



Modification of Consent 2 State significant development SSD 7628



SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

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Modification 2

Moorebank Precinct East Stage 2 (SSD 7628)

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Table of Contents

Figures.....	5
Tables.....	5
1.0 Introduction.....	6
Stormwater Management	6
2.0 The site	7
3.0 Amended Stormwater Management Plan.....	11
4.0 Land to which this application applies.....	14
5.0 Consent Proposed to be Modified.....	15
6.0 Proposed Modification	16
6.1 Modification of the construction and operation footprint	16
6.2 Proposed modification to Condition of Consent B40(c)(iii)	26
7.0 Substantially the Same Development.....	32
8.0 Planning Assessment.....	34
8.1 Biodiversity	34
Introduction	34
Existing environment.....	35
Threatened species.....	35
Impact assessment	36
Management and mitigation	37
Offsets	37
Conclusion.....	39
8.2 Other environmental aspects.....	43
9.0 Management and mitigation.....	49
10.0 Conclusion.....	49
Appendix A Compiled Drawings.....	50
Appendix B MPE Stage 2: Modification (SSD 7628-MOD 2) Biodiversity Development Assessment Report (Arcadis 2019)	51
Appendix C Reference Examples of Approved Vertical-Walled OSDs.....	52
Appendix D Moorebank Precinct East (MPE) Stage 2 (SSD 7628 – MOD 2) – Bushfire review (Arcadis 2019)	54
Appendix E MPE Stage 2 Post-Development Catchments.....	55
Appendix F MPE Stage 2 Updated Stormwater Management Plan – WH1	56

Figures

Figure 1 MPE Stage 2 site (Source: Arcadis MPE Stage 2 SSD 7628 Response to Submissions 2017)	9
Figure 2 MPE Stage 2 SSD 7628 Amended construction area (Arcadis Consolidated Assessment Clarifications, November 2017)	10
Figure 3 MPE Stage 2 EIS masterplan (Arcadis, 2016)	12
Figure 4 MPE Stage 2 Masterplan showing revised OSD 1, OSD 2 and OSD 9 (Reid Campbell, 2019)	13
Figure 5 MPE Stage 2 EIS development layout and design plans (source: Arcadis, 2016)	18
Figure 6 Amended OSD design layout showing revised OSD 2 location	19
Figure 7 Revised OSD 2 design and site boundary (Source: Costin Roe, 2018)	20
Figure 8 Proposed footprint change (red line) to existing footprint (blue dash)	21
Figure 9 Proposed footprint change (red line) to existing footprint (blue dash)	21
Figure 10 Proposed footprint change (red line) to existing footprint (blue dash)	22
Figure 11 Proposed footprint (red line) to existing footprint (blue dash) and extracted photo points	23
Figure 12 Proposed additional footprint area looking east	23
Figure 13 Proposed footprint area looking west	24
Figure 14 Proposed footprint area looking west	24
Figure 15 Proposed footprint area looking east	25
Figure 16 Original OSD 9 footprint	27
Figure 17 Revised OSD 9 design	28
Figure 18 Existing MPE Catchments (Source: Costin Roe, 2018; SSD 7628 Stormwater Management Plan Figure 4-1 Arcadis, 2016)	29

Tables

Table 1 Description of affected land	14
Table 2 PCTs and TECs within the development site (source: Arcadis, 2019)	35
Table 3 Offset requirements for TECs (source: Arcadis, 2019)	38
Table 4 Offset requirements for threatened species (source: Arcadis, 2019)	38
Table 5 MPE Stage 2 Biodiversity Approval conditions (B103 – B110) (Arcadis, 2019)	39
Table 6-1 Other environmental aspects	43

1.0 Introduction

This modification application has been prepared by Aspect Environmental Pty Limited on behalf of SIMTA (as Qube Holdings Limited) (the Applicant), pursuant to Section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to modify the State significant development consent SSD 7628 for the approved second stage of development of the Moorebank Intermodal Precinct East (MPE) site.

The modification application proposes minor changes to the stormwater management system of the approved development in response to the additional design requirements placed on this aspect by the conditions of consent (CoC), specifically by CoC B40, which requires the preparation of an amended Stormwater Management Plan (SMP).

Stormwater Management

The preparation of an amended SMP to satisfy CoC B40 is substantially progressed. An amended staged plan has been completed for the warehouse 1 precinct (W1P) (Arcadis, July 2018), and has been approved by the Department of Planning and Environment (DP&E). The need to modify development consent SSD 7628 has been identified to enable the development to achieve the functional design, as approved in Concept and Stage approvals, of provision of 300,000 m² gross floor area (GFA) of warehousing and 8,000 m² GFA for the freight village.

This modification application relates to the controls identified in CoC B40 for maximum batter slopes for onsite detention basins (OSDs), as set out in CoC B40(c)(iii) as follows:

“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”

To address the spatial requirement for 1V:4H internal and external batters on the site, additional land surface area is required above that originally allocated for vertical-walled OSDs as provided in the submitted design for OSDs under the MPE Stage 2 SSD 7628 application.

The proposed design response to CoC B40(c)(iii) is as follows:

- revision of the design of onsite detention basin 1 (OSD 1) in the north-eastern corner of the MPE site to include 1V:4H batters and the provision of underground storage tanks to replace the central open linear basins. This design change is effected through provision of the amended B40 Stormwater Management Plan to be submitted to the DPE and does not trigger any need for modification;
- extension of the construction and operation footprint at the southern extent of the MPE site to accommodate the revised design for onsite detention basin 2 (OSD 2) that addresses the requirement of CoC B40(c)(iii) for OSDs to have maximum batter slopes of 1V:4H. This change to the construction and operation boundary of the site requires modification to the MPE Stage 2 SSD 7628 consent (this application) as well as to the MPE Concept Plan Approval MP 10_0193 (subject to a separate application); and

- modification application for the removal of the requirement for batter slopes to be applied to onsite detention basin 9 (OSD 9) in the north-western section of the MPE site, allowing this OSD to be constructed with vertical walls.

A detailed description of the proposed modification elements is provided in Section 6, and an assessment of potential environmental impacts is provided in Section 8.

This application identifies the consent, describes the proposed modification and provides an assessment of the relevant matters contained in Section 4.55(1A) of the EP&A Act. It should be read in conjunction with the consent SSD 7628, issued 31 January 2018.

2.0 The site

The MPE site, including the MPE Stage 2 Project site, is located approximately 27 km south-west of the Sydney central business district and approximately 26 km west of Port Botany. The MPE site is situated in the Liverpool local government area, 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 (IMT) including, a rail link to the Southern Sydney Freight Line (SSFL), 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.

The MPE Project is to be developed in stages. The current active stages are:

- Stage 1 - Construction and operation of the Intermodal Terminal (IMT) and rail link;
- Stage 2 - Construction and operation of warehouse and distribution facilities; and

MPE Stage 1 (SSD-6766) was granted approval on 12 December 2016. The construction of the IMT on the eastern side of Moorebank Avenue and the rail link to the SSFL has commenced.

The MPE Stage 2 Project (SSD 7628) involves the construction and operation of warehousing and distribution facilities on the MPE site and upgrades to approximately 1.5 kilometres of Moorebank Avenue (See Figure 1).

Key components of the Project include:

- Earthworks, including the importation of 600,000 m³ of fill and vegetation clearing
- Warehousing and additional ancillary offices comprising approximately 300,000 m² GFA
- A freight village, comprising 8,000 m² 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, lighting and landscaping
- An upgrade to Moorebank Avenue including the following key components:
 - Modifications to the existing lane configuration, including some widening
 - 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
- Operations being undertaken 24 hours per day and seven days per week.

The MPE site is located 5 km east of the M5/M7 Interchange, 2 km from the main north-south rail line and SSFL, and 600 m from the M5 Motorway.

The MPE site is surrounded by a mix of existing and proposed industrial sites, along with bushland and is accessed directly from the M5 Motorway by Moorebank Avenue, which runs north-south from the northern side of the M5 Motorway to the Holsworthy Military Reserve.

The MPE site includes the MPE Stage 1 development, the IMT, which is located in the central and south-western portions of the site. The Defence Joint Logistics Unit, operated by the Department of Defence, is located immediately north of the MPE site. To the east and south of the site there is an area of bushland, known as the “Boot land”, and Moorebank Avenue runs along the western boundary of the site. The Moorebank Precinct West site is located on the other side of Moorebank Avenue and is subject to a separate approval.

A number of residential suburbs are located near the MPE site, the closest being Wattle Grove, which is approximately 380 m south-east of the MPE site boundary at its nearest point. The MPE site is also located near a number of significant industrial precincts, including Moorebank (including but not limited to the Yulong and Amiens and ABB sites) and Warwick Farm to the north, Chipping Norton to the north-east, Prestons to the west, and Glenfield and Ingleburn to the south-west.

The Applicant is progressing with the development of the MPE site and construction activities related to MPE Stage 2 have commenced under the staged approval of management plans. To complete the final stage for the stormwater management plan approval under CoC B40 for the whole of site, an adjustment to the approved construction and operation boundary is required (existing boundary shown in Figure 2), which is subject to this modification application. Revision of the design of OSD 9 requires modification to CoC B40, which is also subject to this modification.

There is presently a separate modification application (SSD 7628 MOD 1) being considered by the Department of Planning and Environment (DPE) in respect of signage (CoC B141(f)); timing for intersection design approvals and upgrades (B13); and biodiversity credit requirements (B104) in addition to an update to cross-referencing of conditions.

MPE Stage 2 Response to Submissions

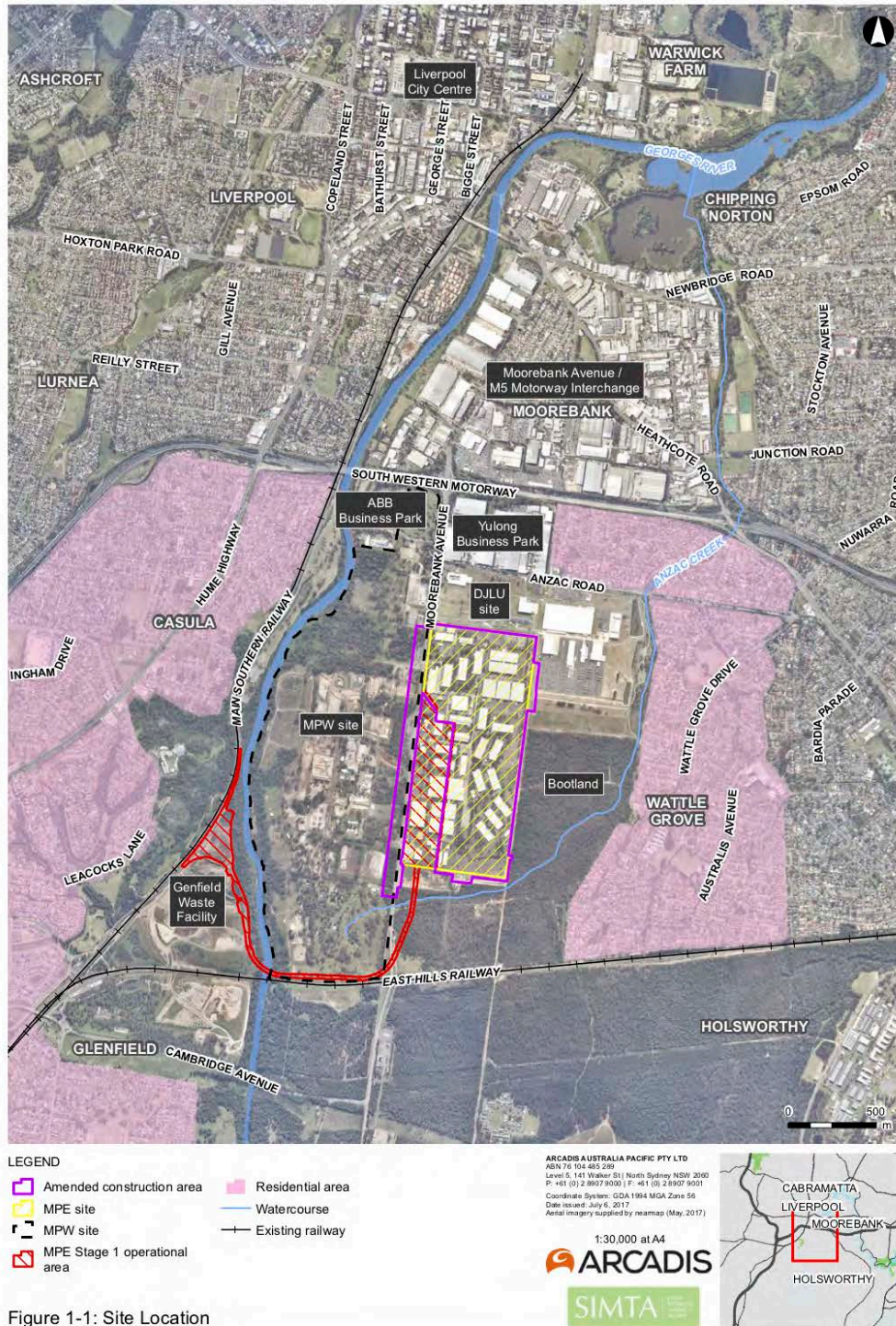


Figure 1 MPE Stage 2 site (Source: Arcadis MPE Stage 2 SSD 7628 Response to Submissions 2017)



Figure 2 MPE Stage 2 SSD 7628 Amended construction area (Arcadis Consolidated Assessment Clarifications, November 2017)

3.0 Amended Stormwater Management Plan

As previously noted, the Applicant is progressing with the development of the MPE site and construction activities related to the MPE Stage 2 project have commenced. The submission of the amended SMP required by CoC B40, has been staged in accordance with CoC A14 and A15 and, accordingly, the satisfaction of this CoC is substantially progressed.

The original stormwater management design as proposed in the MPE Stage 2 EIS (Arcadis 2016) is shown in Figure 3.

The initial stage of the amended SMP, *MPE Stage 2 Warehouse 1 Precinct Stormwater Management Plan* (SMP W1P) (Arcadis Australia, 2018), was approved by DP&E on 2 July 2018. SMP W1P applies to the area known as the Warehouse 1 Precinct (W1P), located in the north-west corner of the MPE site (see Figure 3), and is currently being implemented onsite.

This SMP W1P approval reflected the adaptation of OSD 9 into a covered tank, rather than an open basin, with biofiltration being provided for water quality treatment along the western discharge channel leading to the Georges River.

The second stage of the SMP, the *MPE Stage 2 Stormwater Management Plan – Balance of Site* (SMP BoS), prepared by Costin Roe, was submitted to DP&E on 23 October 2018. The SMP BoS includes an amended stormwater development layout and design in response to the requirements of CoC B40. The detailed design of the amended stormwater system comprises:

- a reduction in the size and number of OSDs at the site, i.e. replacement of central linear basins with underground tanks and redesign and relocation of OSD 1 to include 1V:4H batters; and
- inclusion of 1V:4H batters for the revised OSD 2 in an expanded location into the land described as the “Butcher’s Knife” to the south of the MPE site (Lot 4 DP 1197707)

The SMP BoS has been updated in accordance with DP&E comments and the SMP BoS figures relevant to OSD 2 are provided as Appendix A of this report. The coverage of the SMP BoS identifying OSD 1 and OSD 2 is presented in Figure 4 below.

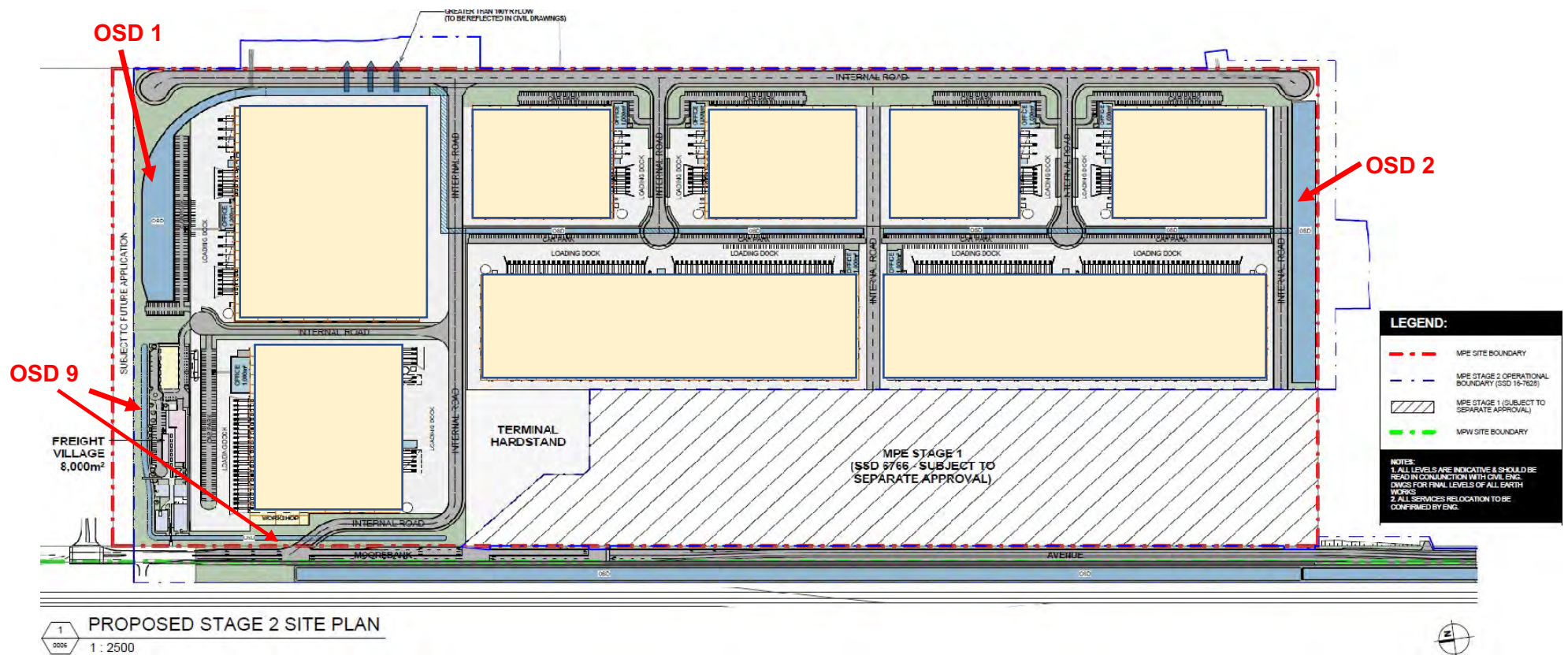


Figure 3 MPE Stage 2 EIS masterplan (Arcadis, 2016)

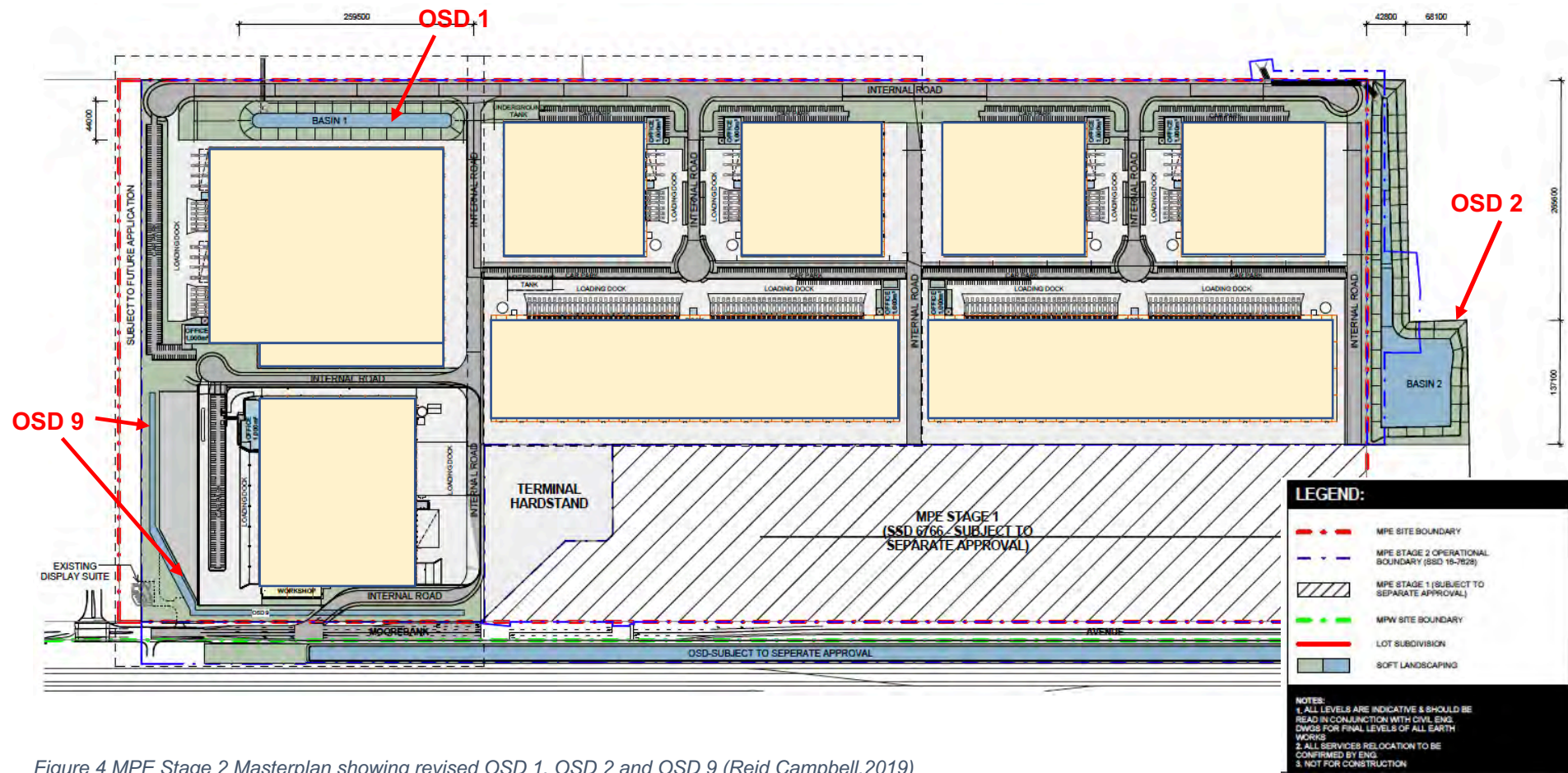


Figure 4 MPE Stage 2 Masterplan showing revised OSD 1, OSD 2 and OSD 9 (Reid Campbell, 2019)

4.0 Land to which this application applies

The proposed modification requires the inclusion of an additional portion of the area at the southern extent of the MPE Site, known as the Butcher's Knife, in the MPE Stage 2 construction and operation footprint to accommodate the revised OSD 2 footprint. A description of the land to which this modification application applies is provided in **Error! Reference source not found.** below.

Table 1 Description of affected land

Name	Lot description
MPE Site	Lot 1 DP1048263
Boot land	Lot 4 DP1197707

Lot 1 DP1048263 is wholly owned by Qube Holdings as The Land Trust. Lot 4 DP1197707 is owned by the Commonwealth of Australia. Land owner's consent was provided in respect of MPE Stage 2 SSD 7628 application, and subsequent amended proposal, which included works in both of the referenced lots, including stormwater management works within the Butcher's Knife (Lot 4 DP1197707). These consents continue to have effect for the scope of the proposed modification.

The subject land forms part of the land that is under a 99-year lease arrangement to a land trust, comprising Moorebank Intermodal Company and Qube Holdings, for the purpose of facilitating the development of the wider Moorebank Intermodal Precinct.

5.0 Consent Proposed to be Modified

The Proponent submitted to the Department of Planning and Environment (DP&E) an application for consent for State significant development (SSD) 7628 for Stage 2 of the Moorebank Precinct East Intermodal Project. The NSW Planning and Assessment Commission (PAC) granted consent to SSD 7628 covering the MPE Stage 2 key components, identified above, on 31 January 2018.

Under SSD 7628 Development Consent Terms of Consent, Condition A2 identifies:

- 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.

Section 4.2.5 of the submitted EIS (Arcadis 2016) addressed the ancillary works as part of the built form for the project, which included the provision of onsite detention basins as part of the water management works. Section 4.2.5 also referenced Appendix P of the EIS, which presented the Stormwater Drainage Design Drawings that show the layout of the surface water catchment, treatment and drainage systems, including the locations of the OSDs (refer Figure 3, above). OSD designs are also included within Appendix B – Revised Architectural Drawings of the Response to Submissions documentation (Arcadis, 2017). All relevant drawings are compiled in Appendix A.

Condition of consent (CoC) A4 of the SSD 7628 consent identifies that the conditions of consent prevail

to the extent of any inconsistency, ambiguity or conflict between them and any of the documents listed in condition A2(c) ... For the purpose of this condition, there will be an inconsistency between documents if it is not possible to comply with both documents, or in the case of a condition of consent or direction of the Secretary and a document, if it is not possible to comply with both the condition or direction and the document.

As SSD 7628 CoC B40(c)(iii) has compelled an amendment to design requirements. The amended design and SMP BoS have been prepared to address this prescribed design change. This modification application has been prepared to give effect to the resultant design amendment and the requirements of CoC B40(c)(iii).

6.0 Proposed Modification

As outlined in Section 1, the proposed modification seeks changes to the issued consent instrument (SSD 7628) in response to the requirements of CoC B40(c)(iii). The changes proposed relate specifically to the prescription for maximum batter slopes for OSDs detailed in CoC B40(c)(iii), which is provided as an extract below.

...(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;...

The prescriptive nature of these controls in the context of the design and layout of the development as assessed in the EIS (Arcadis 2016) has required the Applicant to develop a feasible design that achieves the relevant environmental management outcomes required by the CoC B40 and reasonably enables the site to function as a warehouse precinct in accordance with the approved consent.

Accordingly, there are two elements of the proposed modification:

- the revision of the construction and operation footprint at the southern extent of the site to include the revised design for OSD 2 that addresses the requirement for OSDs to have maximum batter slopes of 1V:4H: and
- the removal of the requirement for batter slopes in respect of OSD 9, located at the north-west of the site, to allow OSD9 to be constructed without 1V:4H batters and instead to be constructed with vertical walls.

Detailed descriptions of the elements of proposed modification are provided below.

6.1 Modification of the construction and operation footprint

The proposed revision of the construction and operation footprint of the MPE Stage 2 Site is required to enable the inclusion of a redesigned OSD 2 comprising a basin with internal biofiltration and 1V:4H batters.

The development layout and design plans for MPE Stage 2, as presented in the MPE Stage 2 SSD 7628 Application EIS, made provision for stormwater management with a series of OSDs with vertical walls across the site (see Figure 5). However, the issued consent instrument for SSD 7628 introduced prescriptions relating to stormwater basin design requirements that were not part of the application, and hence not within the consideration and definition of the construction and operation footprint at the time of lodgement of the application and associated design drawings.

The SMP BoS includes an amended stormwater development layout and design in response to the Water Sensitive Urban Design (WSUD) and stormwater basin design requirements, including Condition B40(c)(iii) that demonstrates capability to achieve batter wall slope objectives of 1V:4H.

To give effect to the required amended layout and design, an increase in construction and operation footprint is necessary to accommodate the revised design of OSD 2, which includes batter walls at a slope of 1V:4H, in an area known as the Butcher's Knife, located immediately to the south of MPE.

In the MPE Stage 2 application, OSD 2 was located at the southern extent of the site within the approved construction and operation footprint (see Figure 5). OSD 2, as originally proposed, ran the length of the southern boundary of the MPE Stage 2 footprint. The OSD 2 drained to an outlet at the eastern boundary (Outlet B) and into Anzac Creek. The OSD 2 design provided as part of the application identified an OSD with vertical walls, to maximise use of available land within the defined footprint.

Additionally, the MPE Stage 2 application included provision for central linear stormwater basins, also with vertical walls.

Condition B40(c)(iii) requires a maximum batter slope of 1V:4H on OSDs requiring an amended design to enable compliance. The amended design has resulted in the replacement of the central linear OSDs with underground tanks and an increased footprint for OSD 2 proximate to the location as originally assessed, however, located fully within the Butcher's Knife land immediately to the south of the MPE site.

The increased footprint is necessary to:

- provide the required batter slopes within OSD 2
- maintain adequate storage volume across the site
- provide the necessary area of biofiltration for water quality treatment, being 1% of the catchment draining to the system in accordance with B40((e)(iv).

To accommodate the inclusion of 1V:4H batter slopes for MPE Stage 2, OSD 2 has increased from a surface area of approximately 1.15 ha and diversion area of 0.53 ha (total 1.68 ha) to a surface area of 2.23 ha.

To accommodate the revised OSD 2 footprint, inclusive of batters, the proposed construction and operation footprint now extends further into the Butcher's Knife land, increasing the construction and operation footprint in the Butcher's Knife by 1.50 ha from 1.24 ha to 2.74 ha.

The revised OSD 2 location and design, inclusive of 1V:4H batters, is shown in below.

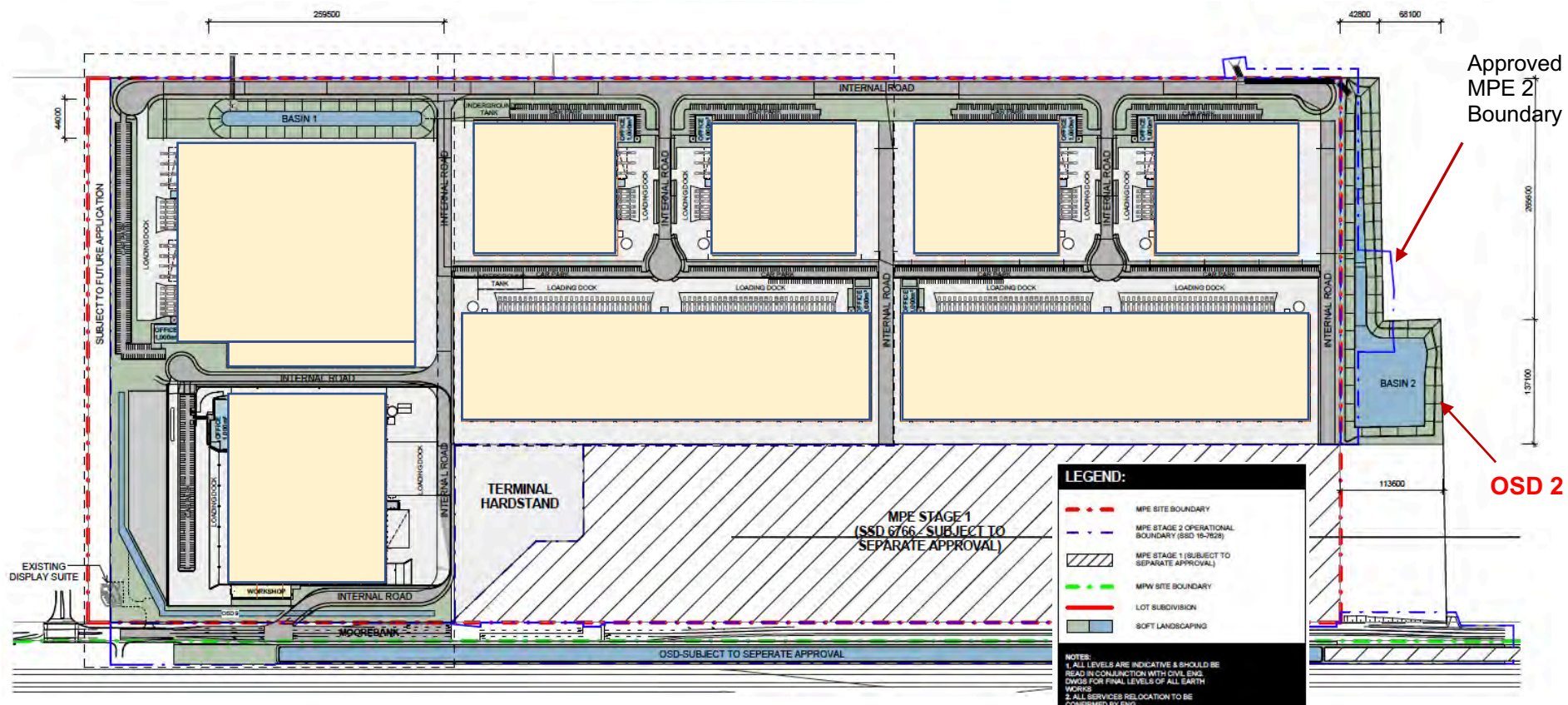


Figure 6 Amended OSD design layout showing revised OSD 2 location

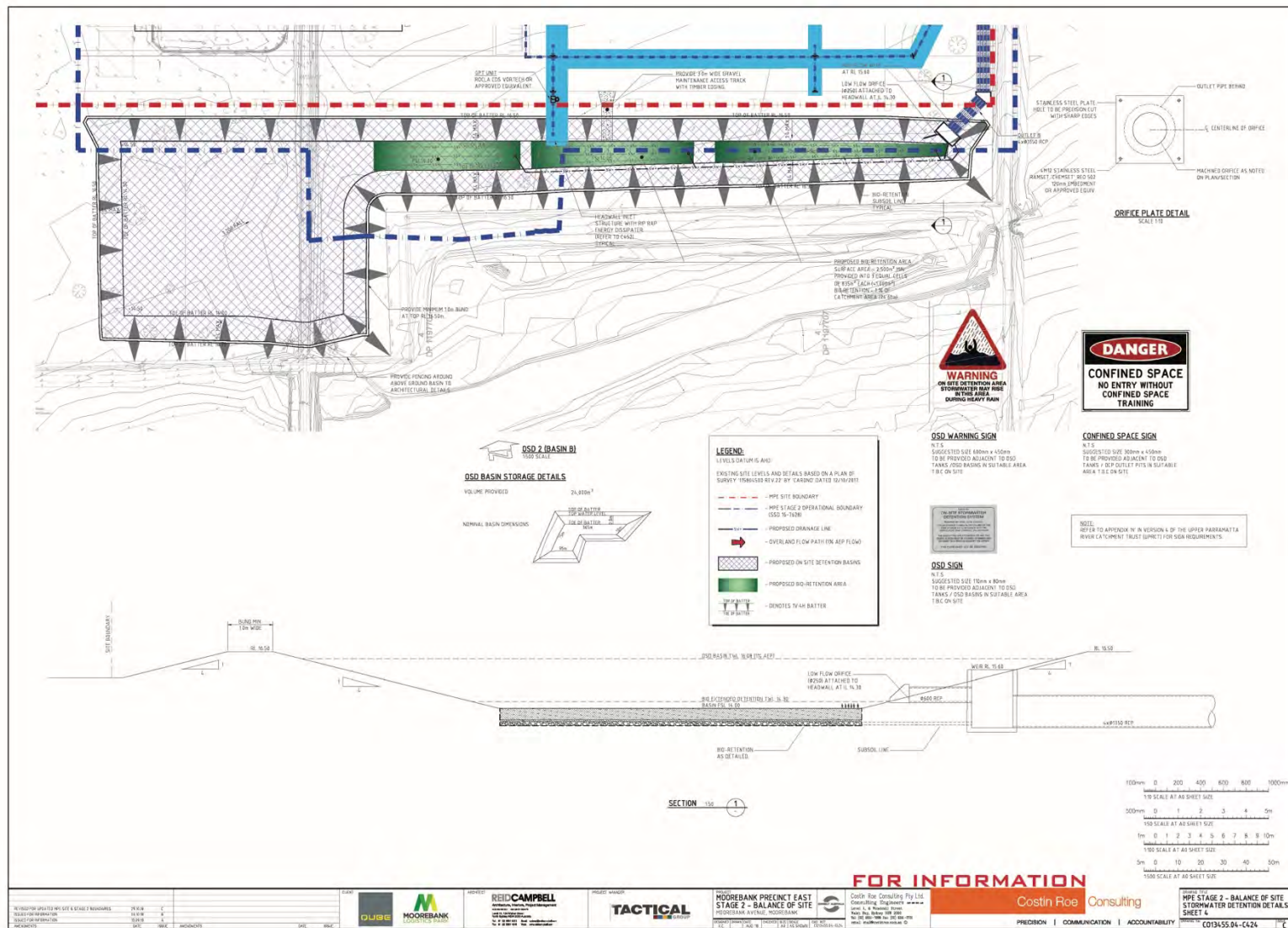


Figure 7 Revised OSD 2 design and site boundary (Source: Costin Roe, 2018)



Figure 8 Proposed footprint change (red line) to existing footprint (blue dash)



Figure 9 Proposed footprint change (red line) to existing footprint (blue dash)



Figure 10 Proposed footprint change (red line) to existing footprint (blue dash)



Figure 11 Proposed footprint (red line) to existing footprint (blue dash) and extracted photo points



Figure 12 Proposed additional footprint area looking east.



Figure 13 Proposed footprint area looking west



Figure 14 Proposed footprint area looking west



Figure 15 Proposed footprint area looking east

The amended design of OSD 2 achieves the drainage, water sensitive urban design, water quantity and water quality requirements and objectives of CoC B40. The proposed revision to the footprint of OSD 2 will not result in any changes to the function or capacity of the stormwater management system for the MPE Site.

The extension of the southern boundary of the development will result in additional impacts to flora, however, is not expected to result in any additional construction or operation impacts for the remaining environmental attributes (fauna, traffic and transport; noise and vibration; air quality, stormwater and flooding; geology, soils and contamination; heritage (indigenous and non-indigenous); visual amenity and landscape; and greenhouse gases and climate change) beyond those already considered and approved for the MPE Stage 2 development. The consideration of impacts is discussed further in Section 8.

6.2 Proposed modification to Condition of Consent B40(c)(iii)

As outlined in Section 1, the proposed modification seeks the revision of the controls relating to maximum batter slopes for OSD 9, as part of the amended Stormwater Management Plan, required by Condition B40 of the consent.

The proponent proposes the revision of condition B40(c)(iii) to read (additional text shown **bold and underlined**):

*...(iii) all on site detention basins to have maximum batter slopes of 1V:4H, **with the exception of OSD 9**, or, for works immediately adjacent to the Moorebank Avenue upgrade, an alternate gradient agreed to by RMS;...*

As the north-south oriented section of OSD 9 runs immediately adjacent to the Moorebank Avenue upgrade, this section of the OSD may have an alternate gradient agreed with RMS, as presently identified under CoC B40(c)(iii). Under the exhibited draft voluntary planning agreement (Ref: 2018/9696 Moorebank Avenue, Moorebank (Moorebank Intermodal)), the east-west section of OSD 9 will run adjacent to the Moorebank Avenue Realignment works that will be dedicated to RMS.

The stormwater management system for the development was originally proposed and assessed in the EIS (Arcadis, 2016). The system was designed in accordance with the design guidelines established by the MPE Concept Approval (MP 10_0193) and overall Water Sensitive Urban Design (WSUD) objectives with reference to Liverpool City Council's OSD Stormwater Detention Technical Specification (LCC, January 2003) and Development Design Specification D5 Stormwater Drainage Design (LCC, January 2003) to manage surface water flows and discharge on and from the site. All original OSD basin designs included vertical walls.

As detailed above, SMP W1P has been approved and implemented on site. SMP W1P included a revised design for the stormwater management system in the north-west of the site that redesigned the open-aired OSD 9 as a covered tank. The establishment of OSD 9 as a covered tank in the SMP W1P removed the obligation for battered walls under CoC B40(c)(iii) in OSD 9.

Subsequent to the approval of SMP W1P, it has been determined that constructing OSD 9 as a tank is not feasible due to redesign of the orientation to facilitate access to the site for underground utilities adjacent to Moorebank Avenue and proximity and zone of influence conflicts with the adjacent café and office suite and future freight village. This redesign has constrained the ability to install a lid over the constructed basin. The revision to SMP W1P has been included for reference as Appendix F.

The original OSD 9 design is shown in Figure 16 and the revised footprint for OSD 9 is shown Figure 17 Revised OSD 9 design. The revised design has a basin width of up to 9 m (along the angled-section), from the original 6 m width. Figure 16 shows the relationship between the freight village and the Warehouse 1 footprint, with OSD 9 located in the limited space to the north and west of these two areas of the development and the future Moorebank Avenue realignment.

The spatial restrictions on the OSD 9 footprint between Warehouse 1 and Moorebank Avenue and between the freight village, perimeter landscaping and the intended Moorebank Avenue Realignment, prevent it from being redesigned to include 1V:4H batter slopes in the same manner used to address OSD 1 and OSD 2 in response to B40(c)(iii).

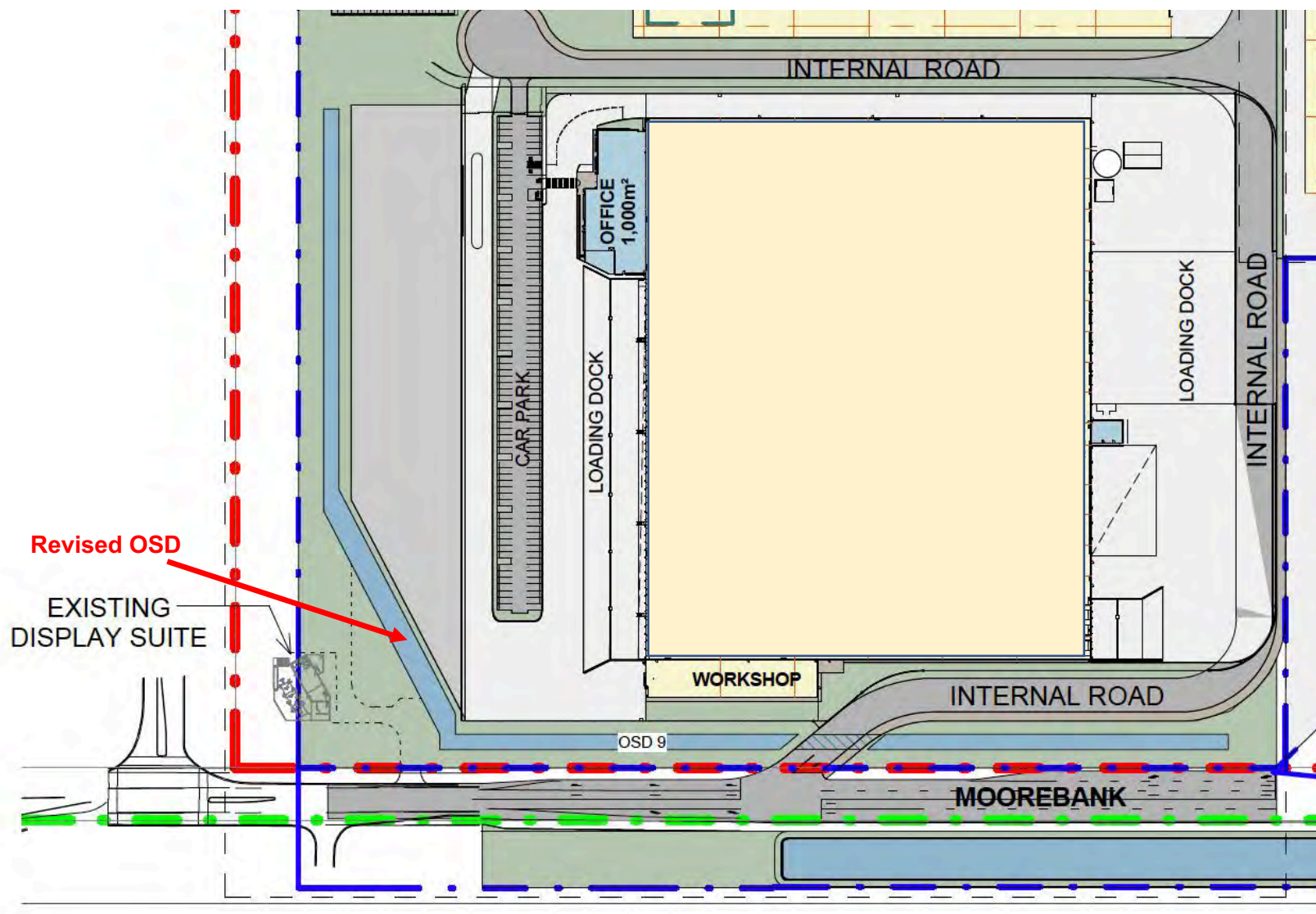


Figure 17 Revised OSD 9 design

There are a number of examples of OSD basins with vertical walls that have been approved and constructed in the Liverpool LGA, which include residential, industrial and infrastructure developments, namely Hollyoake Circuit, M5 Motorway and Prestons. Aerial photography of these and further examples outside of the Liverpool LGA are provided in Appendix C, for reference.

Despite this precedence of acceptability of vertical walls in OSDs, and LCC raising no objections to the vertical-walled OSDs as part of their submissions on the MPE Stage 2 assessment documentation, DP&E issued the design criteria as part of Consent SSD 7628, expressing concerns with this aspect of the OSD design. DP&E's concerns generally focussed on the impact of the vertical walled OSDs on ongoing maintenance, safety and visual obtrusiveness.

As previously noted, the Applicant has amended the stormwater management system design and layout to generally comply with the prescriptive design criteria of CoC B40(c)(iii). However, for the reasons outlined above, the design change is unable to be applied to OSD 9.

