1.92207E+31	0.117	0.16	27.44	1.38	PMP - 15 Minutes
F External Catch	10.689	10.689	0	0.213	0.43	46.66	2	PMP - 15 Minutes

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
Basin 09	16.7	11194.2	23.715	0	23.715
OSD 10	17.5	55245.8	53.834	0	53.834
OSD01	17.17	45411.1	42.568	0	42.568
OSD02	17.8	33630.3	10.786	0	10.786

CONTINUITY CHECK for PMP - 1.5 Hours				
Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Basin 09	53096.84	48476.6	4622.22	0
SimtaChann	245574.14	245574.14	0	0
PR DNSDC	23025.76	23001.69	0	0.1
PR dummy DNSDC	18610.18	18610.18	0	0
S5	123080.93	123081.52	0	0
Moore	14501.68	14501.68	0	0
S Rd 1	12253.13	12253.13	0	0
N MPE ST1	137584.23	137583.22	0	0
S4	107937.93	107937.19	0	0
S3	82605.53	82604.99	0	0
S2	54565.11	54565.11	0	0
S1	26525.4	26525.4	0	0
N MPW	46166.94	46166.94	0	0
OSD 10	194581.77	162070.55	32519.9	0
MB09	48476.6	48468.79	0	0
MBC01/02	27548.49	27548.07	0	0
MBC01/01A	58411.24	58383.73	0	0
MBC01/01	58383.5	58396.27	0	0
MBC02/01	245619.33	245574.14	0	0
MBC04/02	4391.51	4392.82	0	0
MBC02/01a	4392.82	4392.82	0	0
MBC03/03	162070.55	162005.48	0	0
MBC03/02	47953.58	47877.13	0	0.2
MBC02/01b	47877.13	47857.04	0	0
S01/03	150262.3	150214.23	0	0
S01/02	43284.53	43262.94	0	0
S01/01	150980.27	150969.67	0	0
S02/05	53804.21	53804.04	0	0
S02/04	53804.09	53809.67	0	0
S02/03	53809.8	53814.6	0	0
S02/02	53814.68	53815.14	0	0
S02/01	62698.38	62686.14	0	0
OSD01	141850.53	150262.3	-8399.71	0
OSD02	66267.82	53804.21	12464.02	0
Outlet 1	150969.67	150969.67	0	0
PR 3.3	787.45	787.45	0	0
PR Bypass02	2491.99	2491.99	0	0
PR Bypass03	2273.9	2273.9	0	0
PR Bypass01	1980.84	1980.84	0	0
PR3.1	1220.01	1220.01	0	0
PR3.2	915.9	915.9	0	0
PR Outlet2	62686.14	62686.14	0	0
N1139291	0	0	0	0
N1139292	0	0	0	0
W2a	12987.37	12987.37	0	0
MR01	19917.09	19917.06	0	0
W3a	5231.64	5231.64	0	0
OSD1b	66543.02	66542.96	0	0
OSD1c	54702.98	54702.93	0	0
MR02	20559.39	20559.48	0	0
W3ba	2615.82	2615.82	0	0
MR03	5139.87	5139.87	0	0
W3bb	2569.93	2569.93	0	0
W5	4084.36	4084.36	0	0
OSD1a	86459.99	86459.91	0	0
OSD 1d	20329.93	20330.13	0	0
MR04	13262.7	13262.7	0	0
W4a	5644.68	5644.68	0	0
W6a	4864.52	4864.52	0	0
W4b	5552.91	5552.91	0	0
W5b	4084.36	4084.36	0	0
MR05	5369.31	5369.31	0	0
OSD1e	42403.99	42403.8	0	0
MR06	8306.38	8306.38	0	0
W2b	13538.11	13538.11	0	0
MR07	8994.79	8994.79	0	0
MAR1	3074.73	3074.73	0	0
MAR2	3671.35	3671.35	0	0
MAR3	1560.32	1560.32	0	0
OSD2a	46625.61	46626	0	0
OSD2b	41348.41	41348.36	0	0
OSD2c	15190.12	15190.15	0	0
W6b	4772.74	4772.74	0	0
W7a	5644.68	5644.68	0	0
W7b	5552.91	5552.91	0	0
W8a	4084.36	4084.36	0	0
W8b	4084.36	4084.36	0	0
MR08	9361.85	9361.85	0	0
MR09	10876.34	10876.29	0	0
MR10	4818.61	4818.61	0	0
MR11	5461.08	5461.08	0	0
MR12	4222.03	4222.03	0	0
MAR4	4543.28	4543.28	0	0
External Catch	30863.3	30863.23	0	0

Run Log for MPEStage2SMPProposed run at 15:14:41 on 27/2/2018

The maximum water level in these storages exceeds the maximum elevation you specified: OSD 10, Basin 09.
DRAINS has extrapolated the Elevation vs Storage table to a higher Elevation. Please provide accurate values for higher elevations.

Water was lost from the system at: MBC04/02. If this water re-enters the system further downstream you should draw an overflow route from this location.
Upwelling occurred at: PR DNSDC

The maximum flow in these overflow routes is unsafe: F External Catch, F OSD2b, F OSD2a, F MR01, F OSD1e, F OSD1d, F OSD1b, F MR02, F OSD1c, F OSD1a, F OSD01 Surcharge, F PR Outlet2, F Outlet 1, F OSD 10.1,
F PR OVER MOORE, F S4, F S3, F S2, F S1, F S5, F MPE ST1, F MPW, F OutPit 10, Channel

These overflow routes carried water uphill (adding energy): F S02/05, F OSD02, F OSD1 Out, F OSD 10.1, F PR OVER MOORE, Basin 09 Out.
These results may be invalid. You should check for water flowing round in circles (e.g. negative flow in adjacent pipes) at these locations. You may need to reformulate the model.

ARCADIS Design & Consultancy for natural and built assets	**PROJECT** MPE Stage 2 Stormwater Management Plan **TITLE** Stage-Discharge Outlet Relationships OSD 01	**JOB No** AA009335 **PREPARED** [redacted] **CHECKED** [redacted]	**DATE** 27/02/2018 **DATE** 27/02/2018

Stage-Discharge Outlet Relationships - OSD 01 (Unblocked)

DRAINS Model: **F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn**

Calculation Inputs	Value	Comment
Cc	0.62	Orifice loss coefficient
Weir calculation increment (m)	0.01	Recommend using a smaller increment (0.01) to produce a representative flow relationship
Set height of weir increment (m)	0.1	This allows a more detailed calculation of flow for the height entered
Orifice increment (m)	0.10	This sets the increment of calculations
Detention Storage Properties		
Invert (inc. WQ) (mAHD)	13.7	
Height of discharge calculation (mAHD)	18	
OSD height (m)	4.3	
Low Flow Outlet Control		
Orifice Shape	C	C = Circular / R = Rectangular
Orifice Diameter Ø or Height (m)	0.225	
Number or Length of Orifice (m)	2	
Area (m2)	0.080	
Centreline of Orifice (mAHD)	13.813	This level sets the orifice flow calculation
IL of Low Flow Orifice (mAHD)	13.700	
OL of Low Flow Orifice (mAHD)	13.925	
Minimum Trash Screen / Grate Area (m2)	1.99	The area to be 20 times larger than orifice area. Account for 80% grate open area
Weir Perimeter Length (m)	4.500	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of Low Flow Pit (mAHD)	14.000	
High Flow Outlet Control		
Orifice Shape	C	C = Circular/R = Rectangular
Orifice Diameter Ø or Height (m)	0.450	
Number or Length of orifice (m)	3	
Area (m2)	0.477	
Centreline of Orifice (mAHD)	13.925	
IL of Low Flow Orifice (mAHD)	13.700	
OL of Low Flow Orifice (mAHD)	14.150	
Minimum Trash Screen / Grate Area (m2)	11.93	The area to be 20 times larger than orifice area. Account for 80% grate open area
Weir Perimeter Length (m)	12.400	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of High Flow Pit (mAHD)	14.700	
Weir		
Weir Level (mAHD)	15.80	
Weir Length	15.5	
Weir Coefficient	1.6	
PMF Weir		
Weir Level (mAHD)	17.50	
Weir Length	50.0	
Weir Coefficient	1.6	
Trash Screen Detail		
Minimum Screen Clearance (m)	0.338	
Mesh Type Recommended	WELDLOK A40/203	
Minimum trash screen area (m2)	1.590	
Minimum Screen Clearance (m)	0.675	
Mesh Type Recommended	WELDLOK A40/203	
Minimum trash screen area (m2)	9.543	
Checks/Warnings		
Are the orifice centrelines equal?	NO	DOES THIS REPRESENT THE DESIGN?
Height that low flow weir controls	14.01	
Height that low flow orifice controls	14.07	
Depth of low flow weir control	**0.06**	OK
Height that high flow weir controls	14.71	CHECK CALCULATION
Height that high flow orifice controls	14.90	
Depth of high flow weir control	**0.19**	CONSIDER INCREASING WEIR INCREMENT OR INCREASING PIT DIMENSION
Errors		
Low Flow Pit	OK	
High Flow Pit	OK	
Full Stage Discharge calculated	OK	

Stage H (m)	Low Flow Qt (m3/s)	High Flow Qt (m3/s)	Weir Qt (m3/s)	PMF Weir Qt (m3/s)	Discharge Qt (m3/s)
14.00	0.000	0.000	0.000	0.000	0.000
14.01	0.007	0.000	0.000	0.000	0.007
14.02	0.020	0.000	0.000	0.000	0.020
14.03	0.037	0.000	0.000	0.000	0.037
14.04	0.058	0.000	0.000	0.000	0.058
14.05	0.080	0.000	0.000	0.000	0.080
14.06	0.106	0.000	0.000	0.000	0.106
14.07	0.111	0.000	0.000	0.000	0.111
14.08	0.113	0.000	0.000	0.000	0.113
14.09	0.115	0.000	0.000	0.000	0.115
14.10	0.117	0.000	0.000	0.000	0.117
14.20	0.136	0.000	0.000	0.000	0.136
14.30	0.152	0.000	0.000	0.000	0.152
14.40	0.167	0.000	0.000	0.000	0.167
14.50	0.181	0.000	0.000	0.000	0.181
14.60	0.194	0.000	0.000	0.000	0.194
14.70	0.206	0.000	0.000	0.000	0.206
14.71	0.207	0.020	0.000	0.000	0.227
14.72	0.208	0.056	0.000	0.000	0.264
14.73	0.209	0.103	0.000	0.000	0.312
14.74	0.210	0.159	0.000	0.000	0.369
14.75	0.211	0.222	0.000	0.000	0.433
14.76	0.212	0.292	0.000	0.000	0.504
14.77	0.214	0.367	0.000	0.000	0.581
14.78	0.215	0.449	0.000	0.000	0.664
14.79	0.216	0.536	0.000	0.000	0.751
14.80	0.217	0.627	0.000	0.000	0.844
14.90	0.228	1.293	0.000	0.000	1.521
15.00	0.238	1.358	0.000	0.000	1.596
15.10	0.248	1.420	0.000	0.000	1.667
15.20	0.257	1.479	0.000	0.000	1.736
15.30	0.266	1.536	0.000	0.000	1.802
15.40	0.275	1.591	0.000	0.000	1.866
15.50	0.284	1.644	0.000	0.000	1.927
15.60	0.292	1.695	0.000	0.000	1.987
15.70	0.300	1.745	0.000	0.000	2.045
15.80	0.308	1.793	0.000	0.000	2.101
15.90	0.315	1.841	0.784	0.000	2.940
16.00	0.323	1.887	2.218	0.000	4.428
16.10	0.330	1.931	4.075	0.000	6.337
16.20	0.337	1.975	6.274	0.000	8.587
16.30	0.344	2.018	8.768	0.000	11.131
16.40	0.351	2.060	11.526	0.000	13.937
16.50	0.358	2.102	14.524	0.000	16.984
16.60	0.364	2.142	17.745	0.000	20.252
16.70	0.371	2.182	21.175	0.000	23.727
16.80	0.377	2.221	24.800	0.000	27.398
16.90	0.384	2.259	28.612	0.000	31.254
17.00	0.390	2.297	32.600	0.000	35.287
17.10	0.396	2.334	36.759	0.000	39.489
17.20	0.402	2.370	41.081	0.000	43.853
17.30	0.408	2.406	45.561	0.000	48.374
17.40	0.413	2.441	50.192	0.000	53.046
17.50	0.419	2.476	54.970	0.000	57.865
17.60	0.425	2.511	59.891	2.530	65.356
17.70	0.430	2.545	64.950	7.155	75.081
17.80	0.436	2.578	70.145	13.145	86.304
17.90	0.441	2.611	75.471	20.239	98.762
18.00	0.447	2.644	80.926	28.284	112.300
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
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ARCADIS Design & Consultancy for natural and built assets

PROJECT MPE Stage 2			
Stormwater Management Plan	**JOB No** AA009335		
TITLE Stage-Discharge Outlet Relationships	**PREPARED** [redacted]	**DATE** 27/02/2018	
OSD 02	**CHECKED** [redacted]	**DATE** 27/02/2018	

Stage-Discharge Outlet Relationships - OSD 02 (Unblocked)

DRAINS Model: F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn

Calculation Inputs	Value	Comment
Cc	0.62	Orifice loss coefficient
Weir calculation increment (m)	0.01	Recommend using a smaller increment (0.01) to produce a representative flow relationship
Set height of weir increment (m)	0.1	This allows a more detailed calculation of flow for the height entered
Orifice increment (m)	0.10	This sets the increment of calculations

Detention Storage Properties		
Invert (inc. WQ) (mAHD)	14.7	
Height of discharge calculation (mAHD)	18	
OSD height (m)	3.3	

Low Flow Outlet Control		
Orifice Shape	C	C = Circular / R = Rectangular
Orifice Diameter Ø or Height (m)	0.170	
Number or Length of Orifice (m)	1	
Area (m2)	0.023	
Centreline of Orifice (mAHD)	14.785	This level sets the orifice flow calculation
IL of Low Flow Orifice (mAHD)	14.700	
OL of Low Flow Orifice (mAHD)	14.870	
Minimum Trash Screen / Grate Area (m2)	0.57	The area to be 20 times larger than orifice area. Account for 80% grate open area
Weir Perimeter Length (m)	5.700	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of Low Flow Pit (mAHD)	15.000	

High Flow Outlet Control		
Orifice Shape	C	C = Circular/R = Rectangular
Orifice Diameter Ø or Height (m)	0.475	
Number or Length of orifice (m)	3	
Area (m2)	0.532	
Centreline of Orifice (mAHD)	14.938	
IL of Low Flow Orifice (mAHD)	14.700	
OL of Low Flow Orifice (mAHD)	15.175	
Minimum Trash Screen / Grate Area (m2)	13.29	The area to be 20 times larger than orifice area. Account for 80% grate open area
Weir Perimeter Length (m)	12.500	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of High Flow Pit (mAHD)	16.000	

Weir		
Weir Level (mAHD)	16.30	
Weir Length	15.5	
Weir Coefficient	1.6	

PMF Weir		
Weir Level (mAHD)	17.50	
Weir Length	12.0	
Weir Coefficient	1.6	

Trash Screen Detail		
Minimum Screen Clearance (m)	0.255	
Mesh Type Recommended	WELDLOK A40/203	
Minimum trash screen area (m2)	0.454	
Minimum Screen Clearance (m)	0.713	
Mesh Type Recommended	WELDLOK A40/203	
Minimum trash screen area (m2)	10.632	

Checks/Warnings		
Are the orifice centrelines equal?	NO	DOES THIS REPRESENT THE DESIGN?
Height that low flow weir controls	15.01	
Height that low flow orifice controls	15.03	
Depth of low flow weir control	**0.02**	OK
Height that high flow weir controls	16.01	CHECK CALCULATION
Height that high flow orifice controls	16.20	
Depth of high flow weir control	**0.19**	CONSIDER INCREASING WEIR INCREMENT OR INCREASING PIT DIMENSION

Errors		
Low Flow Pit	OK	
High Flow Pit	OK	
Full Stage Discharge calculated	OK	

Stage H (m)	Low Flow Qt (m3/s)	High Flow Qt (m3/s)	Weir Qt (m3/s)	PMF Weir Qt (m3/s)	Discharge Qt (m3/s)
15.00	0.000	0.000	0.000	0.000	0.000
15.01	0.009	0.000	0.000	0.000	0.009
15.02	0.026	0.000	0.000	0.000	0.026
15.03	0.031	0.000	0.000	0.000	0.031
15.04	0.031	0.000	0.000	0.000	0.031
15.05	0.032	0.000	0.000	0.000	0.032
15.06	0.033	0.000	0.000	0.000	0.033
15.07	0.033	0.000	0.000	0.000	0.033
15.08	0.034	0.000	0.000	0.000	0.034
15.09	0.034	0.000	0.000	0.000	0.034
15.10	0.035	0.000	0.000	0.000	0.035
15.20	0.040	0.000	0.000	0.000	0.040
15.30	0.045	0.000	0.000	0.000	0.045
15.40	0.049	0.000	0.000	0.000	0.049
15.50	0.053	0.000	0.000	0.000	0.053
15.60	0.056	0.000	0.000	0.000	0.056
15.70	0.060	0.000	0.000	0.000	0.060
15.80	0.063	0.000	0.000	0.000	0.063
15.90	0.066	0.000	0.000	0.000	0.066
16.00	0.069	0.000	0.000	0.000	0.069
16.01	0.069	0.020	0.000	0.000	0.089
16.02	0.069	0.057	0.000	0.000	0.126
16.03	0.070	0.104	0.000	0.000	0.173
16.04	0.070	0.160	0.000	0.000	0.230
16.05	0.070	0.224	0.000	0.000	0.294
16.06	0.070	0.294	0.000	0.000	0.364
16.07	0.071	0.370	0.000	0.000	0.441
16.08	0.071	0.453	0.000	0.000	0.523
16.09	0.071	0.540	0.000	0.000	0.611
16.10	0.071	0.632	0.000	0.000	0.704
16.20	0.074	1.640	0.000	0.000	1.714
16.30	0.077	1.703	0.000	0.000	1.780
16.40	0.079	1.765	0.784	0.000	2.628
16.50	0.082	1.824	2.218	0.000	4.124
16.60	0.084	1.881	4.075	0.000	6.040
16.70	0.086	1.937	6.274	0.000	7.630
16.80	0.088	1.991	8.768	0.000	7.630
16.90	0.091	2.044	11.526	0.000	7.630
17.00	0.093	2.096	14.524	0.000	7.630
17.10	0.095	2.146	17.745	0.000	7.630
17.20	0.097	2.195	21.175	0.000	7.630
17.30	0.099	2.243	24.800	0.000	7.630
17.40	0.101	2.290	28.612	0.000	7.630
17.50	0.103	2.336	32.600	0.000	7.630
17.60	0.105	2.381	36.759	0.607	8.237
17.70	0.106	2.425	41.081	1.717	9.347
17.80	0.108	2.469	45.561	3.155	10.785
17.90	0.110	2.512	50.192	4.857	12.487
18.00	0.112	2.554	54.970	6.788	14.418
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ARCADIS Design & Consultancy for natural and built assets