Additional detail regarding maintenance, safety and visual obtrusiveness of a vertical-walled OSD 9 is provided below.

- Operational maintenance – Ongoing maintenance requirements have been considered in the design of the OSD basins. Each OSD basin will have maintenance access ramps. Operational and maintenance plans will also be developed, as required by CoC B49, for the ongoing management and maintenance of the OSD basins to ensure they meet their functional and performance objectives.
- Safety – fencing is to be located around the perimeter of OSD 9 to ensure that only those authorised to enter the OSD basin (for maintenance purposes) are permitted. As the OSD basins are designed to temporarily detain (and not retain) stormwater the period of inundation is expected to be short (a matter of hours). The water levels within the OSD basins will therefore generally be low, thereby reducing the potential for drowning of any authorised person, should the fencing be intentionally breached. Any (non-emergency) maintenance activities within the OSD basins will only be conducted when the water level within the OSD basin is low and the forecast is for dry weather.

Notwithstanding this, all OSD basins will have hazard signage, access ramps, flood depth indicators, ladders and refuge areas (outside of the OSD basin in between the fence and the OSD basin), as required, which, would collectively address safety requirements for authorised personnel, and in extremely rare occurrences, unauthorised personnel. Note that authorised personnel would also hold relevant work health and safety accreditation to further reduce risks to safety.

- Visual – the fencing to be included around the perimeter of OSD 9 would be dark in colour and mesh (not chain wire)¹. Landscaping is located along all frontages (north frontage), south (Bootland frontage), east (Bootland frontage) and west (Moorebank Avenue frontage)) of the Project to provide visual screening from surrounding areas. This landscaping would obscure and also soften the visage of the OSD

basins. As a result, the current design of the OSD basins would not be considered visually intrusive.

The construction of OSD 9 as an open basin with vertical walls will not impact the capacity and functionality of the stormwater management system and will not impact the ability of the stormwater management system to achieve the outcomes, in terms of discharge, WSUD, water quality and water quantity, as set out in the consent. This is discussed further in Section 8 and confirmed in the SMP W1P included as Appendix F for reference.

An additional benefit to the proposed approach was identified during a review of the draft Urban Heat Island Mitigation Strategy for MPE Stage 2 with the DP&E and the NSW Government Architect (14 January, 2019), in which the NSW Government Architect indicated its preference to have OSD 9 as an open water body for beneficial outcomes in terms of both aesthetic and ambient air cooling effects.

7.0 Substantially the Same Development

Section 4.55 (1A) of the EP&A Act states that a consent authority may approve an application for the modification of development consent if,

“it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified (if at all).”

While the legislation does not include a strict definition on what constitutes ‘substantially the same development’, the phrase was interpreted by the court in the case of *Moto Projects (No 2) Pty Ltd v North Sydney Council (1999) NSWLEC 280*.

Within this case important principles for consideration in the approval of a modification were established. These included;

- The verb ‘modify’ means to alter without radical transformation
- “Substantially’ in this context means essentially materially or having the same essence
- A development as modified would not necessarily be ‘substantially the same development’ simply because it is for precisely the same use as that for which consent was originally granted
- A modification application involves undertaking both a qualitative and quantitative comparison of the development as originally approved and modified
- Although the comparative task required under section 96 (now Section 4.55) involves a comparison of the whole of the development being compared, the fact does not eclipse or cause it to be eclipsed if a particular feature of the development particularly if that feature is found to be important, material or essential to the development
- Environmental impacts of the proposed modification are relevant in determining whether or not a development is substantially the same.

The proposed modifications do not change the purpose for which the development is being carried out and maintains all the key components of the development, as described in Schedule 1 of the consent.

The proposed modification involves a minor increase in the disturbance footprint of the MPE Site, an increase of approximately 1.5 ha. As previously stated, the extension of the construction and operation boundaries of the MPE Site are required to give effect to the batter requirements of Condition B40(c)(iii). The increase in the disturbance footprint is likely to result in a minor increase in the impacts to biodiversity associated with the development, however, this will be managed in accordance with the existing approved management and mitigation measures (outlined further in Section 8).

The proposed revision to Condition B40(c)(iii) to enable OSD 9 to be built with vertical walls will not result in any changes to the function and capacity of the stormwater management system and enables consistency in design between the north-south section (parallel to Moorebank Ave) and the east-west section. The proposed modification does not result in any change to catchments, received

stormwater, discharge, water quantity or water quality. There is a positive impact in terms of WSUD as identified by the NSW Government Architect.

The proposed modification remains consistent with the applicable legislation, policies and controls, including the residual conditions of consent under MPE Stage 2 SSD 7628.

Accordingly, the consent authority may be satisfied that the proposed modification is 'substantially the same' as the approved development.

8.0 Planning Assessment

Section 4.55(1A) of the EP&A Act states that a consent authority may modify a development consent

“if it is satisfied that the proposed modification is of minimal environmental impact”.

Under Section 4.55(3), the consent authority must also take into consideration the relevant matters to the application referred to in Section 4.15(1) of the EP&A Act. The environmental assessment of the proposed modification remains substantially unchanged to the relevant matters under Section 4.15(1).

The MPE Stage 2 SSD 7628 Environmental Impact Statement (EIS) (Arcadis, 2016) demonstrated the compliance of the development with all relevant legislation and strategic plans and guidelines. In addition, the EIS, in conjunction with the MPE Stage 2 Response to Submissions (RtS) Report (Arcadis, 2017) and additional information submitted as part of the approvals process, addressed the full spectrum of environmental impacts of the project.

As noted in Section 6, this section provides an overview of the potential environmental impacts associated with the proposed modification. The extension of the construction and operation footprint is likely to result in impacts to biodiversity beyond those previously assessed and these potential impacts are described in detail below. The nature, scale and extent of the proposed modification elements mean that it is unlikely to result in any other environmental impacts beyond those previously assessed and approved under Consent SSD 7628.

8.1 Biodiversity

Introduction

The biodiversity impacts of the MPE Stage 2 Project were assessed in a Biodiversity Assessment Report (BAR) prepared to support the Environmental Impact Statement (EIS) for the project. In accordance with the Secretary's Environmental Assessment Requirements issued for the Project (issued 27 May 2016 and revised 24 November 2016), biodiversity impacts were assessed using the NSW Biodiversity Offsets Policy for Major Projects (2014), underpinned by the Framework for Biodiversity Assessment (2014) (FBA). The project approval references the MPE Stage 2 updated BAR dated 16 November 2017. The *Biodiversity Conservation Act 2016* (BC Act) was introduced in 2016 and included a transitional arrangement for existing SSD applications and approvals.

The transitional period for modifications to SSD projects under the BC Act expired on 24 February 2019. As such, the proposed modification is subject to the provisions of the BC Act which require the preparation of a Biodiversity Development Assessment Report (BDAR) in accordance with the Biodiversity Assessment Method (BAM) (2017).

Accordingly, a BDAR has been prepared by Arcadis (June 2019) for the MPE Stage 2 Modification 2 application, and is provided in full as

Appendix B. The BDAR is based on desktop research and detailed field surveys, undertaken across the MPE site on a number of occasions between 2011 and 2019. Most recently, supplementary field investigations of the development site were conducted in February and May 2019.

The biodiversity impacts and offset requirements for the development site were calculated using the Biodiversity Assessment Method Calculator in accordance with the BAM.

Existing environment

The vegetation within the development site is predominantly comprised of exotic grassland vegetation, with two small patches of modified native vegetation. This native vegetation has been classified as Plant Community Type (PCT) 883 Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion. All vegetation within the development site has been categorised into one of two PCT 883 vegetation zones; '883_Poor' incorporating the degraded woodland vegetation and '883_Cleared' incorporating the exotic grassland. A summary of these vegetation zones, along with the threatened ecological community equivalence is provided in Table 1.

Table 2 PCTs and TECs within the development site (source: Arcadis, 2019)

Plant Community Type	Vegetation Zone	Extent	Vegetation integrity score	BC Act TEC	EPBC Act TEC
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	883_Poor	0.17 ha	30.1	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion (vulnerable)	Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community (endangered)
	883_Cleared	1.43 ha	3.1	Not equivalent	Not equivalent

Threatened species

A total of 15 threatened flora species were identified as candidate species credit species in the Biodiversity Assessment Method Calculator. Three of the candidate threatened flora species were considered unlikely to occur within the development site based on an absence of potential habitat. Targeted surveys were undertaken for the remaining 12 candidate threatened flora species during February 2019. These surveys were seasonally appropriate for all threatened species except *Hibbertia fumana*. Four threatened flora species were recorded within and adjoining the development site during the February 2019 surveys, including *Acacia bynoeana*, *Hibbertia puberula* subsp. *puberula*, *Hibbertia fumana* and *Persoonia nutans*.

A total of 22 threatened fauna species were identified as candidate species credit species in the Biodiversity Assessment Method Calculator.

Eighteen of the candidate threatened fauna species were considered unlikely to occur within the development site based on an absence of potential habitat.

Targeted surveys were conducted for three of the remaining candidate threatened fauna species during February 2019. These species were Koala, Cumberland Plain Land Snail and Green and Golden Bell Frog. None of these species were detected. The final candidate species, Southern Myotis, was assumed to be present based on previous records of the species nearby.

Based on the records of the targeted threatened species surveys, species polygons have been prepared for threatened flora species. Whilst Southern Myotis was assumed to be present, none of the features that are required to be included in a species polygon for this species are present within the development site.

Impact assessment

The BDAR considered the construction and operational impacts of the proposed modification. The potential biodiversity impacts of the proposed modification are as follows:

- Clearing of all vegetation within the development site including representatives of one threatened ecological community. The total area of vegetation to be cleared is 0.60 ha; the areas of native vegetation to be cleared comprise two small, fragmented patches of vegetation totalling 0.17 hectares. The total area to be cleared consists of one plant community type (PCT):
 - 0.17 hectares of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin. This PCT corresponds with the TEC *Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion*, which is listed as vulnerable under the BC Act and *Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community* listed as endangered under the EPBC Act.
- The proposed modification will have direct impacts on habitat for three threatened plant species (all of which are 'area' assessed species), including:
 - *Hibbertia puberula* subsp. *puberula* (0.59 hectares)
 - *Hibbertia fumana* (0.14 hectares)
 - *Persoonia nutans* (0.33 hectares).
- *Hibbertia fumana* is a candidate species for Serious and Irreversible Impacts. An assessment of the potential impacts of the proposed modification against the Serious and Irreversible Impacts criteria has been undertaken and a Serious and Irreversible Impact to the species is considered unlikely.

- Potential indirect impacts on records of *Persoonia nutans* and *Hibbertia puberula subsp. puberula* in the Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland immediately adjoining the southern extent of the MPE Stage 2 site. Indirect impacts may include increased sedimentation, changes to hydrology and increased risk of weed invasion, from adjoining areas.

Management and mitigation

The current suite of construction and operation management plans required under the Stage 2 SSD 7628 conditions of consent would remain applicable to the additional construction and operation area and would be implemented consistently with their application across the remainder of the MPE Stage 2 site. The modification, if approved, would be directly reflected in the amended stormwater management plan required under CoC B40.

All approved plans would be updated to reflect the amended design and footprint on approval of the proposed modification.

As described in the BDAR (Arcadis, 2019), the potential impacts on the identified ecological values have been avoided and minimised in the proposed modification as far as practicable. Where impacts cannot be avoided, the scale and extent of impacts has been determined, and a range of mitigation measures have been recommended to ameliorate impacts on the biodiversity values during construction and operation. This would include the revision of the current Construction Flora and Fauna Management Plan (CFFMP) to include the Proposed Modification and the clearing of native vegetation subject to the Proposed Modification would not occur until the approved CFFMP is revised and updated. The full description of proposed mitigation measures is provided in Table 24 of the BDAR (refer to Appendix B).

Should the requested modification to footprint be approved, it would trigger an administrative amendment to conditions B103 and B104 to adjust the area limit of native vegetation clearing and the retirement of ecosystem and species credits, respectively. The credit retirement requirements identified in Tables 6 and 7 of CoC B104 would be amended to reflect the additional credit requirements subject of this modification on approval. Credit requirement values are currently subject of a separate administrative modification (SSD 7628 MOD 1), any required changes arising from this application would be made in addition to those revised values.

Offsets

The Moorebank Precinct East (MPE) Stage 2 Biodiversity Offset package (Arcadis 2018) outlines the impacts and offset requirements for the MPE S2 project. Additional offsetting is required for the biodiversity impacts of the proposed modification which, if approved, would need to be reflected in updated native vegetation clearing and offsets requirements tables in CoC B103 and B104, respectively.

The offset requirements for the Proposed Modification have been determined in accordance with the BAM and are provided in tables 2 and 3 below.

Table 3 Offset requirements for TECs (source: Arcadis, 2019)

Vegetation zone	PCT Name	Vegetation Class	Area to be impacted	Change in vegetation integrity score	Credits required
1 (883_Poor)	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Sydney Sand Flats Dry Sclerophyll Forests	0.17 ha	-30.1	2

Table 4 Offset requirements for threatened species (source: Arcadis, 2019)

Scientific name	BC Act status	EPBC Act status	Vegetation Zone	Habitat integrity score	Direct impact area	Credits required
<i>Hibbertia puberula</i> subsp. <i>puberula</i>	Endangered	Not listed	883_Poor	30.1	0.08	1
			883_Cleared	3.1	0.52	1
<i>Hibbertia fumana</i>	Critically endangered	Not listed	883_Cleared	3.1	0.14	0
<i>Persoonia nutans</i>	Endangered	Endangered	883_Cleared	3.1	0.33	1

The combination of the small area of proposed loss and very low vegetation integrity of much of the habitat present is the key reason for the low offset requirement.

It is anticipated that the timing of offsets for the proposed modification will be subject to the requirements to CoC B104 and evidence of the retirement of credits will be required prior to the impacting of associated native vegetation and threatened species.

Conclusion

The MPE Stage 2 SSD Conditions of Approval that are applicable to biodiversity, and would be affected by the proposed modification, are listed in Table 8.

Table 5 MPE Stage 2 Biodiversity Approval conditions (B103 – B110) (Arcadis, 2019)

Ref.	Condition of Approval				Consistency with proposed modification
B103	The Applicant must: (a) ensure that no more than 4.69 hectares of native vegetation is cleared for the development; and (b) minimise: - the impacts of the development on hollow-bearing trees; and - the clearing of native vegetation and key habitat within the approved disturbance footprint.				The proposed modification would require removal of an additional 0.17 hectares of native vegetation.
B104	Prior to the commencement of construction, unless the Secretary agrees otherwise, the Applicant must retire biodiversity credits of a number and class specified in Tables 6 and 7 and provide evidence to the satisfaction of the Secretary. The retirement of credits must be carried out in accordance with the NSW Biodiversity Offsets Policy for Major Projects, and can be achieved by (a) acquiring or retiring credits under the BioBanking scheme established under the then Threatened Species Conservation Act 1995 (b) making payments unto an offset fund that has been established by the NSW Government; or (c) providing suitable supplementary measures.				See below for additional credit requirements
Table 6	Site	Plant community type	Area to be impacted	Credits required	Two additional credits would be required for impacts to Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin as assessed under the BAM.
	MPE Stage 2 (excluding Moorebank Avenue site)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	0.1 ha	4	
	MPE Stage 2 (excluding Moorebank Avenue site)	Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (ME002)	0.05 ha	3	
	Moorebank Avenue site	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	3.73 ha	167	

	Moorebank Avenue site	(ME003) Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (ME005)	0.22 ha	6	
	Moorebank Avenue site	Forest Red Gum - Roughbarked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney (ME018)	0.59	17	

Table 7	Species	Impacted individuals	Credits required	The following additional species credits would be required, as assessed under the BAM: - Two credits for <i>Hibbertia puberula</i> subsp. <i>puberula</i> - one credit for <i>Persoonia nutans</i>
	Nodding Geebung (<i>Persoonia nutans</i>)	12	924	
	<i>Hibbertia puberula</i> subsp. <i>puberula</i>	110	4400	
	Small-flower Grevillea (<i>Grevillea parviflora</i> subsp. <i>parviflora</i>)	79	1106	
	Note: subsequent to the project approval, OEH requested that impacts and offsets to threatened <i>Hibbertia</i> spp within the Moorebank Precinct be calculated by applying the area method rather than the count method. As documented in the approved MPE Stage 2 BOP (Arcadis 2018), the updated offset credit requirements for <i>Hibbertia puberula</i> subsp <i>puberula</i> for the MPE Stage 2 Project are as follows:			
	Species	Area of impact (hectares)	Credits required	
	<i>Hibbertia puberula</i> subsp. <i>puberula</i>	1.48	58	

B105	Notwithstanding condition B103, the Applicant: (a) may elect to retire biodiversity credits in conjunction with the retirement of biodiversity credits for other developments on the MPE or MPW developments, prior to the commencement of construction of this development, or at another time agreed by the Secretary; and (b) is not required to retire credits for biodiversity impacts that it has already offset under another development consent, pending the	Consistent
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	provision of evidence of what credits were retired to offset which development.	
B106	Prior to early works, a baseline monitoring program must be prepared in consultation with OEH and DPI to define pre-development conditions for water quality, invertebrates and fish assemblages. The results of this monitoring program are to be used to: (a) develop a Biodiversity Monitoring Strategy to identify any changes between upstream and downstream sites as a result of the construction and operation of the development; and (b) set the stormwater water quality and quantity performance criteria referred to in condition B40.	Consistent
B107	Any unavoidable indirect impacts as identified through the Biodiversity Monitoring Strategy required under condition B106, e.g. impacts of change hydrology on vegetation in boot land/ biobank site must be identified and measures to address this must be developed in consultation with OEH and implemented to the satisfaction of the Secretary. Measures may include additional offsetting.	Consistent
B108	Prior to clearing of native vegetation, the Applicant must prepare a Construction Flora and Fauna Management Plan (CFFMP) in consultation with OEH. The CFFMP must form part of the CEMP required by condition C1 and must include the following: (a) measures to minimise the loss of key fauna habitat, including tree hollows; (b) measures to minimise the impacts on fauna on site, including conducting fauna pre-clearance surveys prior to vegetation clearing and building demolition; (c) controlling weeds and feral pests; (d) an Unexpected Finds Procedure detailing procedures and management measures to be implemented in the event that flora and fauna is uncovered in any area not identified in the updated Biodiversity Assessment (BAR); (e) to ensure biodiversity values not intended to be impacted are protected. These measures may include barriers and mapping of protected/ 'no-go' areas; and (f) a program to monitor the effectiveness of the measures in the CFFMP.	The existing CFFMP would be updated to include the proposed modification areas.
B109	Prior to removing/clearing any vegetation, pre-clearing surveys and inspections for threatened species, populations and ecological communities must be undertaken to confirm the on-site location of those entities. The surveys and inspections, and any subsequent relocation of species and associated management measures, must be undertaken under the guidance of a suitably qualified and experienced ecologist. Methodologies must be incorporated into the Construction Flora and Fauna Management Plan required under condition B108. The agreement of OEH, whichever is the relevant agency, is required for any proposed amendments to the location or reclassification of threatened species, populations and ecological communities as identified in the updated BAR.	Pre-clearing surveys of the proposed modification area would be undertaken in accordance with B109 and the CFFMP.

B110

Prior to operation, the Applicant must prepare an **Operational Flora and Fauna Management Plan** (OFFMP) in consultation with OEH. The **OFFMP** must form part of the **OEMP** required by condition C3 and must include measures to ensure biodiversity values not intended to be impacted are protected, including but not limited to:

- (i) weed control;
- (ii) feral animal control;
- (iii) pathogen management procedures;
- (iv) monitoring; and
- (v) rehabilitation actions.

The proposed modification would be incorporated into the OFFMP.

Monitoring of the landscape area along the southern boundary of the proposed modification area would be required to manage any potential impacts on the adjoining biobank site.

8.2 Other environmental aspects

As previously noted, beyond the potential minor impacts to biodiversity described above, the proposed modification is unlikely to present any additional environmental impacts beyond those previously assessed. A summary of the potential impacts of the proposed modification is provided in the Table 8-1 below.

Table 6-1 Other environmental aspects

Environmental aspect	Approved	Proposed Modification
Traffic and transport	An assessment of potential construction and operational traffic impacts generated by the Proposal was undertaken by Arcadis (Section 7 and Appendix K of the EIS (Arcadis, 2016)). Overall, it was concluded that the Proposal (and cumulative scenario including the Proposal) would result in only marginal traffic impacts to the surrounding road network in the presence of mitigation and management measures.	The proposed modification to B40(c)(iii) and to the construction and operation footprint would not result in any change to traffic volumes or the assessed traffic impact or to traffic management and controls during either the construction or operation stage.
Noise and vibration	A Noise and Vibration Assessment was prepared by Wilkinson Murray (2016) (Appendix N of the EIS) to assess the potential noise and vibration impacts arising from the construction and operation of the Proposal	The proposed modification to B40(c)(iii) and to the construction and operation footprint would not result in any change to noise and vibration impact or to noise and vibration management and controls during either the construction or operation stage.
Air quality	An Air Quality Impact Assessment was prepared by Ramboll Environ (2016) (Appendix M of the EIS) to assess the potential air quality impacts arising from the construction and operation of the Proposal. These impacts were identified as being able to be effectively controlled through the implementation of standard control measures. Measures to mitigate air quality impacts would be implemented as per the Air Quality Management Plan, included in the Air Quality Impact Assessment (Appendix	The proposed modification to B40(c)(iii) and to the construction and operation footprint would not result in any change to air quality or the assessed air quality impact or to air quality management and controls in either the construction or operation stage.

Environmental aspect	Approved	Proposed Modification
	M of the EIS), and would be integrated into the OEMP. The following key measures would be included in the OEMP: • Implementation and communication of anti-idling policy for trucks • Complaints line for the community to report on excessive idling and smoky vehicles • Procedures to reject excessively smoky trucks visiting the site based on visual inspection.	
Soils, geology and contamination	Geotechnical investigations and contamination reporting have been undertaken by Golder Associates and JBS&G respectively to determine the suitability of the site for the construction and operation of the Proposal and to address the SEARs (refer to Appendix Q of the EIS). Groundwater is found at approximately 4 to 7 metres below the existing ground levels across the majority of the Proposal site and is anticipated to be deeper than the expected depth of bulk excavations. Groundwater may also be encountered within excavations undertaken towards the south-eastern corner of the Proposal site (i.e. in proximity to Anzac Creek) for depths greater than approximately 1.5 metres. Should bulk excavation to such depths (or greater) be required in this area, consideration will need to be given to the potential for, and management of, groundwater inflows during construction. A Section A Site Audit Statement (SAS) and Site Audit Report developed by JBS&G in September 2016 certified that the site was suitable for commercial/industrial use and that further contamination investigations (i.e. a Phase 2 contamination assessment) were not required. The report noted that construction works on the site should be undertaken in accordance with the Environmental Management Plan (EMP) developed for the site (GHD, 2016), including procedures to control exposure to potential human health and environmental receptors from residual contaminated soil, ACM and potential UXO.	The revised design of OSD 9 does not alter the geotechnical suitability of the proposed location on the OSD. OSD 2 is to be primarily constructed above ground level (approximately <1 m of excavation anticipated) to match the change to surface level of the MPE site and is not expected to intercept or have a material influence on groundwater, in terms of either drawdown or diversion. In accordance with B133 of the CoC, a UXO, EO and EOW Site Assessment survey was undertaken for the site and submitted to the Planning Secretary. The revised OSD 2 footprint was not directly considered as part of the survey, however, the contamination summary report by JBS&G (Appendix Q of the EIS) provides a comprehensive summary of all contamination investigations undertaken at site and includes the location of the revised OSD 2 footprint. In particular, the area was included as part of investigations undertaken by GHD in 2015, on behalf of the Department of Defence. These

Environmental aspect	Approved	Proposed Modification
		investigations included the “<i>preparation of safety and environmental documentation and sampling location clearances for underground services and UXOs within the southern portion of the site</i>” as well as the resultant sampling, which included approximately 18 test pits and a groundwater well in the Butcher’s Knife land. On this basis, it is considered that the revised OSD 2 footprint is suitable and no additional investigations are required. Notwithstanding, unexpected finds procedures would remain applicable for the construction of the proposed modification elements, although, as identified, the construction of OSD 2 is predominantly above ground level rather than involving extensive excavation.
Stormwater and flooding	The Stormwater and Flooding assessment was undertaken by Arcadis (December 2016) and included as Appendix P of the EIS. The assessment presented a design of vertical-walled open basins for OSDs 1, 2, 9 and 10 utilising existing outlets for site discharge of stormwater (refer Figure 3). The DP&E (December 2017), and subsequently PAC (January 2018) in respective determination reports identified a need for amendment to the onsite detention basins and subject to a Stormwater Management Plan to be prepared to the satisfaction of the Secretary.	The proposed adjustment to construction and operation boundary to accommodate an amended design for OSD 2 directly addresses the outcomes sought in respect of amended stormwater basin designs without compromising the function or scope of the MPE Stage 2 SSD 7628 development. Its function as a basin would not alter the capability or capacity of the site’s stormwater system, nor would it alter the downstream hydrology, channel geomorphology or water quality from that assessed within the original assessment. Modification to condition B40(c)(iii) to enable retention of OSD 9 as an open basin with vertical walls would, similarly, not compromise or alter the

Environmental aspect	Approved	Proposed Modification
		downstream hydrology, channel geomorphology or water quality from that assessed within the original assessment, or the subsequently approved SMP W1P, or the updated SMP W1P provided as Appendix F to this application.
Indigenous heritage	Artefact prepared an Aboriginal Heritage Impact Assessment to determine the potential impacts of the Proposal on Indigenous heritage significance (refer to Appendix S of the EIS). No impacts to Indigenous heritage were identified for the operational phase of the Proposal. Further, three isolated finds are located to the south of the Proposal site. An exclusion zone would be provided around these artefacts, thereby avoiding any disturbance during construction of the Proposal. Mitigation measures proposed include the establishment of exclusion zones around the identified artefacts on site and the implementation of an unexpected find procedure.	The proposed modification to B40(c)(iii) would not result in any change to indigenous heritage values or the assessed indigenous heritage impact or to indigenous heritage management and controls in either the construction or operation stage The proposed modification to the construction and operation footprint to accommodate the revised OSD 2 footprint has the potential to impact three isolated finds located along the vehicle track at the southern extent of the proposed footprint extension. The toe of the southern batter would not extend onto the vehicle track where the isolated finds were identified. The track would be maintained to enable inspections, monitoring and maintenance works. These isolated finds, identified as Isolated Finds 2, 3 and 4, were identified as having low archaeological significance with low research potential as part of the <i>Aboriginal Cultural Heritage Assessment</i> prepared by Archaeological & Heritage Management Solutions (AHMS, 2012) as part of the <i>MPE Concept Plan Environmental Assessment</i> (Hyder Consulting, 2013). The Isolated Finds are identified and described in Section 3.1.1.1 of the MPE Stage 2 Construction Heritage Management Plan (CHMP) (Arcadis, 2018) and the Isolated Finds will be managed in

Environmental aspect	Approved	Proposed Modification
		accordance with measures contained in the CHMP. Should impacts to these Isolated Finds be identified as being unavoidable during construction, requirements and/or approval would be sought to salvage these items in consultation with OEH and the Registered Aboriginal Parties. Further, the Unexpected Finds Procedure, provided in Section 3.3.1 of the CHMP, will be implemented during construction of the proposed modification.
Non-indigenous heritage	Artefact prepared a Non-Indigenous Heritage Impact Assessment to determine the potential impacts of the Proposal on non-Indigenous heritage (refer to Appendix T of the EIS).	The proposed modification to B40(c)(iii) and to the construction and operation footprint would not result in any change to non-indigenous heritage or the assessed non-indigenous heritage impact or to non-indigenous heritage management and controls in either the construction or operation stage.
Visual amenity and landscaping	Reid Campbell has undertaken an assessment of the visual amenity implications, including from light spill, associated with the Proposal. A Landscape Plan has been prepared by Groundlink to identify the landscaping features of the Proposal and is included in Appendix E of the EIS. In addition to this a Visual Impact Assessment (VIA) (Reid Campbell, 2016) and Light Spill Assessment (Arcadis, 2016) (refer to Appendix R of the EIS) have been prepared to assess the potential visual and light spill impacts of the Proposal.	The proposed modification to B40(c)(iii) and to the construction and operation footprint would not result in any change to visual amenity or the assessed visual amenity impact or to visual amenity management and controls in either the construction or operation stage. There may be some beneficial visual amenity and ambient cooling impacts associated with the amended design of OSD 2 as a broader basin. There may be some beneficial visual amenity and ambient cooling impacts associated with retaining an open basin structure for OSD 9.

Environmental aspect	Approved	Proposed Modification
Bushfire	Australian Bushfire Protection Planners prepared a Bushfire Impact Assessment to assess the potential impacts of the Proposal on bushfire risk for the site (refer to Appendix U of the EIS) The potential bushfire threat posed by bushland to the south (the Boot Land) is a Bushfire Hazard Rating of high and Bushfire Threat of moderate. It is understood that this rating is based upon the continued management of the 60m defendable space within the MPE Stage 2 Project site and the 50m cleared area to the south of the MPE Stage 2 Project site boundary being maintained.	As noted in the Moorebank Precinct East (MPE) Stage 2 (SSD 7628 – MOD 2) – Bushfire review, prepared by Arcadis (refer to Appendix D), the Proposed Modification will not result in significant changes to the defendable spaces in the south-west extent of the site, and is, therefore, unlikely to result in any changes to the approved Bushfire Hazard Rating or Bushfire Threat. Given the scale and nature of the Proposed Modification additional bushfire assessment and mitigation measures are not required as the MPE Stage 2 Project, as modified, remains compliant with the Planning for Bushfire Protection (2006) guidelines, as required. In addition, the Proposed Modification provides a long-term opportunity for the area to be maintained as defendable space, i.e. not be subject to regrowth, and or, to location of buildings that could be occupied. This is considered a positive outcome for the purposes of bushfire protection.

9.0 Management and mitigation

The current suite of construction and operation management plans required under the Stage 2 SSD 7628 conditions of consent would remain applicable to the additional construction and operation area and would be implemented consistently with their application across the remainder of the MPE Stage 2 site. The modification, if approved, would be directly reflected in the amended stormwater management plan required under CoC B40.

All approved plans would be updated to reflect the amended design and footprint on approval of the proposed modification.

Should the requested modification to footprint be approved, it would trigger an administrative amendment to conditions B103 and B104 to adjust the area limit of native vegetation clearing and the retirement of ecosystem and species credits, respectively. The credit retirement requirements identified in Tables 6 and 7 of CoC B104 would be amended to reflect the additional credit requirements subject of this modification on approval. Credit requirement values are currently subject of a separate administrative modification (SSD 7628 MOD 1), any required changes arising from this application would be made to those values.

10.0 Conclusion

This modification proposes minor changes to the stormwater management system of the approved development in response to the additional design requirements placed on this aspect of the development by the CoC, under CoC B40, which requires the preparation of an amended Stormwater Management Plan (SMP).

Specifically, in respect of the provisions of CoC B40(c)(iii), the proposed modification seeks:

- the revision of the construction and operation footprint at the southern extent of the site to include the revised design for OSD 2 that addresses the requirement for OSDs to have maximum batter slopes of 1V:4H: and
- the removal of the requirement for batter slopes to permit OSD 9, located at the north-west of the site, to be constructed without the 1V:4H batters and instead to be constructed with vertical walls.

In accordance with section 4.55(1A) of the EP&A Act, the proposed modification is considered appropriate to approve as:

- The consent as proposed to be modified is substantially the same development as the development for which consent was granted;
- The proposed modification will result in only minor environmental impacts beyond those previously assessed; and
- The proposed modification remains generally consistent with the approved development.

Appendix A Compiled Drawings

MOOREBANK PRECINCT EAST (MPE) STAGE 2

STATE SIGNIFICANT DEVELOPMENT APPLICATION

CIVIL WORKS

DRAWING LIST

GENERAL

SSS2-ARC-CV-DWG-0001	COVER SHEET AND DRAWING LIST
SSS2-ARC-CV-DWG-0002	GENERAL ARRANGEMENT PLAN
SSS2-ARC-CV-DWG-0003	TYPICAL ROAD CROSS SECTIONS

SITE PREPARATION

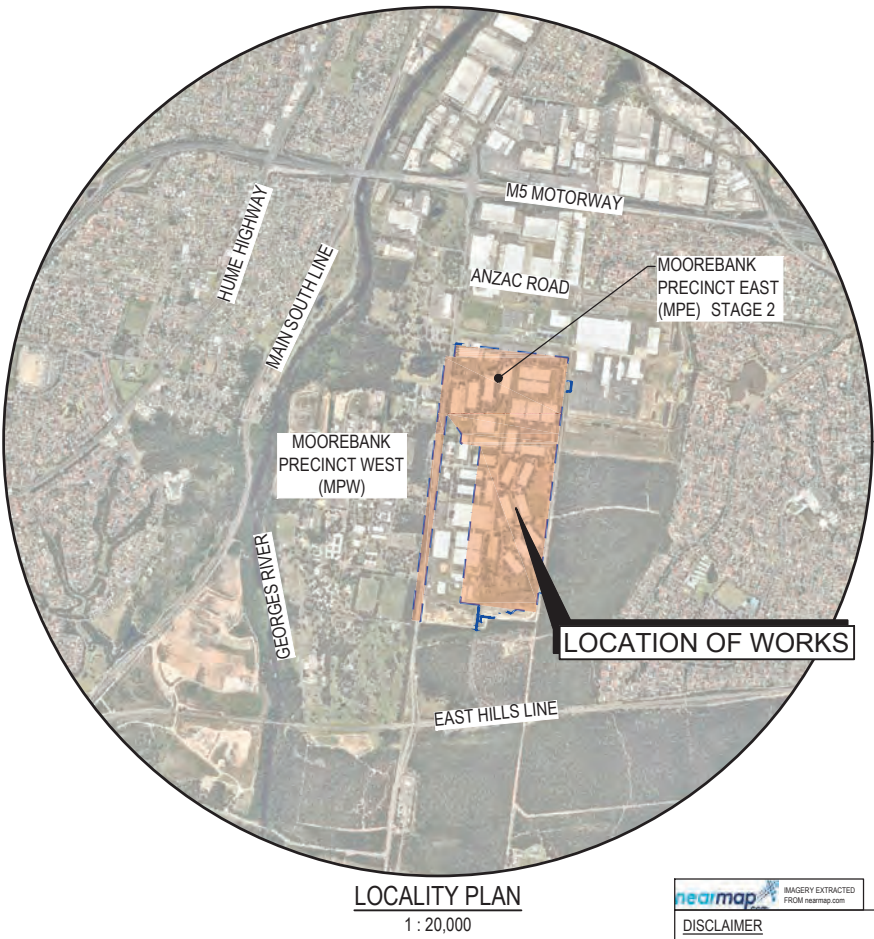
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SSS2-ARC-CV-DWG-0111	BULK EARTHWORKS PLAN
SSS2-ARC-CV-DWG-0121	SITE SECTIONS SHEET 1
SSS2-ARC-CV-DWG-0122	SITE SECTIONS SHEET 2

CIVIL WORKS

SSS2-ARC-CV-DWG-0201	CIVIL AND STORMWATER PLAN SHEET 1
SSS2-ARC-CV-DWG-0202	CIVIL AND STORMWATER PLAN SHEET 2
SSS2-ARC-CV-DWG-0203	CIVIL AND STORMWATER PLAN SHEET 3
SSS2-ARC-CV-DWG-0204	CIVIL AND STORMWATER PLAN SHEET 4
SSS2-ARC-CV-DWG-0205	CIVIL AND STORMWATER PLAN SHEET 5
SSS2-ARC-CV-DWG-0206	CIVIL AND STORMWATER PLAN SHEET 6
SSS2-ARC-CV-DWG-0211	ROAD LONGITUDINAL SECTIONS SHEET 1
SSS2-ARC-CV-DWG-0212	ROAD LONGITUDINAL SECTIONS SHEET 2
SSS2-ARC-CV-DWG-0213	ROAD LONGITUDINAL SECTIONS SHEET 3
SSS2-ARC-CV-DWG-0214	ROAD LONGITUDINAL SECTIONS SHEET 4
SSS2-ARC-CV-DWG-0215	ROAD LONGITUDINAL SECTIONS SHEET 5
SSS2-ARC-CV-DWG-0216	ROAD LONGITUDINAL SECTIONS SHEET 6

STORMWATER DRAINAGE

SSS2-ARC-CV-DWG-0411	STORMWATER DRAINAGE BASIN OUTLET 1
SSS2-ARC-CV-DWG-0412	STORMWATER DRAINAGE BASIN OUTLET 2
SSS2-ARC-CV-DWG-0413	STORMWATER DRAINAGE BASIN OUTLET 9
SSS2-ARC-CV-DWG-0414	STORMWATER DRAINAGE BASIN OUTLET 10
SSS2-ARC-CV-DWG-0431	EXISTING CATCHMENT PLAN
SSS2-ARC-CV-DWG-0432	PROPOSED CATCHMENT PLAN



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03	ISSUE FOR SSD APPLICATION INCORPORATING CLIENT COMMENTS	28/10/2016
02	ISSUE FOR SSD APPLICATION	19/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016
Issue	Description	Date


1 : 20000



Client




Status

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Scales	1:20000	Current Issue Signatures
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Height Datum	AHD	Designed S.MAKIREDDI
Grid	MGA	Checked K.MCAREAVEY
		Approved M.KEFFORD

Filename: SSS2-ARC-CV-DWG-0001-CoverSheetAndDrawingList.dwg

Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2

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-0001-

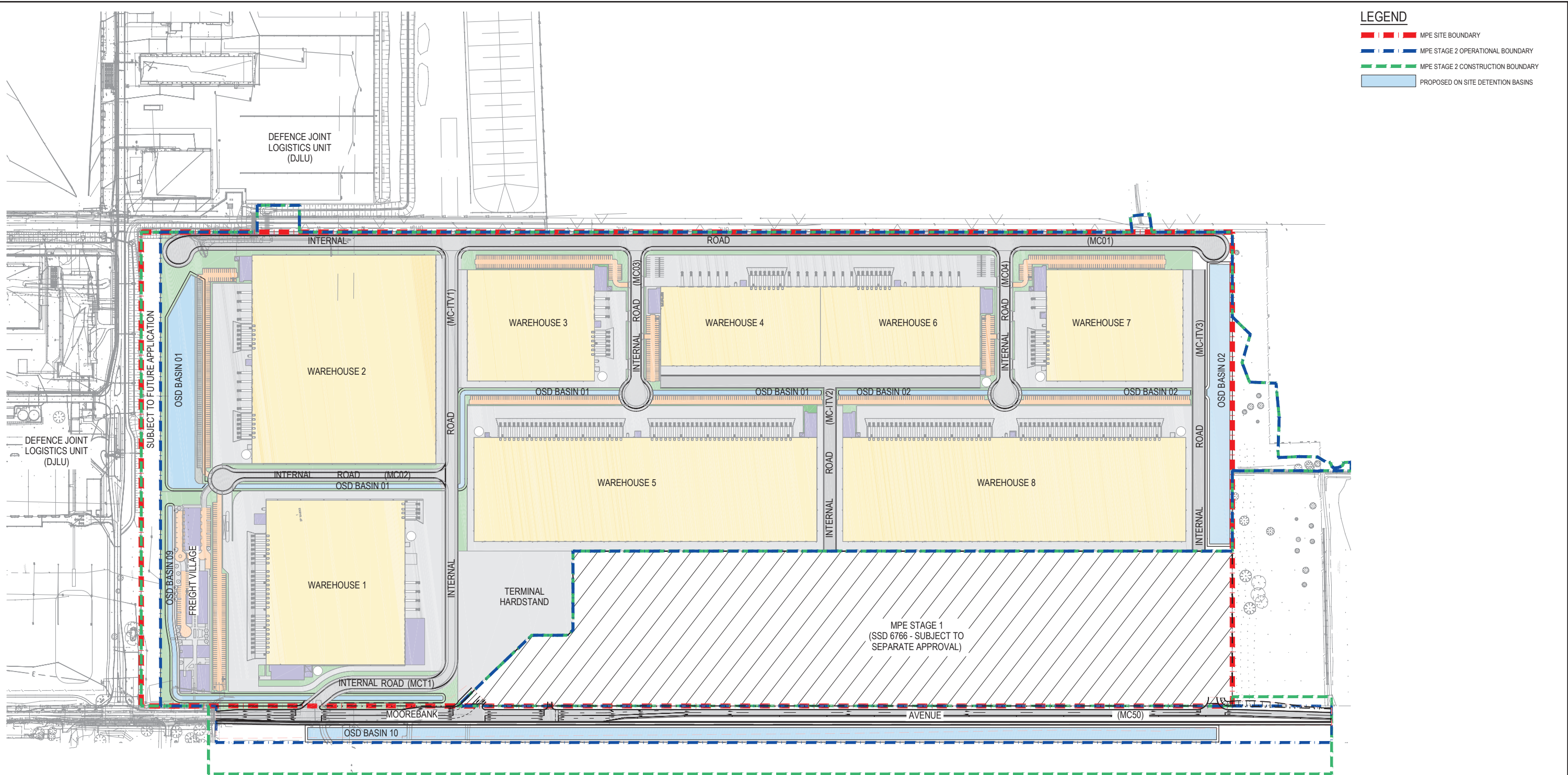
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Date Plotted: 28 Oct 2016 - 02:14PM

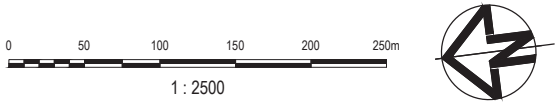
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V1



MPW STAGE 2
(SSD 5067 - SUBJECT TO
SEPARATE APPROVAL)

03	ISSUE FOR SSD APPLICATION INCORPORATING CLIENT COMMENTS	28/10/2016
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Issue	Description	Date



Client

SIMTA SYDNEY INTERNATIONAL TERMINAL ALLIANCE

TACTICAL GROUP

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Grid	MGA	Checked	K.MCAREAVEY
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Approved	M.KEFFORD		

Project

MOOREBANK PRECINCT EAST
(MPE) STAGE 2

Title

GENERAL ARRANGEMENT
PLAN

ARCADIS

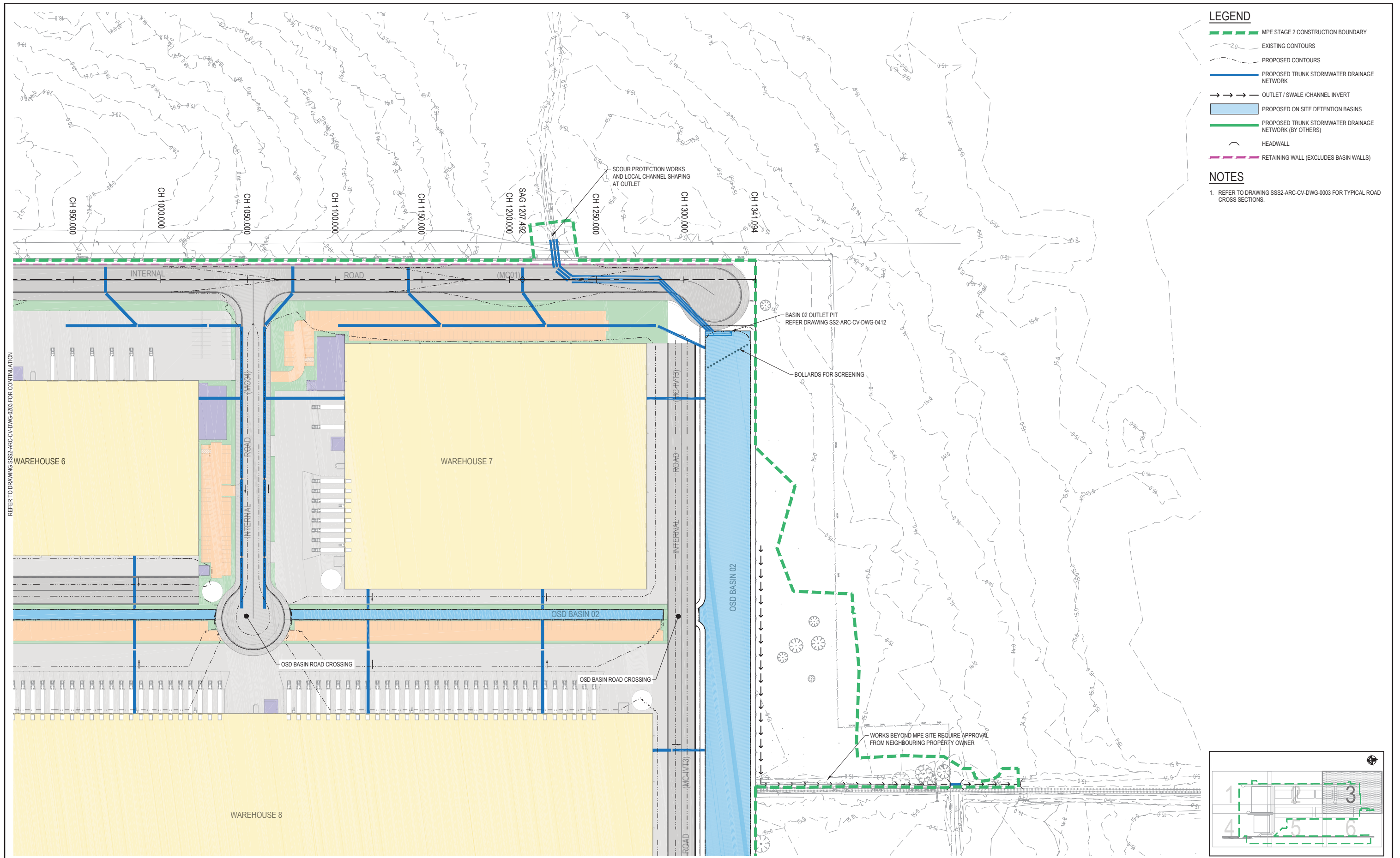
Arcadis Australia Pacific Pty Limited
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NORTH SYDNEY NSW 2060
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Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

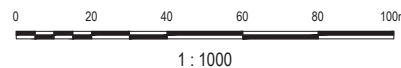
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Issue
03



03	ISSUE FOR SSD APPLICATION INCORPORATING CLIENT COMMENTS	28/10/2016
02	ISSUE FOR SSD APPLICATION	19/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016
Issue	Description	Date



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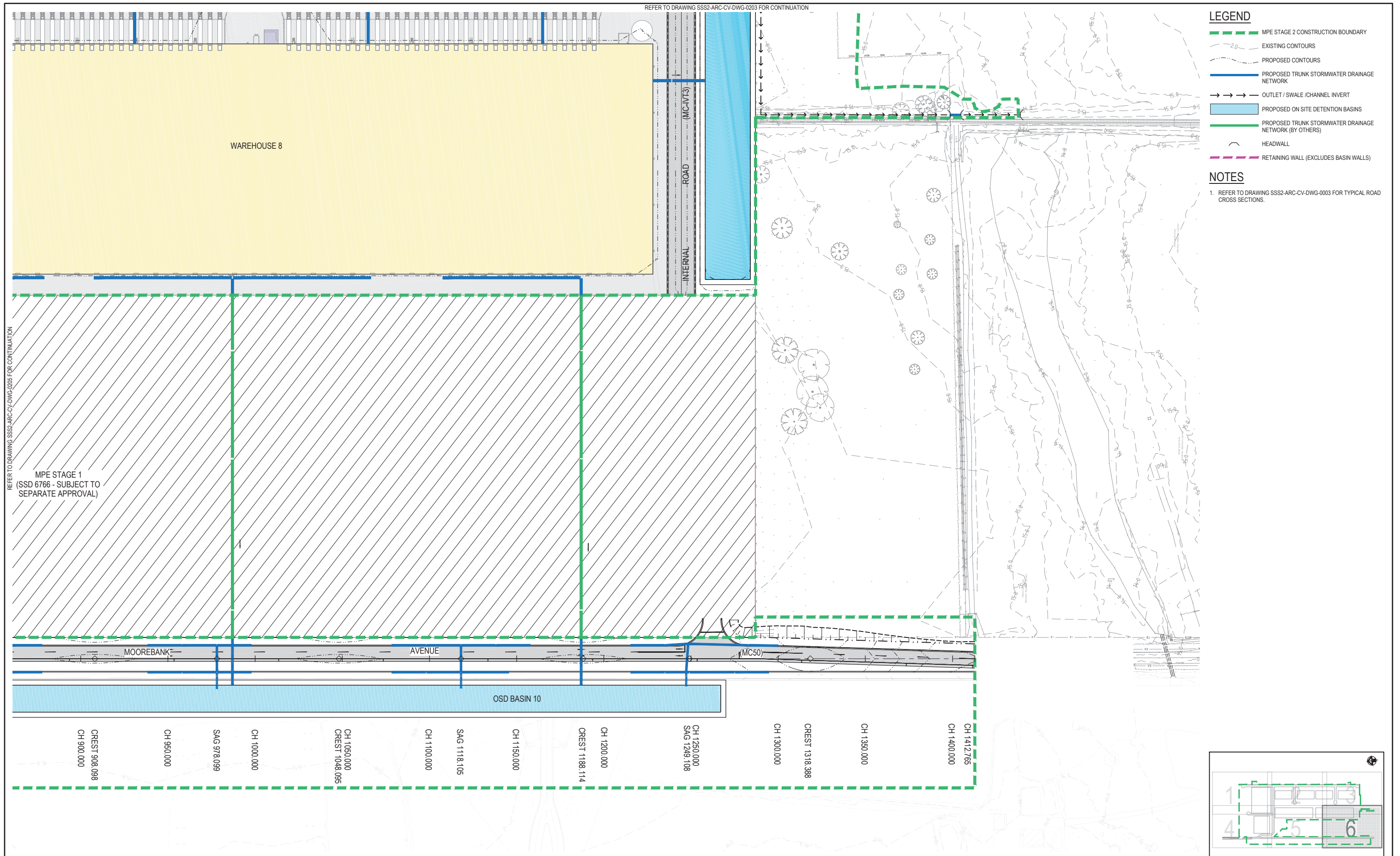
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Fax No: +61 2 8907 9001
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Project No. AA009335

Drawing No. SSS2-ARC-CV-DWG-0203- Issue 03



Issue	Description	Date
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02	ISSUE FOR SSD APPLICATION	19/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016



Client



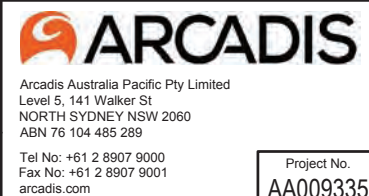
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Project

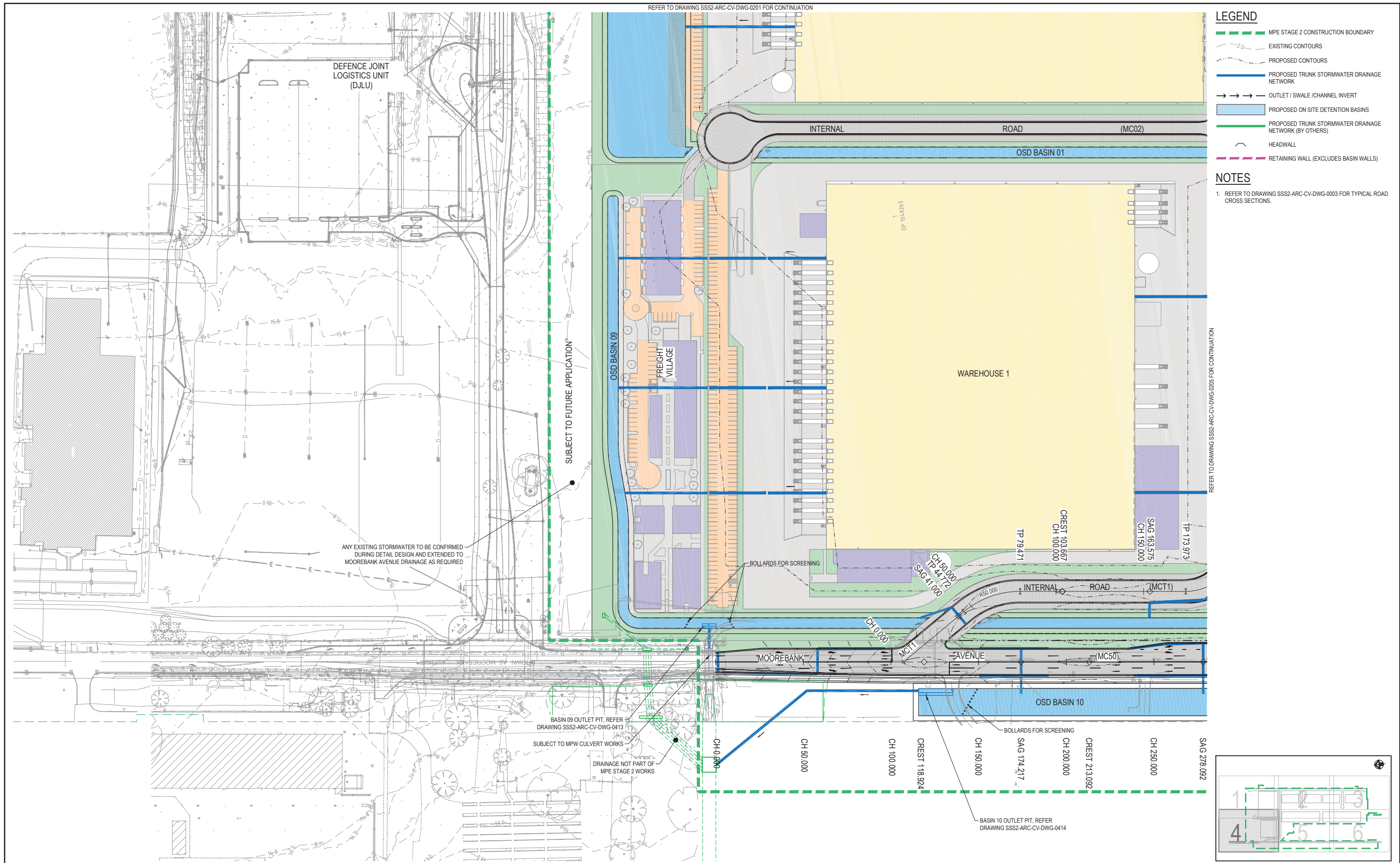
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CIVIL AND STORMWATER PLAN SHEET 6	

Title



Project No.	Issue
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SSS2-ARC-CV-DWG-0206-	03



Issue	Description	Date
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02	ISSUE FOR SSD APPLICATION	19/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016



Client

SIMTA SYDNEY INTERNATIONAL TERMINAL ALLIANCE

TACTICAL GROUP

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Project	MOOREBANK PRECINCT EAST (MPE) STAGE 2
Title	CIVIL AND STORMWATER PLAN SHEET 4

ARCADIS

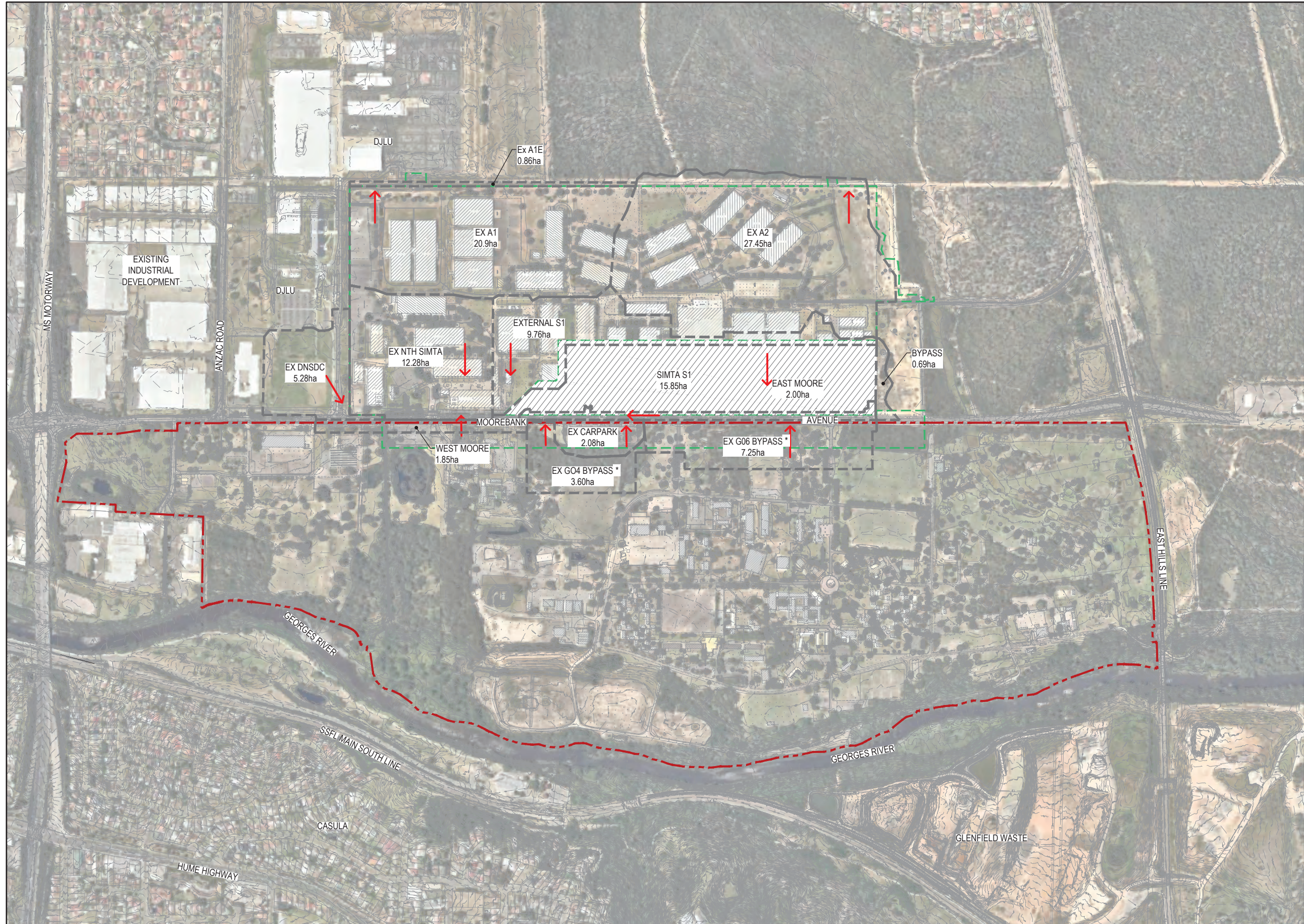
Arcadis Australia Pacific Pty Limited
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ABN 76 104 485 289

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

Project No. AA009335

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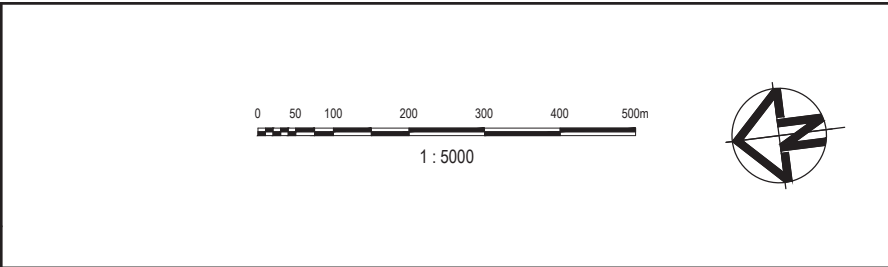
Issue



LEGEND

- MPE STAGE 2 CONSTRUCTION BOUNDARY
- MPW SITE BOUNDARY
- EXISTING CONTOUR
- EXISTING CATCHMENT BOUNDARY
- EXISTING CATCHMENT FLOW DIRECTION
- CATCHMENT AREAS AS A RESULT OF MPW WORKS

03	ISSUE FOR SSD APPLICATION INCORPORATING CLIENT COMMENTS	28/10/2016
02	ISSUE FOR SSD APPLICATION	19/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016
Issue	Description	Date



Client

SIMTA SYDNEY'S INTERNATIONAL TERMINAL ALLIANCE

TACTICAL GROUP

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Project	MOOREBANK PRECINCT EAST (MPE) STAGE 2
Title	EXISTING CATCHMENT PLAN

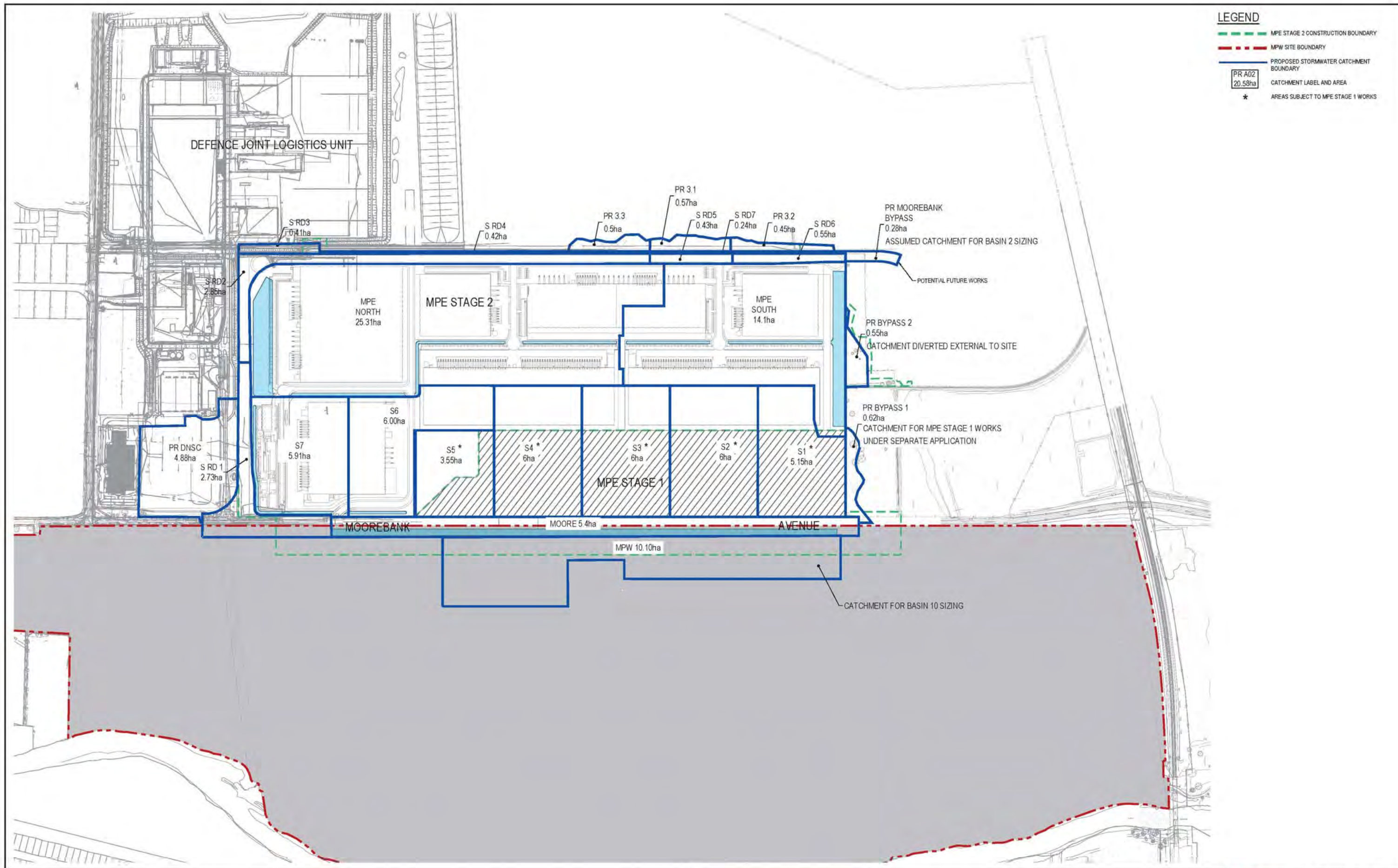
ARCADIS

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Drawing No. SSS2-ARC-CV-DWG-0431- Issue 03



Issue	Description	Date
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02	ISSUE FOR SSD APPLICATION	18/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	18/09/2016

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	Approved M.KEEFFORD	

Project	MOOREBANK PRECINCT EAST (MPE) STAGE 2
Title	PROPOSED CATCHMENT PLAN

ARCADIS
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Fax No: +61 2 8907 9001
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Project No.
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Drawing No.
SSS2-ARC-CV-DWG-0432-03

Issue

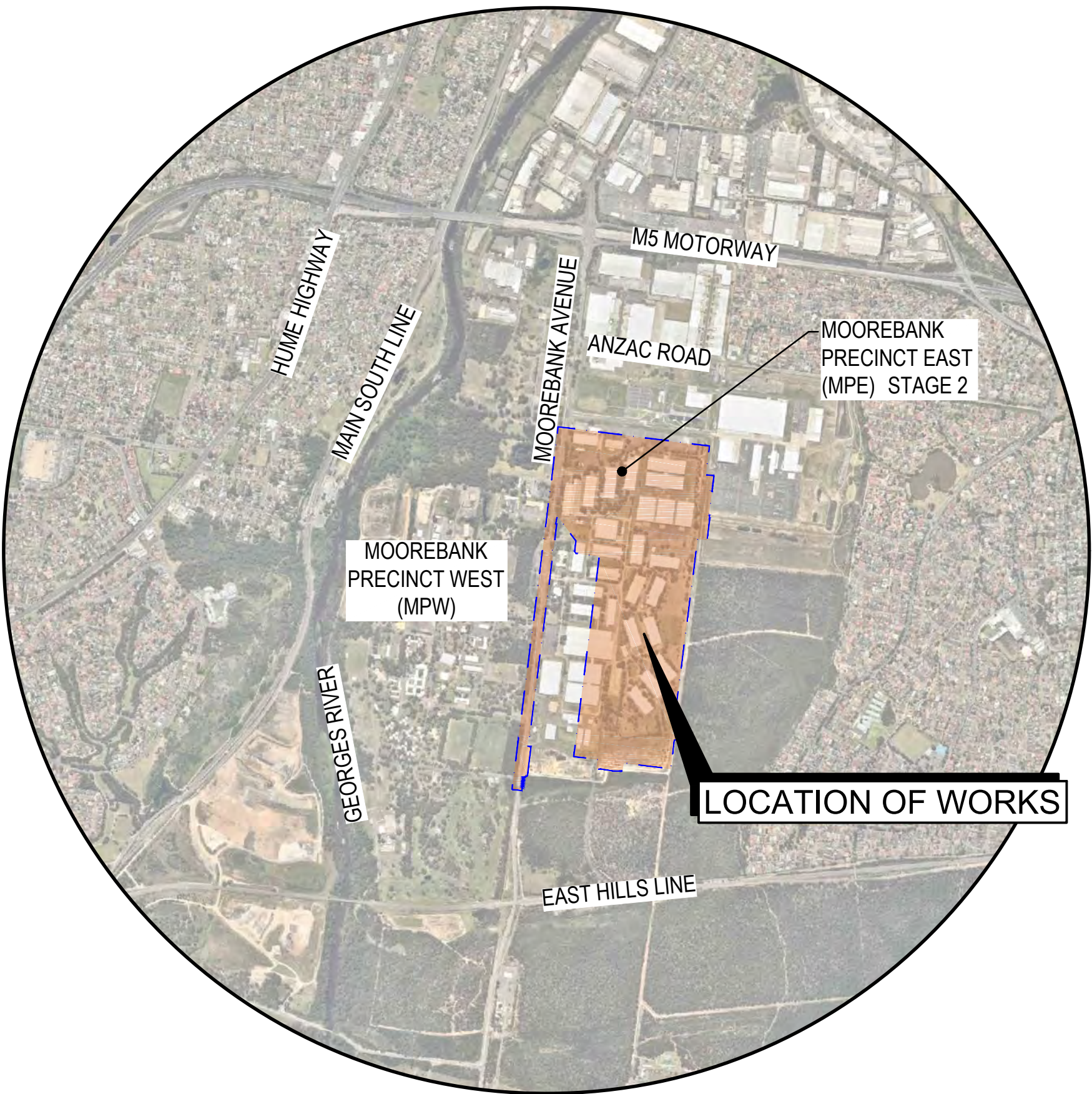
MOOREBANK PRECINCT EAST (MPE) STAGE 2

STATE SIGNIFICANT DEVELOPMENT APPLICATION - RESPONSE TO SUBMISSIONS

CIVIL WORKS

DRAWING LIST
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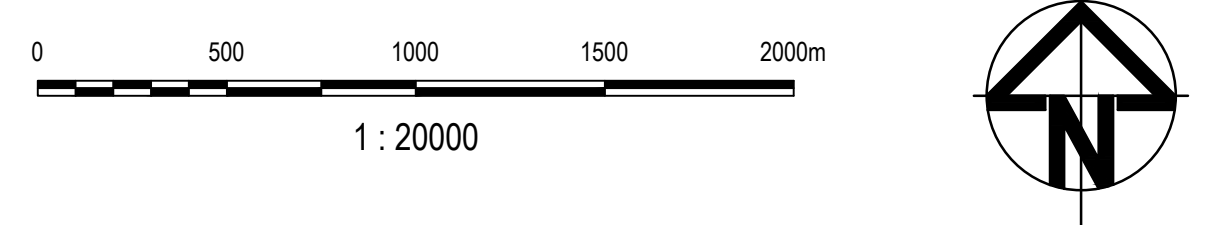
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SSS2-ARC-CV-DWG-0003	TYPICAL ROAD CROSS SECTIONS
SITE PREPARATION	
SSS2-ARC-CV-DWG-0101	EROSION AND SEDIMENT CONTROL PLAN
SSS2-ARC-CV-DWG-0111	BULK EARTHWORKS PLAN
SSS2-ARC-CV-DWG-0121	SITE SECTIONS SHEET 1
SSS2-ARC-CV-DWG-0122	SITE SECTIONS SHEET 2
CIVIL WORKS	
SSS2-ARC-CV-DWG-0201	CIVIL AND STORMWATER PLAN SHEET 1
SSS2-ARC-CV-DWG-0202	CIVIL AND STORMWATER PLAN SHEET 2
SSS2-ARC-CV-DWG-0203	CIVIL AND STORMWATER PLAN SHEET 3
SSS2-ARC-CV-DWG-0204	CIVIL AND STORMWATER PLAN SHEET 4
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SSS2-ARC-CV-DWG-0206	CIVIL AND STORMWATER PLAN SHEET 6
SSS2-ARC-CV-DWG-0211	ROAD LONGITUDINAL SECTIONS SHEET 1
SSS2-ARC-CV-DWG-0212	ROAD LONGITUDINAL SECTIONS SHEET 2
SSS2-ARC-CV-DWG-0213	ROAD LONGITUDINAL SECTIONS SHEET 3
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SSS2-ARC-CV-DWG-0215	ROAD LONGITUDINAL SECTIONS SHEET 5
SSS2-ARC-CV-DWG-0216	ROAD LONGITUDINAL SECTIONS SHEET 6
STORMWATER DRAINAGE	
SSS2-ARC-CV-DWG-0411	STORMWATER DRAINAGE BASIN OUTLET 1
SSS2-ARC-CV-DWG-0412	STORMWATER DRAINAGE BASIN OUTLET 2
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SSS2-ARC-CV-DWG-0414	STORMWATER DRAINAGE BASIN OUTLET 10
SSS2-ARC-CV-DWG-0431	EXISTING CATCHMENT PLAN
SSS2-ARC-CV-DWG-0432	PROPOSED CATCHMENT PLAN



LOCALITY PLAN
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Issue	Description	Date
04	ISSUE FOR SSD APPLICATION (RESPONSE TO SUBMISSIONS)	26/06/2017
03	ISSUE FOR SSD APPLICATION INCORPORATING CLIENT COMMENTS	28/10/2016
02	ISSUE FOR SSD APPLICATION	19/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016



Client



Status

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Height Datum	AHD	Designed J.WOOD
Grid	MGA	Checked K.MCAREAVEY
		Approved M.KEFFORD

Filename: SSS2-ARC-CV-DWG-0001-CoverSheetAndDrawingList.dwg

Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2

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- 0001-

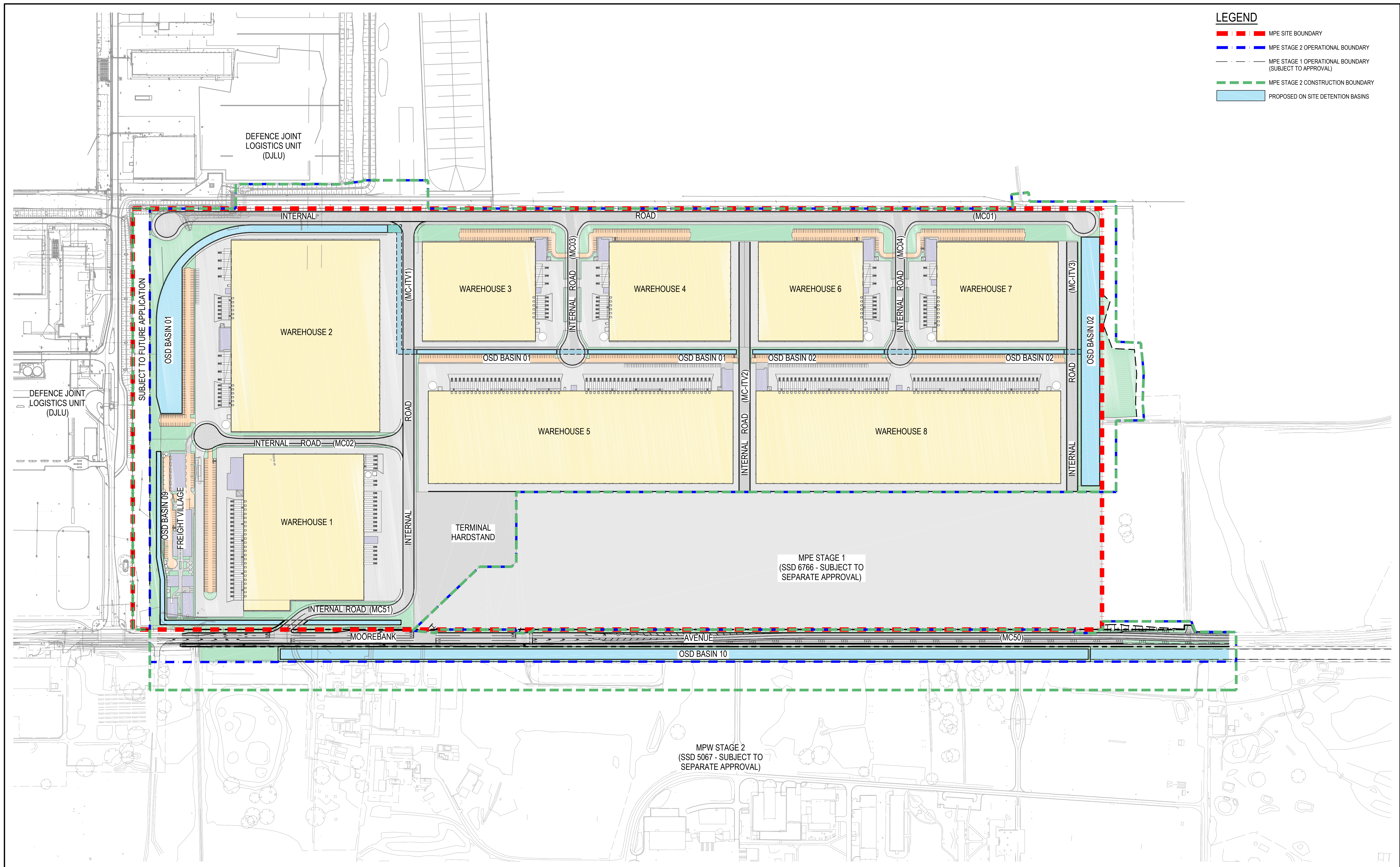
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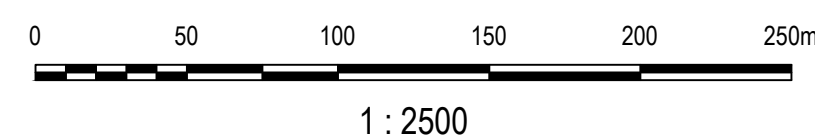
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V1



Issue	Description	Date
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03	ISSUE FOR SSD APPLICATION INCORPORATING CLIENT COMMENTS	28/10/2016
02	ISSUE FOR SSD APPLICATION	19/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016



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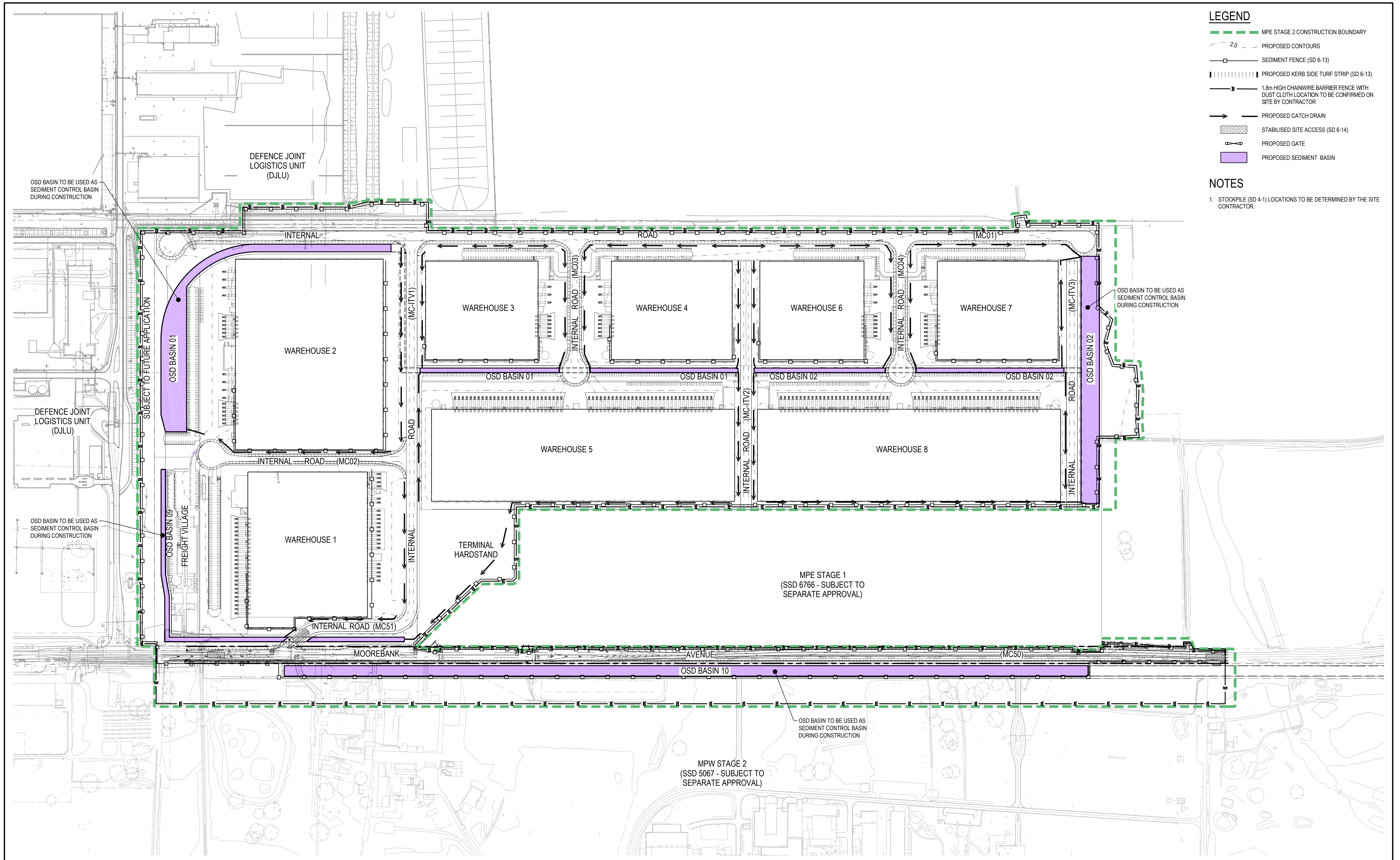
Project MOOREBANK PRECINCT EAST (MPE) STAGE 2
Title GENERAL ARRANGEMENT PLAN

Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
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Fax No: +61 2 8907 9001
arcadis.com

Project No.
AA009335

Drawing No.
SSS2-ARC-CV-DWG-0002- 04

Issue



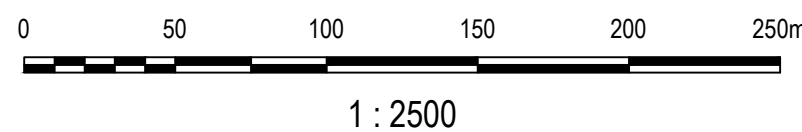
LEGEND

- MPE STAGE 2 CONSTRUCTION BOUNDARY
- PROPOSED CONTOURS
- SEDIMENT FENCE (SD 6-13)
- PROPOSED KERB SIDE TURF STRIP (SD 6-13)
- 1.8m HIGH CHAINWIRE BARRIER FENCE WITH DUST CLOTH LOCATION TO BE CONFIRMED ON SITE BY CONTRACTOR
- PROPOSED CATCH DRAIN
- STABILISED SITE ACCESS (SD 6-14)
- PROPOSED GATE
- PROPOSED SEDIMENT BASIN

NOTES

- STOCKPILE (SD 4-1) LOCATIONS TO BE DETERMINED BY THE SITE CONTRACTOR.

Issue	Description	Date
04	ISSUE FOR SSD APPLICATION (RESPONSE TO SUBMISSIONS)	26/06/2017
03	ISSUE FOR SSD APPLICATION INCORPORATING CLIENT COMMENTS	28/10/2016
02	ISSUE FOR SSD APPLICATION	19/10/2016
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Status PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION	
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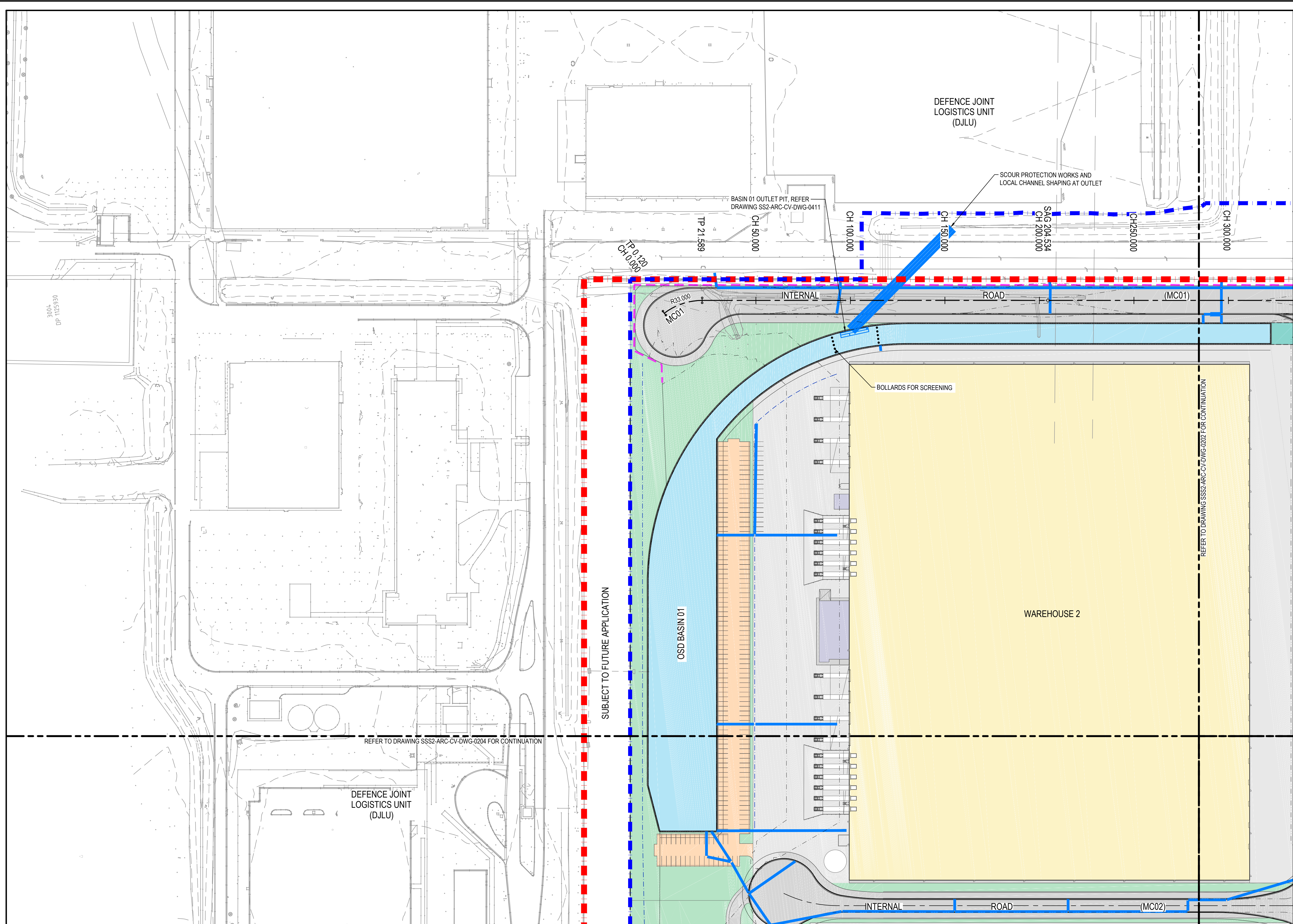
Project MOOREBANK PRECINCT EAST (MPE) STAGE 2	
Title EROSION AND SEDIMENT CONTROL PLAN	

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arcadis.com

Project No.
AA009335

Drawing No.
SSS2-ARC-CV-DWG-0101- 04

Issue



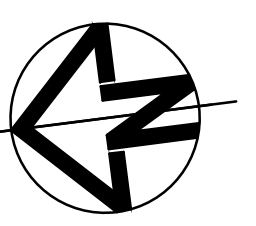
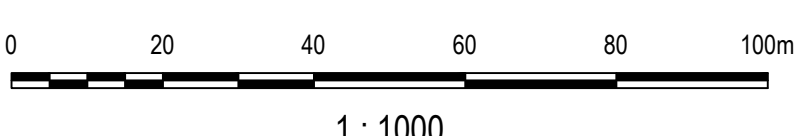
LEGEND

- MPE SITE BOUNDARY
- MPE STAGE 2 OPERATIONAL BOUNDARY
- EXISTING CONTOURS
- PROPOSED CONTOURS
- PROPOSED TRUNK STORMWATER DRAINAGE NETWORK
- PROPOSED TRUNK STORMWATER DRAINAGE NETWORK (BY OTHERS)
- PROPOSED ON SITE DETENTION BASINS
- RETAINING WALL (EXCLUDES BASIN WALLS)

NOTES

- REFER TO DRAWING SSS2-ARC-CV-DWG-0003 FOR TYPICAL ROAD CROSS SECTIONS.