PROJECT MPE Stage 2
Stormwater Management Plan
TITLE Stage-Discharge Outlet Relationships
OSD 09

JOB No AA009335
PREPARED [redacted] **DATE** 27/02/2018
CHECKED [redacted] **DATE** 27/02/2018

Stage-Discharge Outlet Relationships - OSD 09 (Unblocked)

DRAINS Model: **F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn**

Calculation Inputs	Value	Comment
Cc	0.62	Orifice loss coefficient
Weir calculation increment (m)	0.01	Recommend using a smaller increment (0.01) to produce a representative flow relationship
Set height of weir increment (m)	0.1	This allows a more detailed calculation of flow for the height entered
Orifice increment (m)	0.10	This sets the increment of calculations

Detention Storage Properties		
Invert (inc. WQ) (mAHD)	13.2	
Height of discharge calculation (mAHD)	18	
OSD height (m)	4.8	

Low Flow Outlet Control		
Orifice Shape	C	C = Circular / R = Rectangular
Orifice Diameter Ø or Height (m)	0.200	
Number or Length of Orifice (m)	3	
Area (m2)	0.094	
Centreline of Orifice (mAHD)	13.300	This level sets the orifice flow calculation
IL of Low Flow Orifice (mAHD)	13.200	
OL of Low Flow Orifice (mAHD)	13.400	
Minimum Trash Screen / Grate Area (m2)	2.36	The area to be 20 times larger than orifice area. Account for 80% grate open area
Weir Perimeter Length (m)	5.200	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of Low Flow Pit (mAHD)	13.500	

High Flow Outlet Control		
Orifice Shape	C	C = Circular/R = Rectangular
Orifice Diameter Ø or Height (m)	0.400	
Number or Length of orifice (m)	1	
Area (m2)	0.126	
Centreline of Orifice (mAHD)	13.400	
IL of Low Flow Orifice (mAHD)	13.200	
OL of Low Flow Orifice (mAHD)	13.600	
Minimum Trash Screen / Grate Area (m2)	3.14	The area to be 20 times larger than orifice area. Account for 80% grate open area
Weir Perimeter Length (m)	5.900	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of High Flow Pit (mAHD)	14.500	

Weir		
Weir Level (mAHD)	16.50	
Weir Length	160.0	
Weir Coefficient	1.6	

Trash Screen Detail		
Minimum Screen Clearance (m)	0.300	
Mesh Type Recommended	WELDLOK A40/203	
Minimum trash screen area (m2)	1.885	
Minimum Screen Clearance (m)	0.600	
Mesh Type Recommended	WELDLOK A40/203	
Minimum trash screen area (m2)	2.513	

Checks/Warnings		
Are the orifice centrelines equal?	NO	DOES THIS REPRESENT THE DESIGN?
Height that low flow weir controls	13.51	
Height that low flow orifice controls	13.57	
Depth of low flow weir control	**0.06**	OK
Height that high flow weir controls	14.51	CHECK CALCULATION
Height that high flow orifice controls	14.70	
Depth of high flow weir control	**0.19**	CONSIDER INCREASING WEIR INCREMENT OR INCREASING PIT DIMENSION

Errors		
Low Flow Pit	OK	
High Flow Pit	OK	
Full Stage Discharge calculated	INVALID	

Stage H (m)	Low Flow Qt (m3/s)	High Flow Qt (m3/s)	Weir Qt (m3/s)	Discharge Qt (m3/s)
13.50	0.000	0.000	0.000	0.000
13.51	0.008	0.000	0.000	0.008
13.52	0.024	0.000	0.000	0.024
13.53	0.043	0.000	0.000	0.043
13.54	0.067	0.000	0.000	0.067
13.55	0.093	0.000	0.000	0.093
13.56	0.122	0.000	0.000	0.122
13.57	0.134	0.000	0.000	0.134
13.58	0.137	0.000	0.000	0.137
13.59	0.139	0.000	0.000	0.139
13.60	0.142	0.000	0.000	0.142
13.70	0.164	0.000	0.000	0.164
13.80	0.183	0.000	0.000	0.183
13.90	0.200	0.000	0.000	0.200
14.00	0.216	0.000	0.000	0.216
14.10	0.231	0.000	0.000	0.231
14.20	0.245	0.000	0.000	0.245
14.30	0.259	0.000	0.000	0.259
14.40	0.271	0.000	0.000	0.271
14.50	0.283	0.000	0.000	0.283
14.51	0.285	0.009	0.000	0.294
14.52	0.286	0.027	0.000	0.312
14.53	0.287	0.049	0.000	0.336
14.54	0.288	0.076	0.000	0.364
14.55	0.289	0.106	0.000	0.395
14.56	0.290	0.139	0.000	0.429
14.57	0.292	0.175	0.000	0.466
14.58	0.293	0.214	0.000	0.506
14.59	0.294	0.255	0.000	0.549
14.60	0.295	0.299	0.000	0.593
14.70	0.306	0.393	0.000	0.699
14.80	0.317	0.408	0.000	0.725
14.90	0.327	0.422	0.000	0.750
15.00	0.337	0.436	0.000	0.774
15.10	0.347	0.450	0.000	0.797
15.20	0.357	0.463	0.000	0.819
15.30	0.366	0.475	0.000	0.841
15.40	0.375	0.488	0.000	0.863
15.50	0.384	0.500	0.000	0.884
15.60	0.392	0.512	0.000	0.904
15.70	0.401	0.523	0.000	0.924
15.80	0.409	0.534	0.000	0.943
15.90	0.417	0.545	0.000	0.963
16.00	0.425	0.556	0.000	0.981
16.10	0.433	0.567	0.000	1.000
16.20	0.441	0.577	0.000	1.018
16.30	0.448	0.587	0.000	1.035
16.40	0.455	0.597	0.000	1.053
16.50	0.463	0.607	0.000	1.070
16.60	0.470	0.617	8.095	9.182
16.70	0.477	0.627	22.897	24.001
16.80	0.484	0.636	42.065	43.185
16.90	0.491	0.645	64.763	65.900
17.00	0.498	0.654	90.510	91.662
17.10	0.504	0.663	118.978	120.146
17.20	0.511	0.672	149.929	151.113
17.30	0.517	0.681	183.179	184.377
17.40	0.524	0.690	218.577	219.790
17.50	0.530	0.698	256.000	257.229
17.60	0.536	0.707	295.345	296.588
17.70	0.543	0.715	336.521	337.779
17.80	0.549	0.724	379.450	380.723
17.90	0.555	0.732	424.065	425.351
18.00	0.561	0.740	470.302	471.603
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Stage-Discharge Outlet Relationships - OSD 10 (Unblocked)

DRAINS Model:	F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn

Calculation Inputs	Value	Comment
Cc	0.62	Orifice loss coefficient
Weir calculation increment (m)	0.01	Recommend using a smaller increment (0.01) to produce a representative flow relationship
Set height of weir increment (m)	0.1	This allows a more detailed calculation of flow for the height entered
Orifice increment (m)	0.10	This sets the increment of calculations

Detention Storage Properties		
Invert (inc. WQ) (mAHD)	13.5	
Height of discharge calculation (mAHD)	18	
OSD height (m)	4.5	

Low Flow Outlet Control		
Orifice Shape	R	C = Circular / R = Rectangular
Orifice Diameter Ø or Height (m)	0.200	
Number or Length of Orifice (m)	0.700	
Area (m2)	0.140	
Centreline of Orifice (mAHD)	13.600	This level sets the orifice flow calculation
IL of Low Flow Orifice (mAHD)	13.500	
OL of Low Flow Orifice (mAHD)	13.700	
Minimum Trash Screen / Grate Area (m2)	3.50	The area to be 20 times larger than orifice area. Account for 80% grate open area
Weir Perimeter Length (m)	4.200	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of Low Flow Pit (mAHD)	13.800	

High Flow Outlet Control		
Orifice Shape	R	C = Circular/R = Rectangular
Orifice Diameter Ø or Height (m)	0.300	
Number or Length of orifice (m)	2.200	
Area (m2)	0.660	
Centreline of Orifice (mAHD)	13.650	
IL of Low Flow Orifice (mAHD)	13.500	
OL of Low Flow Orifice (mAHD)	13.800	
Minimum Trash Screen / Grate Area (m2)	16.50	The area to be 20 times larger than orifice area. Account for 80% grate open area
Weir Perimeter Length (m)	18.600	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of High Flow Pit (mAHD)	14.000	

Weir		
Weir Level (mAHD)	17.30	
Weir Length	570.0	
Weir Coefficient	1.6	

Trash Screen Detail		
Minimum Screen Clearance (m)	0.300	
Mesh Type Recommended	WELDLOK A40/203	
Minimum trash screen area (m2)	2.800	
Minimum Screen Clearance (m)	0.450	
Mesh Type Recommended	WELDLOK A40/203	
Minimum trash screen area (m2)	13.200	

Checks/Warnings		
Are the orifice centrelines equal?	NO	DOES THIS REPRESENT THE DESIGN?
Height that low flow weir controls	13.81	
Height that low flow orifice controls	13.90	
Depth of low flow weir control	**0.09**	OK
Height that high flow weir controls	14.01	CHECK CALCULATION
Height that high flow orifice controls	14.20	
Depth of high flow weir control	**0.19**	CONSIDER INCREASING WEIR INCREMENT OR INCREASING PIT DIMENSION

Errors		
Low Flow Pit	OK	
High Flow Pit	OK	
Full Stage Discharge calculated	OK	

Stage H (m)	Low Flow Qt (m3/s)	High Flow Qt (m3/s)	Weir Qt (m3/s)	Discharge Qt (m3/s)
13.80	0.000	0.000	0.000	0.000
13.81	0.007	0.000	0.000	0.007
13.82	0.019	0.000	0.000	0.019
13.83	0.035	0.000	0.000	0.035
13.84	0.054	0.000	0.000	0.054
13.85	0.075	0.000	0.000	0.075
13.86	0.099	0.000	0.000	0.099
13.87	0.124	0.000	0.000	0.124
13.88	0.152	0.000	0.000	0.152
13.89	0.181	0.000	0.000	0.181
13.90	0.210	0.000	0.000	0.210
14.00	0.243	0.000	0.000	0.243
14.01	0.246	0.030	0.000	0.276
14.02	0.249	0.084	0.000	0.333
14.03	0.252	0.155	0.000	0.407
14.04	0.255	0.238	0.000	0.493
14.05	0.258	0.333	0.000	0.591
14.06	0.261	0.437	0.000	0.698
14.07	0.263	0.551	0.000	0.815
14.08	0.266	0.673	0.000	0.940
14.09	0.269	0.804	0.000	1.073
14.10	0.272	0.941	0.000	1.213
14.20	0.298	1.344	0.000	1.641
14.30	0.322	1.461	0.000	1.782
14.40	0.344	1.569	0.000	1.913
14.50	0.365	1.670	0.000	2.035
14.60	0.384	1.766	0.000	2.150
14.70	0.403	1.856	0.000	2.259
14.80	0.421	1.943	0.000	2.364
14.90	0.438	2.025	0.000	2.464
15.00	0.455	2.105	0.000	2.560
15.10	0.471	2.181	0.000	2.652
15.20	0.486	2.255	0.000	2.742
15.30	0.501	2.327	0.000	2.828
15.40	0.516	2.397	0.000	2.912
15.50	0.530	2.464	0.000	2.994
15.60	0.543	2.530	0.000	3.073
15.70	0.557	2.594	0.000	3.151
15.80	0.570	2.656	0.000	3.226
15.90	0.583	2.717	0.000	3.300
16.00	0.595	2.777	0.000	3.372
16.10	0.608	2.836	0.000	3.443
16.20	0.620	2.893	0.000	3.513
16.30	0.631	2.949	0.000	3.581
16.40	0.643	3.004	0.000	3.647
16.50	0.654	3.058	0.000	3.713
16.60	0.666	3.112	0.000	3.777
16.70	0.677	3.164	0.000	3.840
16.80	0.687	3.215	0.000	3.903
16.90	0.698	3.266	0.000	3.964
17.00	0.709	3.316	0.000	4.024
17.10	0.719	3.365	0.000	4.084
17.20	0.729	3.413	0.000	4.142
17.30	0.739	3.461	0.000	4.200
17.40	0.749	3.508	28.840	33.097
17.50	0.759	3.555	81.572	85.885
17.60	0.769	3.600	149.857	154.226
17.70	0.778	3.646	230.720	235.144
17.80	0.788	3.691	322.441	326.919
17.90	0.797	3.735	423.859	428.391
18.00	0.806	3.778	534.124	538.708
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APPENDIX D

Flow Comparisons

D.1 Outlet A

D.2 Outlet B

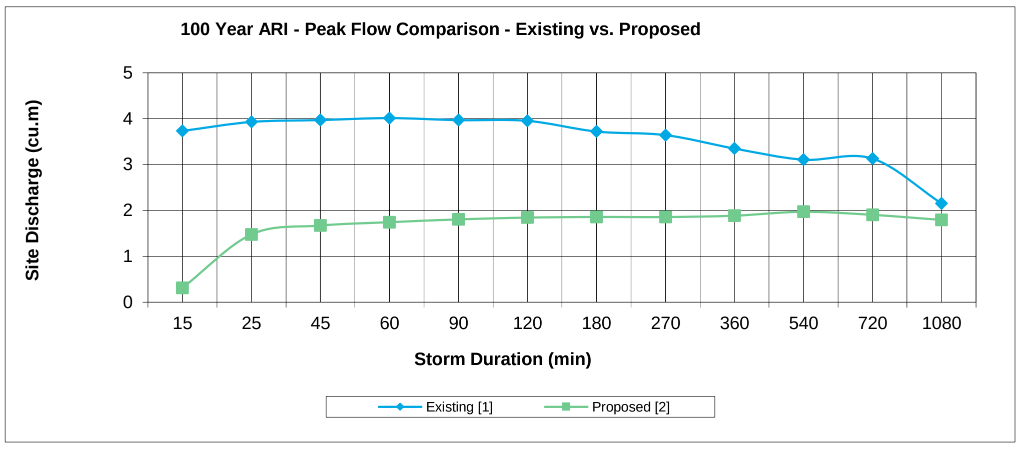
D.3 Outlet C

ARCADIS	PROJECT	MPE Stage 2 Stormwater Management Plan	
	TITLE	DRAINS Peak Flow Comparison - Existing vs. Proposed Outlet A	JOB No AA009335 PREPARED [redacted] DATE 27/02/18 CHECKED [redacted] DATE 27/02/18

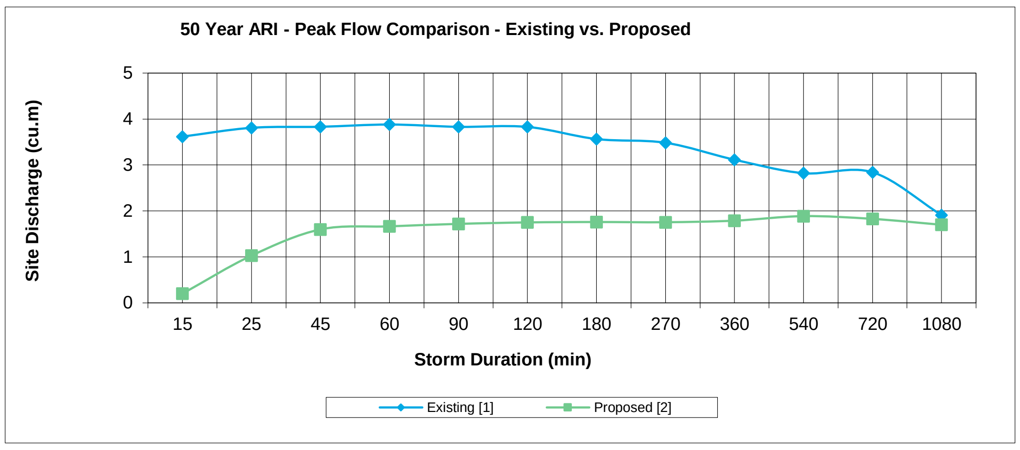
DRAINS Models (existing and proposed):
F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPExisting-18-02-26.drn
F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn

DRAINS Version: Version 2017.10 (64.bit) - 9 August 2017
Existing Outlet Ref: F EX A1 E
Proposed Outlet Ref: F Outlet 1

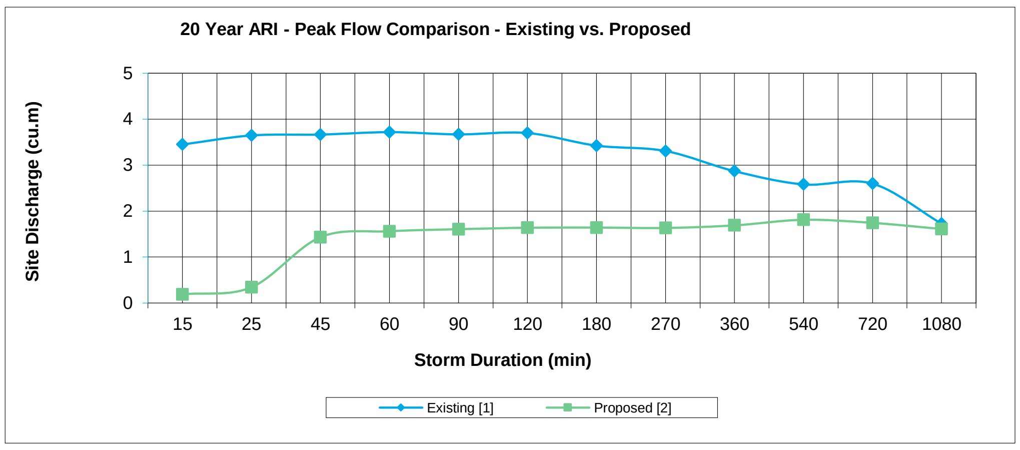
	100yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	3.733	0.311	-3.422
25	3.929	1.477	-2.452
45	3.970	1.671	-2.299
60	***4.013***	1.744	-2.269
90	3.968	1.805	-2.163
120	3.953	1.844	-2.109
180	3.720	1.858	-1.862
270	3.642	1.856	-1.786
360	3.349	1.886	-1.463
540	3.106	***1.971***	-1.135
720	3.130	1.904	-1.226
1080	2.152	1.794	-0.358
Max	***4.013***	***1.971***	



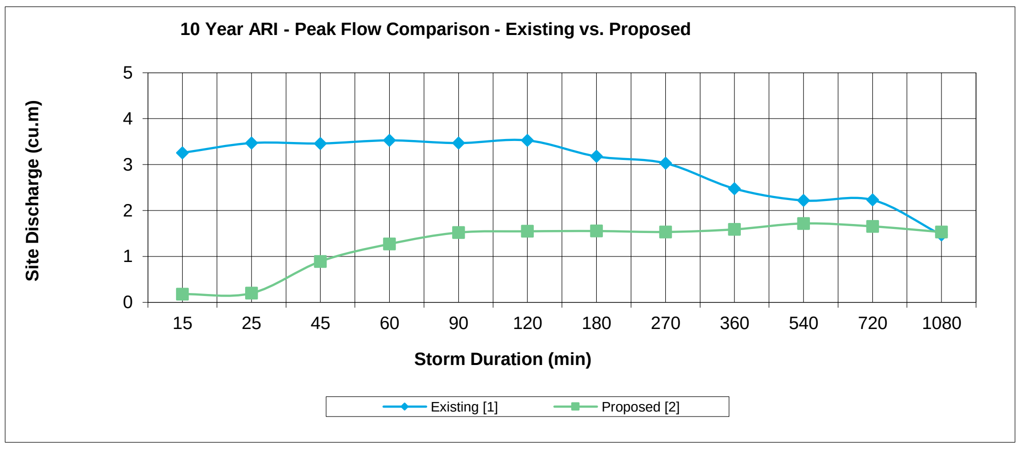
	50yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	3.618	0.201	-3.417
25	3.809	1.028	-2.781
45	3.832	1.599	-2.233
60	***3.881***	1.665	-2.216
90	3.830	1.719	-2.111
120	3.829	1.751	-2.078
180	3.565	1.760	-1.805
270	3.484	1.755	-1.729
360	3.115	1.789	-1.326
540	2.822	***1.888***	-0.934
720	2.841	1.828	-1.013
1080	1.910	1.700	-0.210
Max	***3.881***	***1.888***	



	20yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	3.449	0.189	-3.260
25	3.646	0.343	-3.303
45	3.665	1.433	-2.232
60	***3.718***	1.561	-2.157
90	3.669	1.606	-2.063
120	3.699	1.638	-2.061
180	3.424	1.642	-1.782
270	3.308	1.633	-1.675
360	2.869	1.689	-1.180
540	2.580	***1.811***	-0.769
720	2.597	1.744	-0.853
1080	1.726	1.611	-0.115
Max	***3.718***	***1.811***	



	10yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	3.257	0.180	-3.077
25	3.470	0.199	-3.271
45	3.460	0.892	-2.568
60	***3.528***	1.271	-2.257
90	3.469	1.520	-1.949
120	3.527	1.547	-1.980
180	3.178	1.553	-1.625
270	3.030	1.533	-1.497
360	2.476	1.589	-0.887
540	2.218	***1.718***	-0.500
720	2.230	1.655	-0.575
1080	1.467	1.531	0.064
Max	***3.528***	***1.718***	



ARCADIS

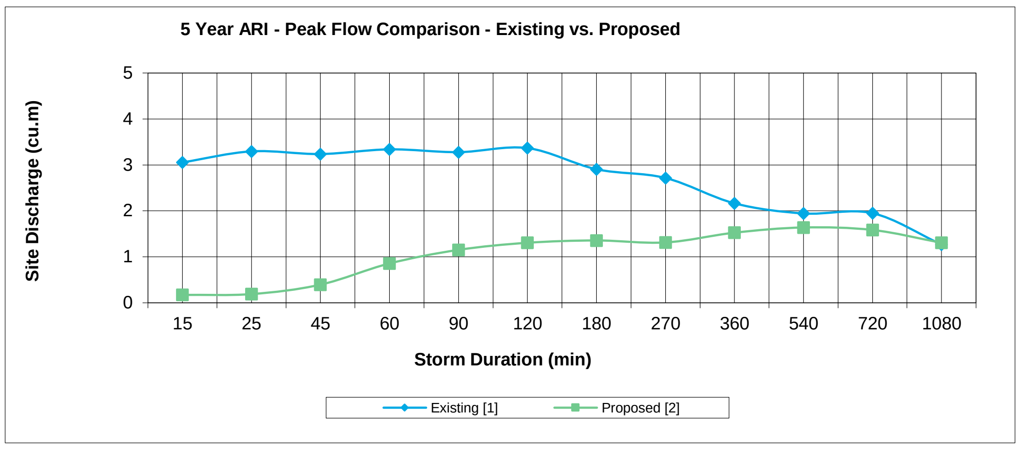
PROJECT	MPE Stage 2 Stormwater Management Plan	JOB No	AA009335		
TITLE	DRAINS Peak Flow Comparison - Existing vs. Proposed Outlet A	PREPARED	[redacted]	DATE	27/02/18
		CHECKED	[redacted]	DATE	27/02/18

DRAINS Models (existing and proposed): F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPExisting-18-02-26.drn

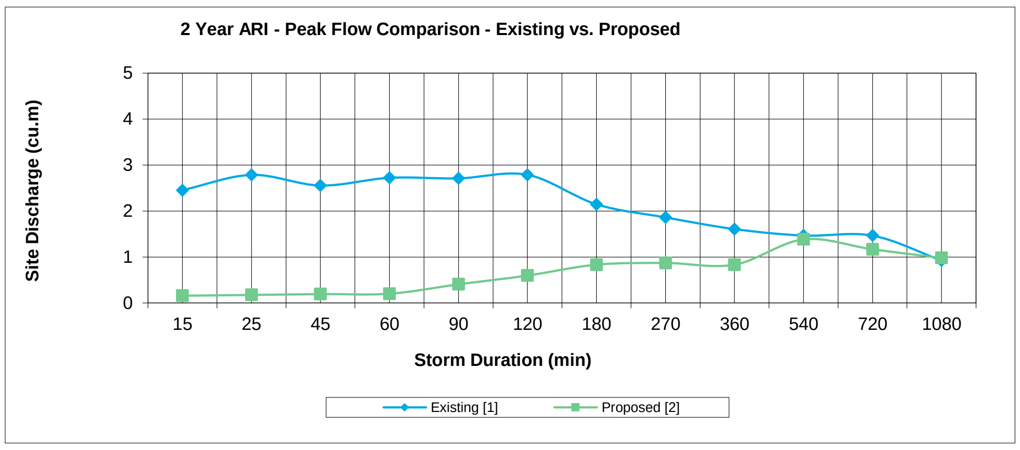
F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn

DRAINS Version: Version 2017.10 (64.bit) - 9 August 2017
Existing Outlet Ref: F EX A1 E
Proposed Outlet Ref: F Outlet 1

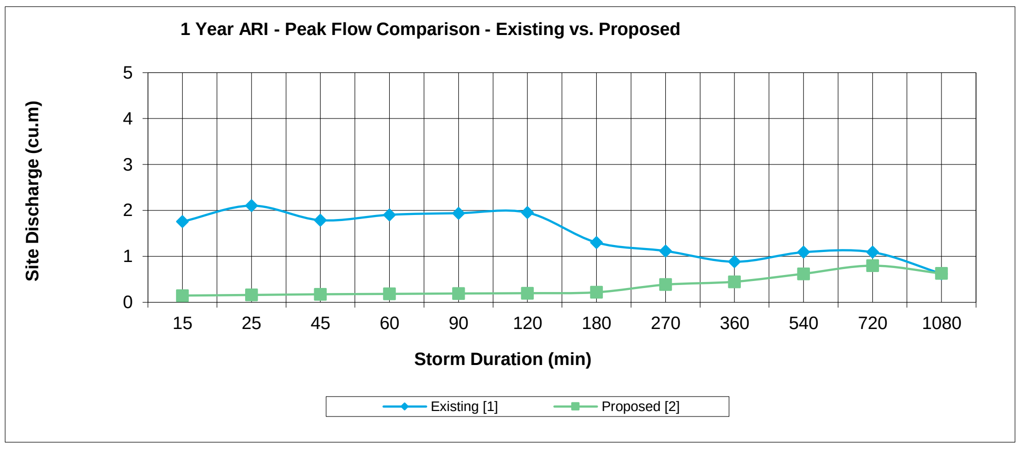
	5yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	3.055	0.172	-2.883
25	3.295	0.190	-3.105
45	3.237	0.395	-2.842
60	3.339	0.856	-2.483
90	3.278	1.152	-2.126
120	***3.366***	1.306	-2.060
180	2.906	1.357	-1.549
270	2.716	1.313	-1.403
360	2.164	1.526	-0.638
540	1.944	***1.639***	-0.305
720	1.949	1.585	-0.364
1080	1.268	1.306	0.038
Max	***3.366***	***1.639***	



	2yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	2.453	0.158	-2.295
25	2.786	0.174	-2.612
45	2.555	0.192	-2.363
60	2.723	0.201	-2.522
90	2.710	0.405	-2.305
120	***2.788***	0.596	-2.192
180	2.146	0.833	-1.313
270	1.861	0.870	-0.991
360	1.607	0.833	-0.774
540	1.466	***1.383***	-0.083
720	1.464	1.167	-0.297
1080	0.924	0.979	0.055
Max	***2.788***	***1.383***	



	1yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	1.756	0.146	-1.610
25	***2.104***	0.159	-1.945
45	1.787	0.174	-1.613
60	1.905	0.182	-1.723
90	1.940	0.191	-1.749
120	1.952	0.198	-1.754
180	1.302	0.217	-1.085
270	1.117	0.384	-0.733
360	0.883	0.447	-0.436
540	1.090	0.621	-0.469
720	1.090	***0.797***	-0.293
1080	0.621	0.627	0.006
Max	***2.104***	***0.797***	



ARCADIS

PROJECT MPE Stage 2 Stormwater Management Plan

TITLE DRAINS Peak Flow Comparison - Existing vs. Proposed
Outlet B

JOB No AA009335
PREPARED [redacted] DATE 27/02/18
CHECKED [redacted] DATE 27/02/18

DRAINS Models (existing and proposed):
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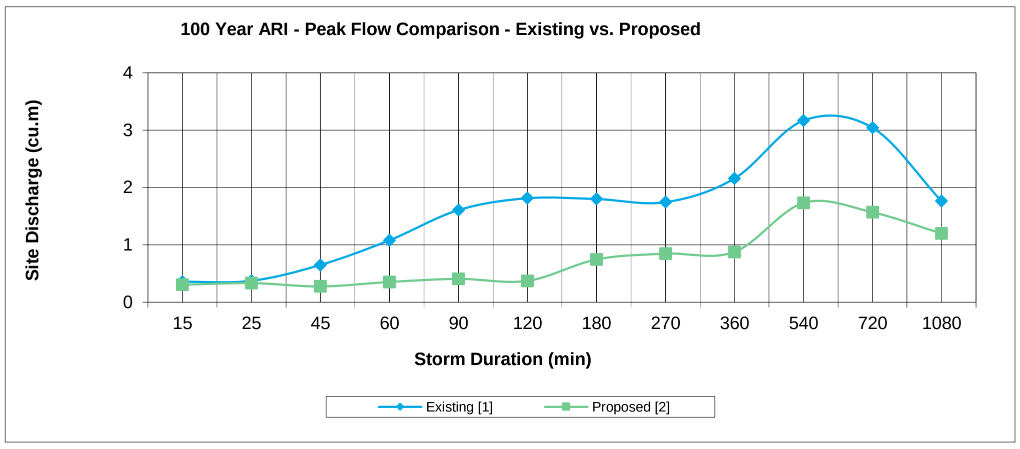
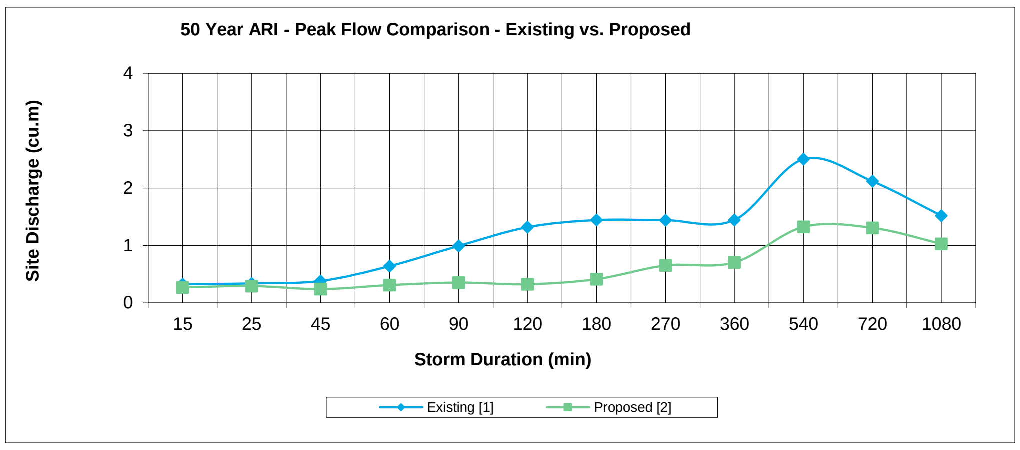
F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn

DRAINS Version: Version 2017.10 (64.bit) - 9 August 2017
Existing Outlet Ref: F EX Anzac
Proposed Outlet Ref: F PR Outlet2

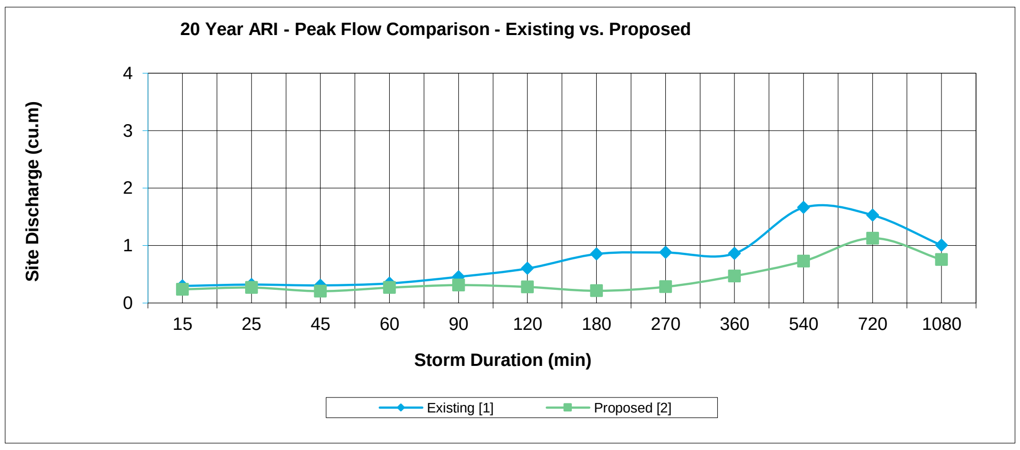
	100yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	0.356	0.304	-0.052
25	0.373	0.333	-0.040
45	0.650	0.275	-0.375
60	1.080	0.353	-0.727
90	1.607	0.407	-1.200
120	1.813	0.372	-1.441
180	1.799	0.746	-1.053
270	1.744	0.847	-0.897
360	2.158	0.877	-1.281
540	***3.168***	***1.732***	-1.436
720	3.041	1.568	-1.473
1080	1.762	1.198	-0.564
Max	***3.168***	***1.732***	