Issue	Description	Date
04	ISSUE FOR SSD APPLICATION (RESPONSE TO SUBMISSIONS)	26/06/2017
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01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016



Client

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

TACTICAL GROUP

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		Approved M.KEFFORD
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Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2

Title

CIVIL AND STORMWATER
PLAN
SHEET 1

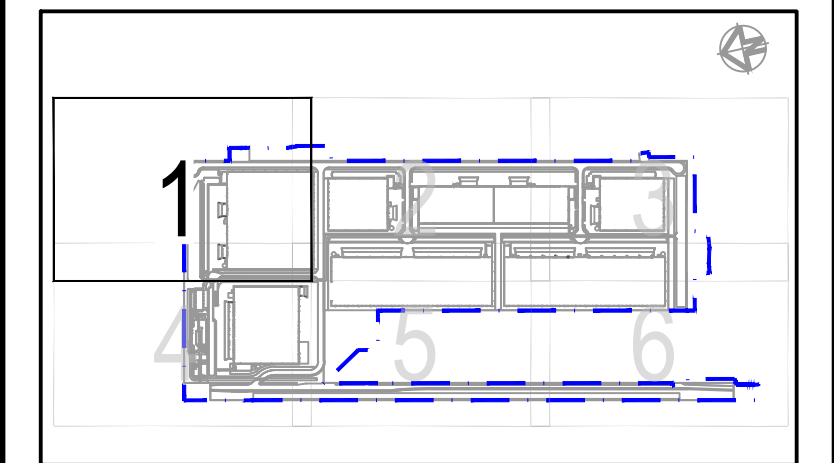
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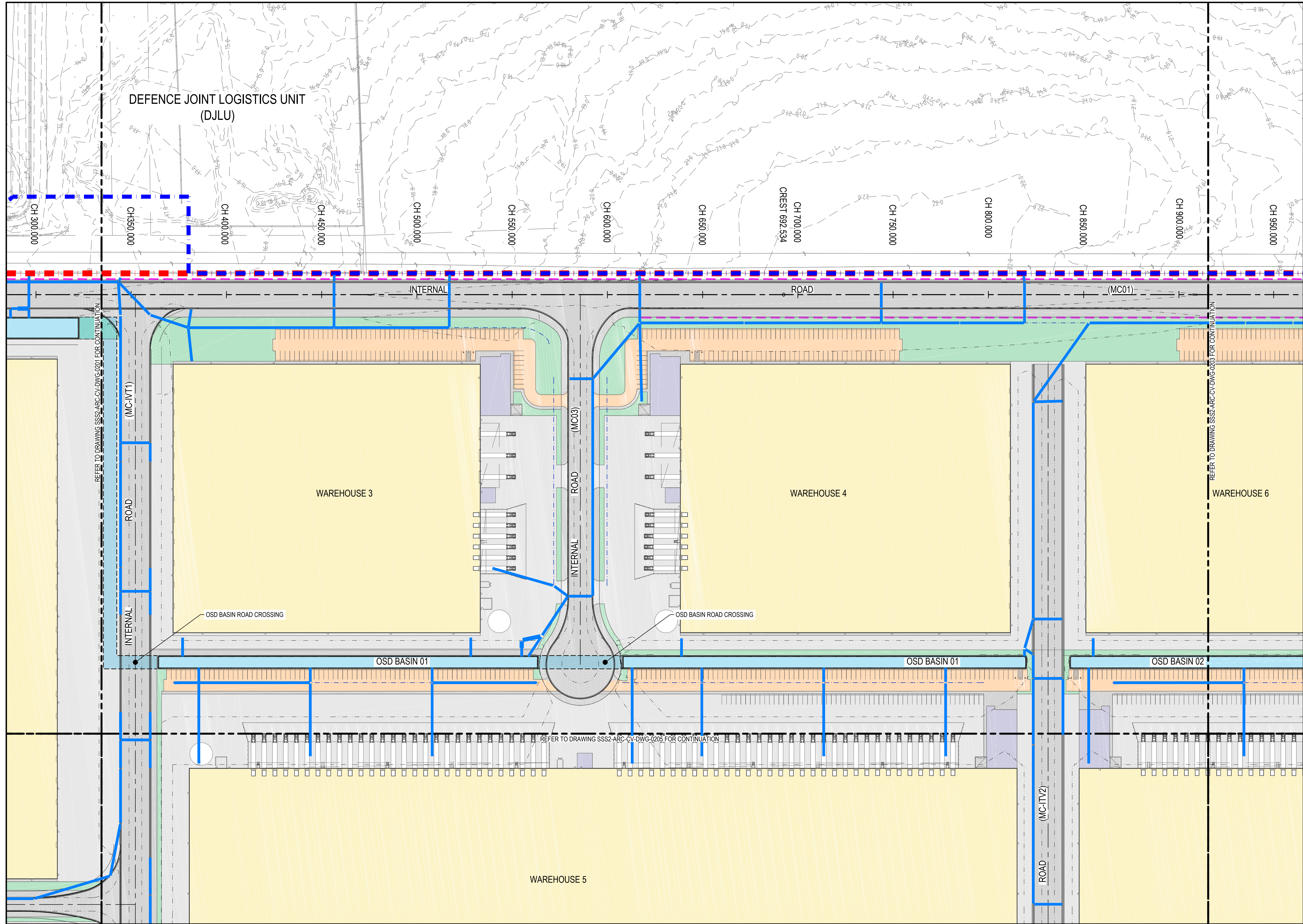
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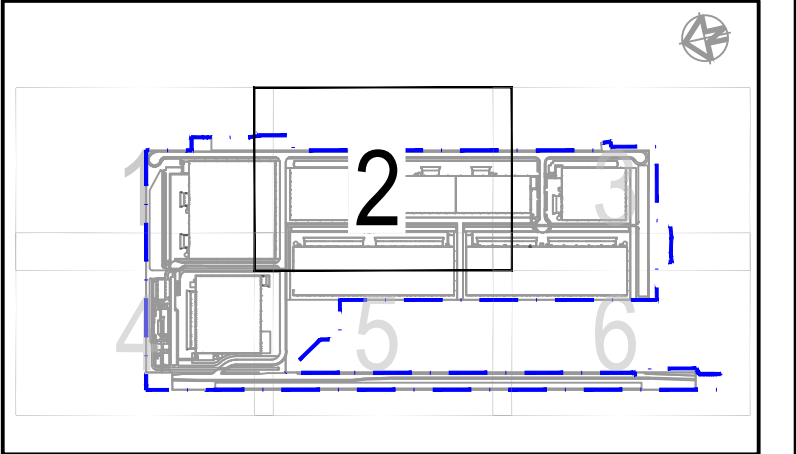


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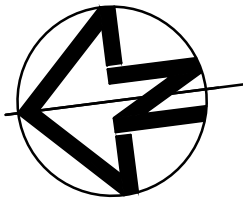
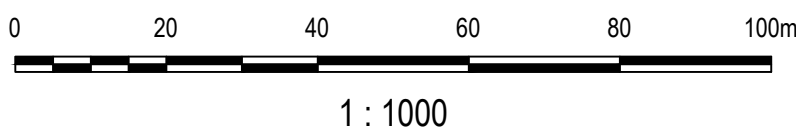
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- MPE STAGE 2 OPERATIONAL BOUNDARY
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- PROPOSED TRUNK STORMWATER DRAINAGE NETWORK
- PROPOSED TRUNK STORMWATER DRAINAGE NETWORK (BY OTHERS)
- PROPOSED ON SITE DETENTION BASINS
- RETAINING WALL (EXCLUDES BASIN WALLS)

NOTES

1. REFER TO DRAWING SSS2-ARC-CV-DWG-0003 FOR TYPICAL ROAD CROSS SECTIONS.



Issue	Description	Date
04	ISSUE FOR SSD APPLICATION (RESPONSE TO SUBMISSIONS)	26/06/2017
03	ISSUE FOR SSD APPLICATION INCORPORATING CLIENT COMMENTS	28/10/2016
02	ISSUE FOR SSD APPLICATION	19/10/2016
01	DRAFT ISSUE FOR SSD APPLICATION	16/09/2016



Client

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

TACTICAL GROUP

Status	PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION	
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Original Size	A1	Drawn J.WOOD
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Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2

Title

CIVIL AND STORMWATER
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SHEET 2

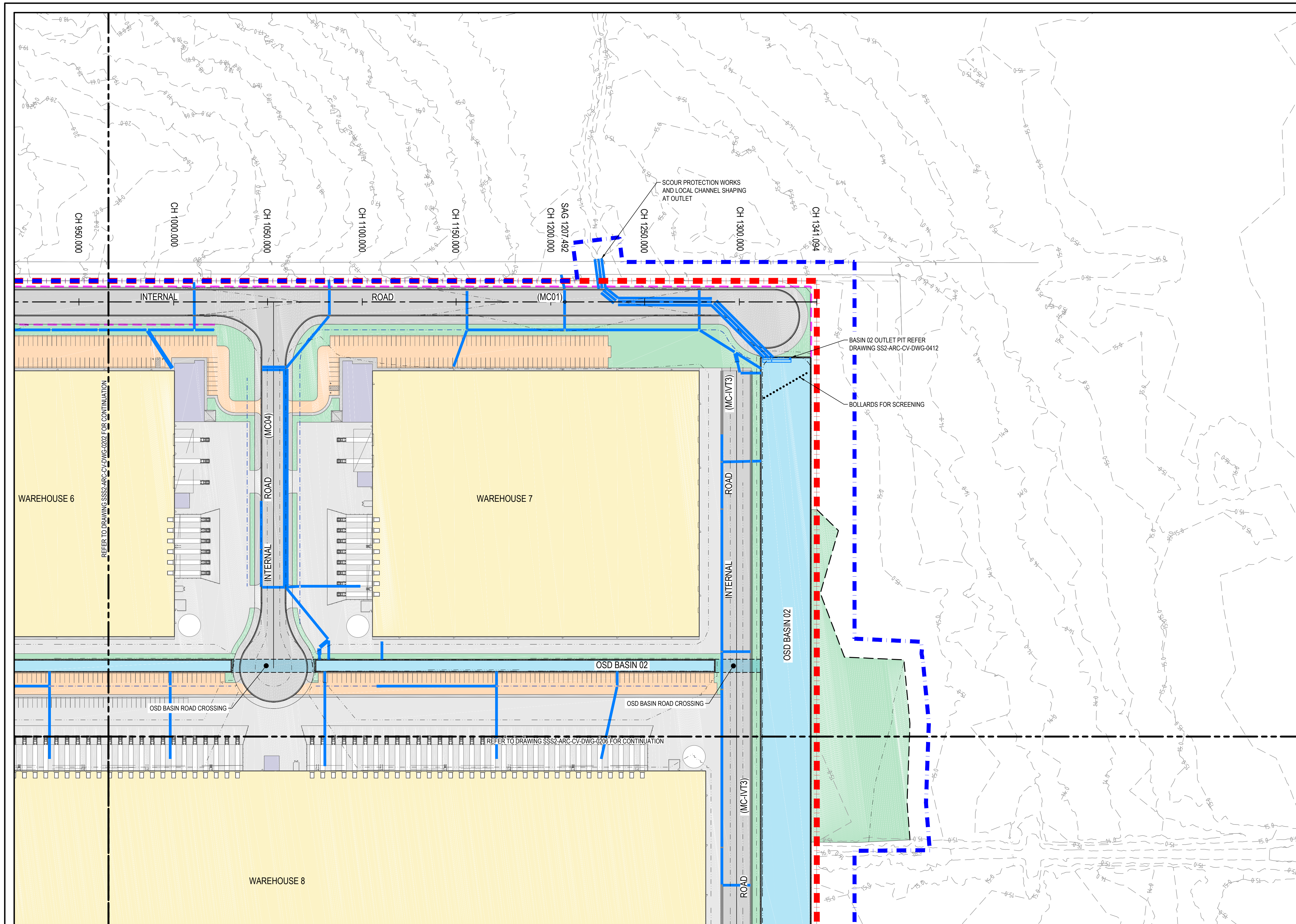
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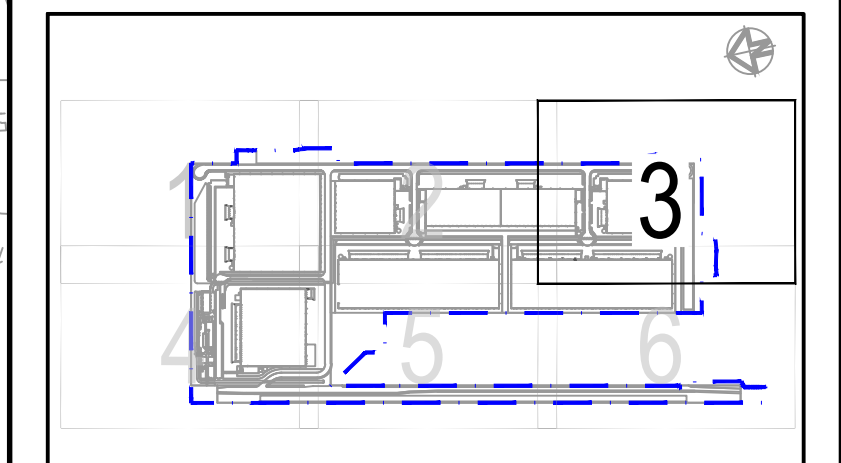


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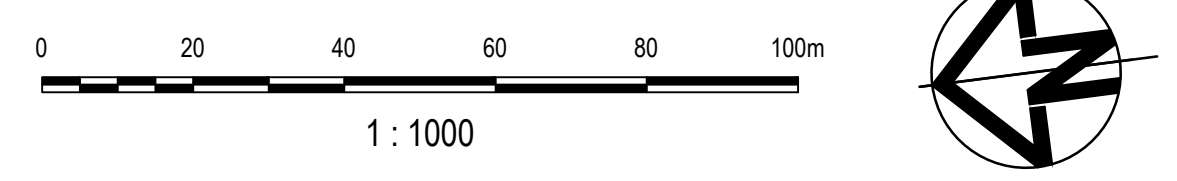
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Client

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

TACTICAL GROUP

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Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2

Title

CIVIL AND STORMWATER PLAN
SHEET 3

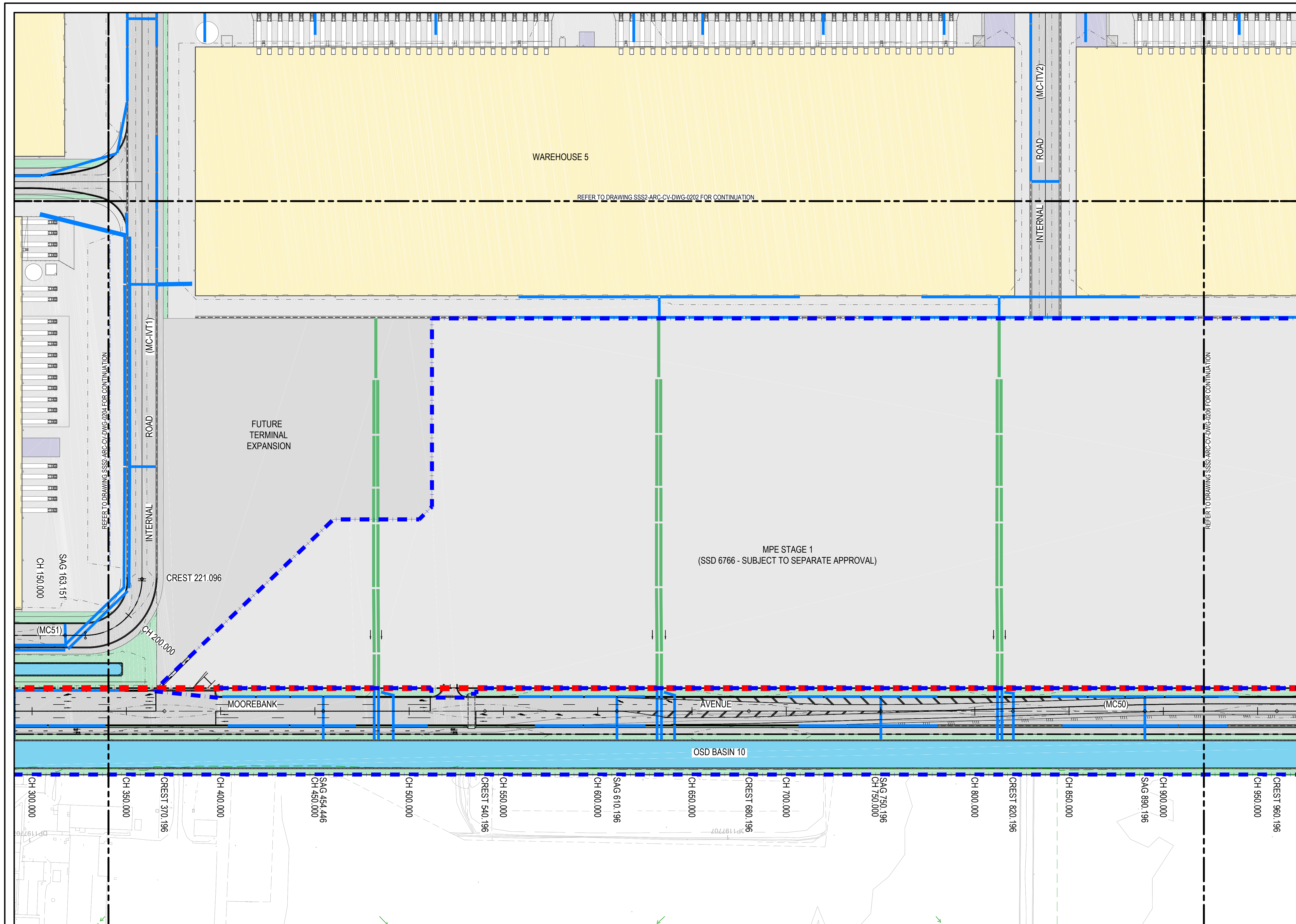
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Issue
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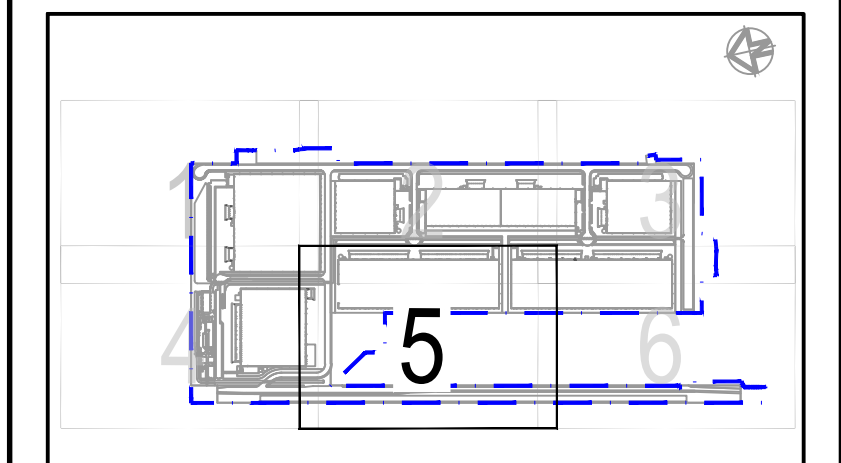


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North Arrow

Client

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Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2

Title

CIVIL AND STORMWATER PLAN SHEET 5

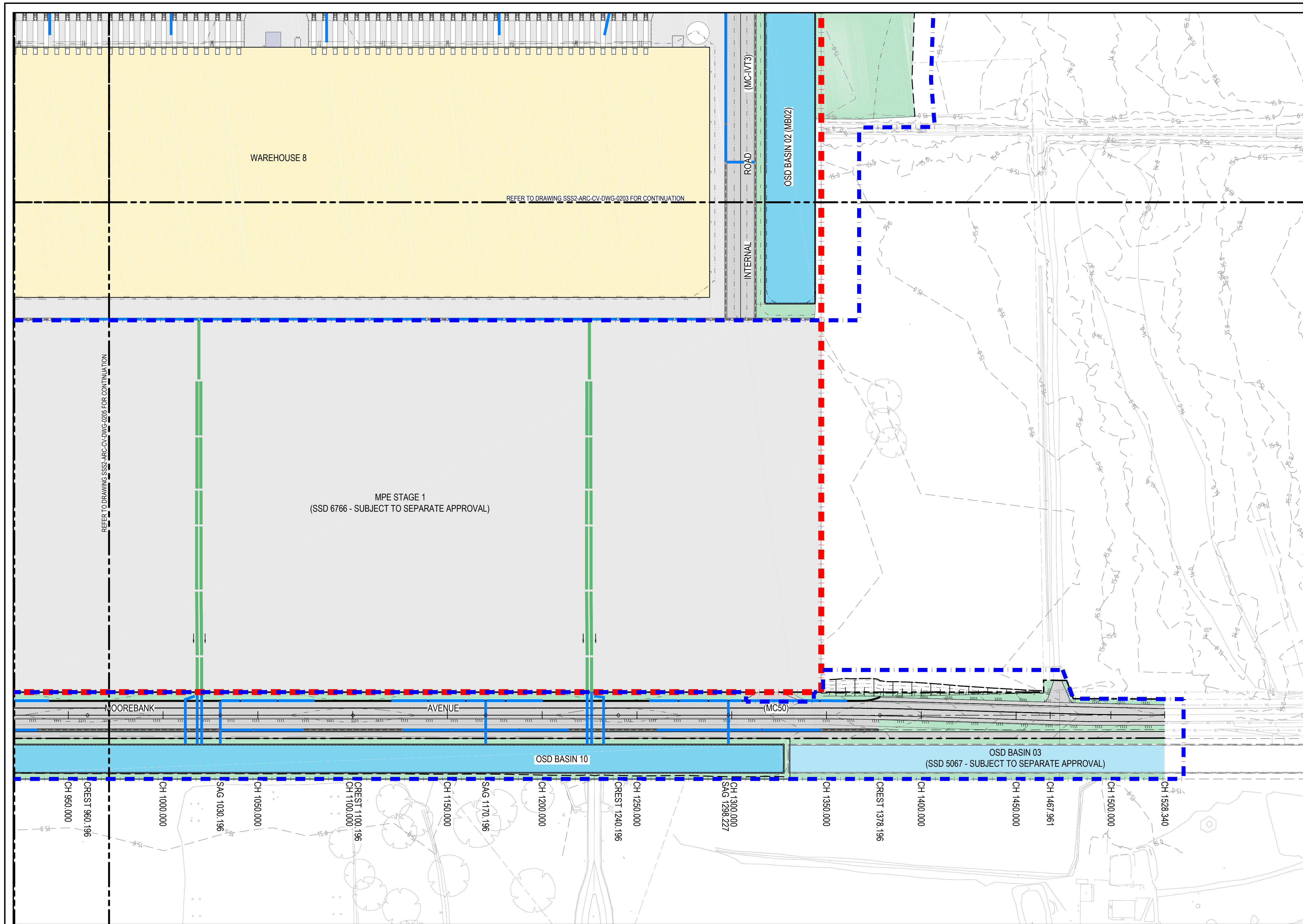
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Issue

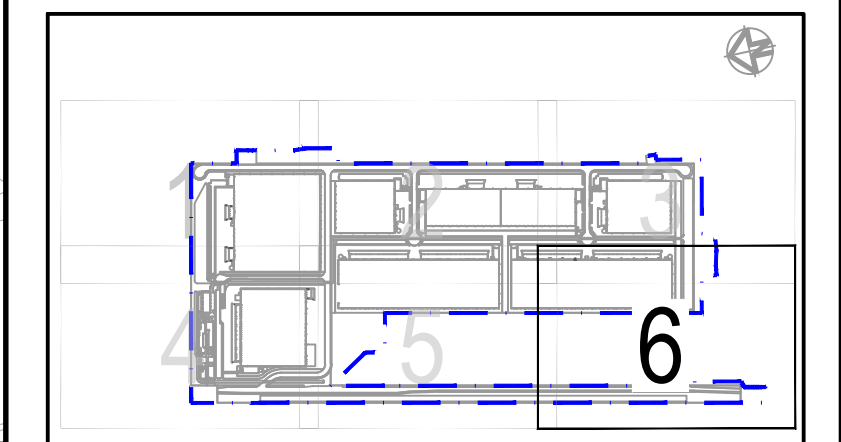


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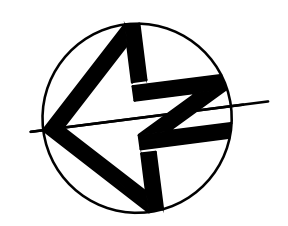
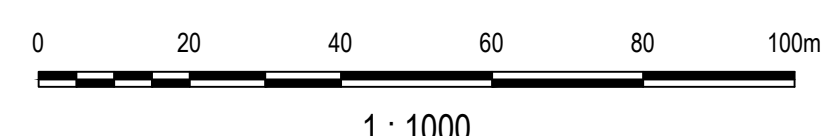
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Client

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

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Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2

Title

CIVIL AND STORMWATER PLAN SHEET 6

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Project No. AA009335

Drawing No. SSS2-ARC-CV-DWG-0206- Issue 04

Appendix B MPE Stage 2: Modification (SSD 7628-MOD 2) Biodiversity Development Assessment Report (Arcadis 2019)

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2)

Biodiversity Development Assessment Report

JUNE 2019

Incorporating



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MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2)

Biodiversity Development Assessment Report

Author Ed Cooper



Checker Jane Rodd



Approver Westley Owers



Report No B

Date 12/06/2019

Revision Text Final BDAR

This report has been prepared for SIMTA in accordance with the terms and conditions of appointment for MPE Stage 2. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
A	11/06/2019	First Draft BDAR	EC	WO
B	12/06/2019	Final BDAR	EC	WO

CONTENTS

GLOSSARY	V
EXECUTIVE SUMMARY	7
1 INTRODUCTION	11
1.1 The MPE Stage 2 Project.....	11
1.1.1 Proposed modification	11
1.2 Proposal location.....	11
1.3 Development site	12
1.4 Sources of information used	14
1.5 Legislative context and SEARS	14
1.5.1 Environment Protection and Biodiversity Conservation Act 1999.....	14
1.5.2 Biodiversity Conservation Act 2016.....	14
1.5.3 Biodiversity Assessment Method Requirements	15
2 LANDSCAPE FEATURES.....	17
2.1 IBRA Bioregions and subregions	17
2.3 NSW Landscape Regions (Mitchell landscapes).....	17
2.4 Cleared areas	17
2.5 Rivers and streams	17
2.6 Wetlands	18
2.7 Connectivity features.....	18
2.8 Areas of geological significance and soil hazard features.....	18
2.9 Areas of outstanding biodiversity value (AOBVs).....	18
2.10 Site Context.....	18
2.10.1 Method applied.....	18
2.10.2 Percent native vegetation cover in the landscape	18
3 NATIVE VEGETATION.....	20
3.1 Survey method.....	20
3.2 Survey effort.....	21
3.3 Plant Community Types present.....	23
3.4 Threatened ecological community assessment	26
3.5 Vegetation integrity assessment	29
4 THREATENED SPECIES	31
4.1 Ecosystem credit species.....	31
4.2 Species credit species	32
4.2.1 Threatened species survey methodology	38
4.2.2 Threatened species survey results.....	43
5 AVOID AND MINIMISE IMPACTS.....	50
5.1 Measures to avoid and minimise impacts on native vegetation and habitat	50
5.1.1 Locating the project.....	50
5.1.2 Designing the project.....	50

5.2 Measures to avoid and minimise prescribed biodiversity impacts.....	51
6 ASSESSMENT OF IMPACTS.....	53
6.1 Direct impacts	53
6.1.1 Native vegetation and threatened flora.....	53
6.1.2 Change in vegetation integrity.....	53
6.1.3 Serious and irreversible impacts	54
6.2 Indirect Impacts	58
7 MITIGATION OF IMPACTS	62
8 IMPACT SUMMARY AND OFFSETS.....	65
8.1 Serious and irreversible impacts.....	65
8.2 Impacts requiring offset.....	65
8.2.1 Impacts on native vegetation	65
8.2.2 Impacts on threatened species	66
8.3 Impacts not requiring offset.....	68
8.4 Areas not requiring assessment.....	68
9 OFFSET STRATEGY	70
9.1 Biodiversity Conservation Fund.....	70
10 CONCLUSION.....	71
11 REFERENCES	74

Table 1: PCTs and TECs within the development site	7
Table 2: Minimum information requirements for a BDAR (OEH, 2017).....	16
Table 3: Native vegetation within the development site and 1500 metre buffer	17
Table 4: Native vegetation cover in the landscape.....	18
Table 5: Weather conditions during survey periods (BOM 2019)	20
Table 6: Comparison of number of transects/plots required and completed per vegetation zone.....	21
Table 7: Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion in the development site	Error! Bookmark not defined.
Table 8: Attribute information for PCT 883 within the development site	23
Table 9: Comparison of the PCT 883 vegetation against the EPBC Act listing criteria	26
Table 10: Plot data and vegetation integrity scores for Vegetation Zone 1 and 2	30
Table 11: Ecosystem credit species predicted to occur within the development site	31
Table 12: Candidate species credit species removed from further consideration	33
Table 13: Threatened flora species targeted in surveys.....	38
Table 14: Threatened fauna species targeted in surveys.....	39
Table 15: Targeted threatened species survey results.....	43
Table 16: Avoidance and minimisation measures implemented during project location.....	50
Table 17: Avoidance and minimisation measures implemented during project design.....	50
Table 18: Direct impacts to native vegetation	53
Table 19: Direct impacts to threatened ecological communities.....	53
Table 20: Direct impacts to threatened flora species	53
Table 21: Vegetation integrity score before and after impact	54
Table 22: Serious and Irreversible Impact Assessment for <i>Hibbertia fumana</i>	54
Table 23: Potential indirect impacts of the proposed modification	59
Table 24: Measures to be implemented to minimise impacts on biodiversity.....	63

Table 25: Impact summary for PCTs requiring offsets and the associated ecosystem credit requirement	65
Table 26: Impact summary for threatened species credit species requiring offsets and the associated species credit requirements	66
Table 27: Impacts to native vegetation not requiring offset	68
Table 28: BCT contribution for offsets required by the proposed modification	70
Table 29: <i>PCTs and TECs within the development site</i>	71
Table 30: BAM plot data	76
Figure 1: Location map	13
Figure 2: Site map	19
Figure 3: Flora quadrat layout	20
Figure 4: Vegetation survey effort	22
Figure 5: PCTs within the development site	25
Figure 6: TECs within the development site	28
Figure 7: Threatened fauna survey effort	42
Figure 8: Species polygon for <i>Hibbertia puberula</i> subsp. <i>puberula</i>	45
Figure 9: Species polygon for <i>Hibbertia fumana</i>	46
Figure 10: Species polygon for <i>Persoonia nutans</i>	47
Figure 11: Known populations of <i>Hibbertia fumana</i>	57
Figure 12: Impacts requiring offset	67
Figure 13: Impacts not requiring offset	69

GLOSSARY

The table below provides a glossary the key acronyms used within this technical report.

Term	Meaning
Acronyms	
BAM	Biodiversity Assessment Method
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BC Reg	NSW <i>Biodiversity Conservation Regulation 2017</i>
BC (Savings and Transitional) Reg	NSW <i>Biodiversity Conservation (savings and Transitional) Regulation 2017</i>
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Strategy
CEMP	Construction Environmental Management Plan
Development site	The area of land subject to the proposed development
DoEE	Commonwealth Department of Environment and Energy
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FFMP	Flora and Fauna Management Plan
FM Act	NSW <i>Fisheries Management Act 1994</i>
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SAII	Serious and Irreversible Impact
SEARs	Secretary's Environmental Assessment Requirements
SEPP	<i>State Environmental Planning Policy</i>
SSI	State Significant Infrastructure
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened Ecological Community
	Vegetation information system

EXECUTIVE SUMMARY

The Moorebank Precinct East (MPE) Stage 2 Project has been assessed by the Department of Planning and Environment (DP&E) under Part 4, Division 4.7 (previously Division 4.1 prior to 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 consent for the MPE Stage 2 Project on 31 January 2018, subject to Conditions of Consent (SSD 7628).

A modification to the SSD 7628 development consent (the proposed modification) is required to address revisions to the design of onsite detention basins for the MPE Stage 2 Project, including the following two elements:

- Revision of the construction and operation footprint at the southern extent of the site to include the revised design for OSD 2 that addresses the requirement for OSDs to have maximum batter slopes of 1V:4H: and
- Removal of the requirement for batter slopes to allow OSD9, located at the north-west of the site, to be constructed without the 1V:4H batters and instead to be constructed with vertical walls.

The transitional period for the *Biodiversity Conservation Act 2016* expired for modifications to State Significant Development projects on 24 February 2019. As such, the proposed modification is subject to the provisions of the BC Act which require the preparation of a Biodiversity Development Assessment Report in accordance with the Biodiversity Assessment Method (2017).

This BDAR is based on desktop research and detailed field surveys, undertaken across the MPE site on a number of occasions between 2011 and 2019. Most recently, supplementary field investigations of the development site were conducted in February and May 2019.

The biodiversity impacts and offset requirements for the development site were calculated using the Biodiversity Assessment Method Calculator in accordance with the Biodiversity Assessment Method.

The vegetation within the development site is predominantly comprised of exotic grassland vegetation, with two small patches of modified native vegetation. This native vegetation has been classified as Plant Community Type (PCT) 883 *Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion*. All vegetation within the development site has been categorised into one of two PCT 883 vegetation zones; '883_Poor' incorporating the degraded woodland vegetation and '883_Cleared' incorporating the exotic grassland. A summary of these vegetation zones, along with the threatened ecological community equivalence is provided in Table 1.

Table 1: PCTs and TECs within the development site

Plant Community Type	Vegetation Zone	Extent	Vegetation integrity score	BC Act TEC	EPBC Act TEC
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	883_Poor	0.17 ha	30.1	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion (vulnerable)	Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community (endangered)
	883_Cleared	1.43 ha	3.1	Not equivalent	Not equivalent

A total of 15 threatened flora species were identified as candidate species credit species in the Biodiversity Assessment Method Calculator. Three of the candidate threatened flora species were considered unlikely to occur within the development site based on an absence of potential habitat. These three species were not considered further. Targeted surveys were undertaken for the remaining 12 candidate threatened flora species during February 2019. These surveys were seasonally appropriate for all threatened species except *Hibbertia fumana*. Four threatened flora species were recorded within and adjoining the development site during the February 2019 surveys, including *Acacia bynoeana*, *Hibbertia puberula* subsp. *puberula*, *Hibbertia fumana* and *Persoonia nutans*.

A total of 22 threatened fauna species were identified as candidate species credit species in the Biodiversity Assessment Method Calculator. Eighteen of the candidate threatened fauna species were considered unlikely to occur within the development site based on an absence of potential habitat. Targeted surveys were conducted for three of the remaining candidate threatened fauna species during February 2019. These species were Koala, Cumberland Plain Land Snail and Green and Golden Bell Frog. None of these species were detected. The final candidate species, Southern Myotis, was assumed to be present based on previous records of the species nearby.

Based on the records of the targeted threatened species surveys, species polygons have been prepared for threatened flora species. Whilst Southern Myotis was assumed to be present, none of the features that are required to be included in a species polygon for this species are present within the development site.

The BDAR considered the construction and operational impacts of the proposed modification. The potential biodiversity impacts of the proposed modification are as follows:

- Clearing of all vegetation within the development site including one threatened ecological community. The total area of vegetation to be cleared is 0.60 ha; the areas of native vegetation to be cleared comprise two small, fragmented patches of vegetation totalling 0.17 hectares. The total area to be cleared consists of one plant community type (PCT):
 - 0.17 hectares of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin. This PCT corresponds with the TEC *Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion*, which is listed as vulnerable under the BC Act and *Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community* listed as endangered under the EPBC Act.
- The proposed modification will have direct impacts on habitat for three threatened plant species (all of which are 'area' assessed species), including:
 - *Hibbertia puberula* subsp. *puberula* (0.59 hectares)
 - *Hibbertia fumana* (0.14 hectares)
 - *Persoonia nutans* (0.33 hectares).
- *Hibbertia fumana* is a candidate species for Serious and Irreversible Impacts. An assessment of the potential impacts of the proposed modification against the Serious and Irreversible Impacts criteria has been undertaken and a Serious and Irreversible Impact to the species is considered unlikely.
- Potential indirect impacts on records of *Persoonia nutans* and *Hibbertia puberula* subsp. *puberula* in the Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland immediately adjoining the southern extent of the MPE Stage 2 site. Indirect impacts may include increased sedimentation, changes to hydrology and increased risk of weed invasion, from adjoining areas.

Impacts on the identified ecological values have been avoided and minimised in the proposed modification as far as practicable. Where impacts cannot be avoided, the scale and extent of impacts has been determined, and a range of mitigation measures have been recommended to ameliorate impacts on the biodiversity values during construction and operation.

The following offset requirements have been determined for the proposed modification:

- 2 ecosystem credits for Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin.
- 2 species credits for *Hibbertia puberula* subsp. *puberula*.
- 0 species credits for *Hibbertia fumana*.
- 1 species credit for *Persoonia nutans*.

It is anticipated that the timing of offsets for the proposed modification will be subject to similar requirements to MPE Stage 2 (i.e. Condition of Consent B104) and evidence of the retirement of credits will be required prior to the impacting of associated native vegetation and threatened species.

The required number of offsets will be met through a combination of making a payment to the Biodiversity Conservation Trust and purchasing credits from offsite sources.

BAM (STAGE 1): BIODIVERSITY ASSESSMENT

1 INTRODUCTION

This Biodiversity Development Assessment Report (BDAR) has been prepared by Ed Cooper, an Accredited Person (BAAS18047) under the NSW *Biodiversity Conservation Act 2016* (BC Act). This BDAR has been prepared in accordance with the minimum requirements outlined in Table 25 of the Biodiversity Assessment Method 2017 (the BAM), as required by the Biodiversity Offset Scheme (the BOS).

1.1 The MPE Stage 2 Project

The Moorebank Precinct East (MPE) Stage 2 Project has been assessed by the Department of Planning and Environment (DP&E) under Part 4, Division 4.7 (previously Division 4.1 prior to 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 consent for the MPE Stage 2 Project on 31 January 2018, subject to Conditions of Consent (SSD 7628).

This Biodiversity Development Assessment Report has been prepared to support the application to modify the State Significant Development consent SSD 7628 for second stage of development of the Moorebank Intermodal Precinct East (MPE) site, pursuant to Section 4.55(1A) of the Environmental Planning and Assessment Act 1979 (EP&A Act).

1.1.1 Proposed modification

The proposed modification seeks changes to the issued consent instrument (SSD 7628) in response to the requirements of CoC B40(c)(iii). The changes proposed relate specifically to the prescription for maximum batter slopes for on-site detention basins (OSDs) detailed in CoC B40(c)(iii), which is provided as an extract below.

...(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;...

There are two elements of the proposed modification:

- Revision of the construction and operation footprint at the southern extent of the site to include the revised design for OSD 2 that addresses the requirement for OSDs to have maximum batter slopes of 1V:4H: and
- Removal of the requirement for batter slopes to allow OSD9, located at the north-west of the site, to be constructed without the 1V:4H batters and instead to be constructed with vertical walls.

This BDAR has been prepared to consider the potential impacts of point one above, being the additional construction and operational impact associated with revising the design of OSD 2.

1.2 Proposal location

The development site is located immediately to the south of the MPE Stage 2 site, approximately 5 kilometres south of the Liverpool City Centre, 2 kilometres south of the Moorebank Avenue/M5 Motorway interchange and 1.5 kilometres to the east of the South Sydney Freight Line.

The majority of the land surrounding the development site is owned 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 Wattle Grove Offset Area), to the east of the development site between the site boundary and the Wattle Grove residential area.

The area immediately south of the development site, known as the Wattle Grove Offset Area, is comprised of heavily vegetated remnant bushland. This land is protected and managed under a Biobanking Agreement (BA341) under Part 7A of the *Threatened Species Conservation Act 1995*.

1.3 Development site

The proposed modification site (referred to in this report as the development site) encompasses an area of 1.60 hectares and is located to the immediate south of the MPE Stage 2 site (Figure 1). The development site is predominantly comprised of exotic grassland vegetation with scattered patches of degraded native vegetation. To the south of the development site is the Wattle Grove Offset Area, an intact patch of bushland protected by a Biobanking Agreement (BA341). Further to the south is the East Hills Rail Line, and beyond that a large expanse of bushland within the Holsworthy Military Area.

The proposed modification would require the clearing of all vegetation within the development site for the purpose of construction and operation of OSD2.

MPE Stage 2 : OSD2 Modification BDAR

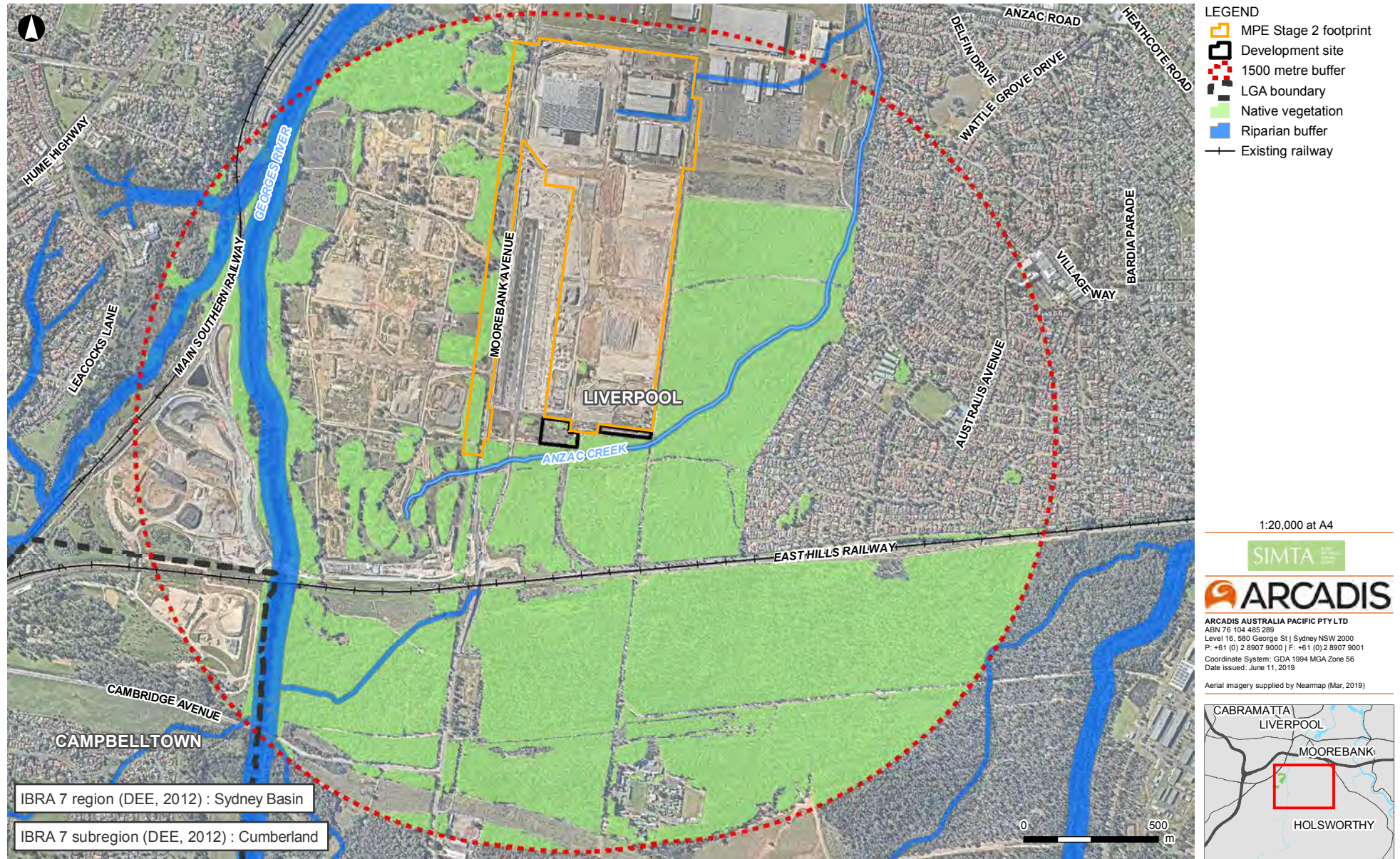


Figure 1: Location map

1.4 Sources of information used

The following data sources were reviewed as part of this report:

- Biodiversity Assessment Methodology Calculator (BAMC)
- Biodiversity Assessment Methodology (OEH 2017)
- BioNet Vegetation Classification (OEH 2018)
- BioNet Atlas of NSW Wildlife (OEH 2018) covering a 10km buffer around the development site
- OEH Threatened Species Profile Data Collection (OEH, 2018b)
- MPE Stage 2 Biodiversity Assessment Report (Arcadis 2017)

1.5 Legislative context and SEARS

1.5.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (MNES). MNES identified in the Act include:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Threatened species and communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).

In accordance with sections 67 and 67A of the EPBC Act, any works that have the potential to result in an impact on any MNES or on Commonwealth land are considered 'controlled actions' and require a referral to the Federal Minister for the Environment for approval. The MPE Project was determined to be a controlled action under the EPBC Act, as a result of the project's impacts on listed threatened species and communities and Commonwealth land. The MPE Project was granted approval as a controlled action under the EPBC Act in March 2014 (EPBC 2011/6229), subject to conditions.

1.5.2 Biodiversity Conservation Act 2016

On 25 August 2017, the *Biodiversity Conservation Act 2016* (BC Act) came into effect, repealing the former *Threatened Species Conservation Act 1995* (TSC Act). The Secretaries Environmental Assessment Requirements (SEARs) for the MPE Stage 2 Project required that the Project was assessed in accordance with the NSW Biodiversity Offsets Policy for Major Projects (2014), underpinned by the Framework for Biodiversity Assessment (2014). A Biodiversity Assessment Report (BAR) (Arcadis 2017) was submitted as a part of the Response to Submissions, to assess the impacts of the Amended Proposal (i.e. the MPE Stage 2 Project) on biodiversity values.

The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development.

The BC Act incorporates broadly similar objectives to those identified the TSC Act, and additionally seeks to establish a framework for assessment and offsetting of development impacts as well as investment in biodiversity conservation, specifically:

- The NSW Biodiversity Offsets Scheme, established under Part 6 of the BC Act
- The BAM, established under Section 6.7 of the BC Act. The purpose of the BAM is to assess certain impacts on threatened species and TECs, and their habitats, and the impact on biodiversity values, where required under the BC Act.

The NSW Biodiversity Offsets Scheme applies to State significant development projects. Under the NSW Biodiversity Offsets Scheme, an accredited assessor must apply the BAM to the proposal.

The Biodiversity Conservation (Savings and Transitional) Regulation 2017 (BC (Savings and Transitional) Reg) provide the criteria under which a project would be saved, meaning the former planning provisions (i.e the *Threatened Species Conservation Act 1995* and the NSW Biodiversity Offsets Policy for Major Projects) would continue to apply.

Clause 30A of the BC (Savings and Transitional) Reg outlines that the new Act (i.e. the BC act) applies to modifications of planning approvals granted or applied for before commencement of new Act (on 25 August 2017).

Clause 30A(2)(d)(ii) of the BC (Savings and Transitional) Reg also states that:

[The biodiversity development assessment report submitted with the application for modification] is to take into account only the additional impact on biodiversity values resulting from the modification of the development and not those associated with the development as approved.

This BDAR has therefore been prepared to satisfy these requirements and to assess only the additional impacts of the proposed modification.

1.5.3 Biodiversity Assessment Method Requirements

The BAM (OEH 2017) is the assessment manual that outlines how an accredited person assesses impacts on biodiversity at development sites. The BAM provides:

- A consistent method for the assessment of biodiversity on a proposed development or major project, or clearing site
- Guidance on how a proponent can avoid and minimise potential biodiversity impacts
- The number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity.