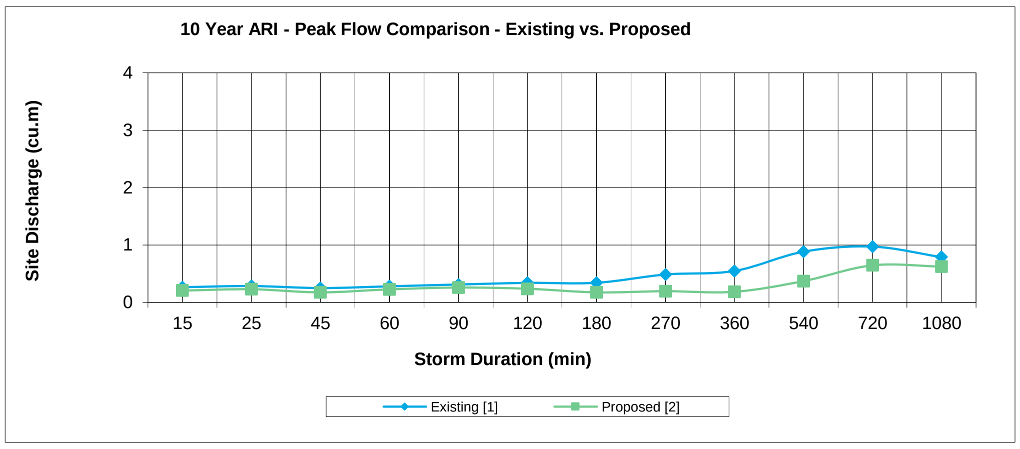
	50yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	0.324	0.269	-0.055
25	0.339	0.293	-0.046
45	0.381	0.239	-0.142
60	0.639	0.309	-0.330
90	0.991	0.353	-0.638
120	1.318	0.324	-0.994
180	1.442	0.412	-1.030
270	1.440	0.651	-0.789
360	1.444	0.704	-0.740
540	***2.503***	***1.323***	-1.180
720	2.118	1.306	-0.812
1080	1.518	1.029	-0.489
Max	***2.503***	***1.323***	



	20yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	0.297	0.238	-0.059
25	0.321	0.269	-0.052
45	0.307	0.206	-0.101
60	0.342	0.268	-0.074
90	0.456	0.312	-0.144
120	0.601	0.280	-0.321
180	0.853	0.213	-0.640
270	0.879	0.282	-0.597
360	0.863	0.470	-0.393
540	***1.661***	0.728	-0.933
720	1.530	***1.128***	-0.402
1080	1.004	0.754	-0.250
Max	***1.661***	***1.128***	



	10yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	0.264	0.205	-0.059
25	0.284	0.228	-0.056
45	0.249	0.174	-0.075
60	0.279	0.226	-0.053
90	0.311	0.258	-0.053
120	0.339	0.237	-0.102
180	0.341	0.174	-0.167
270	0.485	0.194	-0.291
360	0.547	0.184	-0.363
540	0.883	0.370	-0.513
720	***0.971***	***0.645***	-0.326
1080	0.788	0.623	-0.165
Max	***0.971***	***0.645***	



ARCADIS

PROJECT	MPE Stage 2 Stormwater Management Plan	JOB No	AA009335		
TITLE	DRAINS Peak Flow Comparison - Existing vs. Proposed Outlet B	PREPARED	[redacted]	DATE	27/02/18
		CHECKED	[redacted]	DATE	27/02/18

DRAINS Models (existing and proposed):
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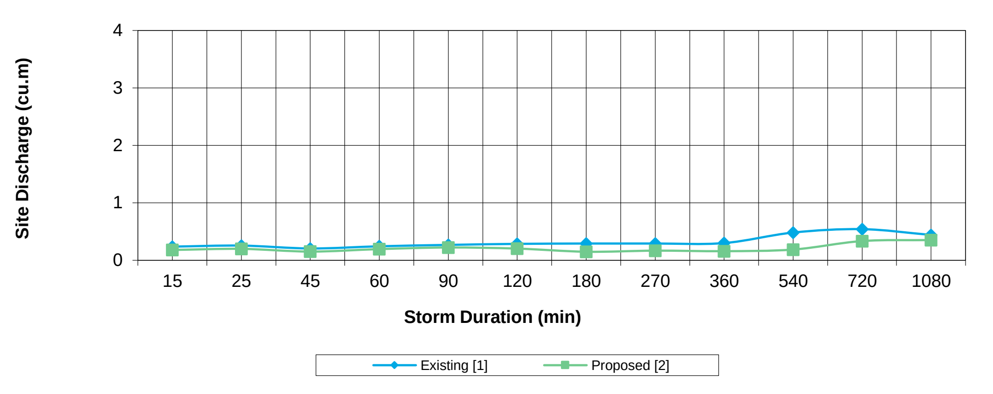
F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn

DRAINS Version: Version 2017.10 (64.bit) - 9 August 2017
Existing Outlet Ref: F EX Anzac
Proposed Outlet Ref: F PR Outlet2

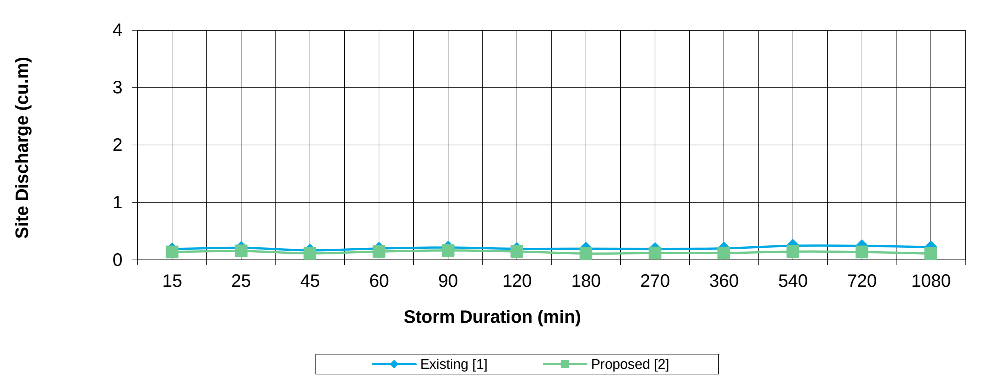
	5yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	0.238	0.180	-0.058
25	0.256	0.199	-0.057
45	0.206	0.152	-0.054
60	0.244	0.195	-0.049
90	0.268	0.223	-0.045
120	0.286	0.204	-0.082
180	0.292	0.149	-0.143
270	0.292	0.168	-0.124
360	0.300	0.159	-0.141
540	0.483	0.187	-0.296
720	***0.542***	0.335	-0.207
1080	0.442	***0.352***	-0.090
Max	***0.542***	***0.352***	

5 Year ARI - Peak Flow Comparison - Existing vs. Proposed



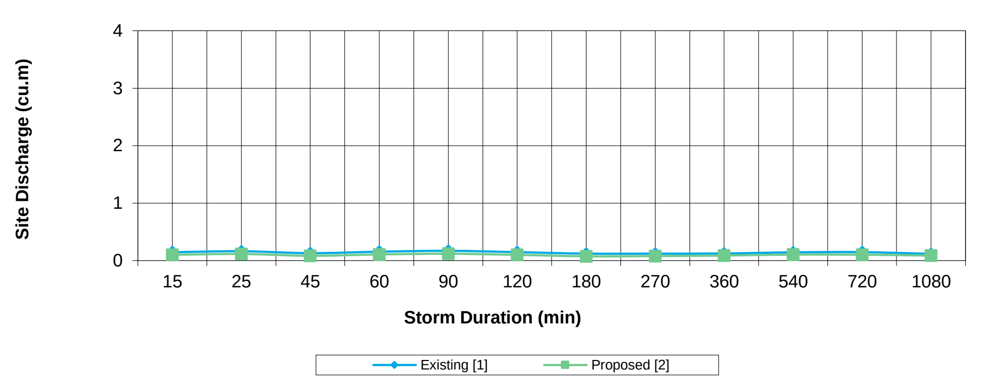
	2yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	0.189	0.138	-0.051
25	0.210	0.154	-0.056
45	0.166	0.114	-0.052
60	0.198	0.145	-0.053
90	0.215	***0.164***	-0.051
120	0.193	0.146	-0.047
180	0.195	0.110	-0.085
270	0.192	0.119	-0.073
360	0.200	0.119	-0.081
540	***0.246***	0.144	-0.102
720	0.244	0.137	-0.107
1080	0.222	0.109	-0.113
Max	***0.246***	***0.164***	

2 Year ARI - Peak Flow Comparison - Existing vs. Proposed



	1yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	0.146	0.101	-0.045
25	0.163	0.115	-0.048
45	0.129	0.084	-0.045
60	0.155	0.107	-0.048
90	***0.170***	***0.119***	-0.051
120	0.147	0.100	-0.047
180	0.121	0.075	-0.046
270	0.121	0.079	-0.042
360	0.124	0.088	-0.036
540	0.144	0.104	-0.040
720	0.147	0.102	-0.045
1080	0.117	0.087	-0.030
Max	***0.170***	***0.119***	

1 Year ARI - Peak Flow Comparison - Existing vs. Proposed



PROJECT	MPE Stage 2 Stormwater Management Plan				
		JOB No	AA009335		
TITLE	DRAINS Peak Flow Comparison - Existing vs. Proposed	PREPARED	[redacted]	DATE	27/02/18
	Outlet C	CHECKED	[redacted]	DATE	27/02/18

DRAINS Models (existing and proposed):
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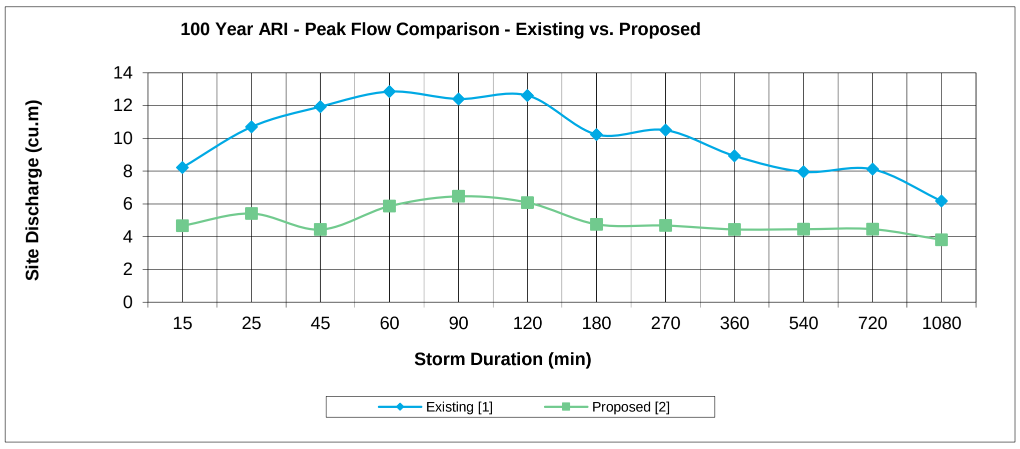
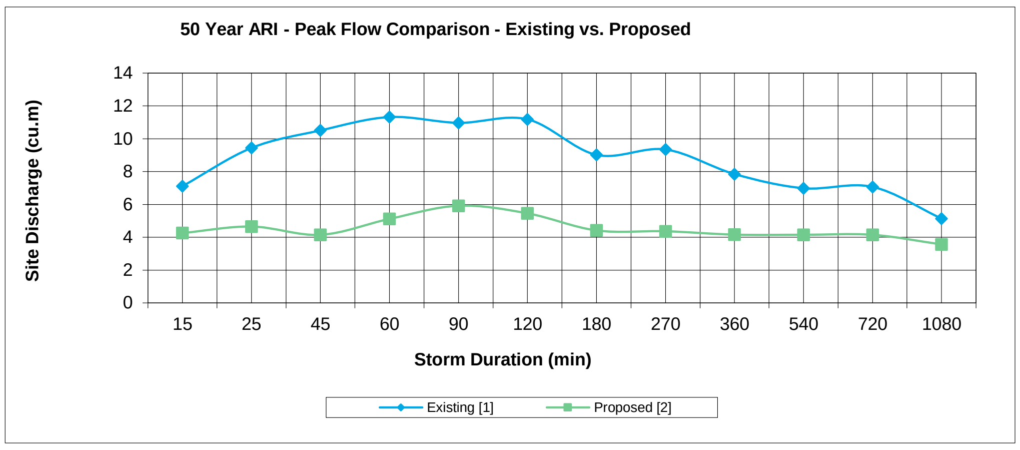
F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn

DRAINS Version: Version 2017.10 (64.bit) - 9 August 2017
Existing Outlet Ref: Ex Channel
Proposed Outlet Ref: Channel

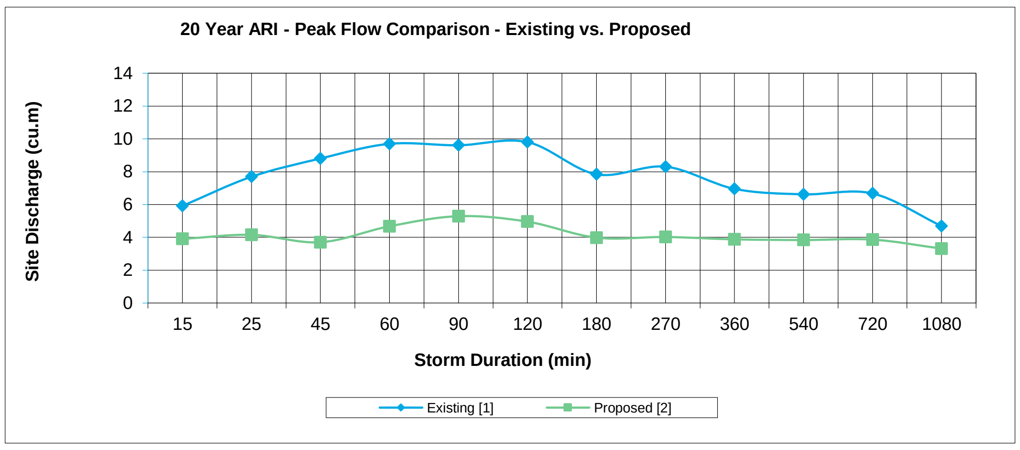
	100yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	8.222	4.665	-3.557
25	10.696	5.411	-5.285
45	11.935	4.433	-7.502
60	***12.853***	5.860	-6.993
90	12.403	***6.461***	-5.942
120	12.615	6.084	-6.531
180	10.234	4.755	-5.479
270	10.501	4.680	-5.821
360	8.926	4.442	-4.484
540	7.960	4.453	-3.507
720	8.112	4.458	-3.654
1080	6.171	3.812	-2.359
Max	***12.853***	***6.461***	



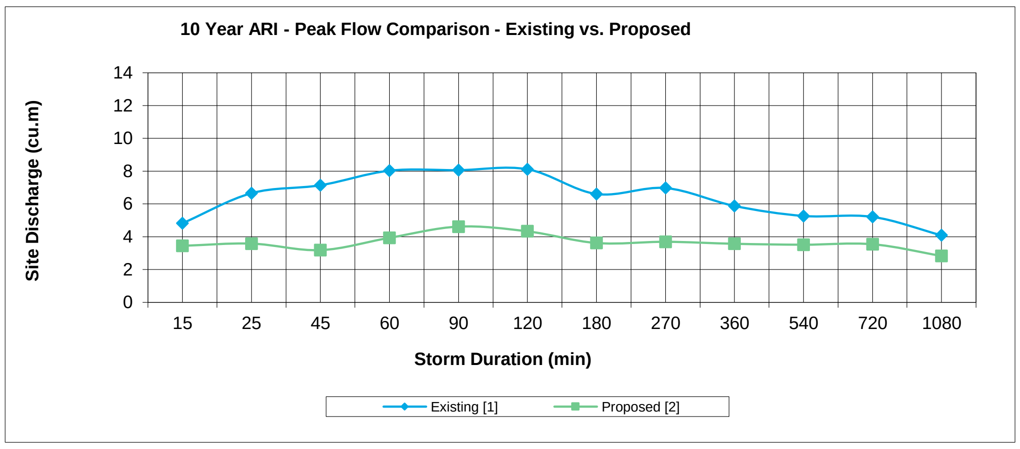
	50yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	7.109	4.255	-2.854
25	9.439	4.653	-4.786
45	10.509	4.147	-6.362
60	***11.321***	5.116	-6.205
90	10.969	***5.919***	-5.050
120	11.182	5.456	-5.726
180	9.017	4.414	-4.603
270	9.347	4.365	-4.982
360	7.848	4.159	-3.689
540	6.985	4.150	-2.835
720	7.067	4.147	-2.920
1080	5.137	3.563	-1.574
Max	***11.321***	***5.919***	



	20yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	5.919	3.906	-2.013
25	7.694	4.156	-3.538
45	8.806	3.703	-5.103
60	9.699	4.676	-5.023
90	9.610	***5.291***	-4.319
120	***9.804***	4.958	-4.846
180	7.841	3.982	-3.859
270	8.307	4.024	-4.283
360	6.955	3.881	-3.074
540	6.622	3.838	-2.784
720	6.673	3.864	-2.809
1080	4.689	3.317	-1.372
Max	***9.804***	***5.291***	



	10yr ARI Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	4.820	3.448	-1.372
25	6.655	3.583	-3.072
45	7.142	3.185	-3.957
60	8.029	3.935	-4.094
90	8.061	***4.618***	-3.443
120	***8.115***	4.331	-3.784
180	6.608	3.618	-2.990
270	6.971	3.694	-3.277
360	5.878	3.571	-2.307
540	5.268	3.515	-1.753
720	5.213	3.543	-1.670
1080	4.086	2.829	-1.257
Max	***8.115***	***4.618***	



ARCADIS

PROJECT	MPE Stage 2 Stormwater Management Plan	JOB No	AA009335		
TITLE	DRAINS Peak Flow Comparison - Existing vs. Proposed Outlet C	PREPARED	[redacted]	DATE	27/02/18
		CHECKED	[redacted]	DATE	27/02/18