An accredited assessor must document the results of the BAM in a Biodiversity Development Assessment Report (BDAR). The BDAR identifies how the proponent proposes to avoid and minimise impacts, any potential impact that could be characterised as serious and irreversible (according to specified principles) and the offset obligation required to offset the likely biodiversity impacts of the development or clearing proposal, expressed in biodiversity credits.

The requirements for a BDAR (major projects) are listed in Appendix 10 of the BAM. Table 2 identifies where each requirement has been met in this report.

Table 2: Minimum information requirements for a BDAR (OEH, 2017)

Biodiversity Assessment Method Requirement		Where addressed in this BDAR
Section	Information to be included	
Introduction	Identification of development site footprint, including: - Operational footprint - Construction footprint indicating clearing associated with temporary construction facilities and infrastructure.	Section 1.3 and Figure 2
	General description of development site	Section 1.3
	Sources of information used in the assessment, including reports and spatial data.	Section 1.4
Landscape features	Interim Biogeographically Regionalisation of Australia (IBRA) bioregions and subregions, NSW landscape region and area (hectares) Native vegetation extent in the assessment area Cleared areas Evidence to support differences between mapped vegetation extent and aerial imagery Rivers and streams classified according to stream order Wetlands within, next to and downstream of the site Connectivity features Areas of geological significance and soil hazard features Site context components, including: Identification of method applied (i.e. linear or site-based) Per cent native vegetation cover in the landscape (development site).	Section 2
Native vegetation	Describe Plant Community Types (PCTs) within the development site	Section 3.3
	Perform a vegetation integrity assessment of the development site	Section 3.5
Threatened species	Identify ecosystem credit species associated with PCTs on the development site	Section 4.1
	Identify species credit species on the development site	Section 4.2
Avoid and minimise impacts	Demonstration of efforts to avoid and minimise impact on biodiversity values	Section 5
	Assessment of direct and indirect impacts unable to be avoided at the development site	Section 6
	For major projects: details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain	Not applicable
Impact summary	Identification and an assessment of the impacts which are potential serious and irreversible impacts	Section 8.1
	Identification of impacts requiring offsets	Section 8.2
	Identification of impacts not requiring offsets	Section 8.3
	Identification of areas not requiring further assessment	Section 8.4
	Ecosystem credits and species credits that measure the impact of the development on biodiversity values	Section 8.2
Biodiversity credit report	Credit classes for ecosystem credits and species credits at the development site	Appendix C

2 LANDSCAPE FEATURES

The following sections describe the landscape features as applicable to the development site.

2.1 IBRA Bioregions and subregions

The Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and subregion associated with the development site and the 1500 metre landscape assessment area are mapped in Figure 1. The proposed modification site is located within the Sydney Basin IBRA Bioregion and the Cumberland IBRA Subregion.

2.2 Native vegetation extent

Regional vegetation mapping (NPWS 2007) has been used for the purposes of mapping native vegetation within the 1500 metre buffer area, whereas ground truthed vegetation mapping has been used within the development site (Figure 1). Recent aerial imagery was used to validate and refine the native vegetation extent within the 1500 metre buffer, where required. The area of native vegetation cover within the development site and buffer area is outlined in Table 3.

Table 3: Native vegetation within the development site and 1500 metre buffer

Location	Extent	Native vegetation extent
Development site	1.60 ha	0.17 ha
1500 m buffer area	849 ha	347 ha

2.3 NSW Landscape Regions (Mitchell landscapes)

The proposed modification site is located within the Georges River Alluvial Plain Mitchell landscape (DECC 2002) (Figure 2). This Mitchell Landscape is characterised by the channel, floodplain and terraces of the Georges River on Quaternary and Tertiary alluvial sediments (Mitchell 2002). The soils are comprised of mostly clayey sand and sand with limited gravel on the highest terrace. Vegetation is typically forest and woodland of cabbage gum (*Eucalyptus amplifolia*), rough-barked apple (*Angophora floribunda*), broad-leaved ironbark (*Eucalyptus fibrosa* ssp. *fibrosa*), scribbly gum (*Eucalyptus sclerophylla*) and narrow-leaved apple (*Angophora bakeri*). Extensive swamp oak (*Casuarina glauca*) along the riverbanks and in low-lying areas often with prickly-leaved tea-tree (*Leptospermum styphelioides*), these extend to brackish estuarine swamps with grey mangrove (*Avicennia marina*) and limited saltmarsh (Mitchell 2002).

2.4 Cleared areas

The development site covers an area of 1.60 hectares of which 1.43 hectares is comprised of exotic grassland. For the purpose of this BDAR, this vegetation has been categorised as a Plant Community Type (PCT) in degraded condition rather than cleared land. A description of the vegetation present in this exotic grassland, including the vegetation integrity score, is provided in Section 3.3. Subsequently, no area within the development site have been categorised as a cleared area.

2.5 Rivers and streams

The development site is located within the Georges River catchment, covering approximately 960 square kilometres and managed by the Sydney Metropolitan CMA. Georges River is located about 900 metres west of the development site, where it flows to the north then meanders south-east from Chipping Norton before draining into Botany Bay.

To the south of the development site is Anzac Creek which originates in the MPW site west of Moorebank Avenue and extends to the north-east, to the south of the development site; at its closest

point, it is located approximately 25 metres from the south-eastern corner of the development site. The creek flows north past the adjoining suburbs of Wattle Grove and Moorebank before draining into Lake Moore in Chipping Norton, which flows into the Georges River. The section of Anzac Creek to the south of the development site is considered to be a first order stream with a riparian buffer width of 10 metres.

There are no formal waterways (or riparian buffers) within the development site (Figure 2).

2.6 Wetlands

The development site does not contain any wetlands. There are no wetlands listed under State Environmental Planning Policy (Coastal Management) 2018 or wetlands of international importance within or near the subject land.

2.7 Connectivity features

The BAM defines connectivity as a *measure of the degree to which an area(s) of native vegetation is linked with other areas of vegetation*. The development site is located on the interface of the cleared and developed MPE Stage 2 site and the Wattle Grove Offset area. there are tenuous connecting links between the development site and the Bushland to the south, however since there is no native vegetation to the north of the development site, it does not provide a connecting link.

The development site is considered unlikely to facilitate the movement of threatened species across their range in its current condition. The development site is not considered to contain any connectivity values.

2.8 Areas of geological significance and soil hazard features

The development site does not contain any karst, caves, crevices, cliffs or other areas of geological significance and soil hazard features.

2.9 Areas of outstanding biodiversity value (AOBVs)

Areas of outstanding biodiversity value (AOBVs), as defined under the BC Act, are currently limited to areas previously declared as critical habitat under the TSC Act. There are no AOBVs within the development site.

2.10 Site Context

The following sections outline the site context components entered into the BAM calculator.

2.10.1 Method applied

The site based method has been applied for this BDAR.

2.10.2 Percent native vegetation cover in the landscape

The percent native vegetation cover in the landscape value has been derived using refined regional vegetation mapping of the 1500 metre development site buffer (Figure 1). The results of this assessment are shown in Table 4.

Table 4: Native vegetation cover in the landscape

Location	Extent	Native vegetation extent	Percent cover of native vegetation
1500 m buffer area	849 ha	347 ha	41%

MPE Stage 2 : OSD2 Modification BDAR

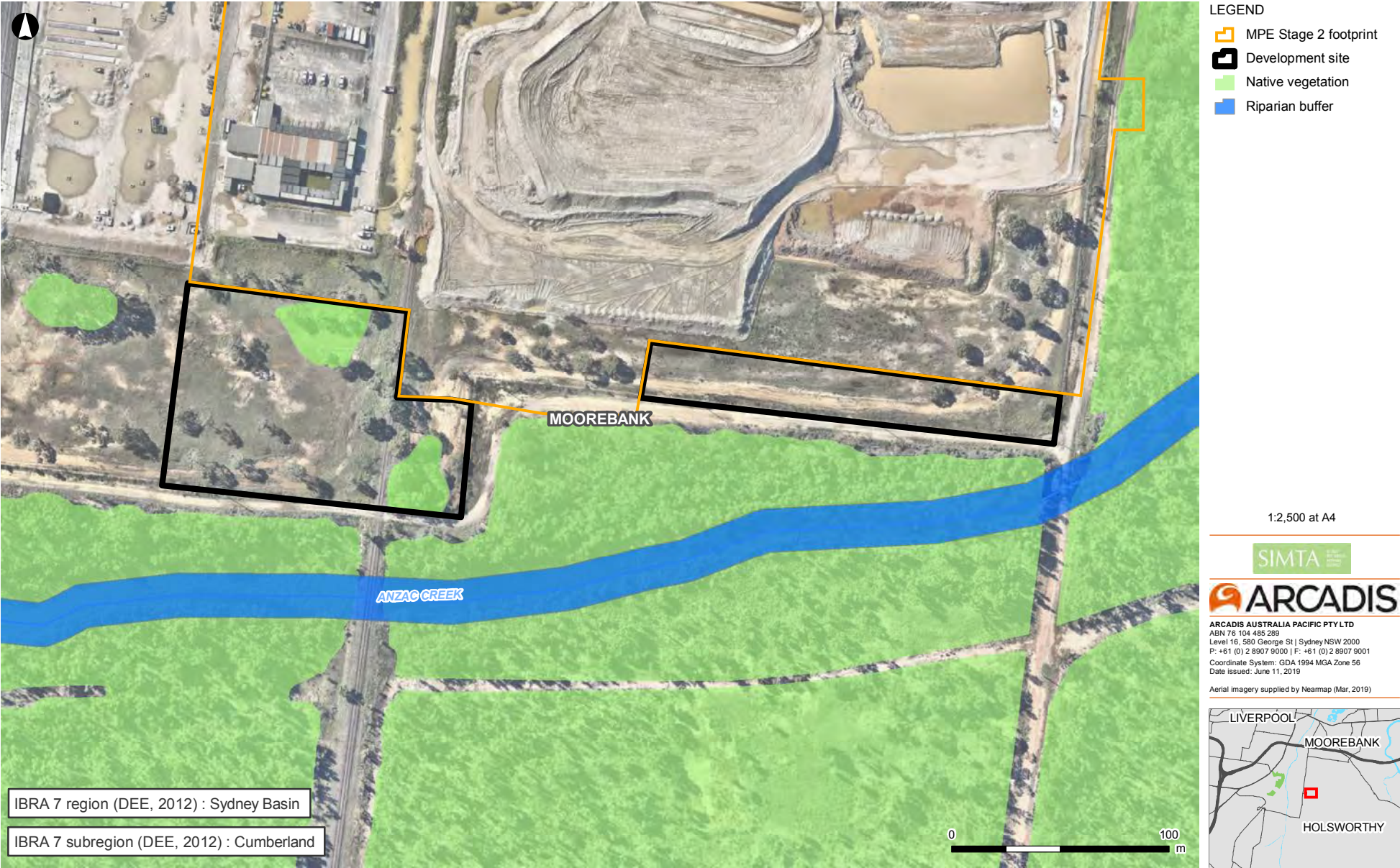


Figure 2: Site map

3 NATIVE VEGETATION

3.1 Survey method

Survey timing

Surveys of the development site were carried out by Arcadis ecologists Jane Rodd, Carl Corden and Meredith Leal on 21 and 22 February 2019. A supplementary survey was completed by Arcadis ecologists Jane Rodd and Ed Cooper on 28 May 2019. Weather conditions at the time of surveys were mild and cloudy. The weather records from Holsworthy Aerodrome (station 066161) for the surveyed dates are shown in Table 5.

Table 5: Weather conditions during survey periods (BOM 2019)

Date	Temperature		Rain	Maximum wind gust	
	Min (°C)	Max (°C)	(mm)	Direction	Speed (km/h)
21 Feb 2019	18.9	24.8	0	SE	33
22 Feb 2019	17.8	23.6	6.6	SSE	52
28 May 2019	8.8	17.8	0	W	44

The proposed modification is subject to the requirements of the Biodiversity Offset Scheme, therefore the assessment methodology that has been employed for this assessment is consistent with the BAM. This is not consistent with the methodology that was used for the MPE Stage 2 Project since this project was subject to the requirements of the NSW Biodiversity Offsets Policy for Major Projects (2014), underpinned by the Framework for Biodiversity Assessment (2014) (the FBA).

Vegetation plots

Four vegetation plots were undertaken in accordance with the requirements of Section 5.3 of the BAM, in the form of a 20 metre x 50 metre plot with a nested 20 metre x 20 metre plot (Figure 3) and five nested one by one metre litter sub-plots.

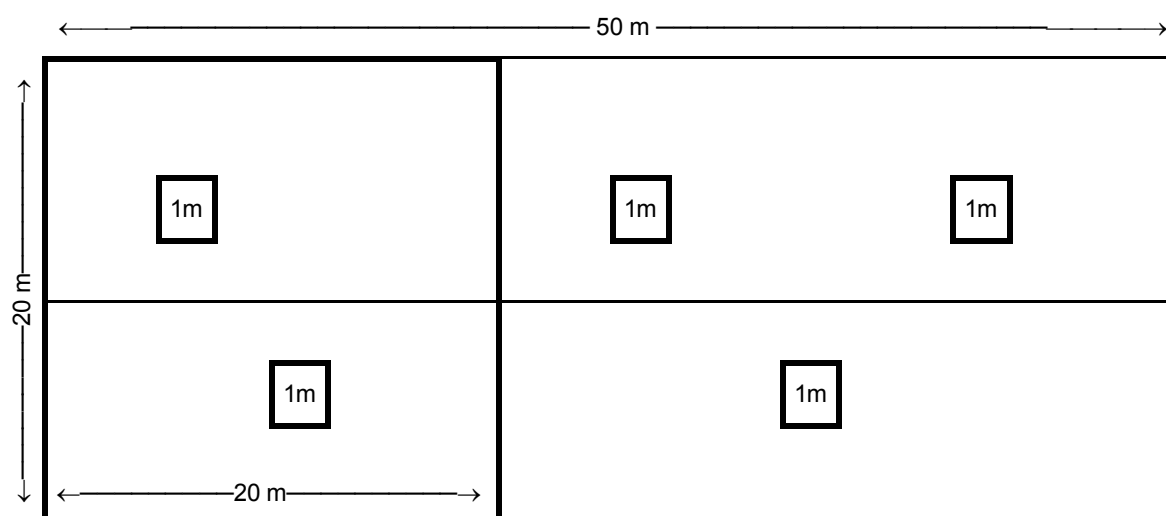


Figure 3: Flora quadrat layout

The following attributes were recorded in the vegetation plot:

- Location: easting – northing (grid type MGA 94, Zone 56)
- Native and exotic species richness: this consisted of recording all species by systematically walking through the 20 by 20 metre quadrat. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded
- Number of trees with hollows: living and dead trees that contain at least one hollow. A hollow was only recorded if (a) the entrance could be seen, (b) the estimated entrance width was at least five centimetres across, (c) the hollow appeared to have depth, (d) the hollow was at least one metre above the ground and (e) the centre of the tree was located within the sampled quadrat
- Number of large trees and stem size diversity: tree stem size diversity was recorded by measuring the diameter at breast height (DBH) (i.e. 1.3 metre from the ground) of living trees (greater than five centimetre DBH). For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by counting all trees with DBH greater than the DBH large trees for each vegetation formation.
- Evaluation of regeneration: presence/absence of juvenile or regenerating individuals of each overstorey species present at the site.
- Total length of fallen logs: cumulative total of logs with a diameter of at least 10 centimetres and a length of at least 0.5 metres.
- Litter cover: estimation of the average percent groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter less than 10 centimetres which is detached from a living plant) from within five one by one metre sub-plots spaced evenly either side of the 50 metre central transect.

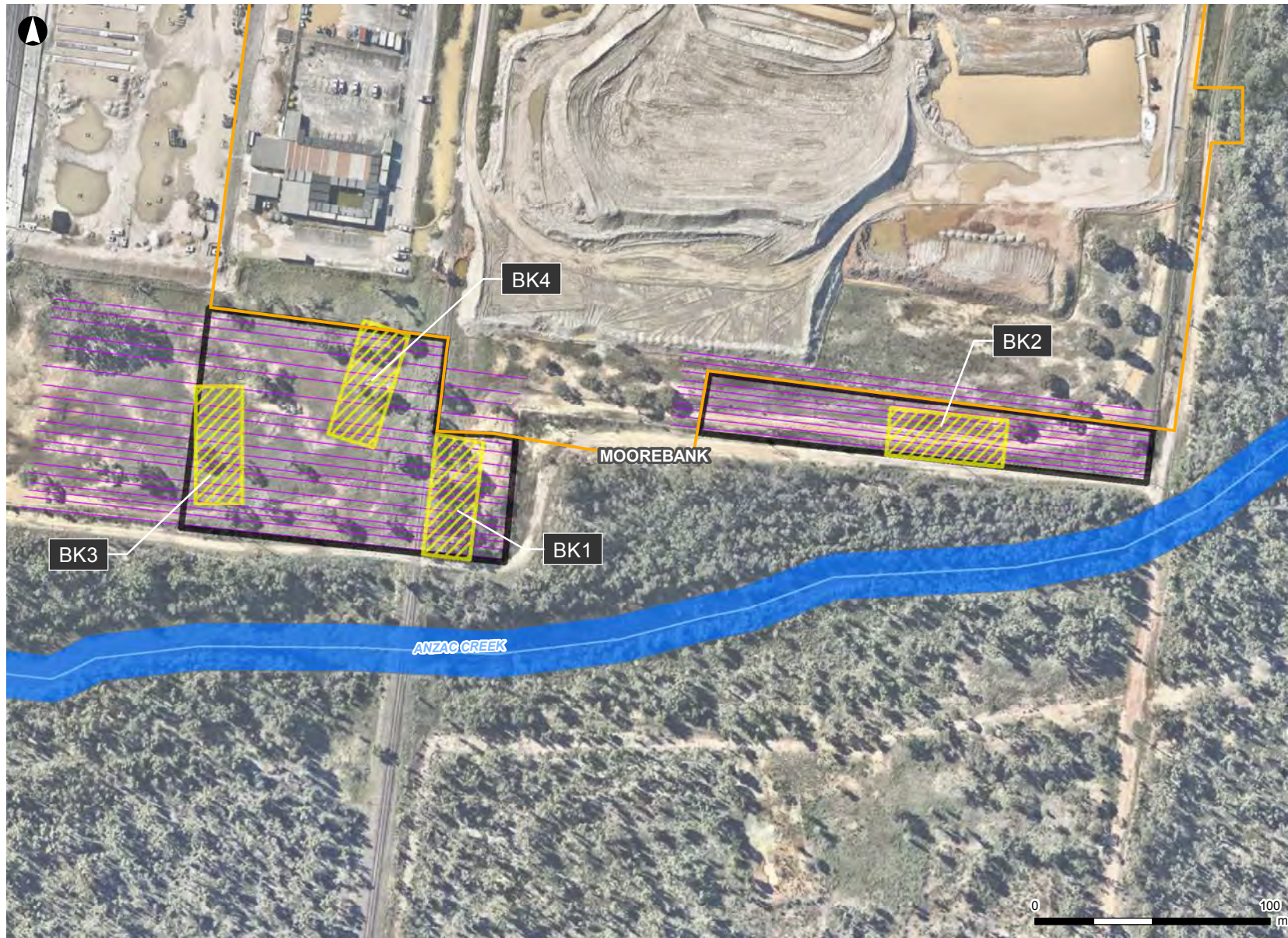
3.2 Survey effort

Native vegetation within the development site was classified into Plant Community Types (PCTs) and then separated into vegetation zones based on broad condition classes. The size of each vegetation zone determines the sampling effort required, as outlined in Table 3.1 of the BAM.

Table 6 provides a summary of the vegetation zones present within the development site and the sampling effort that was applied. A total of four BAM plots were completed.

Table 6: Comparison of number of transects/plots required and completed per vegetation zone

Vegetation zone	Vegetation zone area (ha)	BAM plot requirements	Number of plots completed
1 (PCT 883_Poor)	0.17	1	2
2 (PCT 883_Cleared)	1.43	1	2



LEGEND

- MPE Stage 2 footprint
- OSD 2 proposal footprint
- Vegetation plot
- Threatened flora transect
- Watercourse
- Riparian buffer

1:2,500 at A4

SIMTA

ARCADIS

ARCADIS AUSTRALIA PACIFIC PTY LTD
 ABN 76 104 485 289
 Level 5, 141 Walker St | North Sydney NSW 2060
 P: +61 (0) 2 8907 9000 | F: +61 (0) 2 8907 9001
 Coordinate System: GDA 1994 MGA Zone 56
 Date issued: May 30, 2019

Aerial imagery supplied by nearmap (Dec, 2018)

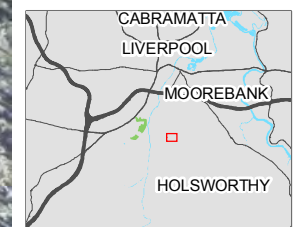


Figure 4: Vegetation Survey Effort

3.3 Plant Community Types present

One Plant Community Type (PCT) was recorded in the development site: Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion (PCT 883). The details of this PCT in the development site are provided below in Table 7.

Table 7: Attribute information for PCT 883 within the development site

Attribute	PCT in development site
Vegetation formation	Dry Sclerophyll Forests (shrubby sub-formation)
Vegetation class	Sydney Sand Flats Dry Sclerophyll Forests
PCT	883
BVT	ME003
Conservation status	EPBC Act: not listed (falls below condition threshold) BC Act: vulnerable
Estimate of percent cleared	50%
Condition	Poor (vegetation zone 1) and Cleared (vegetation zone 2)
Extent in the development site	0.17 ha (vegetation zone 1) and 1.43 (vegetation zone 2)
Plots completed in vegetation zones	Two in vegetation zone 1 (BK1 and BK4) Two in vegetation zone 2 (BK2 and BK3)
Species relied upon for PCT identification	<i>Eucalyptus sclerophylla</i> , <i>Eucalyptus paramattensis</i> , <i>Pimelea linifolia</i> , <i>Entolasia stricta</i> , <i>Themeda australis</i> , <i>Eragrostis brownii</i> , <i>Dianella revoluta</i> var. <i>revoluta</i> , <i>Cheilanthes sieberi</i> .

Vegetation Zone 1 (883_Poor) description

Two small patch of largely native vegetation is present in the development site, one in the south-eastern corner of the western portion of the proposal footprint and one to the north (Figure 5). The vegetation plots BK1 and BK4 were carried out in these two patches respectively. A full inventory of species recorded within all four of the BAM plots is provided in Appendix A.

The vegetation in the BK1 plot consists of a small cluster of regrowth and planted trees and shrubs adjoining the adjacent disused rail spur. Trees recorded include *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum), *Eucalyptus saligna* x *botryoides* and *Angophora floribunda* (Rough-barked Apple); the planted non-local species *Eucalyptus microcorys* (Tallowwood) is located in the larger 50 x 20 metre quadrat, but was not recorded within the nested 20 m x 20 m subquadrat. There is a dense midlayer of native shrubs, mainly *Acacia parramattensis* (Sydney Green Wattle) and *Kunzea ambigua* (Tickbush) in the south of the patch adjoining the fenceline; the understorey is otherwise open, with a sparse to absent ground layer dominated by exotic grass species such as *Eragrostis curvula* (African Lovegrass) and *Paspalum dilatatum* (Paspalum).

The vegetation within the BK4 consists of several semi-mature Hard-leaved Scribbly Gum trees with an understorey of *Acacia longifolia*, *Leptospermum juniperinum*, *Acacia binervia* and *Kunzea ambigua*. The understorey is typically comprised of exotic grasses however there are a high number of native and exotic sedges and rushes in natural depressions. Species recorded include *Juncus usitatus*, *Baumea articulata* and *Fimbristylis dichotomea*.

The vegetation sampled by BK1 and BK4 were somewhat different in terms of structure and composition, however the site value scores for both plots were similar (31 and 26 respectively) as such, and based on the composition of the canopy and shrub strata as well as the expected extant vegetation present, both patches have been categorised as PCT 883 (ME003) Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland in poor condition.



Plate 1 Native vegetation sampled at plot BK1 and BK4

Vegetation Zone 2 (883_Cleared) description

The majority of the vegetation within the proposed modification footprint (1.43 hectares) is exotic grassland with scattered native and planted *Eucalyptus* spp. Native *Eucalypts* present include *Eucalyptus moluccana*, *Eucalyptus sclerophylla* and *Eucalyptus parramattensis* while planted *Eucalyptus microcorys* was present along the disused rail spur. A shrub layer is largely absent except for *Kunzea ambigua* which is present across the proposal footprint, particularly along the southern boundary. Most areas of grassland are dominated by the invasive exotic perennial grass *Eragrostis curvula*, with some small patches of native grass dominated by *Aristida ramosa* (Wiregrass).



Plate 2: Native vegetation sampled at plot BK1 and BK4

MPE Stage 2 : OSD2 Modification BDAR

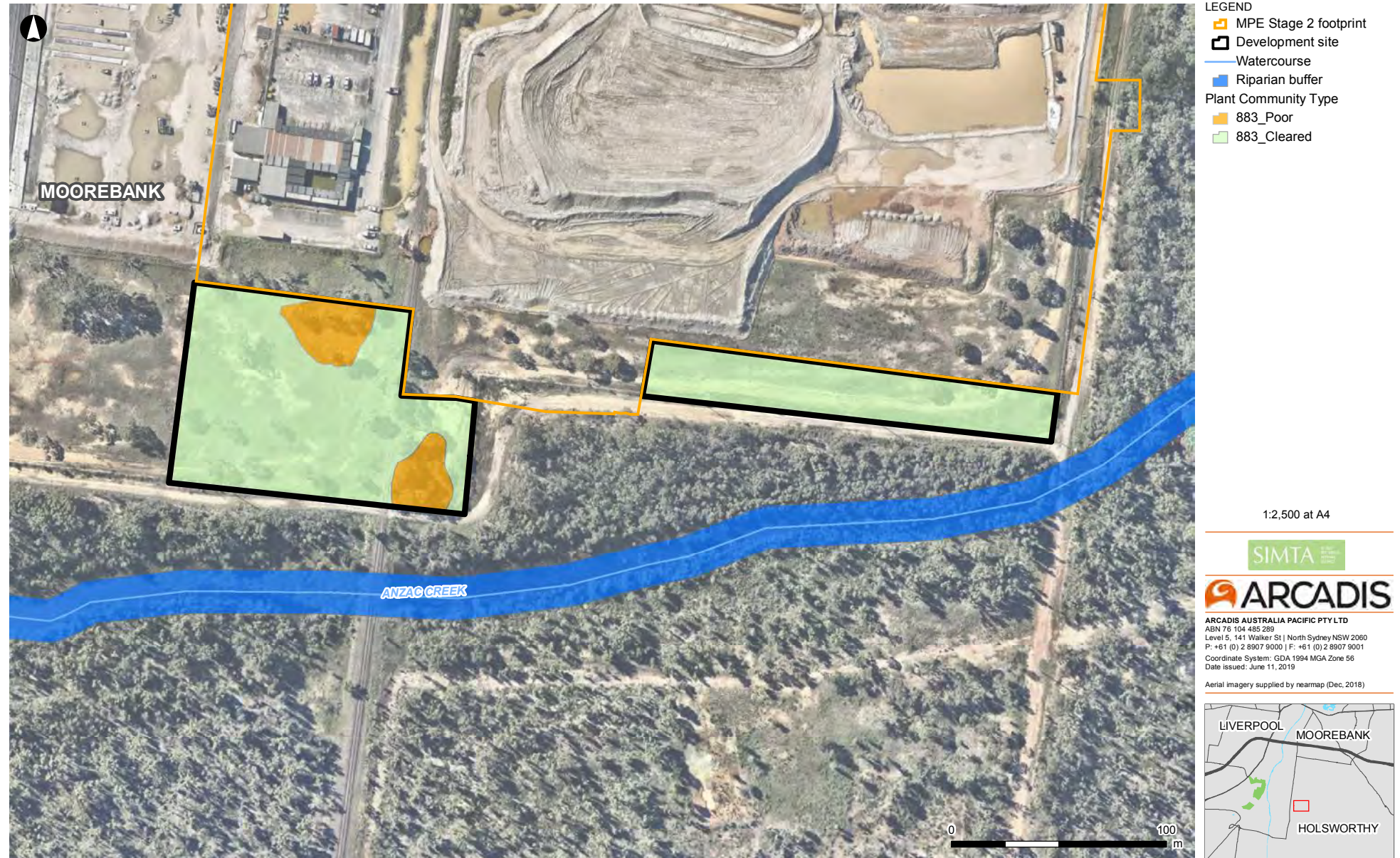


Figure 5: Plant Community Types within the development site

3.4 Threatened ecological community assessment

Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is listed as endangered under the EPBC Act. The Commonwealth Approved Conservation Advice for the community provides a list of diagnostic characteristics of the community that can be referred to when determining whether an assemblage of species is consistent with the EPBC Act listed community. Table 9 provides an assessment of the PCT 883 vegetation within the development site against these criteria.

Table 8: Comparison of the PCT 883 vegetation against the EPBC Act TEC listing criteria

EPBC Act criteria	PCT883_Poor	PCT883_Cleared
Limited to the Sydney Basin Bioregion (IBRA v7)	Consistent	Consistent
Occurs on flat or gently undulating terrain	Consistent	Consistent
Occurs on sandy soil (i.e. sand and sandy gravel), on deposits of Tertiary alluvium which are sometimes overlayed with aeolian deposits (i.e. parts of the Agnes Banks occurrences). The sand deposits often transition to and include areas of gravel and clay.	Consistent	Consistent
The vegetation structure is typically woodland less than 20 m tall with a prominent shrub layer and a variable ground layer.	Consistent	Not consistent. PCT 883_Cleared is comprised of an open grassland structure with scattered and isolated eucalypt trees.
The canopy contains, and is often dominated by, one or more of the following species: <i>Angophora bakeri</i> , <i>Eucalyptus</i> and <i>E. parramattensis</i> subsp. <i>parramattensis</i> . <i>Melaleuca</i> species including <i>M. decora</i> (paperbark) and <i>Eucalyptus fibrosa</i> (red ironbark) may also be prominent in the canopy (and/or mid layer). Other canopy and understorey species that may occur are listed in Appendix A, Table A1.	Consistent. Canopy is dominated by <i>Eucalyptus sclerophylla</i> in combination with <i>Angophora bakeri</i> , <i>E. parramattensis</i> and <i>Melaleucas</i> present	Not-consistent. Canopy is typically absent.
May contain fauna species presented in Appendix A, Table A2.	NA	NA

The Approved Conservation Advice goes on to state that very degraded/modified patches are not protected as the ecological community listed under the EPBC Act. The Approved Conservation Advice provides condition thresholds that must be met in order for a patch to be eligible for listing under the EPBC Act. It is a prerequisite that the patch size must be greater than 0.5 hectares for all condition classes under the EPBC Act. Whilst there is a unsealed track and cyclone fence between the development site and the intact remnant bushland to the south, these areas are considered to be a contiguous patch (from a functional perspective). The sum of the native understorey cover at plot BK1 and BK4 are both greater than 30 percent (but less than 50 percent). The PCT 883_Poor vegetation is therefore consistent with condition category A in the Approved Conservation Advice. A total of 0.17 hectares of EPBC Act listed Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is present within the development site (Figure 6).

Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion is listed as vulnerable under the BC Act. It is described as a woodland dominated by *Eucalyptus parramattensis* subsp. *parramattensis*, *Angophora bakeri* and *E. sclerophylla* occurring almost exclusively on soils derived from Tertiary alluvium, or on sites located on adjoining shale or Holocene alluvium. The PCT 883_Poor vegetation is consistent with this description and therefore considered to be consistent with the BC Act listed vulnerable ecological community (Figure 6). The Final Determination for the community (NSW Scientific Committee 2011) makes no mention of the community occurring as a derived shrubland or grassland. Notwithstanding, the PCT883_Cleared vegetation contain only a low

cover of native understorey species and is not considered to be consistent with a derived native grassland. The PCT883_Cleared vegetation is not consistent with the BC Act listed vulnerable community.

MPE Stage 2 : OSD2 Modification BDAR



Figure 6: TEC within the development site

3.5 Vegetation integrity assessment

The vegetation integrity score is a measure of the condition of native vegetation and is assessed for each vegetation zone by calculating the scores for a range of condition attributes collected in plots within the vegetation zone against the benchmark values for the associated PCT. The further assessment of native vegetation is not required beyond Section 5.4 of the BAM (OEH, 2017), and an assessment of threatened species habitat according to Section 6.2 and Paragraph 6.2.1.4 of the BAM (OEH, 2017) is not required if an assessor determines that a PCT has a vegetation integrity of:

- Less than 15 if the PCT is a Critically Endangered Ecological Community (CEEC) or Endangered Ecological Community (EEC)
- Less than 17 if the PCT is threatened species habitat or vulnerable ecological community, or
- Less than 20 if the PCT is not representative of a TEC or associated with threatened species habitat.

The vegetation plot data was entered into the BAM credit calculator to generate vegetation integrity scores. The composition, structure and function data entered into the credit calculator is shown in Table 9. The benchmark data for PCT 883 has also been included to demonstrate the attributes that are determining the integrity score. No local data is proposed to be used as the benchmarks are considered representative of benchmark condition PCT 883.

With a vegetation integrity score of 30.1 Vegetation Zone 1 is considered to be in poor to moderate condition, but above the offsetting threshold of 17. With a vegetation integrity score of 3.1, Vegetation Zone 2 is considered to be in highly degraded condition and well below the offsetting threshold of 17.

MPE Stage 2: OSD2 Modification - BDAR

Table 9: Plot data and vegetation integrity scores for Vegetation Zone 1 and 2

Plot number	Composition (richness)						Structure (cover)						Function			Integrity Score
	Tree	Shrub	Grass	Forb	Fern	Other	Tree	Shrub	Grass	Forb	Fern	Other	Large tree	Fallen Logs	Leaf litter	
Benchmark	4	21	10	9	1	3	28	82	60	5	0	1	3	47	65	100
Vegetation Zone 1 (883_Poor): PCT 883 (ME003) Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland																
BK1	5	4	7	0	0	2	31	13.1	9	2	0	3	0	5	40	30.1
BK4	2	4	8	5	0	1	10	6.7	25.3	1.8	0	0	0	2	18	
Vegetation Zone 2 (883_Cleared): Non-native vegetation																
BK2	0	3	3	1	0	1	1	3.3	28	0.1	0	0.1	0	0	9	3.1
BK3	1	0	3	0	0	1	3	0	2.1	0	0	0.2	0	0	7	

4 THREATENED SPECIES

4.1 Ecosystem credit species

Ecosystem credit species are those that can be readily predicted to occur within a PCT based on the attributes of a given vegetation zone. The ecosystem credit species that are predicted to occur within the development site, the associated habitat constraints, geographic limitations and sensitivity to gain class are outlined in Table 10.

An assessment of the predicted ecosystem credit species identified has been undertaken to determine whether they have the potential to occur based on the presence of necessary habitat components or habitat constraints, in accordance with BAM sections 6.4.1.10 and 6.4.1.17. All ecosystem credit species identified in the BAMC are considered to have the potential to occur within the development site.

Table 10: Ecosystem credit species predicted to occur within the development site

Common Name	Scientific Name	Sensitivity to gain	Habitat constraints	Geographic limitations	BC Act Status	EPBC Act Status
Regent Honeyeater	<i>Anthochaera phrygia</i>	High	-	-	CE	CE
Dusky Woodswallow	<i>Artamus cyanopterus</i>	Moderate	-	-	V	-
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	Moderate	-	-	V	-
Speckled Warbler	<i>Chthonicola sagittata</i>	High	-	-	V	-
Varied Sittella	<i>Daphoenositta chrysoptera</i>	Moderate	-	-	V	-
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	High	-	-	V	E
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	High	-	-	V	-
Little Lorikeet	<i>Glossopsitta pusilla</i>	High	-	-	V	-
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	High	-	-	V	-
Little Eagle	<i>Hieraaetus morphnoides</i>	Moderate	-	-	V	-
Swift Parrot	<i>Lathamus discolor</i>	Moderate	-	-	E	CE
Square-tailed Kite	<i>Lophoictinia isura</i>	Moderate	-	-	V	-
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata</i>	Moderate	-	-	V	-
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	Moderate	-	-	V	-
Little Bentwing-bat	<i>Miniopterus australis</i>	High	-	-	V	-

Common Name	Scientific Name	Sensitivity to gain	Habitat constraints	Geographic limitations	BC Act Status	EPBC Act Status
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	High	-	-	V	-
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	High	-	-	V	-
Turquoise Parrot	<i>Neophema pulchella</i>	High	-	-	V	-
Barking Owl	<i>Ninox connivens</i>	High	-	-	V	-
Powerful Owl	<i>Ninox strenua</i>	High	-	-	V	-
Eastern Osprey	<i>Pandion cristatus</i>	Moderate	-	-	V	-
Scarlet Robin	<i>Petroica boodang</i>	Moderate	-	-	V	-
Flame Robin	<i>Petroica phoenicea</i>	Moderate	-	-	V	-
Koala (foraging)	<i>Phascolarctos cinereus</i>	High	-	-	V	E
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	High	-	-	V	E
Yellow-bellied Sheathtail-bat	<i>Saccolaimus flaviventris</i>	High	-	-	V	-
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	High	-	-	V	-
Diamond Firetail	<i>Stagonopleura guttata</i>	Moderate	-	-	V	-
Masked Owl	<i>Tyto novaehollandiae</i>	High	-	-	V	-
Rosenberg's Goanna	<i>Varanus rosenbergi</i>	High	-	The northern and south western margins of the sub region	V	-

4.2 Species credit species

Species credit species are those that cannot be readily predicted to occur within a development site based on the PCTs present and must therefore be surveyed for where potential habitat is considered to be present.

Based on the limited suitability of habitat resources present within the development site and the degraded nature of vegetation, several species credit species have been excluded from targeted surveys. Table 11 provides the full list of candidate species credit species returned by BAMC and provides a justification for not conducting threatened species surveys where no suitable habitat is present.

Table 11: Candidate species credit species, including those removed from further consideration

Common name	Scientific name	BC Act status	EPBC Act status	Justification for removal (where applicable)
Threatened flora				
Thick Lip Spider Orchid	<i>Caladenia tessellata</i>	Endangered	Vulnerable	The habitat characteristics for Thick Lip Spider Orchid are relatively broad, being that it is generally found in grassy sclerophyll woodland on clay loam or sandy soils. In Sydney, the species has not been recorded west of the Woronora River, more than 10 km east of the development site. The degraded nature of the development site and the lack of any nearby records means that it is considered highly unlikely that this species would occur within the development site.
<i>Dillwynia tenuifolia</i> , Kemps Creek	<i>Dillwynia tenuifolia</i> - endangered population	Endangered population	Not listed	The endangered population of <i>Dillwynia tenuifolia</i> occurs in Kemps Creek. The development site is not located in Kemps Creek therefore potential impacts to the endangered population do not need to be considered.
Woronora Beard-heath	<i>Leucopogon exolasius</i>	Vulnerable	Vulnerable	This species occurs in heath and woodland on sandstone derived soils. The soils within the development site are comprised of tertiary alluvium and are not suitable for this species.
Bynoe's Wattle	<i>Acacia bynoeana</i>	Endangered	Vulnerable	NA - Targeted surveys conducted.
Downy Wattle	<i>Acacia pubescens</i>	Vulnerable	Vulnerable	NA - Targeted surveys conducted.
-	<i>Allocasuarina glareicola</i>	Endangered	Endangered	NA - Targeted surveys conducted.
-	<i>Dillwynia tenuifolia</i>	Vulnerable	Not listed	NA - Targeted surveys conducted.
Juniper-leaved Grevillea	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Vulnerable	Not listed	NA - Targeted surveys conducted.
Small-flowered Grevillea	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Vulnerable	Vulnerable	NA - Targeted surveys conducted.
-	<i>Hibbertia fumana</i>	Critically endangered	Not listed	NA - Targeted surveys conducted.

Common name	Scientific name	BC Act status	EPBC Act status	Justification for removal (where applicable)
-	<i>Hibbertia puberula</i> subsp. <i>puberula</i>	Endangered	Not listed	NA - Targeted surveys conducted.
-	<i>Micromyrtus minutiflora</i>	Endangered	Vulnerable	NA - Targeted surveys conducted.
Nodding Geebung	<i>Persoonia nutans</i>	Endangered	Endangered	NA - Targeted surveys conducted.
-	<i>Pimelea curviflora</i> var. <i>curviflora</i>	Vulnerable	Vulnerable	NA - Targeted surveys conducted.
-	<i>Pultenaea parviflora</i>	Endangered	Vulnerable	NA - Targeted surveys conducted.

Threatened fauna

Regent Honeyeater (Important areas)	<i>Anthochaera phrygia</i>	Critically endangered	Critically endangered	No suitable foraging habitat present within the study area in the form of preferred blossoming trees or mistletoe. No preferred breeding habitat present in the form of riparian forest/woodland or <i>Casuarina cunninghamiana</i> . The study area is not within an area mapped by OEH as an 'Important Habitat Area' for this species. The study area is not within an area where this species is regularly recorded, or in an area where large numbers of this species have been recorded. The species is a dual credit species, with the species credit component mapped as an important area. These mapped areas do not require survey as it is presumed that the species is present. Any impact from development could potentially be serious and irreversible. Ecosystem credit areas are unlikely to have potential serious and irreversible impacts.
Bush Stone-curlew	<i>Burhinus grallarius</i>	Endangered	Not listed	No suitable habitat present within the study area given the absence of understorey vegetation, fallen leaf litter and coarse woody debris. This species is also highly susceptible to predation by pest species such as cats, foxes and dogs which are known/likely to occur within the study area. A large species which is known to be cryptic when roosting or incubating, but easily detected or flushed where suitable understorey or leaf litter is absent.
Gang-gang Cockatoo (Breeding)	<i>Callocephalon fimbriatum</i>	Vulnerable	Not listed	Gang-gang Cockatoos require large, old growth tree hollows in order to breed. No suitable tree hollows or habitat occur within the development site. Further,

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Common name	Scientific name	BC Act status	EPBC Act status	Justification for removal (where applicable)
				this species is typically a winter visitor to coastal areas, preferring to breed in tall forest at higher altitudes.
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	Vulnerable	Not listed	No suitable habitat present within the study area. This species is highly dependent on dense understorey (shrubby) vegetation which is absent from the study area. Further, the study area does not support substantial nectar resources (e.g. banksia, angophora or eucalyptus blossom) required for foraging.
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Vulnerable	Vulnerable	No suitable roosting or breeding habitat present within the study area or in surrounding lands. The study area is not located within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.
White-bellied Sea-Eagle (Breeding)	<i>Haliaeetus leucogaster</i>	Vulnerable	Not listed	White-bellied Sea-eagle construct large stick nests in the upper branches of tall trees or on tall man-made structures. No evidence of any raptor nesting was recorded within the development site. Further, there are no suitable tall trees within or adjacent to riparian areas that would provide suitable locations for nesting.
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	Vulnerable	Vulnerable	No suitable habitat present within the study area or surrounding lands.
Little Eagle (Breeding)	<i>Hieraaetus morphnoides</i>	Vulnerable	Not listed	Little Eagle construct large stick nests in the upper branches of tall trees. No evidence of any raptor nesting was recorded within the development site. Further, there are no suitable tall trees within or adjacent to riparian areas that would provide suitable locations for nesting.
Swift Parrot (Important habitat area)	<i>Lathamus discolor</i>	Endangered	Critically endangered	Swift Parrot is only present in NSW as a non-breeding migrant during autumn, winter and early spring. No suitable foraging habitat present within the study area in the form of preferred winter-blossoming trees or heavy lerp infestation. The study area is not within an area mapped by OEH as an 'Important Habitat Area' for this species. The study area is not within an area where this species is regularly recorded, or in an area where large numbers of this species have been recorded. The species is a dual credit species, with the species credit component mapped as an important area. These mapped areas do NOT require survey as it is presumed that the species is present. Any impact from

Common name	Scientific name	BC Act status	EPBC Act status	Justification for removal (where applicable)
				development could potentially be serious and irreversible. Ecosystem credit areas are unlikely to have potential serious and irreversible impacts.
Square-tailed Kite (Breeding)	<i>Lophoictinia isura</i>	Vulnerable	Not listed	Square-tailed Kite construct large stick nests in the upper branches of tall trees. No evidence of any raptor nesting was recorded within the development site. Further, there are no suitable tall trees within or adjacent to riparian areas that would provide suitable locations for nesting.
Little Bentwing-bat (Breeding)	<i>Miniopterus australis</i>	Vulnerable	Not listed	No suitable roosting or breeding habitat present within the study area or in surrounding lands. This species is known to breed communally in large colonies at very few sites in NSW. There are no caves, culverts or other structures present that would provide suitable breeding habitat or over-wintering torpor roost habitat.
Eastern Bentwing-bat (Breeding)	<i>Miniopterus schreibersii oceanensis</i>	Vulnerable	Not listed	No suitable roosting or breeding habitat present within the study area or in surrounding lands. This species is known to breed communally in large colonies at very few sites in NSW. There are no caves, culverts or other structures present that would provide suitable breeding habitat or over-wintering torpor roost habitat.
Barking Owl (Breeding)	<i>Ninox connivens</i>	Vulnerable	Not listed	No suitable roosting or breeding habitat present within the study area. No large tree hollows suitable for breeding with 100m of the study area. Unlikely to forage within the study area given the absence of habitat for prey species.
Powerful Owl (Breeding)	<i>Ninox strenua</i>	Vulnerable	Not listed	No suitable roosting or breeding habitat present within the study area. No large tree hollows suitable for breeding with 100m of the study area. Unlikely to forage within the study area given the absence of habitat for prey species.
Eastern Osprey (Breeding)	<i>Pandion cristatus</i>	Vulnerable	Not listed	No suitable habitat present in the form of marine or estuarine environments.

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Common name	Scientific name	BC Act status	EPBC Act status	Justification for removal (where applicable)
Squirrel Glider	<i>Petaurus norfolcensis</i>	Vulnerable	Not listed	No suitable habitat present within the study area. No signs of glider scratches or scats located beneath any hollow-bearing trees within the study area. Gaps separating trees within the study area from adjacent habitat are too large to allow gliders to glide between the study area and adjacent habitat.
Grey-headed Flying-fox (Breeding)	<i>Pteropus poliocephalus</i>	Vulnerable	Vulnerable	Substantial nocturnal surveys have been conducted throughout the Moorebank Precinct over the last 8 years and a breeding colony of Grey-headed Flying-foxes has never been recorded. There is insufficient vegetation within the development site to support a breeding population.
Masked Owl (Breeding)	<i>Tyto novaehollandiae</i>	Vulnerable	Not listed	No suitable roosting or breeding habitat present within the study area. No large tree hollows suitable for breeding within 100m of the study area. Unlikely to forage within the study area given the absence of habitat for prey species.
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	Endangered	Not listed	NA - Targeted surveys conducted.
<i>Phascolarctos cinereus</i>	Koala	Vulnerable	Vulnerable	NA - Targeted surveys conducted.
<i>Litoria aurea</i>	Green and Golden Bell Frog	Endangered	Vulnerable	NA - Targeted surveys conducted.
<i>Myotis macropus</i>	Southern Myotis	Vulnerable	Not listed	NA - Assumed present

Following the removal of threatened species credit species for which potential habitat does not occur within the development site (see Table 12) targeted threatened species surveys were conducted for 12 threatened flora species and three threatened fauna species. The remaining threatened fauna species, Southern Myotis, was assumed to be present based on previous records of the species in the Moorebank Precinct.

4.2.1 Threatened species survey methodology

Targeted threatened flora surveys

Targeted surveys were carried out for threatened flora species listed in Table 12. The surveys were undertaken via walking parallel transects spaced approximately 3 metres apart across the proposed modification footprint and within a 70 metre buffer to the west of the footprint (Figure 4). A 70 metre buffer was used in order to account for areas of occupancy and indirect impacts to threatened species. Where threatened flora species were detected, the number of individuals were recorded and GPS point locations captured. Locations of transects are shown in Table 12.

Table 12: Threatened flora species targeted in surveys

Scientific name	Common name	BC Act status	EPBC Act status	Timing appropriate?
<i>Acacia bynoeana</i>	Bynoe's Wattle	Endangered	Vulnerable	Yes
<i>Acacia pubescens</i>	Downy Wattle	Vulnerable	Vulnerable	Yes
<i>Allocasuarina glaireicola</i>	-	Endangered	Endangered	Yes
<i>Dillwynia tenuifolia</i>	-	Vulnerable	Not listed	Yes
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	Vulnerable	Not listed	Yes
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flowered Grevillea	Vulnerable	Vulnerable	Yes
<i>Hibbertia fumana</i>	-	Critically endangered	Not listed	No (see below)
<i>Hibbertia puberula</i> subsp. <i>puberula</i>	-	Endangered	Not listed	Yes
<i>Micromyrtus minutiflora</i>	-	Endangered	Vulnerable	Yes
<i>Persoonia nutans</i>	Nodding Geebung	Endangered	Endangered	Yes
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	Vulnerable	Vulnerable	Yes
<i>Pultenaea parviflora</i>	-	Endangered	Vulnerable	Yes

Identification of *Hibbertia* species

Targeted surveys for threatened flora species were conducted outside the prescribed survey months (August to December) for *Hibbertia fumana* in the OEH Threatened Species Data Collection (TSDC). Surveys were conducted within the prescribed survey months (September to February) for *Hibbertia puberula* as specified in the TSDC.

Hibbertia puberula subsp. *puberula* recorded in the February 2019 surveys were identified by remnant fruiting and flowering material still attached to plants, which were present on most plants detected. Several plants of the species were in bud and one was in flower. Small samples of stems and leaves were collected from non-flowering plants for microscopic examination, where species can be distinguished by the shape and density of leaf and stem hairs (Plates 1 and 2). Identification of all non-flowering *Hibbertia puberula* subsp. *puberula* and most non-flowering *Hibbertia fumana* were confirmed through field or microscope examination of stem and leaf hairs.



Plate 3 *Hibbertia fumana* leaf and stem hairs viewed through 20x microscope lens



Plate 4 *Hibbertia puberula* subsp. *puberula* leaf and stem hairs viewed through 20x microscope lens

Targeted fauna surveys

Targeted surveys were carried out for species credit species threatened fauna considered to have potential habitat within the development site. These are summarised in in Table 13 and the methodologies applied are detailed in the following sections.

Table 13: Threatened fauna species targeted in surveys

Scientific name	Common name	BC Act status	EPBC Act status	Timing appropriate?
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	Endangered	Not listed	Yes
<i>Phascolarctos cinereus</i>	Koala	Vulnerable	Vulnerable	Yes
<i>Litoria aurea</i>	Green and Golden Bell Frog	Endangered	Vulnerable	Yes
<i>Myotis macropus</i>	Southern Myotis	Vulnerable	Not listed	Assumed present

In addition to the fauna habitat assessment, the fauna survey carried out the following targeted surveys.

Rapid Spot Assessment Technique (SAT)

Rapid SAT surveys for the Koala *Phascolarctos cinereus* (listed as Vulnerable under the BC Act and EPBC Act) were performed at the base of every tree with a diameter at breast height (DBH) greater than 10 cm for a period of 2 minutes at each tree. This totalled 39 trees and locations are shown in Figure 7. The SAT involved an initial inspection of the bottom 1 metre of the surface of the trunk followed by raking of leaf litter and bark to detect older Koala scats.

Canopy Searches

Canopy searches were undertaken across the site for a total of four hours carefully inspecting the canopy of all trees with the naked eye and binoculars to detect Koalas.

Cumberland Plain Land Snail searches

Searches for the Cumberland Plain Land Snail *Meridolum corneovirens* (listed as Endangered under the BC Act) were carried out at the same locations as rapid SAT surveys as well as underneath all suitable shelter habitat such as rocks, fallen logs and artificial material (e.g. corrugated iron sheets) (Figure 7).

Sand track transects

Sand track transects involved the careful inspection of internal sand tracks for animal tracks, scats, diggings and other signs of occurrence. Two transects were completed within or immediately adjacent to the proposed modification footprint, transect 1 was 156 metres long and transect 2 was 268 metres long. The locations of these transects are shown on Figure 7.

Fauna habitat assessment

Substantial fauna habitat assessments and targeted threatened species surveys have been conducted within the MPE Stage 2 site since November 2010. The details of these surveys are comprehensively documented in Table 4-1 of the MPE Stage 2 BAR (Arcadis 2017).

To supplement the previously conducted targeted fauna surveys completed for the MPE Stage 2 Project, and in light of recent threatened species finds within the Wattle Grove Offset Area, additional targeted and habitat based fauna surveys were conducted by Arcadis ecologist Carl Corden over 4 hours on 21 February 2019. The proposed modification footprint and adjacent vegetation was surveyed for the following habitat features:

- Vegetation type, structure and extent
- Wetlands, watercourses, natural and artificial ponds, dams, soaks and drainage channels. No breeding habitat for Green and Golden Bell Frog occurs within the development site, therefore no call-playback surveys could be undertaken.
- Adjacent habitats and barriers (natural or artificial) between the site and adjacent lands
- Hollow-bearing trees species, size of hollows present and signs of fauna occupation
- Forage trees including blossom and fruit trees for birds and Grey-headed Flying Fox, feed trees for Koala and *Allocasuarina* spp. for Glossy Black Cockatoo
- Caves and cliffs
- Artificial microbat roosts (culverts, bridges, tunnels, buildings, mine adits)
- Terrestrial shelter habitat such as coarse woody debris, rock outcrops and artificial shelter (corrugated iron sheets, building refuse, rubbish) for invertebrates, amphibians, reptiles and small terrestrial mammals.

Incidental diurnal fauna surveys

Incidental diurnal fauna surveys involved the recording of all species seen or heard during survey.

MPE Stage 2 : OSD2 Modification BDAR

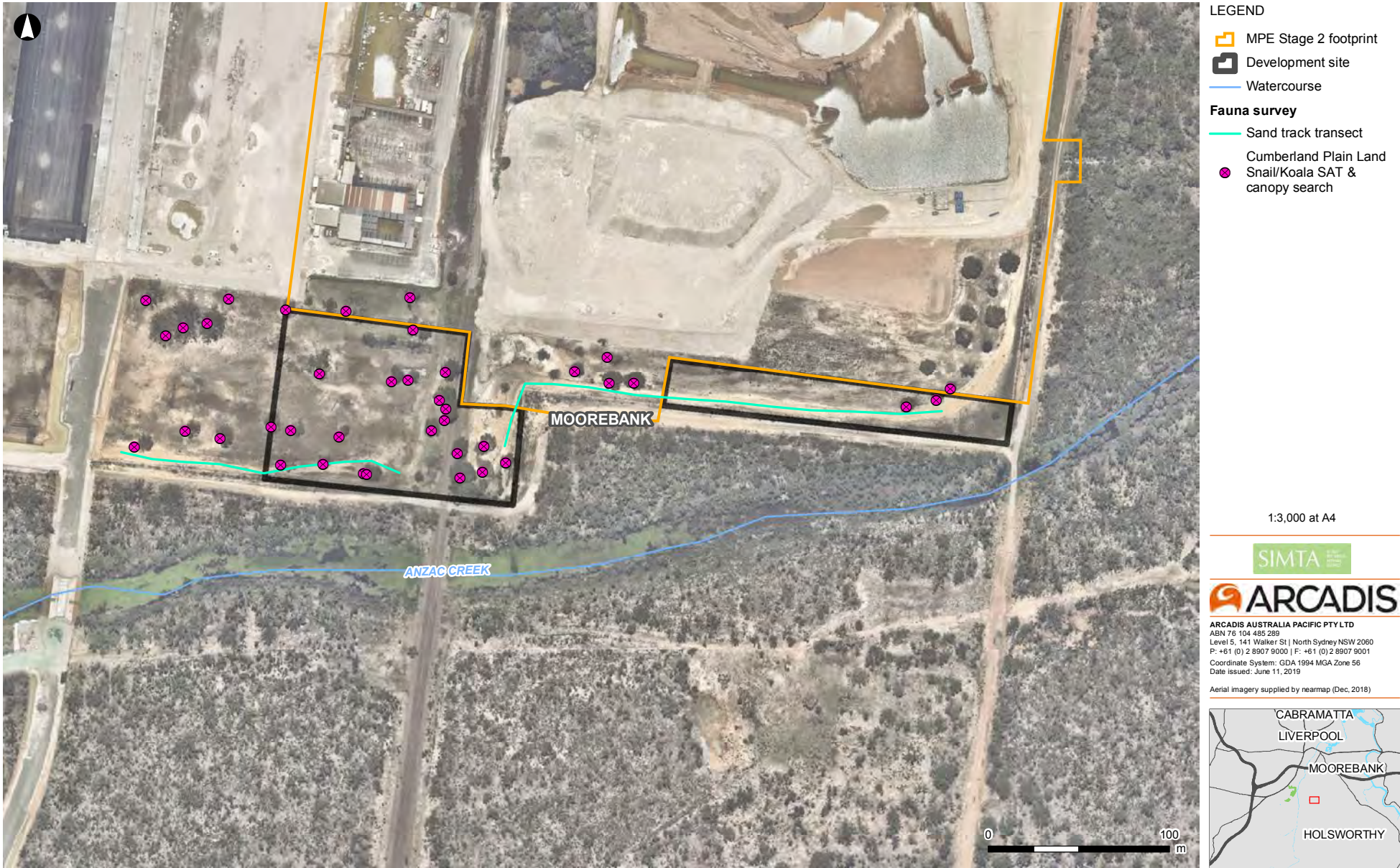


Figure 7: Threatened fauna survey effort

4.2.2 Threatened species survey results

The targeted surveys resulted in the detection of three threatened flora species and no threatened fauna species. A summary of the survey results is provided in Table 14 below.

Table 14: Targeted threatened species survey results

Scientific name	Common name	Presence status	Number/ area	Biodiversity risk weighting
Flora				
<i>Acacia bynoeana</i>	Bynoe's Wattle	Yes (surveyed)	0 ha	2
<i>Acacia pubescens</i>	Downy Wattle	No (surveyed)	-	2
<i>Allocasuarina glauca</i>	-	No (surveyed)	-	3
<i>Dillwynia tenuifolia</i>	-	No (surveyed)	-	1.5
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	No (surveyed)	-	2
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	No (surveyed)	-	2
<i>Hibbertia fumana</i>	-	Yes (surveyed)	0.14 ha	3
<i>Hibbertia puberula</i>	-	Yes (surveyed)	0.59 ha	2
<i>Micromyrtus minutiflora</i>	-	No (surveyed)	-	2
<i>Persoonia nutans</i>	Nodding Geebung	Yes (surveyed)	0.33 ha	2
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	No (surveyed)	-	2
<i>Pultenaea parviflora</i>	-	No (surveyed)	-	2
Threatened fauna				
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	No (surveyed)	-	2
<i>Myotis macropus</i>	Southern Myotis	Yes (assumed present)	0 ha	2
<i>Litoria aurea</i>	Green and Golden Bell Frog	No (surveyed)	-	2
<i>Phascolarctos cinereus</i>	Koala	No (surveyed)	-	2

Threatened flora species

Four threatened flora species were recorded within, or within close proximity to, the proposed modification footprint during surveys: *Persoonia nutans*, *Hibbertia puberula* subsp. *puberula*, *Hibbertia fumana* and *Acacia bynoeana*. Locations of these recorded species are shown in Figure 2.

Impacts to all four of these species are quantified using an area of occupancy calculation in accordance with Section 6.4.1.28 of the BAM. Therefore, for individuals recorded just outside the proposal footprint, their area of occupancy will still be impacted. Area of occupancy is calculated using a 30 metre radius from each individual record, to conservatively ensure that all areas of occupied habitat are captured. The locations and extent of the areas of occupancy are shown in Figure 3.

Acacia bynoeana (Bynoe's Wattle) was recorded as a single individual 70 metres west of the proposal footprint. The plant was observed to be in flower at the time of survey.

Hibbertia fumana was recorded in the far west of the surveyed area, near previous records of the species. The species was not observed in flower, however remnant flowering material was found on some plants which aided identification. No individuals of the species were recorded within the proposal footprint, however one plant was recorded immediately adjacent to the proposal footprint and the area of occupancy of the species overlaps with the western section of the site.

Hibbertia puberula subsp. *puberula* was recorded predominantly in the west of the surveyed area, with scattered individuals recorded in the eastern section of the site. This species was observed in bud, with remnant flowering and fruiting material, and one individual was in flower.

Persoonia nutans was recorded adjoining the southern fenceline in the eastern section of the site, as small sprawling shrubs ranging in height from 15 to 70 centimetres. The upper branches of the shrubs were observed to be denuded or with substantial leaf damage, and numerous weevils (tentatively identified as the native species *Ascerpnodes* sp.) were observed on the upper branches.

MPE Stage 2: OSD2 Modification BDAR

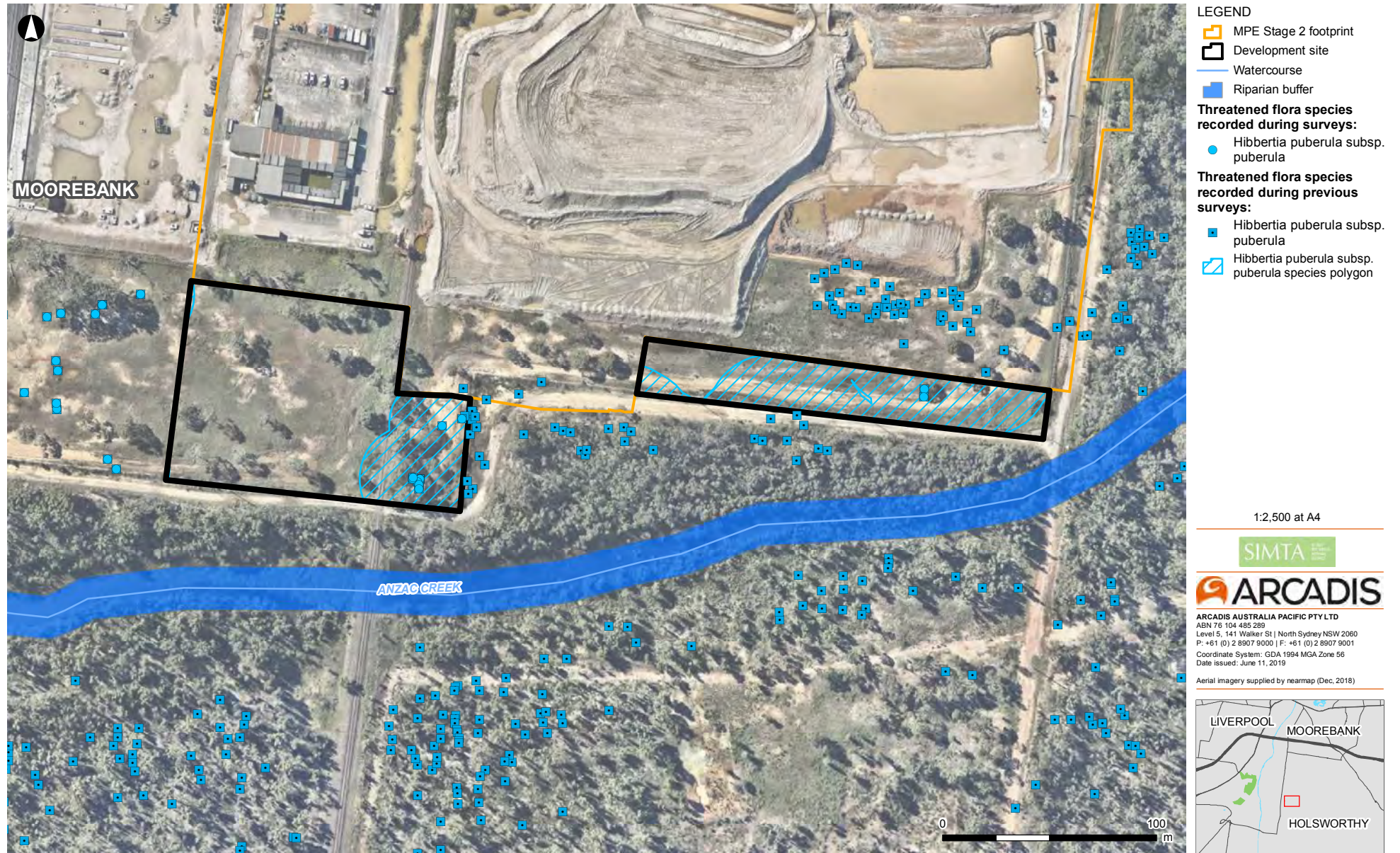


Figure 8: Species polygon for Hibbertia Puberula subsp. Puberula

MPE Stage 2: OSD2 Modification BDAR



Figure 9: Species polygon for Hibbertia Fumana

MPE Stage 2: OSD2 Modification BDAR



Figure 10: Species polygon for Persoonia nutans

Threatened fauna species

No threatened fauna species were detected during surveys. Cumberland Plain Land Snail searches and Koala rapid SAT and canopy searches did not detect either of these species. There was no evidence of Koala occurring or having previously occurred within the development site recorded during the site assessment.

Southern Myotis is assumed to be present based on previous recordings of the species adjacent to the development site. Suitable habitat for Southern Myotis is defined as all habitat on the development site where the development site is within 200m of a waterbody with pools/ stretches 3m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies. Anzac Creek is located less than 25 metres to the south of the development site, however it is ephemeral and heavily vegetated with macrophytes such as *Typha orientalis* and *Bolboschoenus fluvialis*. It does not contain permanent pools that are three metres wide. Since none of the PCT vegetation within the development site is consistent with the features to include within a species polygon for Southern Myotis, no species polygon has been prepared.

While the hollows present in the proposed modification footprint may provide habitat for microbats, there is no potential roosting or breeding habitat for the other species credit bat species identified in Table 12.

Two culverts are present within the proposal footprint, however, due to their small size (diameter of about 300 millimetres) they do not present suitable roosting sites for microbats including the Eastern Bentwing-bat and Little Bentwing-bat.

No breeding habitat for Green and Golden Bell Frog occurs within the development site, therefore no call-playback surveys were undertaken. Similarly, the development site does not occur between two areas of potential breeding habitat such that it could be considered potential dispersal habitat. no potential habitat of any kind was recorded for this species.

Based on the above assessment, no species polygons have been prepared for threatened fauna species.

Aquatic habitats

Anzac Creek comprises a named waterway with intermittent flow supporting semi-permanent water in pools and as such, is classified as Class 3 (Minimal Fish Habitat) in accordance with Fairfull and Witheridge (2003). Anzac Creek is located approximately 25 metres to the south of the development site.

Aquatic habitat types of Anzac Creek include soft substrate pools and extensive macrophyte cover. Water in Anzac Creek was mostly static and shallow; small pools were heavily vegetated with floating and emergent macrophytes.

The introduced *Gambusia* (*Gambusia holbrooki*) was recorded at Anzac Creek. One Long-fin Eel (*Anguilla reinhardtii*) was identified in the upper reaches of Anzac Creek within the MPW site, to the west of the development site.

A total of 23 macroinvertebrate families were recorded in Anzac Creek (ALS 2011). Family diversity was generally low and many sensitive taxa were not recorded. Anzac Creek falls into AUSRIVAS Band B, indicating that the macroinvertebrate community was 'significantly impaired'; fewer families than expected were observed. This result may be attributed to a current/existing 'potential' impact on water quality or habitat quality or both (ALS 2011).

There are no aquatic or riparian habitats within the development site.

BAM (STAGE 2): IMPACT ASSESSMENT (BIODIVERSITY VALUES)

5 AVOID AND MINIMISE IMPACTS

5.1 Measures to avoid and minimise impacts on native vegetation and habitat

The principles in Section 8.1 of the BAM (OEH 2017) have been considered to avoid and minimise impacts on native vegetation and habitat, where possible, through the project development process.

5.1.1 Locating the project

The proposed modification involves a revised design of OSD 2 to incorporate the requirement to have maximum batter slopes of 1V:4H. The updated MPE Stage 2 BAR (Arcadis 2017) outlines how the impacts of the MPE Stage 2 Project were avoided and minimised during planning and design. The avoidance and minimisation steps in Table 15 relate specifically to the proposed modification.

Table 15: Avoidance and minimisation measures implemented during project location

BAM principles	How addressed
(a) locating the project in areas where there are no biodiversity values	Much of the development site is comprised of highly degraded vegetation. Despite this, there are populations of threatened species occurring within it and these would be removed by the proposal. The MPE Stage 2 site is constrained by an active Biobank site to the east and south, therefore there are limited options for relocating the OSD 2.
(b) locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	The development site has been located in the poorest condition portion of the vegetation present. 1.43 hectares of the development site (89%) is comprised of exotic grassland with a vegetation integrity score of 3.1. The native vegetation that would be removed is small in size (0.17 ha) and in degraded condition (integrity score of 30.1)
(c) locating the project in areas that avoid habitat for species that have a high biodiversity risk weighting or native vegetation that is a critically endangered ecological community (CEEC) or an endangered ecological community (EEC)	The development site has been located in a way that avoids direct impacts to the critically endangered <i>Hibbertia fumana</i> plants that occur to the west (although some of the 30 metre buffer area would be impacted). The native vegetation that will be removed is consistent with a vulnerable ecological community under the BC Act and is not consistent with the EPBC Act listed endangered ecological community.
(d) locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained.	The proposed modification would not affect connectivity for species or genetic material.

5.1.2 Designing the project

The avoidance and minimisation measures that have been implemented during the design of the proposed modification are provided in Table 16.

Table 16: Avoidance and minimisation measures implemented during project design

BAM principles	How addressed
(a) reducing the clearing footprint of the project	The clearing footprint for the proposed modification (i.e. the development site) has been reduced in size to the fullest extent practical in order to allow for the

BAM principles	How addressed
	requisite maximum batter slope of 1V:4H and to allow for constructability.
(b) locating ancillary facilities in areas where there are no biodiversity values	No additional ancillary facilities are proposed as a part of the proposed modification. The existing MPE Stage 2 ancillary facilities would be used for construction.
(c) locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	As above.
(d) locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	As above.
(e) providing structures to enable species and genetic material to move across barriers or hostile gaps	Not applicable, the proposed modification would not impact the movement of species or genetic material.
(f) making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.	If approved, the proposed modification would require updates to the existing MPE Stage 2 Construction Environmental Management Plan and sub-plans (including the Construction Flora and Fauna Management Plan). This sub-plan requires the demarcation of clearing boundaries, prevention of spread of weeds, revegetation of batters with native seed mixes and protection of threatened species during construction.

5.2 Measures to avoid and minimise prescribed biodiversity impacts

The BAM (Section 8.2.1.2) and the *Biodiversity Conservation Regulation 2016* (the BC Reg) (clause 6.1) identify actions that are prescribed as impacts to be assessed under the biodiversity offsets scheme. These include:

- Impacts of development on the habitat of threatened species or ecological communities associated with:
 - Karst, caves, crevices, cliffs and other geological features of significance, or
 - Rocks, or
 - Human made structures, or
 - Non-native vegetation
- Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- Impacts of development on movement of threatened species that maintains their life cycle
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)
- Impacts of wind turbine strikes on protected animals
- Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.

It is not anticipated that the proposed modification would result in any of the prescribed impacts listed above. There are no additional potential direct impacts from the proposed modification on water quality, water bodies and hydrological processes beyond those assessed in the MPE Stage 2 BAR

(Arcadis 2017). The potential for indirect impacts on water quality, water quality, water bodies and hydrological processes are considered unlikely, minor and short-term. These will be mitigated through the measures in Section 7.

Although there is 1.43 hectares (89%) of non-native vegetation within the development site, for the purposes of this BDAR, this vegetation has been included as a vegetation zone (PCT 883_Cleared) and therefore the impacts of the removal of this vegetation on threatened species has been considered.

6 ASSESSMENT OF IMPACTS

The following sections outline the potential impacts of the proposed modification. It is anticipated that the proposed modification would result in the removal of all vegetation from within the development site.

6.1 Direct impacts

6.1.1 Native vegetation and threatened flora

The direct impacts of the proposed modification are presented in Table 17 for native vegetation, Table 18 for threatened ecological communities and Table 19 for threatened species.

Table 17: Direct impacts to native vegetation

PCT ID	PCT name	Condition	Vegetation integrity score	Direct impact
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Poor	30.1	0.17
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Cleared	3.1	1.43

Table 18: Direct impacts to threatened ecological communities

TEC name	Listing status	Vegetation zone	Direct impact
Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community	Endangered (EPBC Act)	883_Poor	0.17 ha
Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable (BC Act)		

Table 19: Direct impacts to threatened flora species

Scientific name	Common name	Direct impact	
		883_Poor	883_Cleared
<i>Hibbertia puberula</i> subsp. <i>puberula</i>	<i>Hibbertia puberula</i> subsp. <i>puberula</i>	0.08 ha	0.51 ha
<i>Hibbertia fumana</i>	<i>Hibbertia fumana</i>	0 ha	0.14 ha
<i>Persoonia nutans</i>	Nodding Geebung	0 ha	0.13 ha

6.1.2 Change in vegetation integrity

The proposed modification would result in the removal of all vegetation from within the development site. The reduction in vegetation integrity that would occur in each vegetation zone is outlined in Table 20.

Table 20: Vegetation integrity score before and after impact

Vegetation zone	PCT name	Vegetation integrity score		
		Before impact	After impact	Overall loss
883_Poor	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	30.1	0	-30.1
883_Cleared	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	3.1	0	-3.1

6.1.3 Serious and irreversible impacts

The OEH (2017) *Guidance to assist a decision-maker to determine a serious and irreversible impact* identifies threatened species and ecological communities most at risk of serious and irreversible impacts.

One threatened species at risk of a serious and irreversible impact was identified by the credit calculator: *Hibbertia fumana*, listed as critically endangered under the BC Act (Figure 11). To assist the consent authority to evaluate the nature of an impact on a potential entity at risk of a serious and irreversible impact, the BDAR must contain details of the assessment of serious and irreversible impact, in accordance with the assessment criteria set out in Section 10.2 of the BAM. The information in Table 21 is required by the BAM to be provided for threatened species or populations.

Table 21: Serious and Irreversible Impact Assessment for *Hibbertia fumana*

Impact Assessment Provision	Assessment
The actions and measures taken to avoid direct and indirect impacts on the entities.	The development site has been located in a way that avoids direct impacts to the critically endangered <i>Hibbertia fumana</i> plants that occur to the west (although some of the 30 metre buffer area would be impacted) Figure 11. The development site has been located in the poorest condition portion of the vegetation present. 1.43 hectares of the development site (89%) is comprised of exotic grassland with a vegetation integrity score of 3.1.
The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification	No individuals of <i>Hibbertia fumana</i> were recorded within the development site. A total of 54 plants of the species were recorded within 70 metres to the west of the development site during surveys in February 2019, and more individuals have previously been recorded further west. The core population of <i>Hibbertia fumana</i> is located over 200 metres south of the development site in the Wattle Grove Offset Area. Arcadis (2017) estimated that there were at least 7,972 plants in the core population, based on extrapolation of the species' density by sampling over the area of occupancy.
The extent to which the impact exceeds any threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	There is currently no threshold for <i>Hibbertia fumana</i> specified in the OEH guidance, nor in the Threatened Biodiversity Data Collection. The OEH webpage for Serious and irreversible impacts (OEH, 2019) states that in the absence of thresholds, the consent authority can disregard references to considering thresholds in the OEH guidance when making their determination.
An estimate of the change in habitat available to the local population as a result of the proposed development	The proposal would remove 0.14 hectares of the mapped species polygon for <i>Hibbertia fumana</i>, representing the area within 30 metres of the recorded plants. In comparison, the area of the species polygon for <i>Hibbertia fumana</i> in the Wattle Grove Offset Area is approximately 10.2 hectares (Arcadis 2019).

Impact Assessment Provision	Assessment
	The loss of 0.14 hectares of the species polygon for <i>Hibbertia fumana</i> represents a loss of about 1% of the habitat available to the local population of the species.
The proposed loss, modification, destruction or isolation of the available habitat used by the local population,	The proposal would result in permanent removal of 0.14 hectares of the mapped species polygon for <i>Hibbertia fumana</i> . The remaining habitat to the west of the development site that is used by the local population is already highly modified, consisting of sparse grassland with a long history of mowing. This area will be further isolated as a result of the proposal.
The proposed modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.	The proposal would remove areas of potential further dispersal for <i>Hibbertia fumana</i> , however most of the areas to be directly impacted are currently in poor condition, with a vegetation integrity score of 3.1. The extent to which they represent potential habitat for <i>Hibbertia fumana</i> is not known, however targeted surveys did not record the species in these areas.
For flora, address how the proposal is likely to affect the ecology and biology of any residual plant population that will remain post development including where information is available: – pollination cycle – seedbanks – recruitment, and – interactions with other species (e.g. pollinators, host species, mycorrhizal associations)	Most of the distribution of <i>Hibbertia fumana</i> is in the central southern part of the Wattle Grove Offset Area, and is located over 200 metres to the south of the proposal. It is considered unlikely that the proposal would result in indirect impacts to the core population of the species, given the distance of the population from the area of direct impact. The pollination cycle of <i>Hibbertia fumana</i> is not yet well understood. The species has been observed to mostly flower between September and December, with occasional flowers at other times of the year. <i>Hibbertia</i> species are pollinated primarily by female pollen-collecting bees and some pollen-eating flies (Tucker and Bernhardt 2000). <i>Hibbertia</i> in subgenus <i>Hemistemma</i>, to which <i>H. fumana</i> belongs, have a floral arrangement associated with buzz pollination by bees 7-22 mm long (Tucker and Bernhardt 2000). The level of pollinator specificity for <i>Hibbertia fumana</i>, and the presence of pollinator populations in the Wattle Grove Offset Area, is unknown. The proposal is however unlikely to impact the pollination cycle for the population of <i>Hibbertia fumana</i>. The majority of native vegetation in the Wattle Grove Offset Area will be conserved and managed as a biobank site, which, along with large tracts of native vegetation in the Holsworthy Military Area south of East Hills Rail Line, would provide ample habitat for pollinator populations. The construction of the proposal would not result in fragmentation or isolation of pollinator populations from the core population of <i>Hibbertia fumana</i>. The seed biology of <i>Hibbertia fumana</i> is not yet understood. Seed production has been observed and plants of different ages were observed within the population (NSW Scientific Committee 2017). Seed dormancy is known to occur in several <i>Hibbertia</i> species (NSW Scientific Committee 2010), and <i>H. fumana</i> may have a persistent soil seedbank. If there is a soil-stored seedbank for the species, it is considered unlikely that the majority of it will not be disturbed by the proposal. Similarly, it is considered unlikely that the proposal would affect the mycorrhizal associations of the species, as the soil in the area of the core population would not be disturbed.
A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development	The area of the <i>Hibbertia fumana</i> species polygon that would be cleared as a result of the proposal represents the edge of the known extent of the species in the Moorebank Precinct, with no further records in adjoining areas to the north-east. These adjoining areas are cleared and do not form potential habitat for the species.

Impact Assessment Provision	Assessment
	The proposed modification would result in further isolation of the small sub-population of <i>Hibbertia fumana</i> remaining between the MPE Stage 1 RALP corridor and the development site.
The relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range	There are currently only two known populations of <i>Hibbertia fumana</i>: the population in the Moorebank precinct, most of which occurs within the Wattle Grove offset area; and another population at Bankstown Airport, over 6 km to the north-east. Given that the species has only recently been rediscovered, it is possible that other populations occur in the locality. The population of <i>Hibbertia fumana</i> at Bankstown Airport consists of about 1550 plants with an area of occupancy of 0.61 hectares (Cumberland Ecology, 2018b). The population in the Moorebank Precinct is unlikely to interact with the population at Bankstown Airport, due to the distance between the populations. <i>Hibbertia fumana</i> has a very small range, therefore both populations are at the limits of the known range of the species.
The extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population	The <i>Hibbertia fumana</i> recorded in grassland areas to the west of the proposal are currently threatened by invasive flora, particularly the invasive perennial exotic grass <i>Eragrostis curvula</i>, which is dominant in the development site. The proposed modification would leave an island population of <i>Hibbertia fumana</i> habitat between the MPE Stage 1 RALP corridor and the development site. This island would be susceptible to edge effects due to its high perimeter to area ratio, therefore adequate mitigation will be important to managing these indirect impacts. The core population of <i>Hibbertia fumana</i> is located over 200 metres to the south of the proposal in the Wattle Grove offset area and would not be subject to indirect impacts as a result of the proposal.
The measure/s proposed to contribute to the recovery of the species in the Interim Biogeographic Regionalisation for Australia (IBRA) subregion.	The Threatened Biodiversity Data Collection (OEH 2019) lists seven management actions for <i>Hibbertia fumana</i>: • Assess threats and determine recovery strategies • Captive Husbandry or ex-situ collection/propagation • Community and land-holder liaison/ awareness and/or education • Habitat Rehabilitation/Restoration and/or Regeneration • Monitoring • Habitat management: Site Protection (eg Fencing/Signage) • Survey and/or Mapping Most of these management actions are being implemented as part of development of the Moorebank Precinct (survey, mapping, assessment, ex-situ collection and propagation) and within the Wattle Grove Offset Area (habitat management and restoration, monitoring).

MPE Stage 2 : OSD2 Modification BDAR



Figure 11: Serious and Irreversible Impacts

6.2 Indirect Impacts

The BAM (Section 9.1.4.2) outlines 16 potential indirect impacts that must be considered as a part of a BDAR, as a minimum. The majority of these indirect impacts are not relevant to the proposed modification and are therefore not considered further. Table 23 provides consideration of the indirect impacts of the proposed modification on biodiversity values.

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Table 22: Potential indirect impacts of the proposed modification

Indirect impact type	Nature	Extent	Frequency	Duration	Timing
Inadvertent impacts on adjacent habitat or vegetation	The development site contains and is in close proximity to threatened species and ecological communities that will be retained during construction and operation. Construction activities in proximity to threatened plants and ecological communities to be retained presents a risk of inadvertent impacts. Although the consequence of inadvertent impacts is potentially high, the probability is low based on the implementation of relevant mitigation measures.	Adjacent vegetation	Ongoing during construction activities	Throughout the construction period	Potentially permanent
Reduced viability of adjacent habitat due to edge effects	The vegetation immediately adjacent to the development is typically degraded. A large patch of intact vegetation occurs to the south of the development site (the Wattle Grove Offset Area and this vegetation is also part of a Biobank site. An existing, unsealed access road is located between the development site and the biobank site. There are existing edge effects associated with this unsealed road and it is considered unlikely that these would be exacerbated by the proposed modification. The proposed modification would leave an island population of <i>Hibbertia puberula</i> subsp. <i>puberula</i>, <i>Hibbertia furmana</i> and <i>Acacia bynoeana</i> habitat between the MPE Stage 1 RALP corridor and the development site. This island would be susceptible to edge effects due to its high perimeter to area ratio, therefore adequate mitigation will be important to managing these indirect impacts.	Adjacent vegetation	Ongoing during construction and operation activities	Throughout the construction and operation period	Potentially long term
Reduced viability of adjacent habitat due to noise, dust or light spill	Construction of OSD 2 has the potential to increase dust pollution which could have a negative impact on threatened plants occurring on adjacent land. Monitoring of populations of the species that occur in proximity to existing construction activities have not detected any indirect impacts to date, including from dust. It is considered that the additional potential impacts of dust that can be attributed to the proposed modification would be negligible. No additional impacts from noise or light spill are anticipated.	Adjacent vegetation	Ongoing during construction activities	Throughout the construction period	Short term
Transport of weeds and pathogens from the site to adjacent vegetation	The development area and immediately surrounding vegetation contains a high proportion of exotic grasses, particularly African Love Grass. Whilst there is a potential risk of spreading exotic species to areas beyond the development site, it is considered unlikely that this	Adjacent vegetation	Ongoing during construction activities	Throughout the construction period	Potentially long term

Indirect impact type	Nature	Extent	Frequency	Duration	Timing
	would further degrade the habitat for threatened species known to occur there based on the existing levels of degradation.				
Increased risk of starvation, exposure and loss of shade or shelter	The proposed modification is not expected to result in any indirect impacts resulting in an increased risk of starvation, exposure and loss of shade or shelter.	NA	NA	NA	NA
Loss of breeding habitats	The proposed modification is not expected to result in any loss of breeding habitats.	NA	NA	NA	NA
Trampling of threatened flora species	Construction personnel and heavy machinery would be operating in close proximity to threatened flora species that would be retained. This interaction presents a risk of trampling of threatened species. The likelihood of this happening is considered low as these plants would be afforded suitable protection pre-construction.	Adjacent vegetation	Ongoing during construction and operation activities	Throughout the construction and operation period	Potentially permanent
Inhibition of nitrogen fixation and increased soil salinity	The proposed modification is not expected to result in any inhibition of nitrogen fixation.	NA	NA	NA	NA
Fertiliser drift	The proposed modification is not expected to result in any fertiliser drift.	NA	NA	NA	NA
Rubbish dumping	The proposed modification is not expected to result in any additional rubbish dumping.	NA	NA	NA	NA
Wood collection	The proposed modification is not expected to result in any wood collection.	NA	NA	NA	NA
Bush rock removal and disturbance	The proposed modification is not expected to result in any bush rock removal or disturbance.	NA	NA	NA	NA
Increase in predatory species populations	The proposed modification is not expected to result in any increase in predatory species populations	NA	NA	NA	NA
Increase in pest animal populations	The proposed modification is not expected to result in any increase in pest animal populations.	NA	NA	NA	NA
Increased risk of fire	The proposed modification is not expected to result in any increased risk of fire.	NA	NA	NA	NA
Disturbance to specialist breeding and	The proposed modification is not expected to result in any disturbance to specialist breeding and foraging habitat.	NA	NA	NA	NA

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Indirect impact type	Nature	Extent	Frequency	Duration	Timing
foraging habitat, e.g. beach nesting for shorebirds.					
Impacts to aquatic habitats	Whilst no instream vegetation within Anzac Creek would be directly impacted as a result of the proposed modification, construction activities approximately 25 metres from Anzac Creek have the potential to adversely affect aquatic habitat. The proposed modification includes construction of an OSD within the development site that would capture surface flows from the MPE site and discharge via an outlet to the east, towards Anzac Creek. The key aim of the stormwater plan for the MPE project is to maintain or improve existing water quality. OSD 2 would perform biofiltration to reduce pollutant loads, namely total suspended solids, phosphorus and nitrogen. It has been designed to attenuate both the 1 year and 100 year average recurrence interval (ARI) event flows therefore indirect impacts are considered unlikely to be significant.	Anzac Creek downstream of the outlet	Ongoing during construction and operation	Immediately following storm events	Short term

7 MITIGATION OF IMPACTS

Biodiversity impacts cannot be avoided for many aspects of the proposed modification. As such, the measures in Table 24 should be implemented to mitigate these impacts during construction and operation. These mitigation measures have been compiled with reference to those adopted on the MPE Stage 2 Project to ensure consistency with the wider project.

Table 23: Measures to be implemented to minimise impacts on biodiversity

Mitigation measure	Outcome	Timing	Responsibility
A revised Construction Flora and Fauna Management Plan (CFFMP) would be prepared. Clearing of native vegetation and threatened species habitat within the development site would not occur until the Flora and Fauna Management Plan is approved. This would include the following: • Updates to the environmental constraints maps to clearly identify the locations of threatened species within and adjacent to the proposed modification site (the development site) • Updates to avoid and minimise indirect impacts to threatened species and ecological communities located adjacent to the development site • Clear identification of vegetation exclusion zones • Any required updates to the site induction procedure • Pre-clearance surveys of threatened flora species to confirm the number of individuals/area of habitat being impacted and requiring offset	Flora and fauna would be managed in accordance with the requirements of the FFMP; prevention of over clearing of vegetation; prevention of weed establishment and invasion.	Pre-construction and construction	SIMTA and construction contractor
Threatened plant populations occurring within 30 metres of the development site would be monitored to ensure they are not being indirectly impacted by the proposal. Where impacts are detected, the project ecologist would prepare an adaptive management plan to avoid further impacts. To avoid doubt, this mitigation measure would not apply to threatened species located within the BA341 biobank site, which are subject to alternative management and monitoring.	Prevention of indirect impacts to threatened plant species.	Monthly during construction and annually during the first 5 years of operation.	Construction contractor
Where possible, topsoil sourced from within the Moorebank Precinct would be used instead of imported fill for the OSD batters. Revegetation of batters would use local native shrub and ground layer species.	Conservation of existing soils that may contain propagules of threatened plant species and minimisation of spread of exotic species	Pre-construction and construction	Construction contractor
Undertake a two-stage approach to clearing: • Remove non-hollow bearing trees at least 48 hours before habitat trees are removed. • Hollow bearing trees are to be knocked with an excavator bucket or other machinery to encourage fauna to evacuate the tree immediately prior to felling. • Felled trees must be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further processing of the trees.	Prevents fauna injury/mortality	Construction	Construction contractor

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Mitigation measure	Outcome	Timing	Responsibility
Felled hollow bearing trees must be inspected by an ecologist as soon as possible (not longer than 2 hours after felling).			
Site inductions are to include a briefing regarding the local fauna of the site and protocols to be undertaken if fauna are encountered.	Prevents fauna injury/mortality	Construction	Construction contractor
If any animal is injured, contact the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by: - Handling fauna with care and as little as possible. - Covering larger animals with a towel or blanket and placing in a large cardboard box. - Placing small animals in a cotton bag, tied at the top. - Keeping the animal in a quiet, warm, ventilated and dark location.	Prevents fauna injury/mortality	Pre-construction, construction and operation	Construction contractor and SIMTA
Directional lighting will be used where lighting is required in construction areas.	Minimises disruption to fauna foraging, nesting or roosting behaviours	Construction	Construction contractor
Frequent maintenance of construction machinery and plant will be undertaken to minimise unnecessary noise.	Minimises disruption to fauna foraging, nesting or roosting behaviours	Construction	Construction contractor
The Flora and Fauna Management Plan that has been prepared as part of the OEMP for the MPE Stage 2 Project will be updated to address the operational impacts associated with the proposed modification.	Prevention of impacts to flora and fauna within conservation area.	Pre-construction/construction	Construction contractor

8 IMPACT SUMMARY AND OFFSETS

The following section summarises the impacts of the proposed modification and outlines the offsets required in accordance with the BAM.