DRAINS Models (existing and proposed):
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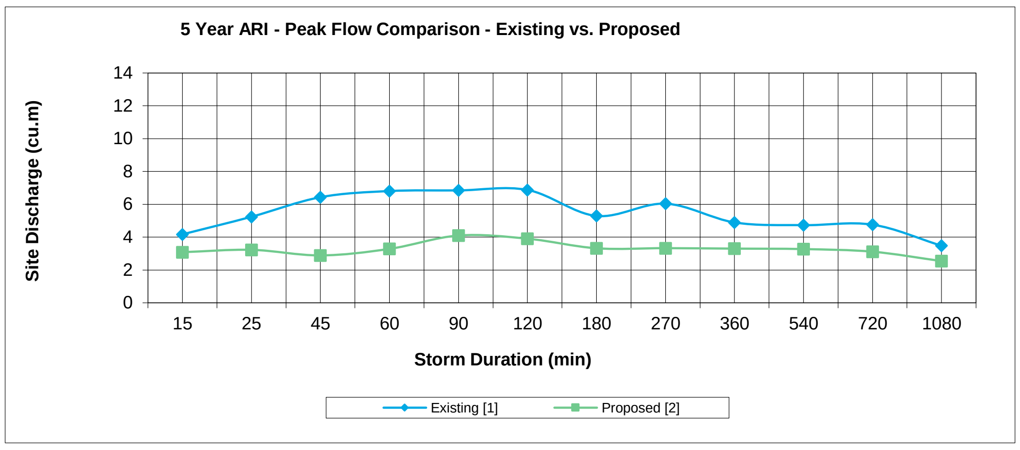
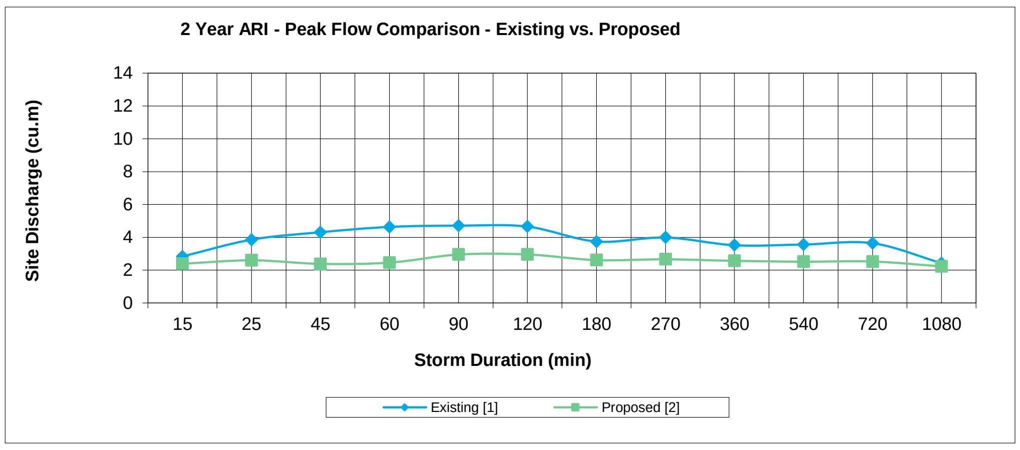
F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-18-02-27.drn

DRAINS Version: Version 2017.10 (64.bit) - 9 August 2017
Existing Outlet Ref: Ex Channel
Proposed Outlet Ref: Channel

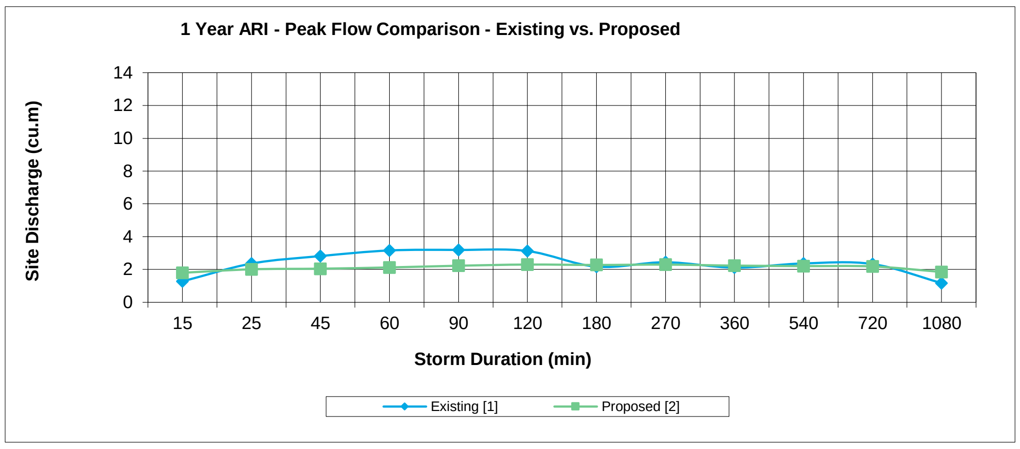
	5yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	4.171	3.085	-1.086
25	5.242	3.228	-2.014
45	6.434	2.888	-3.546
60	6.809	3.285	-3.524
90	6.847	***4.099***	-2.748
120	***6.877***	3.908	-2.969
180	5.292	3.323	-1.969
270	6.039	3.330	-2.709
360	4.896	3.302	-1.594
540	4.730	3.273	-1.457
720	4.761	3.114	-1.647
1080	3.477	2.543	-0.934
Max	***6.877***	***4.099***	



	2yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	2.834	2.387	-0.447
25	3.855	2.598	-1.257
45	4.307	2.380	-1.927
60	4.632	2.455	-2.177
90	***4.708***	2.949	-1.759
120	4.651	***2.954***	-1.697
180	3.740	2.610	-1.130
270	3.986	2.658	-1.328
360	3.516	2.566	-0.950
540	3.559	2.512	-1.047
720	3.639	2.526	-1.113
1080	2.424	2.226	-0.198
Max	***4.708***	***2.954***	



	1yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	1.274	1.798	0.524
25	2.359	2.010	-0.349
45	2.817	2.047	-0.770
60	3.159	2.124	-1.035
90	***3.191***	2.228	-0.963
120	3.126	***2.300***	-0.826
180	2.169	2.274	0.105
270	2.441	2.296	-0.145
360	2.113	2.235	0.122
540	2.368	2.207	-0.161
720	2.331	2.186	-0.145
1080	1.172	1.850	0.678
Max	***3.191***	***2.300***	



APPENDIX E

MUSIC Model Information

E.1 MUSIC Model Layouts & Catchments

E.2 Rainfall Data

E.3 Evapotranspiration Data

E.4 Rainfall-Runoff Parameters and Pollutant Loading Rates

E.5 Bioretention Basin & GPT Modelling Parameters

E.6 Rainwater Reuse Parameters

E.7 MUSIC Model Treatment Train Effectiveness Results

E.1 MUSIC Model Layouts & Catchments

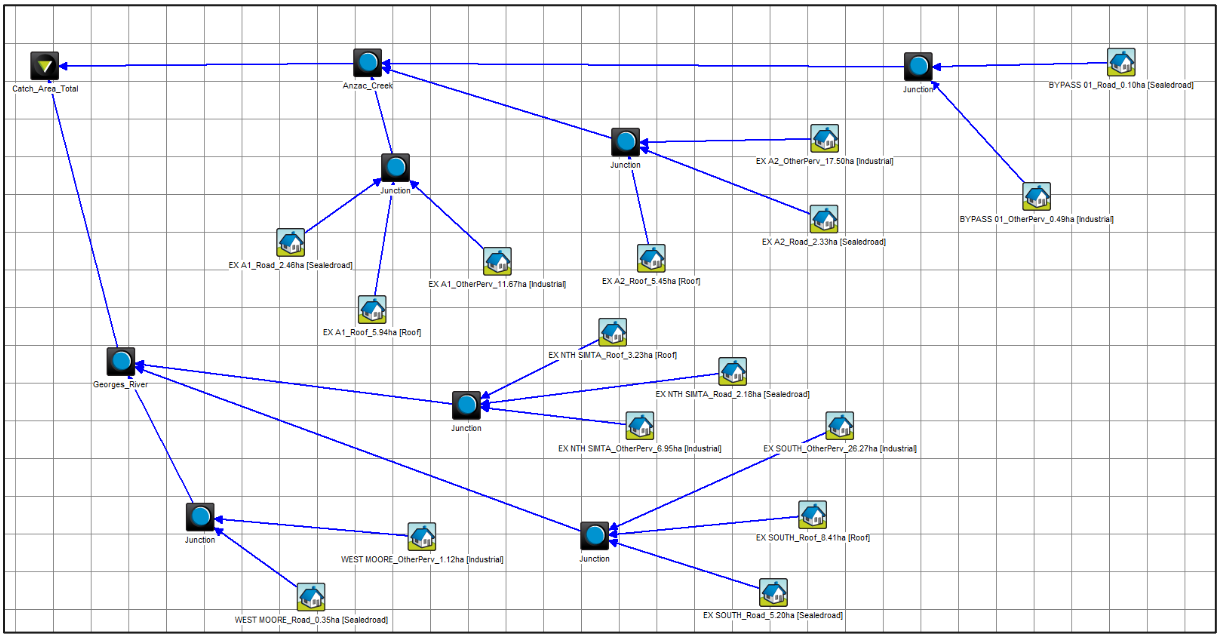


Figure E-1: MUSIC Model Layout for Stage 2 Site – Existing Conditions

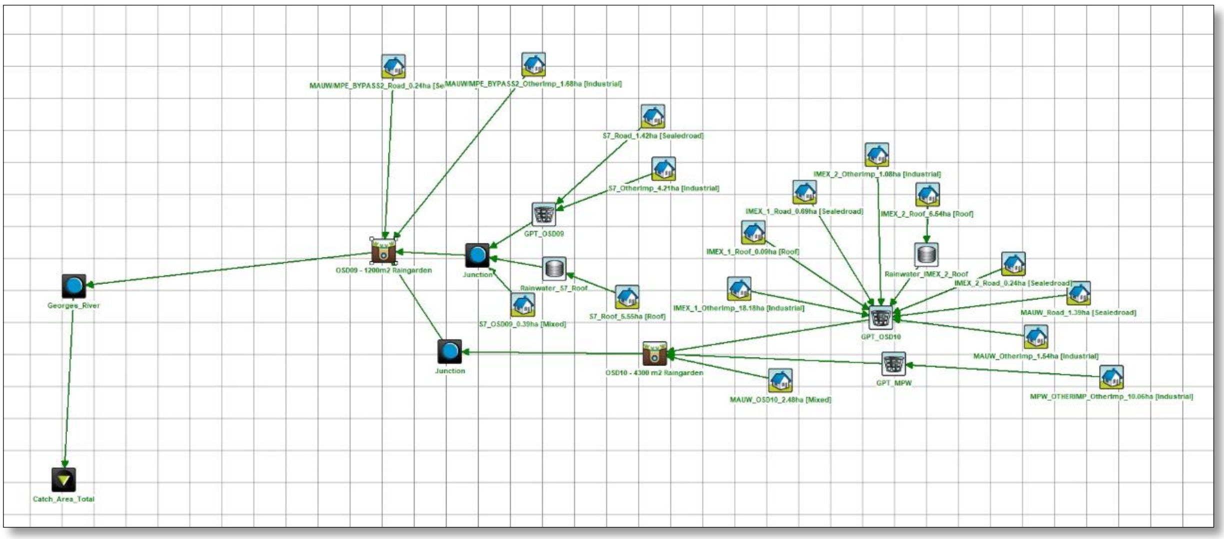
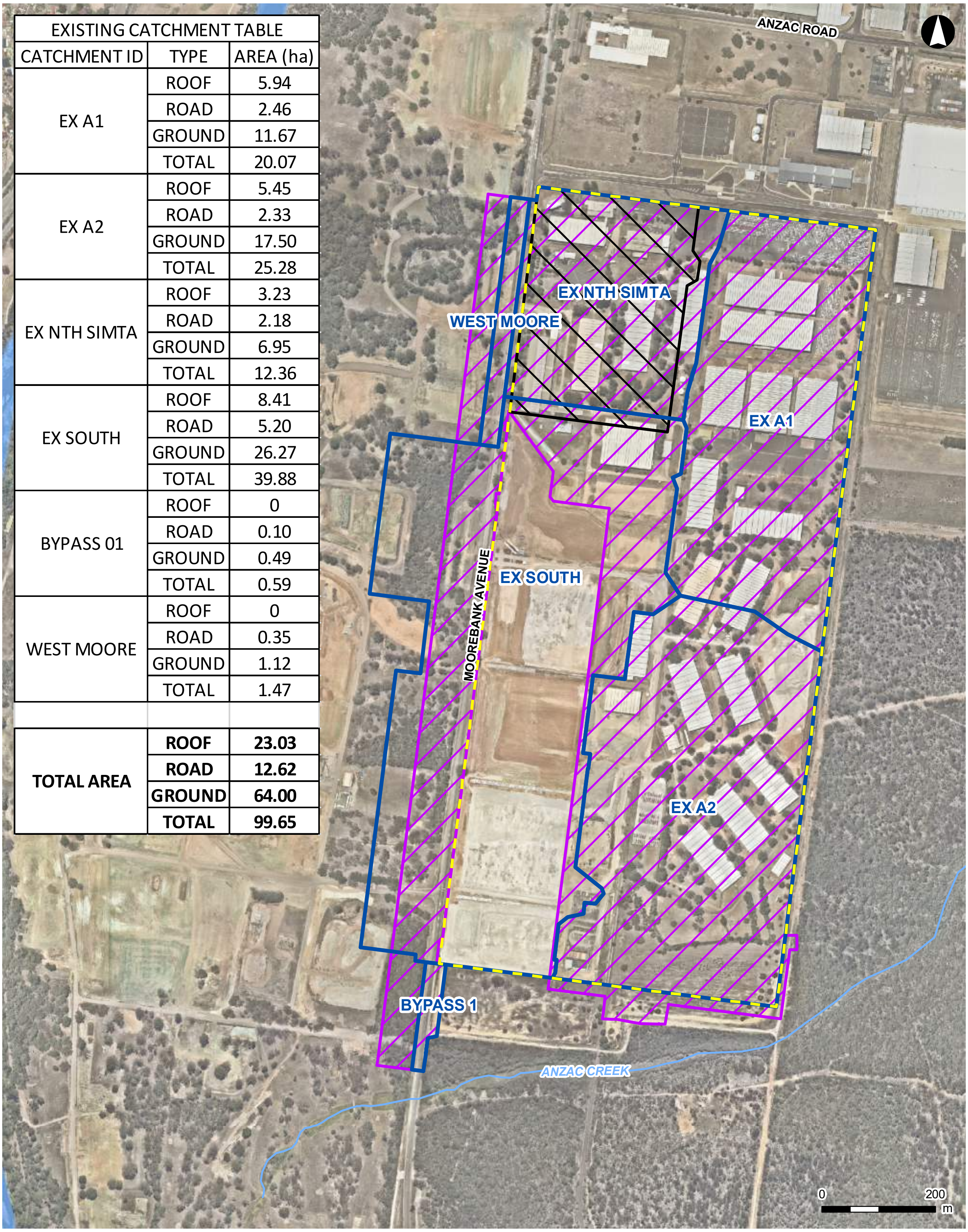


Figure E-2: MUSIC Model Layout for Warehouse 1 Precinct Site – Developed Conditions

EXISTING CATCHMENT TABLE		
CATCHMENT ID	TYPE	AREA (ha)
EX A1	ROOF	5.94
	ROAD	2.46
	GROUND	11.67
	TOTAL	20.07
EX A2	ROOF	5.45
	ROAD	2.33
	GROUND	17.50
	TOTAL	25.28
EX NTH SIMTA	ROOF	3.23
	ROAD	2.18
	GROUND	6.95
	TOTAL	12.36
EX SOUTH	ROOF	8.41
	ROAD	5.20
	GROUND	26.27
	TOTAL	39.88
BYPASS 01	ROOF	0
	ROAD	0.10
	GROUND	0.49
	TOTAL	0.59
WEST MOORE	ROOF	0
	ROAD	0.35
	GROUND	1.12
	TOTAL	1.47
TOTAL AREA	**ROOF**	**23.03**
	ROAD	**12.62**
	GROUND	**64.00**
	TOTAL	**99.65**



LEGEND

- MPE Stage 2 construction area
- MPE site
- Warehouse 1 Precinct
- MUSIC Model existing catchment
- Watercourse