8.1 Serious and irreversible impacts

Consideration of the impacts to serious and irreversible impacts candidate species *Hibbertia fumana* has been given in Section 6.1.3. Since SAI thresholds have not yet been published for *Hibbertia fumana*, all potential impacts are considered to be potentially serious and irreversible. Impacts to *Hibbertia fumana* include the removal of 0.14 hectares of habitat for the species. This area has been calculated by considering all land within 30 metres of a known record to be potential habitat. Since the proposed modification would not result in direct impacts to individuals of *Hibbertia fumana* (as no plants occur within the development site) the proposal is considered unlikely to result in a serious and irreversible impact to the species.

8.2 Impacts requiring offset

8.2.1 Impacts on native vegetation

The impacts of the proposed modification on native vegetation that require offset (in accordance with Section 10.3.1 of the BAM) are outlined in Table 25 and Figure 12.

Table 24: Impact summary for PCTs requiring offsets and the associated ecosystem credit requirement

Vegetation zone	PCT Name	Vegetation Class	Area to be impacted	Change in vegetation integrity score	Credits required
1 (883_Poor)	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Sydney Sand Flats Dry Sclerophyll Forests	0.17 ha	-30.1	2

8.2.2 Impacts on threatened species

The impacts of the proposed modification on native vegetation that require offset (in accordance with Section 10.3.2 of the BAM) are outlined in Table 26 and Figure 12.

Offsets for threatened species are calculated by multiplying the area of habitat, integrity score, risk weighting and a coefficient of 0.25. A combination of the small area of loss and very low vegetation integrity for much of the habitat present is driving the low offset requirement. The *Hibbertia fumana* habitat being removed requires zero credits in accordance with the BAM. The BAMC credit report for the development site is provided in Appendix B.

Table 25: Impact summary for threatened species credit species requiring offsets and the associated species credit requirements

Scientific name	BC Act status	EPBC Act status	Vegetation Zone	Habitat integrity score	Direct impact area	Credits required
<i>Hibbertia puberula</i> subsp. <i>puberula</i>	Endangered	Not listed	883_Poor	30.1	0.08	1
			883_Cleared	3.1	0.52	1
<i>Hibbertia fumana</i>	Critically endangered	Not listed	883_Cleared	3.1	0.14	0
<i>Persoonia nutans</i>	Endangered	Endangered	883_Cleared	3.1	0.33	1

MPE Stage 2 : OSD2 Modification BDAR



- LEGEND
- MPE Stage 2 footprint
 - Development site
 - Plant Community Type**
 - Hard-leaved Scribbly Gum – Parramatta Red
 - Gum heathy woodland (883_Poor)
 - Threatened species**
 - Hibbertia fumana species polygon
 - Hibbertia puberula subsp. puberula species polygon
 - Persoonia nutans species polygon

1:2,500 at A4

SIMTA

ARCADIS

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Coordinate System: GDA 1994 MGA Zone 56
Date issued: June 11, 2019

Aerial imagery supplied by Nearmap (Mar, 2019)

Figure 12: Impacts Requiring Offset

8.3 Impacts not requiring offset

The impacts of the proposed modification on native vegetation that require offset (in accordance with Section 10.3.3 of the BAM) are outlined in Table 27 and Figure 13. These impacts are limited to native vegetation¹ and ecosystem credit species habitat in highly degraded condition (i.e. with a vegetation integrity score less than 15).

Table 26: Impacts to native vegetation not requiring offset

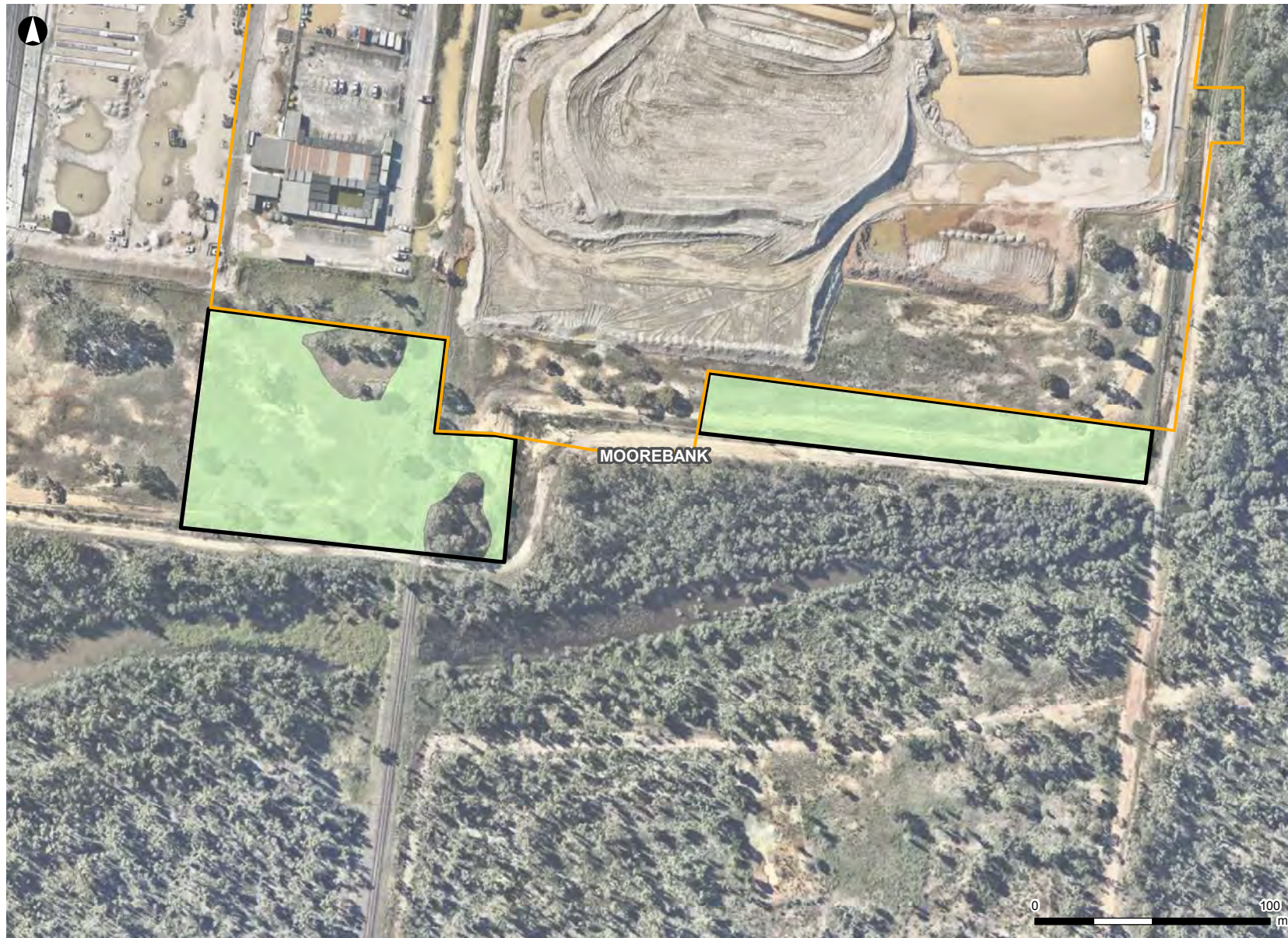
Vegetation zone	PCT Name	Vegetation Class	Area to be impacted	Change in vegetation integrity score	Credits required
1 (883_Cleared)	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Sydney Sand Flats Dry Sclerophyll Forests	1.43 ha	-3.1	0

8.4 Areas not requiring assessment

All parts of the development site have been classified as a PCT for the purpose of assessing under the BAM, therefore there are no areas that do not require assessment.

¹ The 883_Cleared vegetation zone is not considered native vegetation however for the purpose of assessing its integrity score it was entered into the BAMC as a cleared form of PCT 883.

MPE Stage 2 : OSD2 Modification BDAR



LEGEND

- MPE Stage 2 footprint
- Development site
- Plant Community Type**
 - Hard-leaved Scribbly Gum – Parramatta Red
 - Gum heathy woodland (883_Cleared)

1:2,500 at A4

SIMTA

ARCADIS

ARCADIS AUSTRALIA PACIFIC PTY LTD
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 Coordinate System: GDA 1994 MGA Zone 56
 Date issued: June 11, 2019

Aerial imagery supplied by Nearmap (Mar, 2019)



Figure 13: Impacts not requiring offset

9 OFFSET STRATEGY

The impacts of the proposed modification have been assessed in accordance with the BC Act and the BAM. As such, the offset requirement presented in Section 8.2 of this BDAR are in the form of BAM credits. To date, all projects within MPE and Moorebank Precinct West (MPW) have been assessed in accordance with the FBA and have therefore had a requirement for BBAM credits.

A biobank site (BA341) (WSP 2018) has been established within the Moorebank Precinct and is generating a suite of Biobanking Credits that are being used to offset other MPE and MPW projects. Whilst the BBAM credits being generated by BA341 could be converted to BAM credits required by the proposed modification (see Section 8.2), there is a net shortfall of credits across the precinct for PCT 833 (ME003), *Persoonia nutans* and *Hibbertia puberula* subsp. *puberula* therefore this is unlikely to be a viable option.

9.1 Biodiversity Conservation Fund

It is proposed that the offset requirement for the proposed modification be wholly met through a contribution to the Biodiversity Conservation Fund (BCF). The BCF is administered by the Biodiversity Conservation Trust (BCT) whom take on responsibility for sourcing the requisite land offsets from a proponent once the payment to the BCF has been made. Table 28 outlines the required financial contribution for offsets required by the proposed modification.

Table 27: BCT contribution for offsets required by the proposed modification (see Appendix B)

PCT/species name	Impact	Price per credit	Credits required	Total price
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion (PCT883)	0.17 ha	\$13,186.69	2	\$26,373.38
<i>Hibbertia puberula</i> subsp. <i>puberula</i>	0.59	\$2,096.03	2	\$4,192.06
<i>Hibbertia fumana</i>	0.14	NA	0	NA
<i>Persoonia nutans</i>	0.33	\$1,730.17	1	Must contact BCT for pricing

10 CONCLUSION

This Biodiversity Development Assessment Report (BDAR) has been prepared by an accredited Person (Ed Cooper BAAS18047) to support a modification to the *Moorebank Precinct East-Stage 2 Project* (SSD 7628). This BDAR considers the potential impacts of the proposed modification which comprises two elements:

- Revision of the construction and operation footprint at the southern extent of the site to include the revised design for OSD 2 that addresses the requirement for OSDs to have maximum batter slopes of 1V:4H: and
- Removal of the requirement for batter slopes to allow OSD9, located at the north-west of the site, to be constructed without the 1V:4H batters and instead to be constructed with vertical walls.

The transitional period for the *Biodiversity Conservation Act 2016* expired for modifications to State Significant Development projects on 24 February 2019. As such, the proposed modification is subject to the provisions of the BC, Act which require the preparation of a Biodiversity Development Assessment Report in accordance with the BAM.

This BDAR is based on desktop research and detailed field surveys, undertaken across the MPE site on a number of occasions between 2011 and 2019. Most recently, supplementary field investigations of the development site were conducted in February and May 2019.

The biodiversity impacts and offset requirements for the development site were calculated using the BAMC in accordance with the BAM.

The vegetation within the development site is predominantly comprised of exotic grassland vegetation, with two small patches of modified native vegetation. This native vegetation has been classified as Plant Community Type (PCT) 883 *Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion*. All vegetation within the development site has been categorised into one of two PCT 883 vegetation zones; '883_Poor' incorporating the degraded woodland vegetation and '883_Cleared' incorporating the exotic grassland. A summary of these vegetation zones, along with the threatened ecological community equivalence is provided in Table 29.

Table 28: PCTs and TECs within the development site

Plant Community Type	Vegetation Zone	Extent	Vegetation integrity score	BC Act TEC	EPBC Act TEC
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	883_Poor	0.17 ha	30.1	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion (vulnerable)	Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community (endangered)
	883_Cleared	1.43 ha	3.1	Not equivalent	Not equivalent

A total of 15 threatened flora species were identified as candidate species credit species in the BAMC. Three of the candidate threatened flora species were considered unlikely to occur within the development site based on an absence of potential habitat. These three species were not considered further. Targeted surveys were undertaken for the remaining 12 candidate threatened flora species during February 2019. These surveys were seasonally appropriate for all threatened species except *Hibbertia fumana*. Four threatened flora species were recorded within and adjoining the development site during the February 2019 surveys, including *Acacia bynoeana*, *Hibbertia puberula* subsp. *puberula*, *Hibbertia fumana* and *Persoonia nutans*.

A total of 22 threatened fauna species were identified as candidate species credit species in the BAMC. Eighteen of the candidate threatened fauna species were considered unlikely to occur within the development site based on an absence of potential habitat. Targeted surveys were conducted for

three of the remaining candidate threatened fauna species during February 2019. These species were Koala, Cumberland Plain Land Snail and Green and Golden Bell Frog. None of these species were detected. The final candidate species, Southern Myotis, was assumed to be present based on previous records of the species nearby.

Based on the records of the targeted threatened species surveys, species polygons have been prepared for threatened flora species. Whilst Southern Myotis was assumed to be present, none of the features that are required to be included in a species polygon are present within the development site.

The BDAR considered the construction and operational impacts of the proposed modification. The potential biodiversity impacts of the proposed modification are as follows:

- Clearing of all vegetation within the development site including one threatened ecological community. The total area of vegetation to be cleared is 1.60 hectares; the areas of native vegetation to be cleared comprise two small, fragmented patches of vegetation totalling 0.17 hectares. The total area to be cleared consists of one plant community type (PCT): Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin. This PCT corresponds with the TEC *Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion*, which is listed as vulnerable under the BC Act and *Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community* listed as endangered under the EPBC Act.
- The proposed modification will have direct impacts on habitat for three threatened plant species (all of which are 'area' assessed species), including:
 - *Hibbertia puberula* subsp. *puberula* (0.59 hectares)
 - *Hibbertia fumana* (0.14 hectares)
 - *Persoonia nutans* (0.33 hectares).
- *Hibbertia fumana* is a candidate species for Serious and Irreversible Impacts. An assessment of the potential impacts of the proposed modification against the Serious and Irreversible Impacts criteria has been undertaken and a Serious and Irreversible Impact to the species is considered unlikely.
- Potential indirect impacts on records of *Persoonia nutans* and *Hibbertia puberula* subsp. *puberula* in the Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland immediately adjoining the southern extent of the MPE Stage 2 site. Indirect impacts may include increased sedimentation, changes to hydrology and increased risk of weed invasion, from adjoining areas.
- Some loss of specific fauna habitat components, including live trees, tree hollows, foraging resources, and groundlayer habitats such as ground timber and minor leaf litter.
- The small areas of habitat to be removed from within the development site for the proposed modification are currently fragmented by the existing development. There is good quality fauna habitat on land immediately adjacent to the proposed modification site, known as the Wattle Grove Offset Area, which would be retained. The Wattle Grove Offset Area contains approximately 83 hectares of native vegetation in moderate to good condition which would not be impacted by the proposed modification and is protected in-perpetuity under Biobanking Agreement BA341.
- Minimal impact on wildlife and habitat corridors as neither the proposed modification would not alter existing connectivity values and would not further sever native vegetation or form a hard barrier within existing connecting links.

Impacts on the identified ecological values have been avoided in the proposed modification as far as practicable. Where impacts cannot be avoided, the scale and extent of impacts has been determined, and a range of mitigation measures have been recommended to ameliorate impacts on the biodiversity values during construction and operation.

The following offset requirements have been determined for the proposed modification:

- 2 ecosystem credits for Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin.

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

- 2 species credits for *Hibbertia puberula* subsp. *puberula*.
- 0 species credit species for *Hibbertia fumana*
- 1 species credits for *Persoonia nutans*.

It is anticipated that the timing of offsets for the proposed modification will be subject to similar requirements to MPE Stage 2 (i.e. Condition of Consent B104) and evidence of the retirement of credits will be required prior to the impacting of associated native vegetation and threatened species. The required number of offsets will be met through a combination of making a payment to the BCT and purchasing credits from offsite sources.

11 REFERENCES

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APPENDIX A: BAM PLOT DATA

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Table 29: BAM plot data

(Key: HTE – High Threat Exotic, C – Cover, A – Abundance)

Scientific Name	Common Name	Family	Growth form	HTE	BK1		BK2		BK3		BK4	
					C	A	C	A	C	A	C	A
Native species												
<i>Alternanthera denticulata</i>	Lesser Joyweed	<i>Amaranthaceae</i>	Forb (FG)								0.5	200
<i>Acacia binervia</i>	Coast Myall	<i>Fabaceae Mimosoideae</i>	Tree (TG)		1	5						
<i>Acacia decurrens</i>	Black Wattle	<i>Fabaceae (Mimosoideae)</i>	Tree (TG)								1	10
<i>Acacia falcata</i>		<i>Fabaceae (Mimosoideae)</i>	Shrub (SG)								0.1	1
<i>Acacia floribunda</i>	White Sally	<i>Fabaceae Mimosoideae</i>	Shrub (SG)		2	20						
<i>Acacia longifolia</i>		<i>Fabaceae (Mimosoideae)</i>	Shrub (SG)								2	40
<i>Acacia parramattensis</i>	Parramatta Green Wattle	<i>Fabaceae Mimosoideae</i>	Tree (TG)		10	100						
<i>Angophora floribunda</i>	Rough-barked Apple	<i>Myrtaceae</i>	Tree (TG)		10	50						
<i>Aristida ramosa</i>	Purple Wiregrass	<i>Poaceae</i>	Grass & grasslike (GG)		1	50	1	100			0.2	50
<i>Aristida warburgii</i>	Wiregrass	<i>Poaceae</i>	Grass & grasslike (GG)		1	25						
<i>Astroloma humifusum</i>	Native Cranberry	<i>Ericaceae</i>	Shrub (SG)		1	5	0.1	1				
<i>Baumea articulata</i>	Jointed Twig-rush	<i>Cyperaceae</i>	Grass & grasslike (GG)								2	500
<i>Bothriochloa macra</i>	Red Grass	<i>Poaceae</i>	Grass & grasslike (GG)						1	50		
<i>Cassytha glabella</i>		<i>Lauraceae</i>	Other (OG)		1	5						
<i>Cassytha pubescens</i>	Downy Dodder-laurel	<i>Lauraceae</i>	Other (OG)				0.1	20				
<i>Centella asiatica</i>	Indian Pennywort	<i>Apiaceae</i>	Forb (FG)								1	200
<i>Cynodon dactylon</i>	Common Couch	<i>Poaceae</i>	Grass & grasslike (GG)		3	300	25	200	1	100	10	500
<i>Dichondra repens</i>	Kidney Weed	<i>Convolvulaceae</i>	Forb (FG)								0.1	1

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Scientific Name	Common Name	Family	Growth form	HTE	BK1		BK2		BK3		BK4	
					C	A	C	A	C	A	C	A
<i>Drosera spatulata</i>		<i>Droseraceae</i>	Forb (FG)				0.1	1				
<i>Eragrostis brownii</i>	Brown's Lovegrass	<i>Poaceae</i>	Grass & grasslike (GG)		2	200						
<i>Eragrostis leptostachya</i>	Paddock Lovegrass	<i>Poaceae</i>	Grass & grasslike (GG)				2	200				
<i>Eucalyptus saligna x botryoides</i>		<i>Myrtaceae</i>	Tree (TG)		2	1						
<i>Eucalyptus parramattensis</i>	Parramatta Red Gum	<i>Myrtaceae</i>	Tree (TG)						2	1		
<i>Eucalyptus sclerophylla</i>	Hard-leaved Scribbly Gum	<i>Myrtaceae</i>	Tree (TG)		8	2			1	0	10	8
<i>Fimbristylis dichotoma</i>	Common Fringe-sedge	<i>Cyperaceae</i>	Grass & grasslike (GG)						0.1	15	2	500
<i>Fimbristylis dichotoma</i>		<i>Cyperaceae</i>	Grass & grasslike (GG)		1	50						
<i>Glycine clandestina</i>	Twining glycine	<i>Fabaceae (Faboideae)</i>	Other (OG)						0.2	20		
<i>Glycine tabacina</i>	Variable Glycine	<i>Fabaceae (Faboideae)</i>	Other (OG)								0.1	5
<i>Goodenia hederacea</i>	Ivy Goodenia	<i>Goodeniaceae</i>	Forb (FG)		1	50						
<i>Goodenia paniculata</i>		<i>Goodeniaceae</i>	Forb (FG)								0.5	500
<i>Gratiola pedunculata</i>		<i>Scrophulariaceae</i>	Forb (FG)								0.1	50
<i>Hardenbergia violacea</i>	False Sarsaparilla	<i>Fabaceae Faboideae</i>	Other (OG)		1	5						
<i>Hibbertia puberula</i> subsp. <i>puberula</i>		<i>Dilleniaceae</i>	Shrub (SG)		0.1	5						
<i>Juncus prismatocarpus</i>		<i>Juncaceae</i>	Grass & grasslike (GG)								1	100
<i>Juncus usitatus</i>		<i>Juncaceae</i>	Grass & grasslike (GG)								1	100
<i>Kunzea ambigua</i>	Tick Bush	<i>Myrtaceae</i>	Shrub (SG)		10	50	3	100				
<i>Leptospermum juniperinum</i>	Prickly Tea-tree	<i>Myrtaceae</i>	Shrub (SG)								3	50
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	<i>Lomandraceae</i>	Grass & grasslike (GG)								5	100

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Scientific Name	Common Name	Family	Growth form	HTE	BK1		BK2		BK3		BK4	
					C	A	C	A	C	A	C	A
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark	<i>Myrtaceae</i>	Shrub (SG)								0.1	1
<i>Microlaena stipoides</i>	Weeping Grass, Meadow Rice-grass	<i>Poaceae</i>	Grass & grasslike (GG)		1	100						
<i>Opercularia diphylla</i>	Stinkweed	<i>Rubiaceae</i>	Forb (FG)		1	25						
<i>Persoonia nutans</i>	Nodding Geebung	<i>Proteaceae</i>	Shrub (SG)				0.2	4				
<i>Themeda australis</i>	Kangaroo Grass	<i>Poaceae</i>	Grass & grasslike (GG)								1	25
<i>Themeda triandra</i>	Kangaroo Grass	<i>Poaceae</i>	Grass & grasslike (GG)		1	10						
Exotic species												
<i>Alternanthera philoxeroides</i>	Alligator Weed	<i>Amaranthaceae</i>	Exotic	Yes							0.5	200
<i>Alternanthera pungens</i>	Khaki Weed	<i>Amaranthaceae</i>	Exotic		1	50						
<i>Andropogon virginicus</i>	Whisky Grass	<i>Poaceae</i>	Exotic	Yes					0.1	2	1	100
<i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass	<i>Poaceae</i>	Exotic	Yes			5	200	0.1	50	10	500
<i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass	<i>Poaceae</i>	Exotic		1	50						
<i>Briza subaristata</i>		<i>Poaceae</i>	Exotic	Yes							1	100
<i>Conyza bonariensis</i>	Fleabane	<i>Asteraceae</i>	Exotic						0.1	1		
<i>Cortaderia selloana</i>	Pampas Grass	<i>Poaceae</i>	Exotic	Yes							1	10
<i>Cyperus eragrostis</i>	Umbrella Sedge	<i>Cyperaceae</i>	Exotic	Yes							0.2	200
<i>Ehrharta erecta</i>	Panic Veldtgrass	<i>Poaceae</i>	Exotic	Yes							1	100
<i>Eragrostis cilianensis</i>	Stinkgrass	<i>Poaceae</i>	Exotic						2	400		
<i>Eragrostis curvula</i>	African Lovegrass	<i>Poaceae</i>	Exotic	Yes	10	1000	40	1000	85	1000	30	1000
<i>Gamochaeta coarctata</i>	Cudweed	<i>Asteraceae</i>	Exotic								0.1	20
<i>Gomphrena celosioides</i>	Gomphrena Weed	<i>Amaranthaceae</i>	Exotic						0.2	50		
<i>Hypochaeris radicata</i>	Catsear	<i>Asteraceae</i>	Exotic						0.2	30	0.1	20

MPE STAGE 2: MODIFICATION (SSD 7628-MOD 2) – BDAR

Scientific Name	Common Name	Family	Growth form	HTE	BK1		BK2		BK3		BK4	
					C	A	C	A	C	A	C	A
<i>Ludwigia peruviana</i>		<i>Onagraceae</i>	Exotic	Yes							0.1	2
<i>Olea europaea subsp. cuspidata</i>	African Olive	<i>Oleaceae</i>	Exotic	Yes	1	1						
<i>Paspalum dilatatum</i>	Paspalum	<i>Poaceae</i>	Exotic	Yes	2	200	0.1	5	0.2	50	0.2	50
<i>Paspalum urvillei</i>	Vasey Grass	<i>Poaceae</i>	Exotic								0.2	200
<i>Pennisetum clandestinum</i>	Kikuyu Grass	<i>Poaceae</i>	Exotic								1	20
<i>Plantago lanceolata</i>	Lamb's Tongues	<i>Plantaginaceae</i>	Exotic						0.1	20	0.1	20
<i>Richardia humistrata</i>		<i>Rubiaceae</i>	Exotic				2	200	1	200	1	100
<i>Senecio madagascariensis</i>	Fireweed	<i>Asteraceae</i>	Exotic	Yes					0.5	100	0.1	25
<i>Setaria parviflora</i>		<i>Poaceae</i>	Exotic						0.2	50	2	200
<i>Solanum nigrum</i>	Black-berry Nightshade	<i>Solanaceae</i>	Exotic								0.1	5
<i>Sonchus oleraceus</i>	Common Sowthistle	<i>Asteraceae</i>	Exotic								0.1	5
<i>Trifolium sp</i>	Berseem Clover	<i>Fabaceae (Faboideae)</i>	Exotic						0.1	30		
<i>Verbena bonariensis</i>	Purpletop	<i>Verbenaceae</i>	Exotic								0.2	50

APPENDIX B: BAMC CREDIT REPORT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015713/BAAS18047/19/00015714	MPE Stage 2 - OSD2 Modification	12/06/2019
Assessor Name	Report Created	BAM Data version *
Ed Cooper	12/06/2019	11
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18047		
Revision No		
0		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAIL	Ecosystem credits
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion								
1	883_Cleared	3.1	1.4	0.25	High Sensitivity to Potential Gain	1.75		0

BAM Credit Summary Report

2	883_Poor	30.1	0.2	0.25	High Sensitivity to Potential Gain	1.75		2
							Subtotal	2
							Total	2

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
Acacia bynoeana / Bynoe's Wattle (Flora)						
883_Cleared	3.1	0	0.25	2	False	0
883_Poor	30.1	0	0.25	2	False	0
					Subtotal	0
Hibbertia fumana / Hibbertia fumana (Flora)						
883_Cleared	3.1	0.14	0.25	3	True	0
					Subtotal	0
Hibbertia puberula / Hibbertia puberula (Flora)						
883_Cleared	3.1	0.51	0.25	2	False	1
883_Poor	30.1	0.08	0.25	2	False	1
					Subtotal	2

BAM Credit Summary Report

<i>Myotis macropus / Southern Myotis (Fauna)</i>						
883_Cleared	3.1	0	0.25	2	False	0
883_Poor	30.1	0	0.25	2	False	0
					Subtotal	0
<i>Persoonia nutans / Nodding Geebung (Flora)</i>						
883_Cleared	3.1	0.33	0.25	2	False	1
					Subtotal	1



BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015713/BAAS18047/19/00015714	MPE Stage 2 - OSD2 Modification	12/06/2019
Assessor Name	Assessor Number	BAM Data version *
Ed Cooper	BAAS18047	11
Proponent Names	Report Created	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.
Revision No	12/06/2019	
0		

Potential Serious and Irreversible Impacts

Nil

Species

Hibbertia fumana / Hibbertia fumana

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

BAM Biodiversity Credit Report (Like for like)

Predicted Threatened Species Not On Site

No Changes

Ecosystem Credit Summary

PCT	TEC	Area	Credits
883-Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	1.6	2.00

Credit classes for 883	Like-for-like options		
	TEC	HBT	IBRA region
	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (including PCT's 883)	No	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Area	Credits
Acacia bynoeana / Bynoe's Wattle	0.0	0.00
Hibbertia fumana / Hibbertia fumana	0.1	0.00
Hibbertia puberula / Hibbertia puberula	0.6	2.00
Myotis macropus / Southern Myotis	0.0	0.00
Persoonia nutans / Nodding Geebung	0.3	1.00

Acacia bynoeana / Bynoe's Wattle	883_Cleared	Like-for-like options	
		Spp	IBRA region
		Acacia bynoeana /Bynoe's Wattle	Any in NSW
	883_Poor	Like-for-like options	
		Spp	IBRA region
		Acacia bynoeana /Bynoe's Wattle	Any in NSW
Hibbertia fumana / Hibbertia fumana	883_Cleared	Like-for-like options	
		Spp	IBRA region

BAM Biodiversity Credit Report (Like for like)

		Hibbertia fumana /Hibbertia fumana	Any in NSW
Hibbertia puberula / Hibbertia puberula	883_Cleared	Like-for-like options	
		Spp	IBRA region
		Hibbertia puberula /Hibbertia puberula	Any in NSW
	883_Poor	Like-for-like options	
		Spp	IBRA region
		Hibbertia puberula /Hibbertia puberula	Any in NSW
Myotis macropus / Southern Myotis	883_Cleared	Like-for-like options	
		Spp	IBRA region
		Myotis macropus /Southern Myotis	Any in NSW
	883_Poor	Like-for-like options	



BAM Biodiversity Credit Report (Like for like)

Myotis macropus/ Southern Myotis	883_Poor	Spp		IBRA region
		Myotis macropus /Southern Myotis		Any in NSW
Persoonia nutans/ Nodding Geebung	883_Cleared	Like-for-like options		
		Spp		IBRA region
		Persoonia nutans /Nodding Geebung		Any in NSW

Biodiversity payment summary report

Assessment Id	Payment data version	Revision number	Report created
00015713/BAAS18047/19/00015714	57	0	12/06/2019
Assessor Name	Assessor Number	Proposal Name	
Ed Cooper	BAAS18047	MPE Stage 2 - OSD2 Modification	

PCT list

Include	PCT common name	Credits
Yes	883 - Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	2

Species list

Include	Species	Credits
Yes	<i>Acacia bynoeana</i> (Bynoe's Wattle)	0
Yes	<i>Hibbertia puberula</i> (Hibbertia puberula)	2
Yes	<i>Myotis macropus</i> (Southern Myotis)	0
Yes	<i>Persoonia nutans</i> (Nodding Geebung)	1
Yes	<i>Hibbertia fumana</i> (Hibbertia fumana)	0

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Biodiversity payment summary report

IBRA sub region	PCT common name	Baseline price	Dynamic coefficient	Market coefficient	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Cumberland	883 - Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Warning: This PCT has NO trades recorded in Cumberland	\$ 11,009.56	0.85991810	1.29971600	19.99%	\$28.51	1.0000	\$ 13,186.69	2	\$26,373.38
Subtotal (excl. GST)										\$26,373.38
GST										\$2,637.34
Total ecosystem credits (incl. GST)										\$29,010.72

Species credits for threatened species

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price
10402	Hibbertia puberula (Hibbertia puberula)	Endangered	\$1,730.17	19.9900%	\$20.00	2	\$4,192.06
10598	Persoonia nutans (Nodding Geebung)	Endangered	\$1,730.17	19.9900%	\$20.00	0	Contact BCT for pricing
20323	Hibbertia fumana (Hibbertia fumana)	Critically Endangered	Not listed	-	\$0.00	0	Contact BCT for pricing



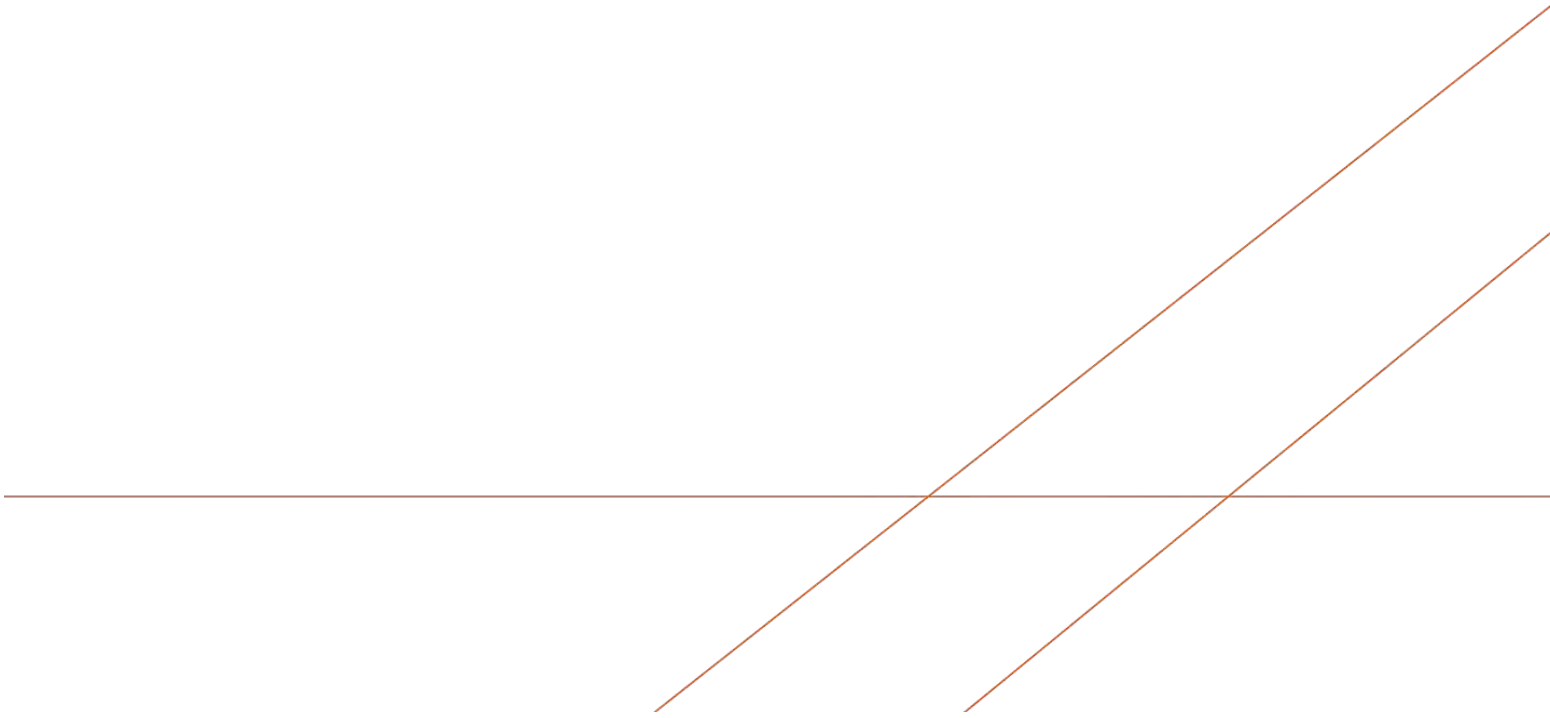
Biodiversity payment summary report

Subtotal (excl. GST)	Contact BCT for pricing
----------------------	-------------------------

GST	Contact BCT for pricing
-----	-------------------------

Total species credits (incl. GST)	Contact BCT for pricing
-----------------------------------	-------------------------

Grand total	Contact BCT for pricing
-------------	-------------------------



Appendix C Reference Examples of Approved Vertical-Walled OSDs

Arcadis (2018) prepared the following desk-top review comprising a review of known sites, plans and review of aerial photography across a number of sites within the Liverpool LGA that include OSD basins with vertical walls, namely:

- Hollyoake Circuit
- M5 Motorway
- Prestons.

Aerial photography (from Google Maps) has been provided in *Attachment A* of this technical memorandum.

Outside of the LCC LGA there are also a number of other projects, industrial and otherwise, that have been designed by various consultants (including Arcadis, Northrop, Costin Roe and others) and include similar OSD basin designs to that shown in the MPE Stage 2 current design. A summary of this information is provided in the table below, with some examples provided in *Attachment B*.

Site Name (and location)	Basin / Tank	Development type
Caddies Boulevard (Rouse Hill)	Basin	Residential
Tarlington Reserve (Bonnyrigg)	Basin	Residential
Bungarribee Reserve (Bungarribee)	Basin	Residential
Susannah Drive - Ropes Crossing (Blacktown)	Basin	Residential
Gregory Hills (Narellan)	Basin	Residential
Emerald Hills Estate (Leppington)	Basin	Residential
The Gables Marsden Park (Marsden Park)	Basin	Residential
Sydney Business Park (Marsden Park)	Basin	Commercial
Northern Beaches Hospital (Frenches Forest)	Tank	Health
Royal North Shore Hospital (St Leonards)	Tank	Health
Richlands Industrial Estate (Richlands)	Tank	Industrial
WestConnex (various locations)	Tank	Infrastructure
Sydney Metro (various locations, including Rapid Transit Stabling Facility)	Tank	Infrastructure
12 Second Avenue (Blacktown)	Tank	Residential
1 Parramatta Square (Parramatta)	Tank	Commercial
Burwood Tower (Burwood)	Tank	Residential
Banksmeadow Waste Transfer Terminal (Banksmeadow)	Tank	Industrial
Gordon Apartments Dumaresq Street (Gordon)	Tank	Residential

The purpose of these examples is to demonstrate acceptability of OSD basin designs which are similar to that included in the MPE Stage 2 Project, however it is recognised that both landscaping and fencing selection are key to the integration of OSD basins into the surrounding environment. Not all of these designs reflect this intent, however the overall premise and approach to the design, from a stormwater perspective is considered suitable and good practice.

ATTACHMENT A: LCC OSD EXAMPLES

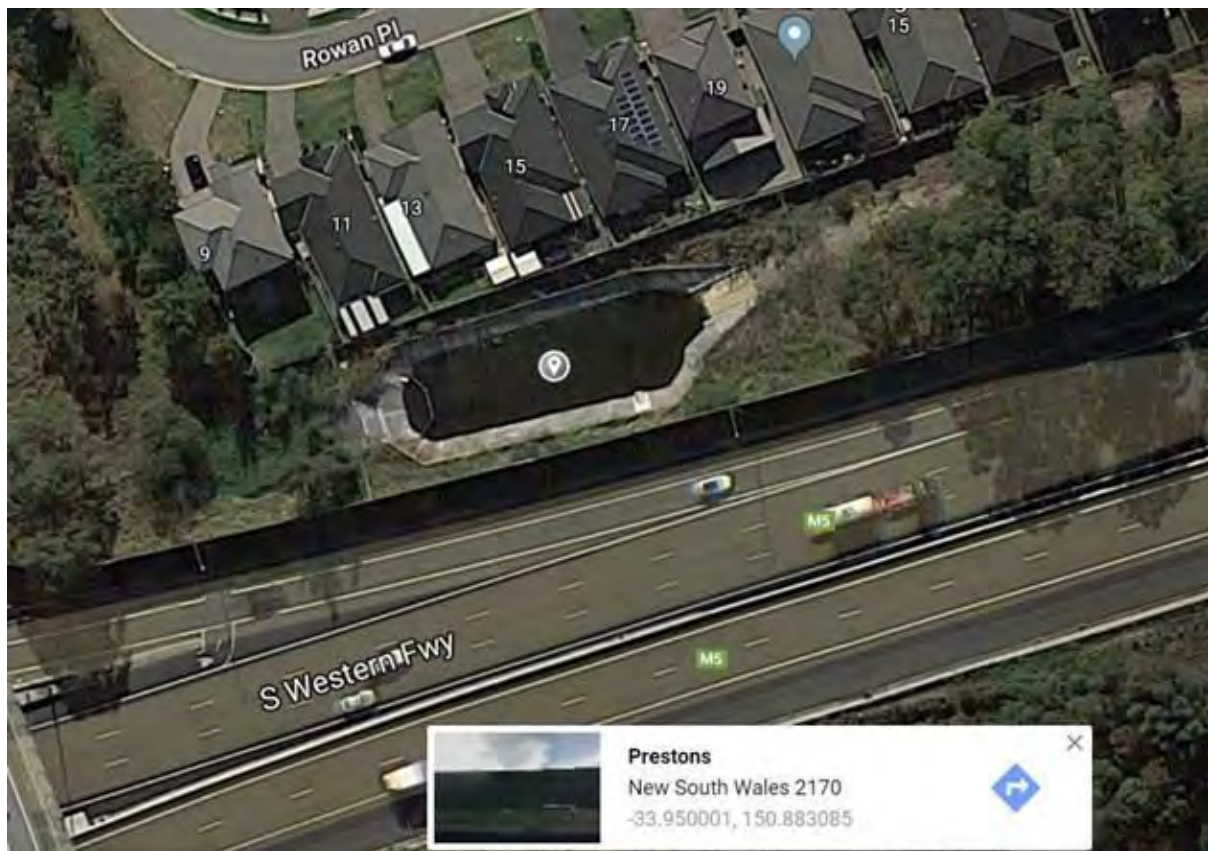
Hollyoake Circuit



M5 Motorway



Prestons



ATTACHMENT B: NSW/AUSTRALIA OSD DESIGN EXAMPLES

Caddies Boulevade (Rouse Hill)



Wall

Wall

Wall

Wetland







White Hart Dr
Rouse Hill, New South Wales

Google, Inc.

Street View - Feb 2014

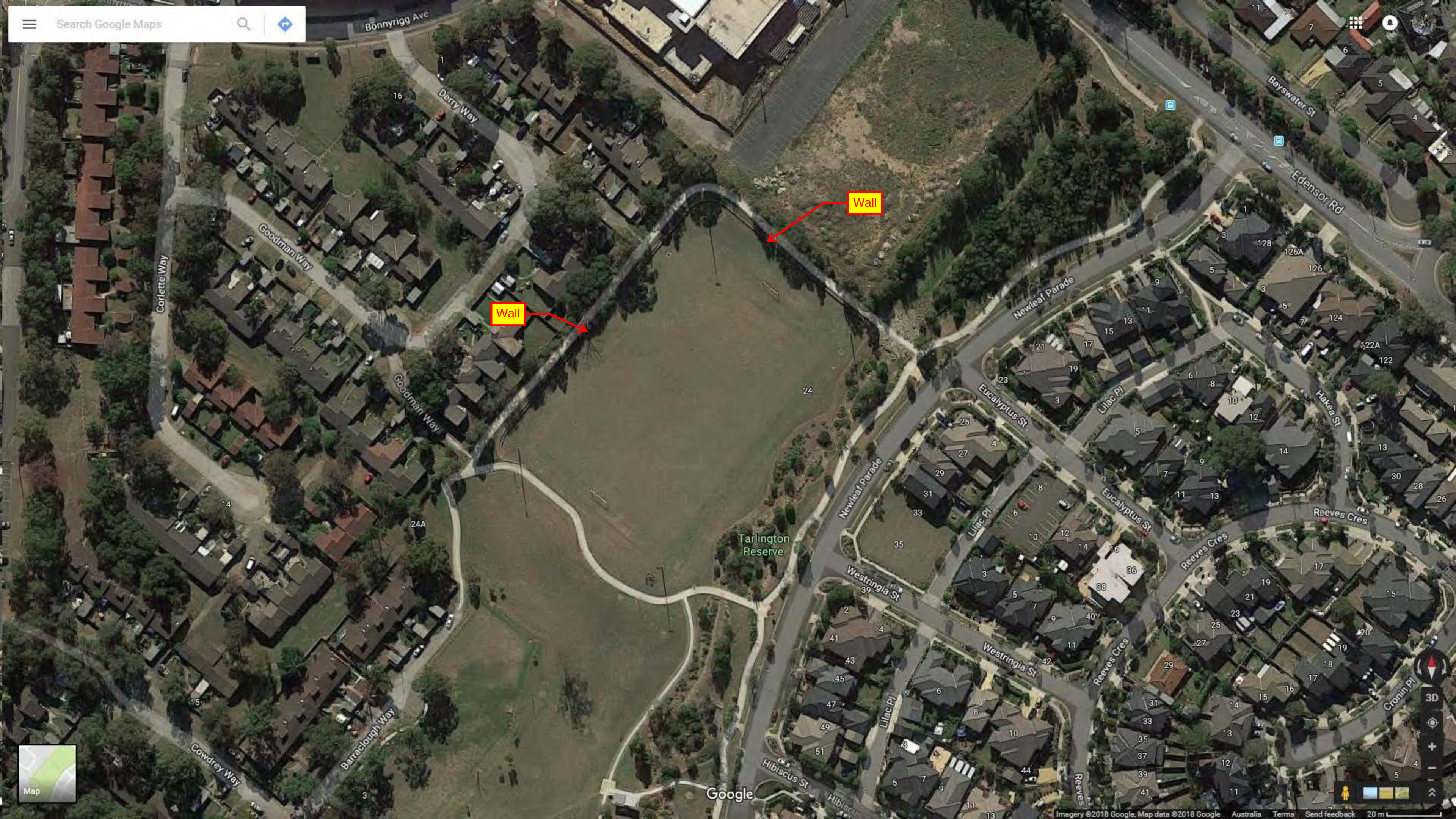


Google



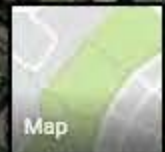
Image capture: Feb 2014 © 2018 Google Australia Terms Report a problem

Tarlington Reserve (Bonnyrigg)



Wall

Wall









Newleaf Parade

Bonnyrigg, New South Wales

Google, Inc.