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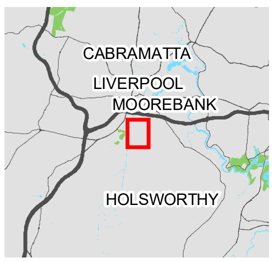
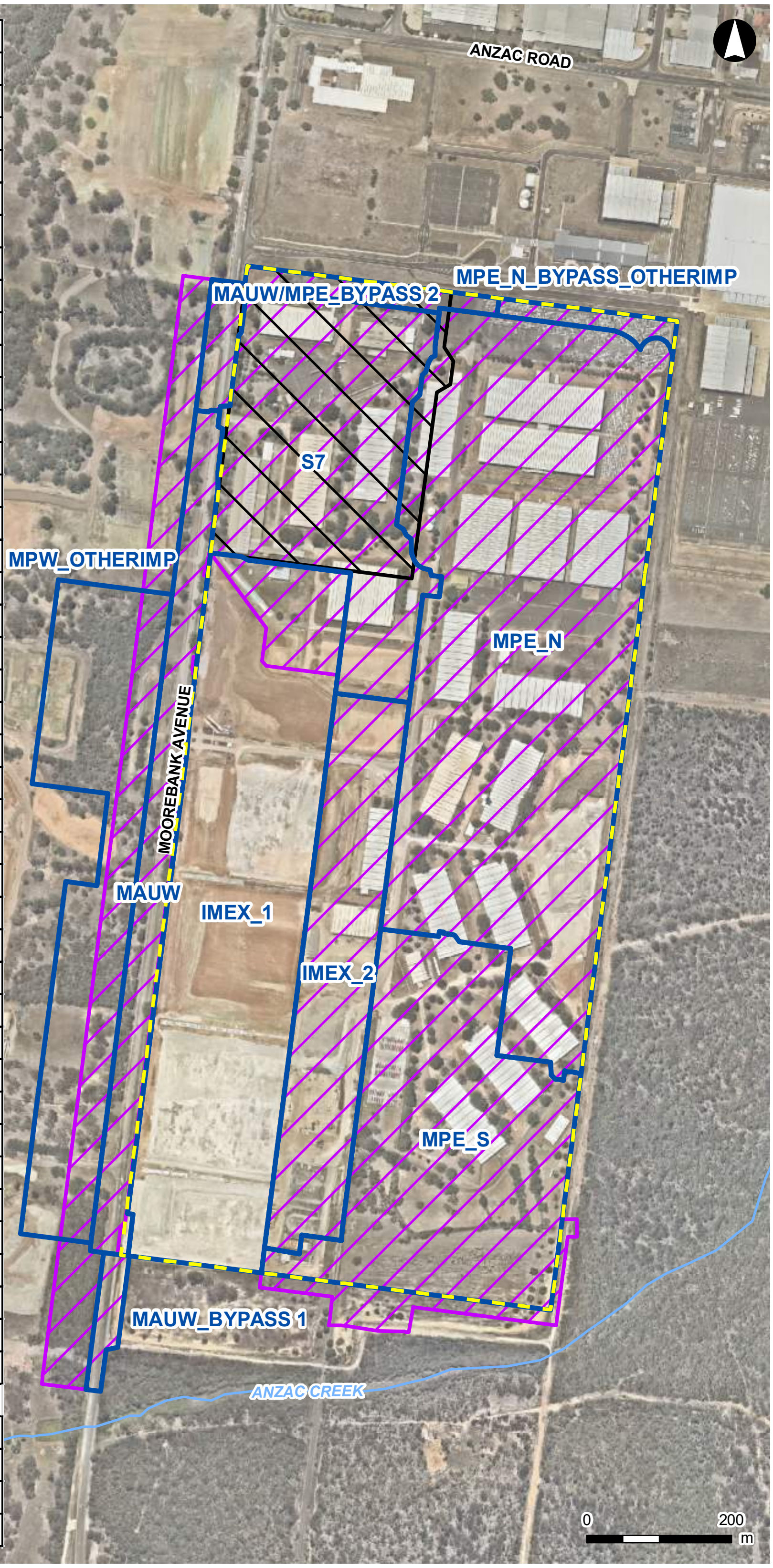


Figure E-3: MUSIC Model Existing Catchments

Stormwater Management Plan - Warehouse 1 Precinct

POST DEVELOPED CATCHMENT TABLE		
CATCHMENT ID	TYPE	AREA (ha)
MPE_S	ROOF	5.41
	ROAD	2.13
	GROUND	5.90
	TOTAL	13.44
MPE_N	ROOF	13.58
	ROAD	4.55
	GROUND	11.05
	TOTAL	29.18
IMEX_1	ROOF	0.09
	ROAD	0.69
	GROUND	18.18
	TOTAL	18.96
IMEX_2	ROOF	6.54
	ROAD	0.24
	GROUND	1.08
	TOTAL	7.86
S7	ROOF	5.55
	ROAD	1.42
	GROUND	4.60
	TOTAL	11.57
MAUW	ROOF	0
	ROAD	1.39
	GROUND	4.02
	TOTAL	5.41
MAUW_BYPASS1	ROOF	0
	ROAD	0.12
	GROUND	0.47
	TOTAL	0.59
MAUW/MPE _BYPASS2	ROOF	0
	ROAD	0.24
	GROUND	1.68
	TOTAL	1.92
MPE_N_BYPASS OTHERIMP	ROOF	0
	ROAD	0
	GROUND	0.68
	TOTAL	0.68
MPW_OTHERIMP	ROOF	0
	ROAD	0
	GROUND	10.06
	TOTAL	10.06
TOTAL AREA	**ROOF**	**31.17**
	ROAD	**10.78**
	GROUND	**57.72**
	TOTAL	**99.66**



LEGEND

- MPE Stage 2 construction area
- MPE site
- Warehouse 1 Precinct
- MUSIC Model post development catchment
- Watercourse

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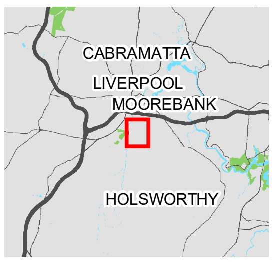


Figure E-4: MUSIC Post Development Catchments

E.2 Rainfall Data

Pluviograph data from Liverpool's Whitlam Centre (Station No. 067035), which is situated about 3km north of the site, was used in the MUSIC model. The pluviograph record from 1 January 1967 to 31 December 1976 was selected for the MUSIC modelling. The mean annual rainfall for this 10 year data period is 857mm, while the long-term average annual rainfall for the station (for the 36 years that have complete annual records within the station's lifespan of 1962 to 2001) is 866 mm. A six-minute time step was used in the MUSIC modelling analysis, in accordance with the NSW MUSIC Modelling Guidelines (BMT WBM, 2015).

A summary of the rainfall data is given in **Table E-1** while a plot of the 10-year pluviograph data is shown in **Figure E-5**.

Table E-1: Rainfall Data

Station No.	Location	Years of Record	Type of Data
067035	Liverpool	1967 – 1976 (10 years)	6 minutes

Source: Bureau of Meteorology, eWater Pluviograph Rainfall Data Tool

E.3 Evapotranspiration Data

Monthly average areal potential evapotranspiration (PET) data for Sydney are shown in **Table E-2** and plotted in **Figure E-5**.

Table E-2: Potential Evapotranspiration (Sydney)

Month	Potential Evapotranspiration (mm/month)
January	180
February	135
March	128
April	85
May	58
June	43
July	43
August	58
September	88
October	127
November	152
December	163

Source: MUSIC V6.3

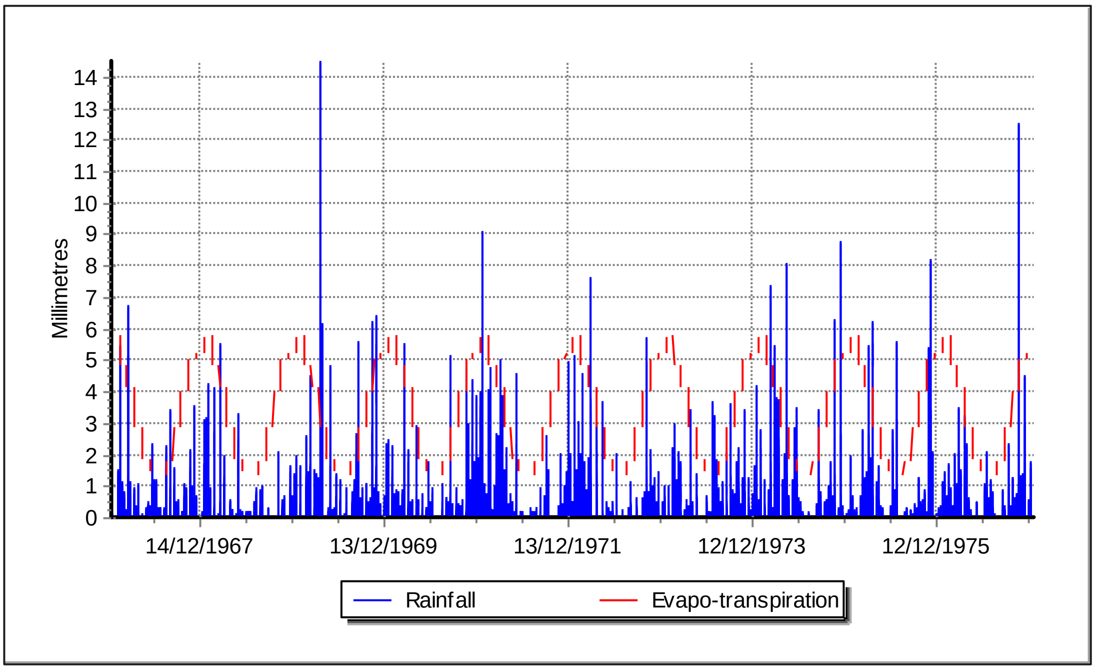


Figure E-5: Rainfall and potential evapotranspiration data used in MUSIC for the 1967-1976 period

E.4 Rainfall-Runoff Parameters and Pollutant Loading Rates

The upper soil profile within the Warehouse 1 Precinct site has been generally classified as of the Berkshire Park Group, consisting of Clayey Sand soils (MPE Stage 2 Draft Geotechnical Interpretive Report, Golder Associates, 15 Dec 2017). The pervious rainfall-runoff parameters corresponding to Clayey Sand adopted for the MUSIC model, as well as the adopted rainfall threshold parameters for impervious areas, are consistent with the values recommended by the NSW MUSIC Modelling Guidelines (BMT WBM, 2015). These rainfall-runoff parameters are summarised in **Table E-3**.

Table E-3: Rainfall-Runoff Parameters

Parameter	Units	Value
Impervious Areas		
Rainfall Threshold	mm	0.3 (Roof) 1.5 (Roads) 1.0 (Other Impervious)
Pervious Areas (Clayey Sand)		
Soil Storage Capacity	mm	107
Initial Storage	% of Storage Capacity	30 (default MUSIC value)
Field Capacity	mm	75
Infiltration Capacity Coefficient – a	mm/day	250
Infiltration Capacity Coefficient – b	-	1.3

Parameter	Units	Value
Groundwater Properties		
Initial Depth	mm	10 (default MUSIC value)
Daily Recharge Rate	%	60
Daily Baseflow Rate	%	45
Daily Deep Seepage Rate	%	0

Source: NSW MUSIC Modelling Guidelines (BMT WBM, 2015)

The pollutant loading rates adopted for TSS, TP and TN for various land use categories are also based on the NSW MUSIC Modelling Guidelines (BMT WBM, 2015). The event mean concentration values (EMC) and standard deviation values for TSS, TP and TN adopted for both dry weather (baseflow) and wet weather (stormflow) are summarised in **Table E-4**.

Table E-4: Adopted Mean Pollutant Concentration & Standard Deviation Values

Pollutant	Pollutant Concentration (log mg/L) *					
	Sealed Road Pavement		Roofs		Industrial Areas; Landscaped Areas	
	Wet Weather	Dry Weather	Wet Weather	Dry Weather	Wet Weather	Dry Weather
TSS	2.43 (0.32)	1.20 (0.17)	1.30 (0.32)	-	2.15 (0.32)	1.20 (0.17)
TP	-0.30 (0.25)	-0.85 (0.19)	-0.89 (0.25)	-	-0.60 (0.25)	-0.85 (0.19)
TN	0.34 (0.19)	0.11 (0.12)	0.30 (0.19)	-	0.30 (0.19)	0.11 (0.12)

* Standard deviation values are in brackets below the log concentration values.

Source: NSW MUSIC Modelling Guidelines (BMT WBM, 2015)

E.5 Bioretention Basin & Gross Pollutant Trap (GPT) Modelling Parameters

Table E-5: Bioretention Basin Modelling Parameters

Parameter	Bioretention Basin 9	Bioretention Basin 10 *
Catchment Area (ha)	11.57	42.29
Minimum Filter Media Area (m²) **[% Catchment Area]**	1,300 [1.1%]	4,300 [1.0%]
Minimum Storage Surface Area (m²)	2,600	8,600
Extended Detention Depth (m)	0.3	0.3
Minimum Filter Media Depth (m)	0.4	0.4
Unlined Filter Media Perimeter (m)	0.01	0.01
Saturated Hydraulic Conductivity (mm/hour)	100	100
Filter Media Total Nitrogen (mg/kg)	500	500
Filter Media Orthophosphate (mg/kg)	10	10

*Bioretention 10 is not part of the Warehouse 1 Precinct and is therefore not considered part of this Stormwater Management Plan. The information above is included to show full compliance of the development in regards to Water Quality discharge to Georges River.

Source: NSW MUSIC Modelling Guidelines (BMT WBM, 2015), M165 Biofilter Media Supplier Specifications (Benedict Industries, 10 Apr 2017)

Table E-6: Gross Pollutant Trap Modelling Parameters

Target Element	Concentration Based Capture Efficiency	
	Input	Output
Gross Pollutants (mg/L)	0	0
	15	1.5
Total Suspended Solids (mg/L)	0	0
	75	75
	1000	350
Total Phosphorus (mg/L)	0	0
	0.5	0.5
	1	0.85
Total Nitrogen (mg/L)	0	0
	0.5	0.5
	5	4.3

Source: NSW MUSIC Modelling Guidelines (BMT WBM, 2015)

E.6 Rainwater Reuse Parameters

Calculations and assumptions for site-wide water demand are outlined below in Table E-7.

Table E-7: Site-Wide Water Demand calculations and assumptions

Item	Value	Units	Comment
Toilet Demand:			
People	1430	people	From correspondence with Arcadis Planning team
Toilet Flushes / day	4	flushes	
L / Toilet Flush	3	L	5 Star WELS toilet, average flush
Work Days / year	260	days	Taken as work days (week days). No allowance for weekends. Site would be operational 24/7 and therefore this value could be increased (a conservative approach has been undertaken).
Total Toilet Demand	4.46	ML / year	
Irrigation Demand:			
Site Area (approx.)*	68	ha	
Landscaped Area (soft)	4.35	ha	Taken as 10% of site area
Required Weekly Water	5	mm / week	Active irrigation assumed. From correspondence with Tactical Group 28/02/2018
Required Depth Annual Water	0.26	m / year	
Required Water Over Area	11315	m^3	
Total Irrigation Demand	13.86	ML / year	
Wash-Down Area Demand	0.5	ML / year	Estimated
Total Site Demand	**18.82**	**ML / year**	

For modelling purposes, the site-wide water demand is distributed between the roof catchments in proportion to their area, as outlined below in **Table E-8**.

Table E-8: Split of Site-Wide Water Demand between Roof Catchments

Roof Catchment ID	Catchment Area (ha)	Roof Runoff Volume (ML / year)	% Roof Catchment Area	Irrigation Demand (kL / year)	Toilet and Wash-Down Demand (kL / day)
MPE_N_Roof_13.58ha	13.58	111.9	43.7%	6056	5.9
MPE_S_Roof_5.41ha	5.41	44.6	17.4%	2413	2.4
IMEX_2_Roof_6.54ha	6.54	53.9	21.0%	2917	2.9
S7_Roof_5.55ha	5.55	45.7	17.9%	2475	2.4
Total	31.08	256.1	100%	13861	14

A seasonal yield analysis was undertaken to determine the optimum volume of rainwater tank storage per hectare of roof, producing the chart shown below in **Figure E-6**. Storage sizes of 20kL/ha were adopted in the MUSIC model as highlighted below, corresponding to typical best practice of 80% reliability in meeting water demand.

Figure E-6: Optimum Rainwater Tank Sizing per Hectare of Roof

E.7 MUSIC Model Treatment Train Effectiveness Results

The below results were obtained from a run of the Developed Conditions MUSIC model "Warehouse 1 Precinct _Proposed-18-05-11.sqz" on 11 May 2018. Since MUSIC models rely on a statistically varying distribution of pollutant concentrations, other runs of the same model may produce slightly different results.

These results indicate that the proposed water quality treatment measures for Warehouse 1 Precinct are in compliance with the pollutant reduction targets in Condition of Consent (CoC) B40. It is important to note that results include Bioretention 10 which is not part of the Warehouse 1 Precinct and therefore not considered part of this Stormwater Management Plan. The information is included however to show full compliance of the development in regards to Water Quality discharge to Georges River.

Treatment Train Effectiveness - Georges_River

	Sources	Residual Load	% Reduction
Flow (ML/yr)	407	394	3.1
Total Suspended Solids (kg/yr)	63600	8430	86.7
Total Phosphorus (kg/yr)	114	39.7	65.3
Total Nitrogen (kg/yr)	897	445	50.4
Gross Pollutants (kg/yr)	11100	28	99.7

Figure E-7: Treatment Train Effectiveness Results for Developed Conditions – Flows to Georges River

APPENDIX F

Liverpool City Council DCP Compliance Matrix

LIVERPOOL CITY COUNCIL COMPLIANCE MATRIX FOR THE WAREHOUSE 1 PRECINCT

The Liverpool Development Control Plan 2008 (the Liverpool DCP) provides detailed development controls that generally apply to the Liverpool Local Government Area (LGA). In addition to the general provisions within Part 1 (8th March 2017) of the Liverpool DCP, Part 2.4 Moorebank Defence Lands (19th February 2014) is specifically the Moorebank Intermodal Area, which under the Liverpool Local Environmental Plan 2008 (LEP) is zoned as IN1 General Industrial land (the land zoning of the Warehouse 1 Precinct) Part 7 Development in Industrial Zones (3rd September 2014) of the Liverpool DCP relates directly to this zoning. Under Clause 11 of the State Environmental Planning Policy (State and Regional Development) 2011 (SEPP), DCPs developed under LEPs are not applicable to State Significant Developments (SSD). Notwithstanding this, an assessment in consideration of the Liverpool DCP has been provided below in response to the Condition of Consent B40.

A summary of the key considerations within the DCP of relevance to the Project is provided below:

- Deliver a warehousing and distribution facility which would act as a keystone for attracting industrial and business development to the Moorebank Defence Lands and industrially zoned areas
- Attract land uses which would complement, and not compete with, the employment role of the Liverpool CBD
- Provide a concentrated freight and logistics employment hub, which would provide key employment opportunities for the surrounding residential community, and accordingly promote close-to-home work opportunities
- Include travel demand measures to promote employee use of public transport and alternative travel modes such as bicycle or walking
- Locate land uses across the Project site in a manner that responds to the needs of surrounding land uses and accommodates measures such as landscaping, water sensitive urban design (WSUD) and flood mitigation
- Provide high quality landscaping that establishes an attractive streetscape character, provides consistency with surrounding biodiversity values and reduces the visual impact of industrial buildings and car parking areas
- Commit to employing Ecologically Sustainable Development (ESD) principles in the design and development of the warehousing and distribution facilities.

Although the Liverpool DCP requirements are not directly applicable to the Warehouse 1 Precinct and the broader Project, this Stormwater Management Plan is considered generally compliant with the requirements of this DCP, as detailed in **Table 1** below. In addition, urban design principles for the Project were developed primarily in accordance with the Liverpool DCP (as approved under the MPE Concept Plan Approval).

Furthermore, compliance with the additional following Liverpool City Council documents has also been assessed, and are detailed in **Table 2** and **Table 3** below respectively.

- Liverpool City Council Development Design Specification D5: Stormwater Drainage Design (January 2003)
- Liverpool City Council On-site Stormwater Detention Technical Specification (January 2003)

Table 1 – Compliance Matrix for Liverpool City Council Development Control Plan 2008 – Part 1: General Controls for all Development (8th March 2017)

Section	Requirement	Compliance	Conformance
1.1 The Vision of Liverpool Development Control Plan 2008			
The Future	10. New suburbs and redevelopment in existing suburbs will be compatible with adjoining creeks, parkland and major transport corridors.	Addressed in specific detail throughout this matrix.	Yes
	11. There will less development that is subject to risks such as flooding, salinity etc.	Addressed in specific detail throughout this matrix.	Yes
	12. Development in new and existing suburbs will assist in making creeks and rivers attractive and clean.	Addressed in specific detail throughout this matrix.	Yes
	14. Development in new and existing suburbs will contribute to a clean and sustainable environment.	Addressed in specific detail throughout this matrix.	Yes
	16. There will continue to be open space linked along creek networks.	Addressed in specific detail throughout this matrix.	Yes
	17. New development near the Georges River will allow access to the foreshore.	Addressed in specific detail throughout this matrix.	Yes
3.4 Landscape Specifications			
Controls	16. Reducing the amount of surface water runoff entering the stormwater system.	Options have been considered to reduce stormwater runoff volumes from the site by collecting runoff for reuse purposes (Stormwater Management Plan, Section 7.5 and 7.7).	Yes
	17. Maintaining the existing natural drainage patterns.	Mitigation measures aim to maintain stormwater peak discharge rates to no greater than existing conditions (Stormwater Management Plan, Section 5).	Yes
6. Water Cycle Management			
Objectives	a) To ensure that there is no adverse impact from stormwater runoff on downstream properties as a result of development in the catchment for all storm events up to and including a 100-year ARI event.	Mitigation measures maintain stormwater peak discharge rates to no greater than existing conditions up to and including a 100-year ARI event. Events larger than that have also been assessed for flood emergency management purposes (Stormwater Management Plan, Section 5.3.1 and 8.3.2).	Yes

Section	Requirement	Compliance	Conformance
	b) To collect and use rainwater from roof tops to reduce town water consumption.	The use of rainwater from roof tops has been considered in relation to the proposed site usage (Stormwater Management Plan, Section 5.3.4 and 7.5).	Yes
	c) To ensure adequate drainage is provided for developments.	DRAINS modelling results indicate that the proposed drainage systems and OSDs would provide adequate system capacities (Stormwater Management Plan, Section 5.3).	Yes
	d) To protect properties from localised flooding.	Measures have been implemented to avoid, minimise and mitigate potential adverse stormwater and flooding impacts during construction and operation of the Warehouse 1 Precinct (Stormwater Management Plan, Section 4, 5 and 8.3.2).	Yes
	e) To prevent contaminated run-off from entering watercourses.	WSUD principles and a treatment train approach have been applied to treat stormwater runoff. The site meets the reduction targets of (Stormwater Management Plan, Section 6): • TSS: 85% • TP: 65% • TN: 45%	Yes
	f) To minimise erosion and reduce the volume of waste water entering waterways.	Erosion controls have been identified for use during and after the construction period (Stormwater Management Plan, Section 6.7.1).	Yes
	g) To minimise sedimentation and pollution in waterways and drainage systems.	Sediment controls have been identified for use during and after the construction period (Stormwater Management Plan, Section 6.7.2).	Yes
	h) To maintain and enhance the quality of natural water bodies such as creeks, rivers and groundwater.	WSUD principles and a treatment train approach have been applied to treat stormwater runoff (Stormwater Management Plan, Section 6).	Yes
6.1 Gravity Drainage to Council's drainage system			
Controls	Stormwater runoff shall be connected to Council's drainage system by gravity means. Mechanical means (i.e. pump) for disposal of stormwater runoff will not be permitted except for basement car parks. Charged systems will not be permitted.	All proposed drainage will be via gravity systems. No mechanical means are proposed (Stormwater Management Plan, Section 5.3).	Yes
Easements to drain stormwater	1. The acquisition of drainage easements over downstream properties will be required where direct access is not possible to Council's drainage system (i.e. street kerb and gutter, piped system or open channels and watercourses).	Easements will be established for downstream drainage lines (Stormwater Management Plan, Section 5.3.9).	Yes

Section	Requirement	Compliance	Conformance
	3. Written consent for the piping and acquisition of an easement is to be obtained from adjoining owners and provided to Council at the time of lodging the Development Application. Inability to provide a gravity stormwater drainage system and easement to drain water in favour of the development site will prevent the granting of Development Consent. Creation of easement(s) shall be completed prior to the issue of the Construction Certificate.		Yes
Stormwater Drainage Concept Plan (SDCP)	For developments that require construction of stormwater drainage, a SDCP shall be submitted with the Development Application demonstrating the feasibility of the proposed drainage system within the site and connection to Council's system. Early consultation between engineers and architects is required to reduce possible conflicts in the final plan.	The Stormwater Drainage Concept Plan has been prepared and submitted as part of the application process. The Concept Plan has then been adjusted to comply with the Conditions of Consent (Stormwater Management Plan, Section 1.2.3).	Yes
Visual impact	All drainage structures and storage areas are to be designed to be visually unobtrusive and sympathetic with the environment. This requirement is necessary to help ensure that future occupants do not adjust or remove facilities for aesthetic reasons without understanding the functional impact of such actions.	All OSDs are considered to be visually unobtrusive (Stormwater Management Plan, Section 5.3.1).	Yes
Surface flow Paths	1. Surface flow paths, including the provision of an emergency overflow to cater for blockage of the system or flows in excess of the 100-year ARI storm flow must be provided.	Overland flow paths for larger events have generally been nominated as the roadways and have been checked to be adequate (Stormwater Management Plan, Section 5.3.1 and 5.3.3).	Yes
	2. The flow route must be capable of carrying the flows generated by a 100-year ARI storm with a freeboard of 300mm to the adjacent habitable floor levels of the development site and adjoining properties.	A minimum freeboard of 300mm above the 100 year ARI water level has been considered in the design (Stormwater Management Plan, Section 5.3.1).	Yes
	3. Development must not cause any adverse impact on adjoining or any other properties. This includes maintaining surface flow paths and not increasing water levels in these flow paths. Diverting flows from one catchment to another will not be permitted.	A flood impact assessment has been undertaken showing no impacts on adjoining or any other properties (Stormwater Management Plan, Sections 3, 4, 5 and 8.3.2).	Yes
Runoff from adjacent properties	Surface runoff from upstream properties shall not be allowed to enter OSD systems. On Site Detention systems must not be located in overland flow paths, which convey catchment flows through the site.	External catchments have been designed to bypass basins (Stormwater Management Plan, Section 5.3.3).	Yes
Floor and Ground Levels	All habitable floor levels are to be a minimum of 300mm and garage/non habitable floor levels to be a minimum of 150mm above the maximum design storage water surface level and flow path levels.	All habitable floor levels are designed to a minimum of 300mm and garage/non-habitable floor levels to a minimum of 150mm above the maximum design storage water surface level and flow path levels (Stormwater Management Plan, Section 5.3.8).	Yes

Section	Requirement	Compliance	Conformance
On-Site Stormwater Detention	1. On-Site Detention (OSD) systems provide temporary storage of stormwater runoff from developments and restrict discharge from the site at a rate which council's existing drainage system is capable of accommodating.	OSDs will be provided to control site discharge to pre-development levels (Stormwater Management Plan, Section 5).	Yes
	2. OSD may only be used where: - The existing or proposed stormwater pipe system that is unable to cater for the increase in discharge due to development. - The development will involve an increase in impervious area on the site. - It is intended to connect stormwater directly to the street kerb and gutter only and the discharge exceeds 20 litres per second for the 10-year ARI.	OSDs will be provided to control site discharge to pre-development levels (Stormwater Management Plan, Section 5).	Yes
	3. OSD will not be required where: - The increased discharge for all storms up to and including a 100-year ARI can be accommodated by the existing stormwater pipe system. - A building addition or internal alteration is within the footprint (plan area) of the existing building. - The additional impervious surfaces (e.g. roof, driveway, paving) total is less than 30sqm in plan area. (NOTE: the designer is advised to confirm with council engineer first to ensure the cumulative total of previous and future additions still remain less than 30sqm, otherwise OSD will apply). - The sub-division of an existing development does not change the buildings or the impervious areas of the site. - Sites substantially inundated by flooding. - The development contributes funds to a major basin strategy that mitigates the impact of the increased impervious area and there are no other local drainage issues requiring OSD.	OSDs are required on site and will be implemented (Stormwater Management Plan, Section 5.3.1).	Yes
	4. Calculations shall account for the total development site area.	All development site areas have been accounted for (Stormwater Management Plan, Section 5.2.3).	Yes

Section	Requirement	Compliance	Conformance
6.2 Gravity drainage to a creek system			
Controls	All buildings shall be setback a minimum of 40m from the top of the bank of a creek or river, subject limitations imposed by flooding or Foreshore Building Lines.	The development is located outside of applicable setbacks (Stormwater Management Plan, Appendix A).	Yes
Nutrient loading / effluent	Depending on the proposed use there may be a need to provide a permanent water quality basin to minimise any contaminated runoff.	A treatment train is proposed to reduce nutrient loads in accordance with Council requirements (Stormwater Management Plan, Section 6).	Yes
Erosion protection of creek banks	All outlet structures discharging to a creek system shall provide scour protection and energy dissipaters.	Not applicable to the Warehouse 1 Precinct but the broader project is compliant	Yes
6.3 Gross Pollutant Traps			
Objectives	a) To prevent the transportation of gross pollutants and sediment from a site by stormwater runoff during the operational stages of a development.	Gross pollutant traps have been implemented (Stormwater Management Plan, Section 6.2.1).	Yes
	b) To install gross pollutant traps or utilise equivalent water sensitive urban design treatment train prior to discharge of stormwater from a site.	Gross pollutant traps have been implemented (Stormwater Management Plan, Section 6.2.1).	Yes
	c) To require developments to capture or prevent the generation of gross pollutants and sediment on site and at their own cost.	Gross pollutant traps have been implemented (Stormwater Management Plan, Section 6.2.1).	Yes
	d) Ensure that any gross pollutant traps on Council land are installed in accordance with a master plan or water cycle management plan to the satisfaction of Council.	Gross pollutant traps are generally located within private property and will be maintained by the site (Stormwater Management Plan, Appendix A).	Yes
Controls	1. A minimum of one gross pollutant trap shall be required between the last downstream stormwater pit or pollution source and prior to discharge from the site.	GPTs are located immediately upstream of the OSDs (Stormwater Management Plan, Appendix A).	Yes
	2. Gross pollutant traps shall not be located within the banks of watercourses or within riparian zones.	GPTs are located immediately upstream of the OSDs (Stormwater Management Plan, Appendix A).	Yes
	4. The design of the gross pollutant trap shall comply with Council's drainage design specifications.	The design of GPTs are generally compliant with Council's drainage design specifications (Stormwater Management Plan, Section 6.2.1).	Yes

Section	Requirement	Compliance	Conformance
	5. Details of the proposed gross pollutant trapping system, performance and compliance with Council's drainage design specifications shall be included in the Stormwater Drainage Concept Plan.	The design of GPTs are generally compliant with Council's drainage design specifications (Stormwater Management Plan, Section 6.2.1).	Yes
6.4 Stormwater Runoff Quality			
Objectives	a) To ensure that stormwater runoff is of suitable quality to protect the aquatic ecosystems of waterbodies within Liverpool and downstream receiving catchments.	WSUD principles and a treatment train approach have been applied to treat stormwater runoff (Stormwater Management Plan, Section 6.1).	Yes
	b) To protect the aquatic environment of the Georges River catchment and the Hawkesbury Nepean River catchment.	WSUD principles and a treatment train approach have been applied to treat stormwater runoff (Stormwater Management Plan, Section 6.1).	Yes
Controls	1. The post development water quality shall be reduced to the following targets when compared to pre development water quality: - 45% reduction in the mean annual load of total nitrogen. - 45% reduction in the mean annual load of total phosphorus. - 80% reduction in the mean annual load of total suspended solids.	Higher pollutant reduction has been achieved (Stormwater Management Plan, Section 6.1 and 6.4).	Yes
	2. In the case of areas where council has adopted a master plan or in Part 2 specifying water quality targets. The requirements of those documents shall be utilised in preference to the targets listed above.	Additional documents have been checked and higher pollutant reduction has been achieved, in accordance with the specific requirements of the Conditions of Consent (Stormwater Management Plan, Section 6.1 and 6.4).	Yes
6.5 Environmental Flows			
Objectives	a) To ensure that development does not adversely impact on flow patterns from that of a natural undeveloped catchment.	Proposed mitigation measures aim to maintain drainage patterns and discharge rates to no greater than existing conditions (Stormwater Management Plan, Section 5).	Yes
	b) Prevent bed and bank erosion and instability of waterways.	Not applicable to the Warehouse 1 Precinct but the broader project is compliant. In particular the upgrade of the channel through MPW will reduce bed and bank erosion of the Georges River	Yes
Controls	1. The peak runoff for the 1-year ARI post development does not exceed that of an undeveloped catchment.	The peak runoff for the 1-year ARI post development does not exceed that of an undeveloped catchment (Stormwater Management Plan, Section 5.2.3).	Yes
	2. The peak runoff for the 1-year ARI post development is not less than 50% from that of an undeveloped catchment.	The peak flow comparison table (Stormwater Management Plan, Section 5.2.3) suggests that not all outlets meet this 50% target.	Yes

Section	Requirement	Compliance	Conformance
		However, this table does not include flows from the bioretention systems (which are designed to capture the full 3-month ARI flows), and hence is inaccurate by approximately a factor of 1.5. Post-development flows therefore do meet this 50% target.	
7. Development near a Watercourse			
Objectives	a) To protect, restore and maintain ecological processes, natural systems and biodiversity in wetlands and waterfront areas.	Foreshore land is zoned as E3 Environmental Management land and has been dedicated as an environmental offset area.	Yes
	b) To maintain watercourse bed and bank stability.	Maintaining watercourse bed and bank stability have been considered (Stormwater Management Plan, Section 6.1).	Yes
	c) To minimise sedimentation and pollution of watercourses and wetlands.	Sediment controls will be applied (Stormwater Management Plan, Section 6.7.2). WSUD principles and a treatment train approach have been applied to treat stormwater runoff (Stormwater Management Plan, Section 6.1).	Yes
	d) Ensure conservation and long term maintenance of existing native vegetation in waterfront areas.	Foreshore land is zoned as E3 Environmental Management land and has been dedicated as an environmental offset area.	Yes
	e) To maintain lateral connectivity between waterways and riparian vegetation.	Foreshore land is zoned as E3 Environmental Management land and has been dedicated as an environmental offset area.	Yes
	f) To protect the visual amenity of the water and land interface.	Foreshore land is zoned as E3 Environmental Management land and has been dedicated as an environmental offset area.	Yes
8. Erosion and Sediment Control			
Objectives; Controls	This section	Erosion and sediment controls have been proposed for during and after the construction period (Stormwater Management Plan, Section 6.7). A full Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP) have been prepared separately, in accordance with the general principles and requirements of this section of the Liverpool DCP, and will be implemented as part of the Construction Environmental Management Plan (CEMP) for the MPE Stage 2 Project.	Yes
9. Flooding Risk			

Section	Requirement	Compliance	Conformance
Objectives	a) To minimise the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors.	Foreshore land is zoned as E3 Environmental Management land and has been dedicated as an environmental offset area.	Yes
	b) To ensure essential services and land uses are planned in recognition of all potential floods.	Essential services and land uses are planned in recognition of all potential floods (Stormwater Management Plan, Section 3 and 8.3.2).	Yes
	c) To reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods.	The site has been designed to be low hazard on all flow events up to 100 year ARI (Stormwater Management Plan, Section 3 and 8.3.2).	Yes
	d) To ensure that the economic and social costs which may arise from damage to property due to flooding is minimised and is not greater than that which can be reasonably managed by the property owner and general community.	The development seeks to minimize flood risk within itself and ensure no adverse impact to external properties (Stormwater Management Plan, Section 3 and 8.3.2).	Yes
	e) To limit developments with high sensitivity to flood risk (e.g. critical public utilities) to land with minimal risk from flooding.	Not applicable.	N/A
	f) To prevent intensification of inappropriate use of land within high flood risk areas or floodways.	The Warehouse 1 Precinct is not within high flood risk areas or floodways (Stormwater Management Plan, Section 3).	Yes
	g) To permit development with a lower sensitivity to the flood hazard to be located within the floodplain, subject to appropriate design and siting controls.	Not applicable.	N/A
	h) To ensure that development should not detrimentally increase the potential flood affectation on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain.	A flood study has been undertaken to ensure the development will not detrimentally increase the potential flood affectation on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain (Stormwater Management Plan, Section 3 and 8.3.2).	Yes
9.1 Determining Relevant Controls			
Controls	1. Sensitivity of a land use to flooding	A sensitivity assessment has been carried out for the 100 year ARI rainfall intensities increased by 10%. Consideration of OSD water levels have been given to the setting of minimum floor levels for the Project (Stormwater Management Plan, Section 5.2.4).	Yes
	2. Severity of flood impact on site	Previous flooding and stormwater reports have been prepared. Also a sensitivity assessment has been carried out for the 100 year ARI rainfall intensities increased by 10%. Consideration of OSD water levels have	Yes

Section	Requirement	Compliance	Conformance
		been given to the setting of minimum floor levels for the Project (Stormwater Management Plan, Section 3 and 5.2.4).	
22. Water Conservation			
Objectives	a) To reduce per-capita mains consumption of potable water.	Rainwater harvesting and reuse have been considered (Stormwater Management Plan, Section 7.5).	Yes
	b) To harvest rainwater and urban stormwater runoff for use.	Rainwater harvesting and reuse have been considered (Stormwater Management Plan, Section 7.5).	Yes
	e) To safeguard the environment by improving the quality of water run-off.	WSUD principles and a treatment train approach have been applied to treat stormwater runoff. (Stormwater Management Plan, Section 6.1).	Yes
Controls	Non-Residential 2. A comprehensive Water Management Plan is to be submitted with all non-residential development to address the following criteria, for any development above $1 million: - Stormwater runoff control, capture and reuse, including water quality management in accordance with Council guidelines. - Select water efficient plants and/or, indigenous vegetation for landscape in accordance with Council's recommendations. - For development of more than $1 million construction cost, consideration of separate pipe-work for the utilisation of recycled stormwater for non-potable purposes should be considered.	WSUD principles and a treatment train approach have been applied to treat stormwater runoff. Furthermore, water efficient plants and/or indigenous vegetation for landscaping in accordance with Council's recommendations have been considered in the design. A separate rainwater pipe system has also been considered as part of the development (Stormwater Management Plan, Section 6.1 and 7.5).	Yes
	Non-Residential 5. Any development that contains a rainwater tank is to satisfy the following criteria: - Rainwater is to be sourced only from roof structures via a tank storage system. - The tank capacity, or combined tank capacity, is to be at least 5,000L (10,000L preferred). - Tanks may be connected to toilets and garden/outdoor taps (the common tanks in residential flat buildings are to be connected to common outdoor taps only). - Tanks may be connected to laundry taps with suitable filters.	Rainwater is sourced only from roof structures and tank capacities meet minimum requirements. Tanks are proposed to service toilets and garden/outdoor taps and will be fitted with an effective first flush device for removing roof surface contamination. The system will also contain a facility for periodic de-sludging and will be connected to main water to top them up during times of low rainfall, with supplemental inflow not taking place until the tank is 80% empty. (Stormwater Management Plan, Section 7.5.1 and 7.5.2).	Yes

Section	Requirement	Compliance	Conformance
	- The system is to be fitted with an effective first flush device for removing roof surface contamination. - The system is to contain a facility for periodic de-sludging. - Tanks are to be connected to main water to top them up during times of low rainfall with supplemental inflow not taking places until the tank is 80% empty.		

Table 2 – Compliance Matrix for Liverpool City Council Development Design Specification D5: Stormwater Drainage Design (January 2003)

Section	Requirement	Compliance	Conformance
D5.02 OBJECTIVES			
1. The objectives of stormwater drainage design are as follows:	(a) To ensure that inundation of private and public buildings located in floodprone areas occurs only on rare occasions and that, in such events, surface flow routes convey floodwaters below the prescribed velocity/depth limits.	The site has been designed to be low hazard on all flow events up to the 100 year ARI. Furthermore, the development is not within high flood risk areas or flood ways. The development seeks to minimise flood risk within itself and ensure that no adverse impacts will occur to external properties. A flood study has been undertaken to ensure that the development will not detrimentally increase the potential flood affection on other development or properties, either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain. Furthermore, the 100 year ARI surface ponding is limited to no greater than 0.2m and the depth x velocity (DxV) is limited to no greater than $0.4m^2/s$ within the Project site (excluding open waterways) (Stormwater Management Plan, Section 3, 5.3.3 and 8.3.2).	Yes
	(b) To provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed limits.	The proposed pit and pipe system has been designed to comply with council's low flow design criteria (Stormwater Management Plan, Section 5.3.1 and 5.3.3).	Yes
	(c) Retain within each catchment as much incident rainfall and runoff as is possible and appropriate for the planned use and the characteristics of the catchment.	The proposed system will capture and re-use roof runoff where appropriate. All rainfall runoff is directed to the OSD to be controlled prior to discharge (Stormwater Management Plan, Section 5.3.4 and 7.5).	Yes
	(d) To ensure all developments do not adversely impact adjoining, downstream or upstream properties. This includes surface flow paths and increasing water levels and velocities.	Modelling indicates that the project would adequately mitigate potential flood impacts on the neighbouring downstream areas as well as safely convey flows through the site (Stormwater Management Plan, Section 8.3.2).	Yes
2. In pursuit of these objectives, the following principles shall apply:	(a) New Developments are to provide a stormwater drainage system in accordance with the "major/minor" system concept set out in Chapter 14 of Australian Rainfall & Runoff, 1987 (AR&R) (as amended); that is, the "major" system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events.	The "major/minor" system concept has been adopted as storm events up to the 100 year ARI have been assessed. Furthermore, overland flow paths for larger events have been nominated as the roadways and OSDs. These are considered adequate for the larger events (Stormwater Management Plan, Section 5.3.3).	Yes
	(b) Redevelopment - Where the proposed development replaces an existing development, the on-site drainage system is to be designed in accordance with Councils On site detention Policy.	OSDs have been designed in accordance with Councils On Site Detention Policy as detailed in Table 3 of this document (Stormwater Management Plan, Section 5.3.1 and Appendix H).	Yes

Section	Requirement	Compliance	Conformance
	(c) All Developments are to be designed in accordance with Liverpool City Council Floodplain Management Plan	Not applicable as the development is not within the floodplain.	N/A
	(d) All developments within the floodplain are to be designed in accordance with the requirements of the New South Wales Government Floodplain Management Manual: The Management of Flood Liable Land, January 2001	The design will be undertaken in accordance with the NSW Floodplain Management Manual (Stormwater Management Plan, Section 1.2).	Yes

Table 3 – Compliance Matrix for Liverpool City Council On-site Stormwater Detention Technical Specification (January 2003)

Section	Requirement	Compliance	Conformance
1.1.1 Gravity Drainage	This section	Detailed in Table 1.	Yes
1.1.3 Visual Impact	This section	Detailed in Table 1.	Yes
1.2.1 OSD Storage/Discharge Requirements	The OSD storage is to be designed to the storage/discharge relationship appropriate to the development type.	OSDs have been designed to demonstrate adequate mitigation of potential flow increases discharging to neighbouring and downstream areas (Stormwater Management Plan, Section 5.3.1).	Yes
	Computations must be performed for the existing site conditions for a low recurrence interval (5 year ARI), a medium recurrence interval (10 or 20 or 50 year ARI), and the upper value, which will be the 100year ARI storm. Times of concentration for the site are to be calculated and not assumed.	Computations have been performed in accordance with Councils criteria (Stormwater Management Plan, Section 5.3.1 and Appendix D).	Yes
	The rate of stormwater runoff (both piped and overland) from the post developed site is not to exceed the rate of runoff from the pre-developed site for the above storm events.	The OSDs have been designed to attenuate the post-development peak discharge rate to not exceed the pre-development peak discharge rate for the 1, 2, 5, 10, 20, 50 and 100 year ARIs (Stormwater Management Plan, Section 5.2 and Appendix D).	Yes
	The determination of the volume of the site storage requirement (SSR) is to be undertaken by trial and error, using the above runoff constraints.	Detention volume has been determined to show no increase in re-development flows in accordance with Council's objectives (Stormwater Management Plan, Section 5.2)	Yes
	Drainage systems must be analysed using a full hydrographic producing computer model. ILSAX is one such model, is public domain and requires minimum data.	A DRAINS model has been created using a RAFTS add on (where applicable) to assess the existing and proposed drainage system (Stormwater Management Plan, Section 5 and Appendix B, C and D).	Yes
1.2.2 Surface Flow Paths	This section	Detailed in Table 1.	Yes
1.2.3 Runoff From Adjacent Properties	This section	Detailed in Table 1.	Yes

Section	Requirement	Compliance	Conformance
1.2.4 Floor and Ground Levels	This section	Detailed in Table 1.	Yes
1.2.5 Site Discharge And Connection To Council System	The Permissible Site Discharge (PSD) is to be piped to the Council's drainage system. Piped discharge from the total site may be connected to the kerb and gutter of a Council roadway, provided that this does not exceed 20 litres per second for the 1 in 10 year ARI and total post development flows off site do not exceed pre development flows.	All outlets from the project site are to discharge to constructed drainage lines that do not form part of the Council's drainage system (Stormwater Management Plan, Section 5.3.9).	N/A
	Where an outlet pipe exceeds 100mm diameter (or insufficient cover exists over the pipe) and flow is to be discharged to the kerb and gutter of a Council roadway, then: (i) A minimum 450mm x 450mm grated converter pit is to be constructed inside the front boundary of the property.	Not applicable to the site as the Warehouse 1 Precinct does not discharge to Council's system.	N/A
	Where an outlet pipe exceeds 100mm diameter (or insufficient cover exists over the pipe) and flow is to be discharged to the kerb and gutter of a Council roadway, then: (ii) Flows between the converter pit and the kerb and gutter are to be discharged using hot dipped galvanised steel box-section pipes as follows: 100 dia outlet pipe – use 1 x 100mm x 100mm x 6mm thick 150 dia outlet pipe – use 1 x 200mm x 100 x 6mm thick 225 dia outlet pipe – use 2 x 200mm x 100mm x 6mm thick	Not applicable to the site as the Warehouse 1 Precinct does not discharge to Council's system.	N/A
	Outlets to Kerb and gutter should be at an angle no less than 45 degrees.	Not applicable.	N/A
	Pipe junctions are to be configured for the minimum hydraulic losses. Pits are to be located at any change of direction, at the property boundary or, at Council's discretion, at the connection to its system.	The proposed system has been designed to minimise hydraulic losses. with pits located as per Council requirements (Stormwater Management Plan, Appendix A).	Yes
	Where the frontage of the development exceeds 24m Council will consider a second outlet connected to the kerb and gutter provided that there is a minimum of 12m separation between outlets and discharge does not exceed 20 litres/second for the 1 in 10 year ARI and total post development flows off site do not exceed pre development flows.	Not applicable.	N/A
	A high level outlet is to be provided at the discharge control pit to cater for surcharge during major storm events. Access to the discharge	All basin outlet pits have been designed to cater for surcharge during major storm events. Easy access, silt traps and trash screens are also	Yes

Section	Requirement	Compliance	Conformance
1.2.6 Discharge Control Devices And Storage Pits	control pit is to be provided for inspections and maintenance of the silt trap and mesh screen. Such opening is to have a minimum size of 600mm x 600mm to be fitted with a removable galvanised steel grate and to be placed above the outlet and silt trap. Additional access may be required for larger underground storage. **Underground storage shall not be allowed without approval by council and evidence that above ground storage cannot be provided anywhere else on site.** Essentially, the system is to be designed to minimise ease of maintenance and ensure safety for the proprietor. To avoid unpleasant odours and health risks, maintenance of the OSD structure must be carried out on a regular basis by the owner.	provided. Furthermore, the proposed system has been designed to maximise ease of maintenance and ensure safety. Lastly, all maintenance will be undertaken in accordance with the proposed operation and maintenance plan (Stormwater Management Plan, Section 5.3.1).	
	The minimum pit sizes are to be: 600 x 600 for pits up to 800mm in depth 600 x 900 for pits greater than 800mm in depth.	Pits will be sized in accordance with council criteria (Stormwater Management Plan, Appendix A).	Yes
	Step irons are required for pits greater than 1200mm in depth.	Step irons will be provided in all pits with depths greater than 1200mm (Stormwater Management Plan, Appendix A).	Yes
	A stainless steel or galvanised mesh screen (Maxi-mesh RH3030 or equivalent) with a minimum area of 50 times the orifice area, and fitted with a lifting handle, shall be provided between the orifice and the inlet. The screen is to be a minimum distance from the orifice equal to 1.5 times the diameter of the orifice or 200mm, whichever is the greater. The screen should be positioned so that the inflows are directed perpendicular to the screen.	Trash screens will be installed to provide protection to the outlet structures and orifices in accordance with these requirements (Stormwater Management Plan, Section 5.3.1 and 6.5 and Appendix A)	Yes
	The orifice plate is to be a minimum 200mm x 200mm flat stainless steel plate, 3mm thick. The orifice is to be tooled to the exact dimensions as calculated, uniform circular shape with sharp (not rounded) edges. The plate is to be 'Dyna bolted' onto the wall and epoxied and securely fixed over the outlet pipe by at least four Dyna bolts or similar, one at each corner.	Orifice plates will be installed in accordance with Council specifications (Stormwater Management Plan, Appendix A).	Yes
	For safety, all maintenance access to storage must conform to the current Confined Spaces Regulations.	Access points to the OSD will be locked. These locked access points will prevent the general public from entering the OSDs. Only maintenance personnel or other relevant personnel with induction would be allowed into the basins. Hazard signage (hazard warnings, water level indicators etc.) will also be located at all entry points to the OSD and outlet pits (Stormwater Management Plan, Section 5.3.1).	Yes

Section	Requirement	Compliance	Conformance
	Venting shall be provided where there is potential for gas build up. A hydrostatic valve is to be provided where necessary.	Vents are provided	N/A
	Step irons are to be installed where the depth of the underground tank is 1200mm or greater.	Step irons are provided (Stormwater Management Plan, Appendix A).	Yes
1.2.7 Surface Storage Systems	Where the storage is located in an area where frequent ponding could create maintenance problems or personal inconvenience to property owners, the first 10-20 per cent of the storage should be provided in an area able to tolerate frequent inundation. For example, a paved outdoor entertainment area or a rock garden can be used.	The OSDs are not located in an area where frequent ponding could create maintenance problems or personal inconvenience to property owners (Stormwater Management Plan, Appendix A).	Yes
	The structural adequacy of any retaining walls, including the hydrostatic loads caused by a full storage should be checked and certified by a suitably qualified Engineer. Walls used in storage should be watertight and continuous.	All proposed On Site Detention basin retaining walls are designed by a suitably qualified Engineer including hydrostatic loads caused by a full storage. These walls are to be watertight and continuous..	Yes
	To avoid damage to vehicles, depths of ponding on driveways and car parks shall not be greater than 200mm.	Not applicable as the OSDs are not driveway or carpark storages.	Yes
	Transverse paving slopes within storage areas should not be less than 0.5 per cent.	Not applicable.	Yes
	Where the storage is to be provided in a commonly used area where ponding will cause inconvenience (e.g. a car park), the area should only flood about once every year on average. This will require approximately the first 15 per cent of the storage to be provided in a non-sensitive area.	Not applicable.	Yes
	Standard marker plates are to be fixed to all OSD basins to indicate to owners, residents, maintenance personnel, contractors, etc. the vicinity of the OSD system. The requirements of the standard On-Site Detention Marker plate are as follows: Minimum size: 150mm x 60mm Material: Non-corrosive metal or 4mm thick laminated plastic. Location: Screwed to the nearest concrete or Permanent surface and be above the expected water surface level in the basin. If in doubt contact Council. Wording: Minimum letter height of 5mm.	Hazard signage will be located at all entry points to the OSDs as well as around the OSD outlet pits (Stormwater Management Plan, Section 5.3.1).	Yes

APPENDIX G

Raingarden Details

FULL SUN SEDGES AND GRASSES


Baumea articulata (Jointed Twig-rush)


Bolboschoenus fluviatilis (Club-rush)


Carex appressa (Tall Sedge)


Carex breiculmis (Short-Stem Sedge)


Juncus usitatus (Common Rush)


Schoenus apogon (Fluke Bog-rush)

PART SHADE SEDGES AND GRASSES


Hemarthria uncinata (Mat Grass)


Juncus prismatocarpus

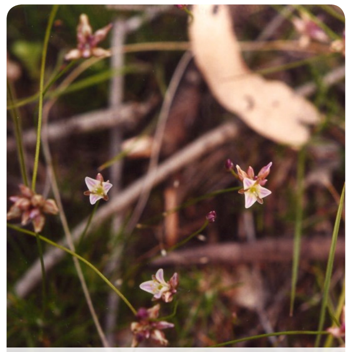

Dampiera stricta (Blue Dampiera)


Leptocarpus tenax (Slender Twine Rush)


Philydrum lanuginosum (Wooly Waterlily)


Goodenia hederacea (Ivy Goodenia)


Gahnia clarkei (Tall Saw-sedge)


Lazmannia gracilis (Slender Wire Lily)

FULL SHADE SEDGES AND GRASSES


Dichondra repens (Kidney Weed)


Juncus continuus (Rush)


Isolepis inundata (Water Club-rush)


Lepyrodia scariosa (Scale rush)


Microlaena stipoides (Weeping Grass)

GROUND INK
LANDSCAPE ARCHITECTS

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RAIN GARDEN PLANTING PALETTE