Street View - Sep 2015

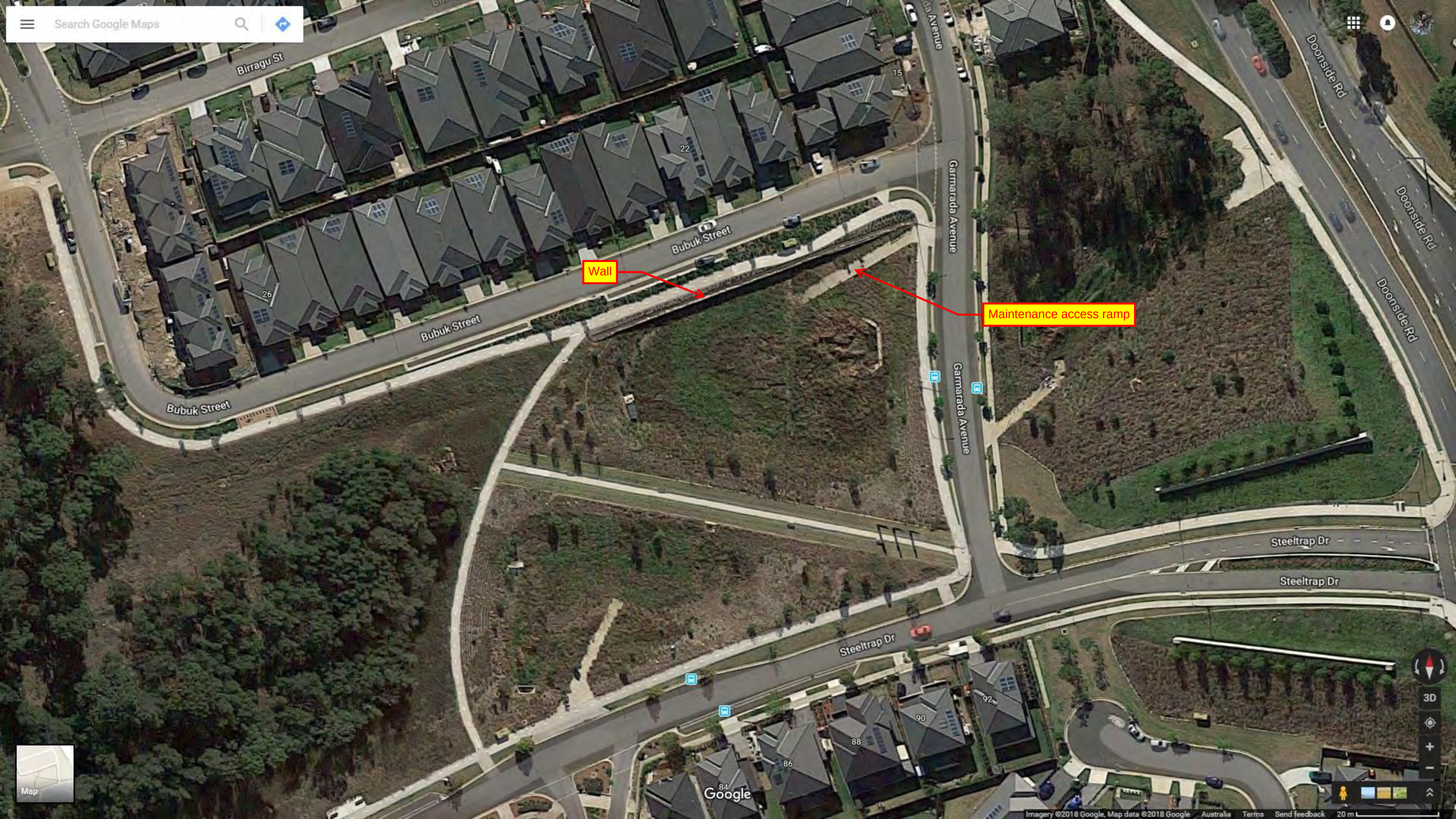
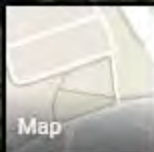
Wall

Hazard signage



Google

Bungaribee Reserve (Bungaribee)



Wall

Maintenance access ramp



Garmarada Avenue
Bungaribee, New South Wales

Google, Inc.

Street View - Sep 2016

Bioretention system
in invert of basin

Wall

Fencing

Maintenance access ramp



Google

Susannah Drive - Ropes Crossing (Blacktown)





Susannah Dr
Ropes Crossing, New South Wales

Google, Inc.

Street View - Oct 2015

Wall

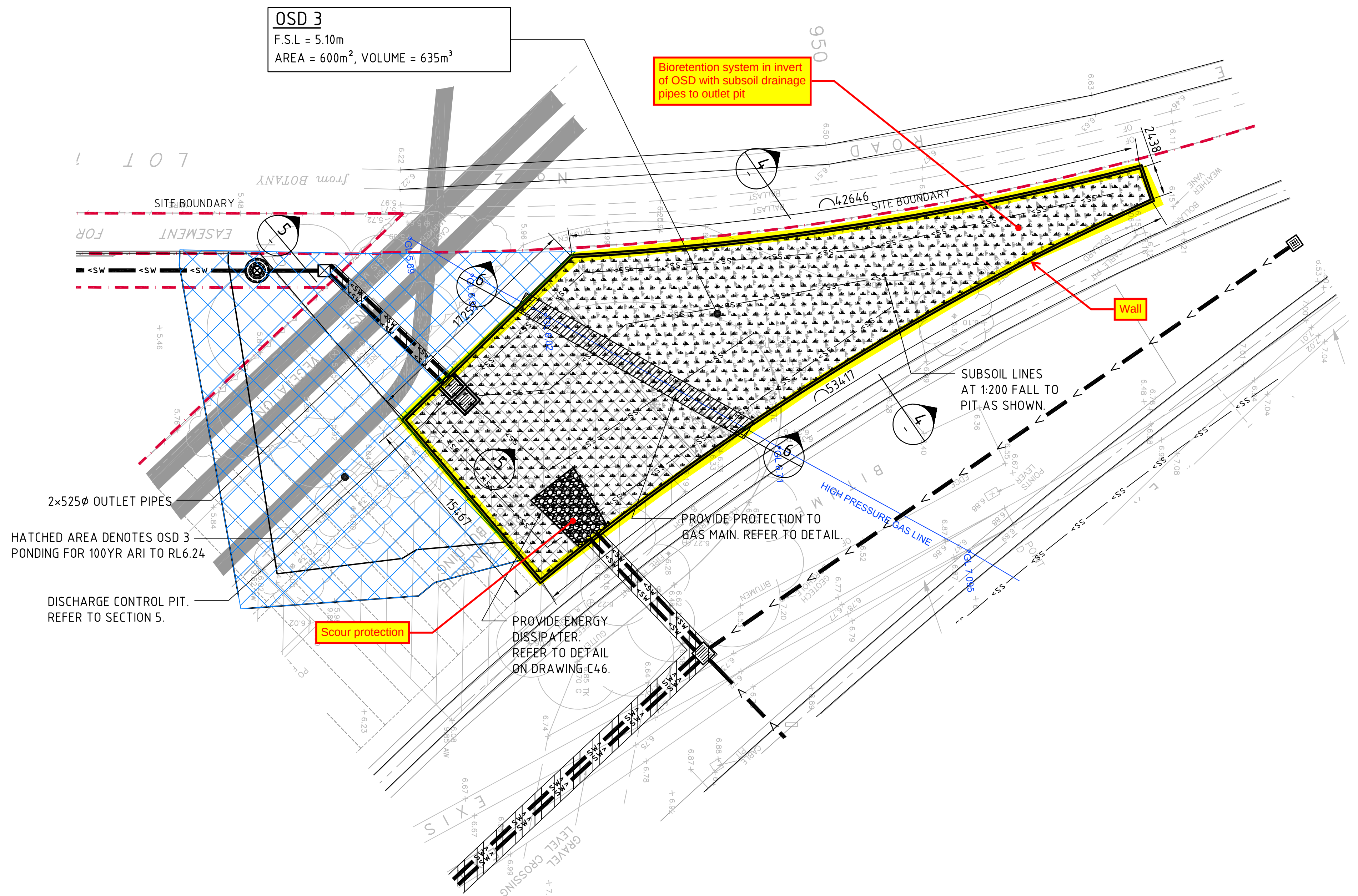
Fencing



Google

Navigation controls including a compass, zoom in (+) and zoom out (-) buttons, a street view pegman icon, and a full screen button.

Banksmeadow Waste Transfer Terminal (Banksmeadow)



OSD BASIN '3' PLAN
SCALE 1:200

OSD '3' DETAILS

SITE AREA DRAINING TO STORAGE

2.323 ha

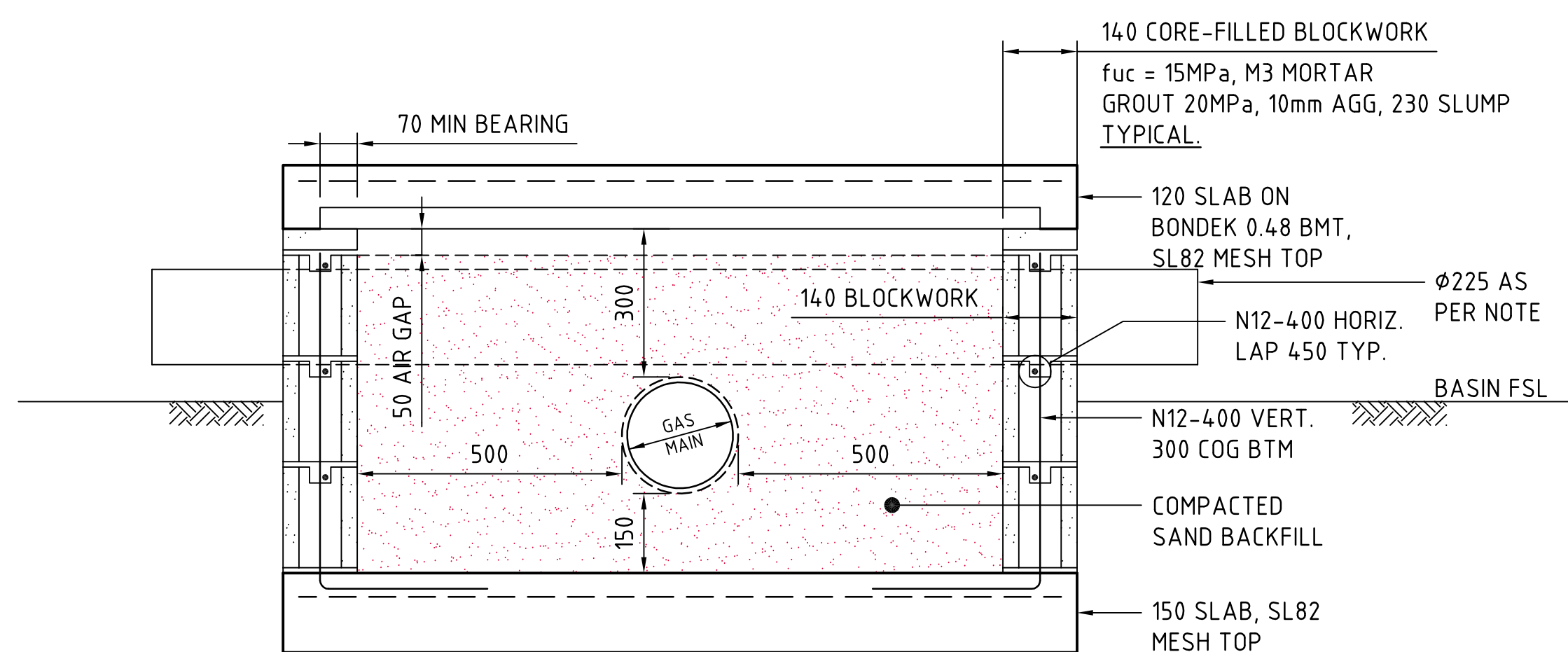
STORAGE

VOLUME OSD PROVIDED (BASED DRAINS ILSAX MODEL)

635m³

INTERNAL BASIN DIMENSIONS

0.9m
VARIES
VARIES

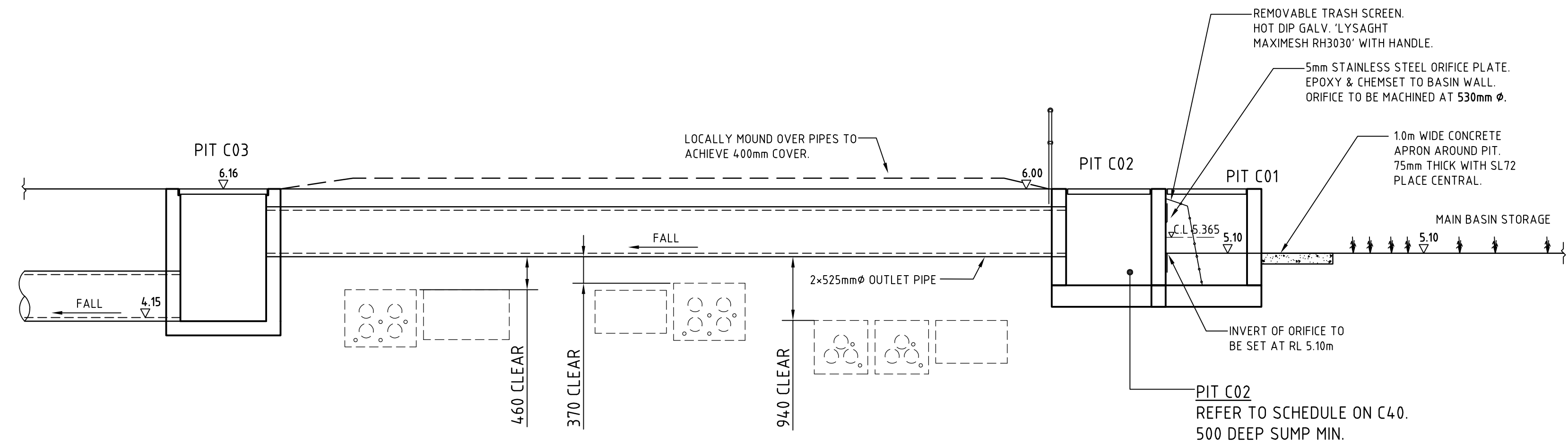
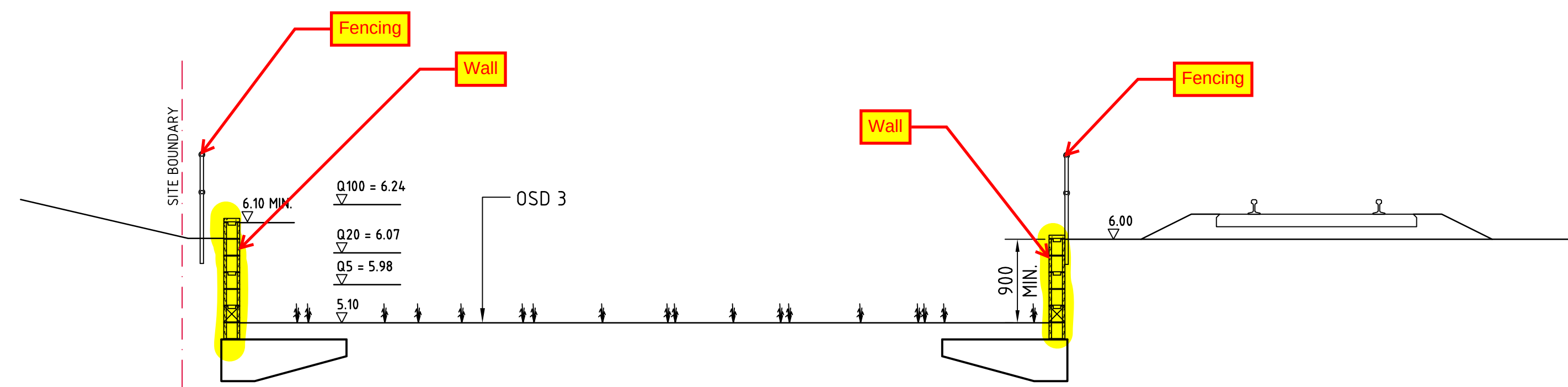


GAS MAIN CONCRETE PROTECTION DETAIL

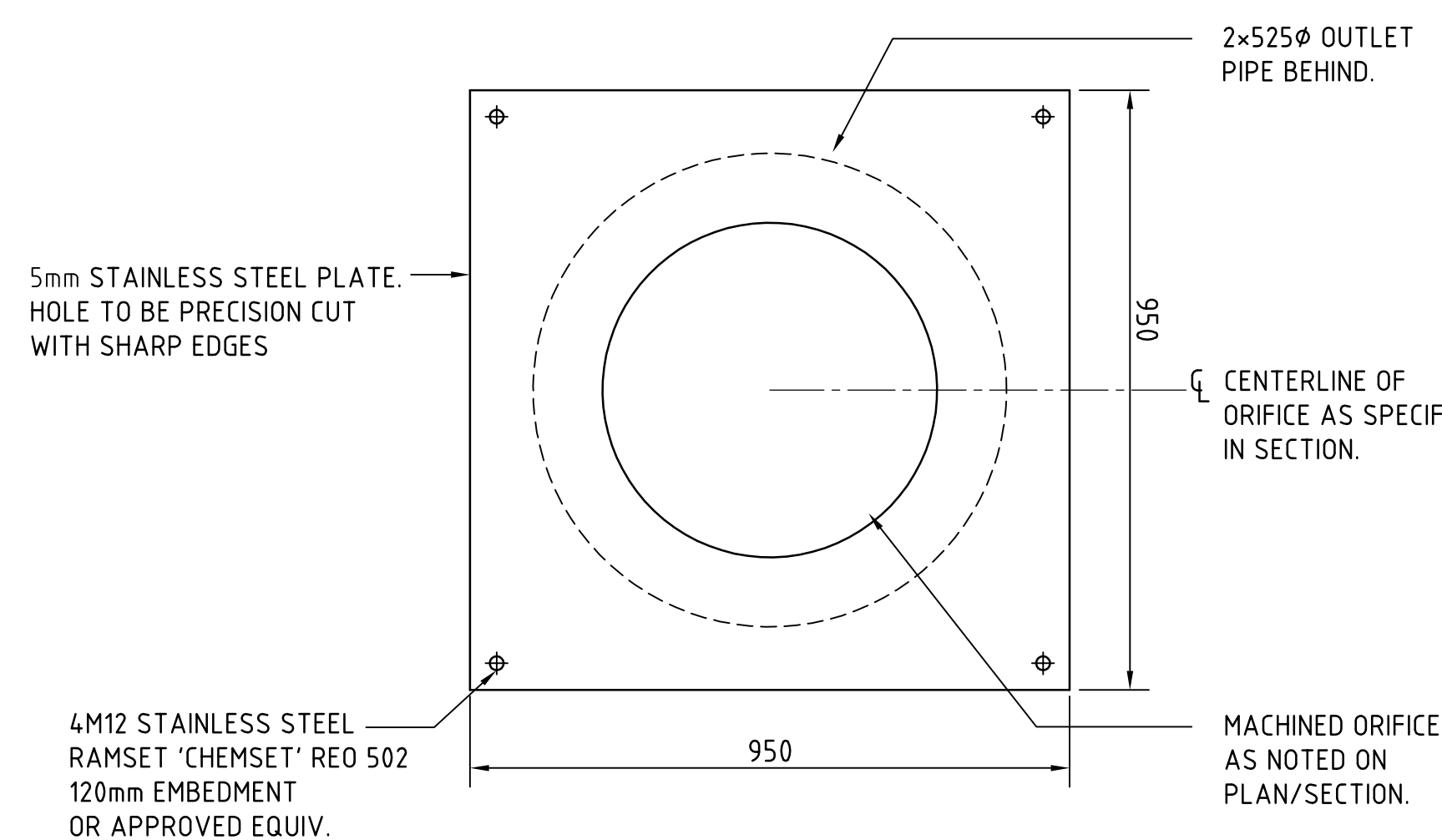
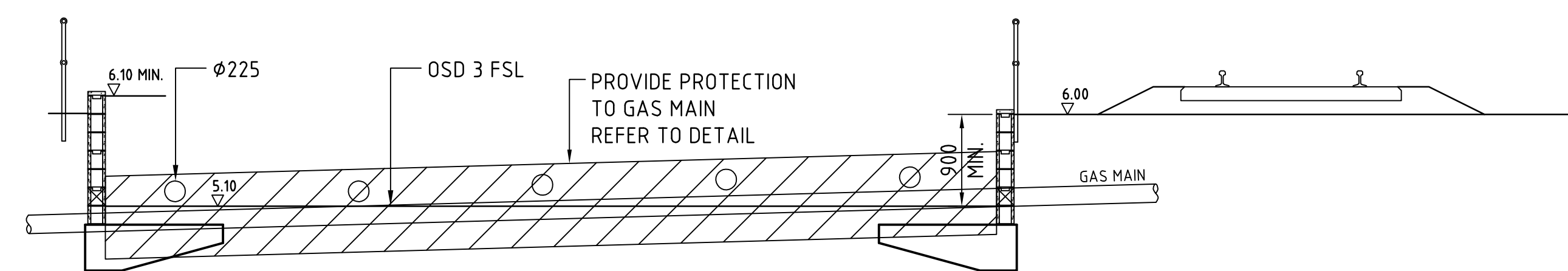
SCALE 1:10

PROVIDE 225Ø UPVC - 2000mm MAX CTS AT 50mm ABOVE BASIN FSL TYPICAL ALONG LENGTH OF GAS MAIN.

CONCRETE QUALITY					
ELEMENT	SLUMP	AGGREGATE (MAX SIZE)	CEMENT TYPE	AD MIXTURE	F _{cu} (MPa)
BASE SLAB	80	20	SL	NIL	32
ROOF SLAB	80	20	SL	NIL	32



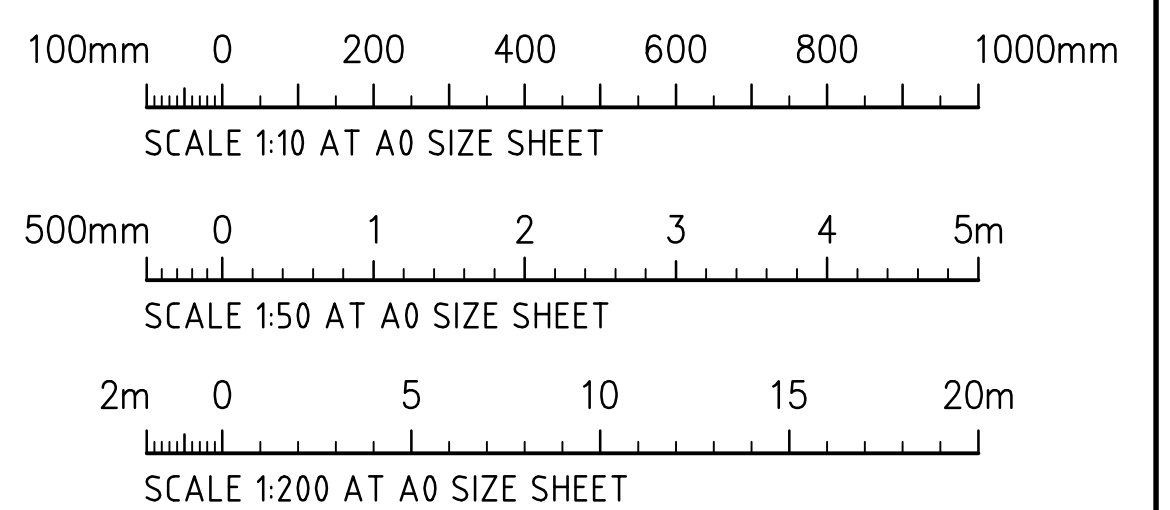
SECTION 150 (5) : TYPICAL THRU' OSD 3 OUTLET



ORIFICE PLATE DETAIL

FOR OSD 3 OUTLET PIPE
1:10

NOTE:
REFER TO WORK AS CONSTRUCTED
DRAWING, PREPARED BY AWJ CIVIL
PTY LTD (REGISTERED SURVEYOR:
MR WARREN F. COLE) DATED 16 MAY
2016 FOR ALL WORK AS EXECUTED
INFORMATION AND LEVELS.



RECORD OF CONSTRUCTION

REVISED GAS MAIN PROTECTION & ADDED SECTION 6	11.02.16	F			
REVISED AS CLOUDED FOR GAS MAIN AND INLET PIPES	07.12.15	E			
DRAWING REVISED	26.10.15	D			
ISSUED FOR CONSTRUCTION CERTIFICATE	12.06.15	C			
OSD 4 & 5 REVISED AS CLOUDED	01.06.15	B			
ISSUED FOR INFORMATION	22.05.15	A			
AMENDMENTS	DATE	ISSUE	RECORD OF CONSTRUCTION	DATE	ISSUE
			AMENDMENTS	DATE	ISSUE



PROJECT
VEOLIA TERMINAL
McPHERSON STREET, BANKSMEADOW



Costin Roe Consulting Pty Ltd.
Consulting Engineers
Level 1, 8 Windmill Street
Wahah Bay, Sydney NSW 2000
Tel: (02) 9551-7699 Fax: (02) 9541-3721
email: mail@costinroe.com.au

CostinRoe Consulting

Value in Engineering and Management

DRAWING TITLE
**OSD TANK DETAILS
SHEET 2**

DRAWING No **C012589.00- C48**

ISSUE
G

Lenore Drive as part of SRG Facility - shows a constructed basin on and approved by the Department under MP-08_0016 MOD. (Logos). Bio-retention at base with vertical landscape walls + batters.



Constructed basin at TNT Facility Erskine Park per SSD 6040. (CIP/GPT Group). Bio-retention at base with vertical landscape walls + batters.



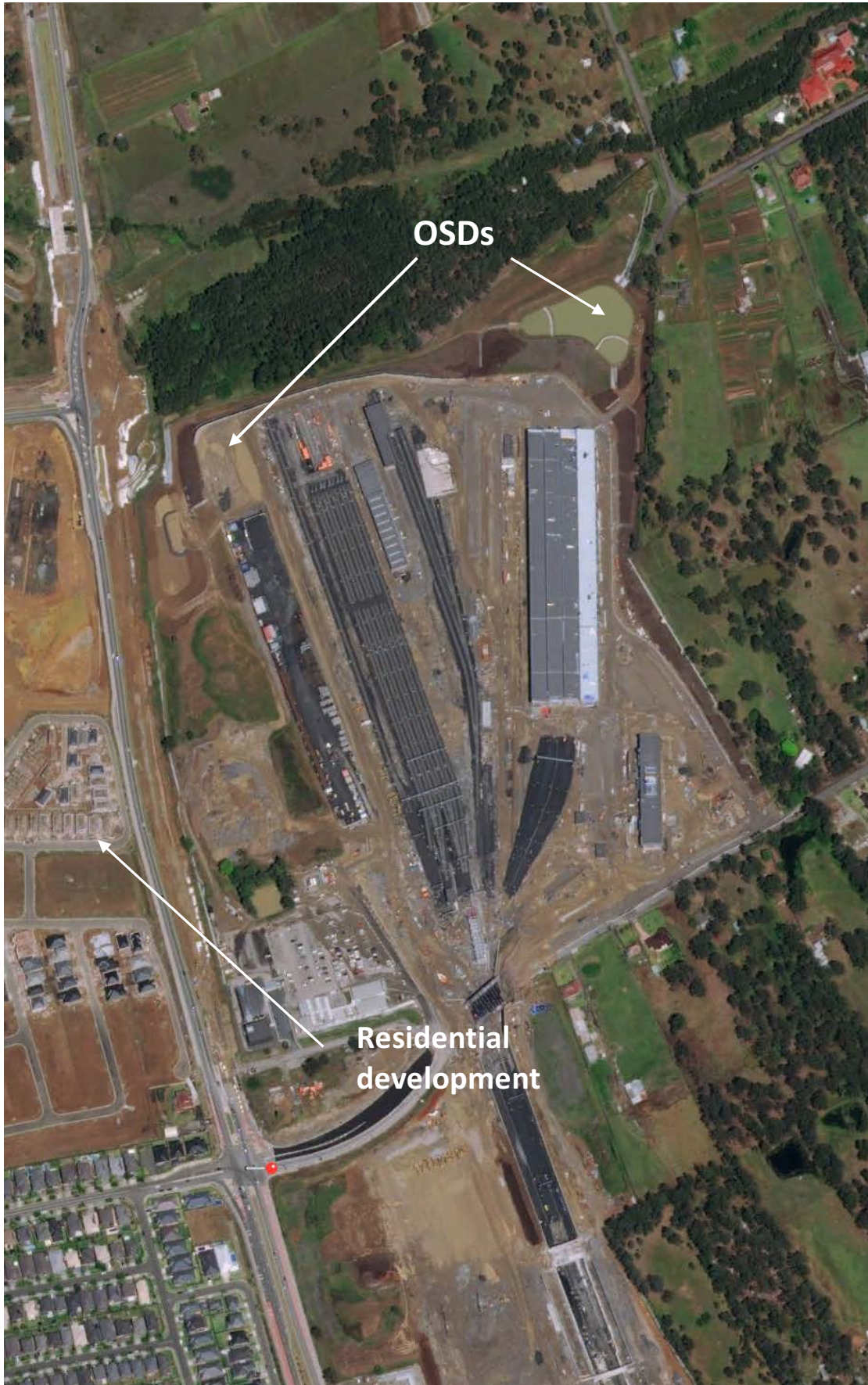
Basin constructed at Eastern Creek Business Park (Fraser's) per MP06_0025 MOD. Bio-retention & wetland at base with vertical landscape walls + batters.



Constructed basin, Horsley Drive Business Park, Wetherill Park (Fraser's/ Western Sydney Parkland Trust) per SSD 5169. Note photo taken during construction with final arrangement including bio-retention to the base.



Sydney Metro – Rapid Transit Rail Facility (Schofields Road/Tallawong Road Rouse Hill opposite the Ponds residential development) (SSI-5931)











Appendix D Moorebank Precinct East (MPE) Stage 2 (SSD 7628 – MOD 2) – Bushfire review (Arcadis 2019)

Date 12/06/2019
To Nathan Cairney (Tactical Group)
From Ketan Patel (Arcadis)
Copy to Richard Johnson (Aspect Environmental), Westley Owers (Arcadis), Jamie Crawford (Arcadis)
Subject Moorebank Precinct East (MPE) Stage 2 (SSD 7628 – MOD 2) – Bushfire review

1. Introduction

The purpose of this technical memorandum is to provide further information to the Department of Planning and Environment (DP&E) in relation to potential bushfire impacts of the MPE Stage 2 Modification 2 (SSD 7628 MOD 2). In an email provided to Aspect Environmental on the 23 May 2019, DP&E requested the following:

An updated bushfire assessment including drawings and plans for maintaining an APZ on the southern boundary of the site. Report must also address how the site can be managed having regard to the management of the offset site including controlled environmental burns.

Modification 2 is seeking approval for minor changes to the stormwater management system of the approved development in response to the additional design requirements placed on this aspect by the Conditions of Consent (CoC), specifically by CoC B40(c)(iii), which stipulates that “*all on site detention basins [are] 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.*”

Accordingly, there are two key elements of the proposed modification:

1. The revision of the construction and operation footprint at the southern extent of the site to include the revised design for On-Site Detention (OSD) Basin 2 that addresses CoC B40(c)(iii), and
2. The removal of the requirement for batter slopes to allow OSD9, located at the north-west of the site, to be constructed without the 1V:4H batters and instead to be constructed with vertical walls.

This technical memorandum has been prepared by Arcadis¹ to address item 1 above and determine whether the modification (in relation to item 1), is consistent with the Bushfire Assessment as presented within Appendix U of the MPE Stage 2 Environment Impact Statement (EIS) (Arcadis 2016, SSD 7628), the MPE Stage 2 Response to Submissions (RtS) (Arcadis 2017) and the MPE Stage 2 Consolidated Assessment Clarifications (Arcadis, 2017).

In the preparation of this technical memorandum, the following documentation has been reviewed:

- MPE Stage 2 EIS Appendix U Bushfire Protection Assessment, Arcadis 2016
- MPE Stage 2 Modification 2, March 2019
- MPE Stage 2 Development Consent (SSD 7628), January 2018
- Planning for Bushfire Protection – 2006 (Rural Fire Service)

¹ This document is considered a review only and has not been prepared by a bushfire consultant.

2. Summary of MPE Stage 2 Approval

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

The Project has been assessed by DP&E under Part 4, Division 4.7 (previously Division 4.1 prior to 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 consent for the MPE Stage 2 Project on 31 January 2018 and is subject to the Minister's CoCs (SSD 7628).

The bushfire impact assessment (Appendix U of the MPE Stage 2 EIS) noted that the Dry Sclerophyll Low Open Forest on the vacant land to the east and south (known as 'the Boot Land') of the MPE Stage 2 Project site and the vegetation² on the MPW Stage 2 Proposal site (outside of the Project site to the west) presents a potential bushfire threat to the Project.

The potential bushfire threat posed by bushland to the south (the Boot Land) is a Bushfire Hazard Rating of **high** and Bushfire Threat of **moderate**. It is understood that this rating is based upon the continued management of the 60m defendable space within the MPE Stage 2 Project site and the 50m cleared area to the south of the MPE Stage 2 Project site boundary being maintained, (Figure 1).

Of note is that the Butchers Knife Land³ includes overhead powerlines and a fire trail, indicating that clearing practices in this area are likely to continue. However, should this activity cease, the hazard will increase to high.

In industrial applications the defendable space must be greater than the flame length, the flame length being measured from the vegetation to the end of the flame. The flame length associated with the Dry Sclerophyll Low Open Forest was assessed to be in the order of 25m. Therefore, the separation between the fixed assets and the bushfire prone vegetation (at least 50m) exceeds the defendable space widths required by *Planning for Bushfire Protection 2006* and reduces the risk of flame contact, high levels of radiant heat and ember attack.

² This vegetation is to be removed as part of the MPW Stage 2 SSD Application (SSD 7709) (separate approval), which is currently under assessment with the Independent Planning Commission (IPC).

³ Land to the immediate south in which OSD 2 is to be located, the subject of the SSD 7628 – MOD 2.

ATTACHMENT A – Plan showing the Defendable Spaces to the MPE Stage 2 site



© Australian Bushfire Protection Planners Pty Limited
 Tel. 612 43622112 / 612 43621184
 Email. abpp@bigpond.net.au

Figure 1 Defendable Space as per RtS Design (Extract of Bushfire Technical Assessment (MPE Stage 2 EIS 2016))

3. Impact Review

The MPE Stage 2 Modification 2 seeks approval for an alteration to a discrete part of the stormwater design. This requires an extension of the construction and operational boundary within the area south of the site known as the Butchers Knife Land and a minor adjustment in the location of Warehouses 7 and 8 to the south in relation to the MPE Stage 2 site boundary as per the MPE Stage 2 Approval, (Figure 2). Warehouse 7 has moved approximately 15m to the south, whilst Warehouse 8 has moved approximately 26m to the south. This still provides for a minimum of 32m defendable space from the edge of Warehouse 8 to the MPE Stage 2 site boundary, and an additional 50m of defendable space from the MPE Stage 2 site boundary to the Boot Land, (Figure 3).

With regards to bushfire assessment, the extension of OSD2 into the Butchers Knife is not applicable as the assessment is focussed on the impact of bushfire on buildings, and occupants of buildings. This is reflected in the MPE Stage 2 Bushfire Protection Assessment which assess defendable space from the edge of Warehouses 7 and 8 to the MPE Stage 2 site boundary and edge of the bushfire prone vegetation in the Boot Land and does not include OSD2.

Further, the location of the OSD2 within the Butchers Knife Land also provides a long-term opportunity for this area to be maintained as defendable space, i.e. not be subject to regrowth and or to location of buildings that could be occupied (subject to separate approvals). This is considered to result in a positive outcome for the purposes of bushfire protection.

A review of compliance against the *Planning for Bushfire Protection* (2006) guidance document has been provided in Table 1.

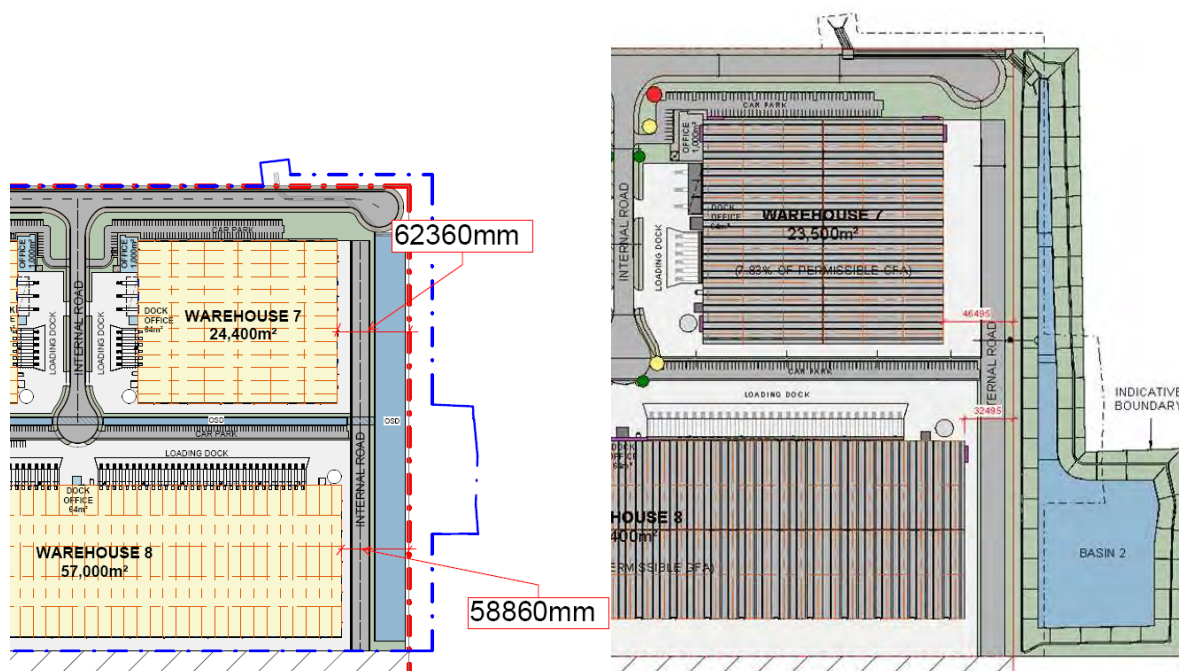
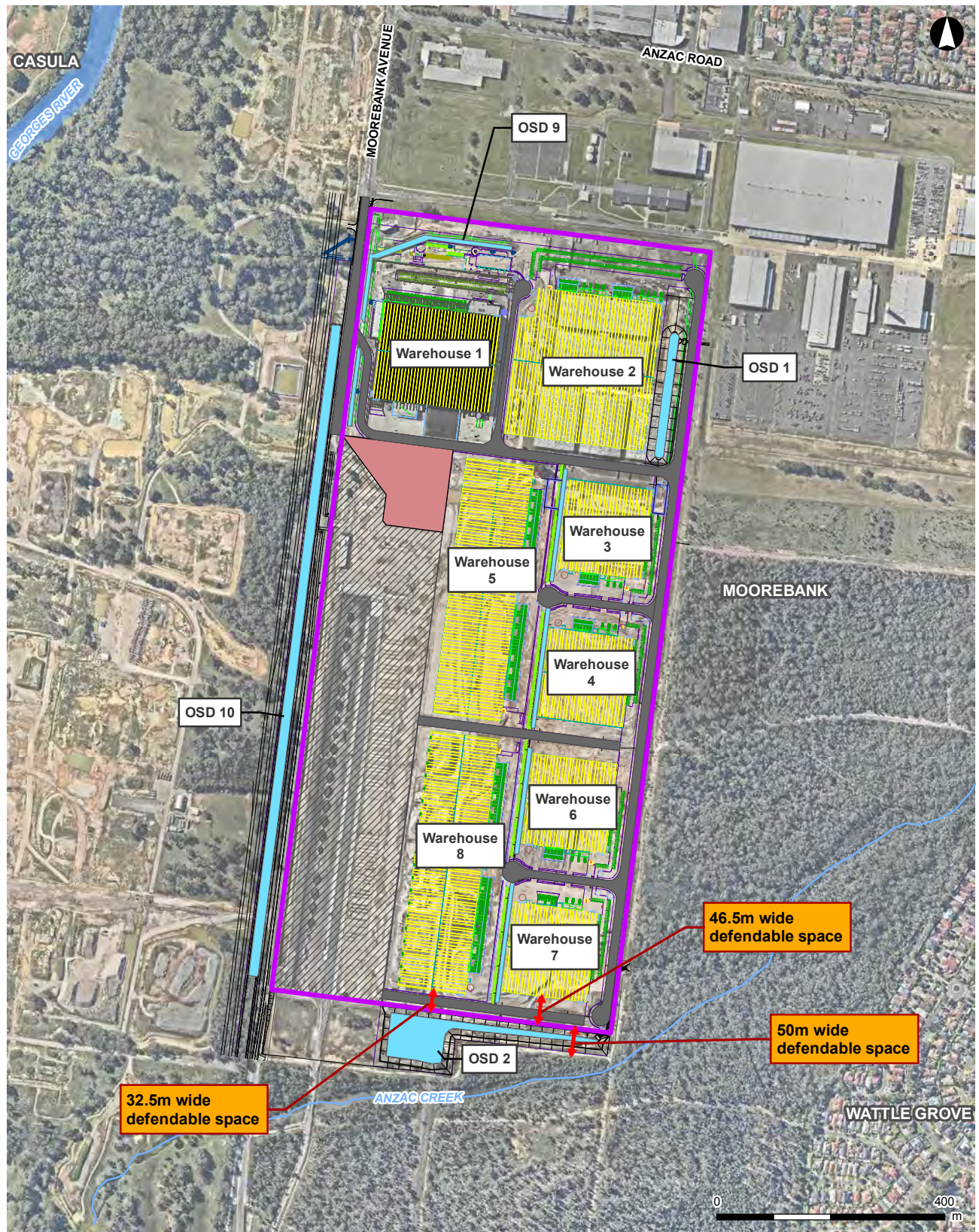


Figure 2 Comparison of RtS (left) and Modification 2 (right) designs and distances to MPE Site boundary

Moorebank Precinct East (MPE) Stage 2 (SSD 7628 – MOD 2) – Bushfire Assessment Overview



LEGEND

- MPE site
- Warehouse
- Internal road
- OSD
- Terminal hardstand
- MPE Stage 1 (subject to separate approval)
- Watercourse

ARCADIS AUSTRALIA PACIFIC PTY LTD
 ABN 76 104 485 289
 Level 16, 560 George St | Sydney NSW 2000
 P: +61 (0) 2 8907 9000 | F: +61 (0) 2 8907 9001
 Coordinate System: GDA 1994 MGA Zone 56
 Date issued: June 12, 2019
 Aerial imagery supplied by Neamap (Mar, 2019)



Figure 3: Defendable Space in Relation to Modified Design

Table 1 Review of Compliance in Relation to Planning for Bushfire Protection, 2006.

Objective	Compliance with deemed-to-satisfy provisions of Planning for Bushfire Protection, 2006	Compliance with deemed-to-satisfy provisions of Planning for Bushfire Protection, 2006	Consistency with MPE Stage 2 objectives
	MPE Stage 2 EIS/RtS	MPE Stage 2 Modification 2 – Southern Boundary	
Afford occupants of any building adequate protection from exposure to a bushfire.	The flame length associated with the vegetation to the south of the Project is in the order of 25m. Therefore, the separation between the fixed assets and the bushfire prone vegetation (at least 50m) exceeds the defensible space widths required by <i>Planning for Bushfire Protection 2006</i> and reduces the risk of flame contact, high levels of radiant heat and ember attack.	The warehousing as amended still provide for a greater than 25m separation between the fixed assets and the bushfire prone vegetation (at least 50m).	Yes
Provide for a defensible space to be located around the building	A defensible space of at least 50 metres is provided to the east and more than 100 metres to the south of the Warehouse buildings.	A defensible space of at least 82m is still provided including land both inside and outside of site.	Yes
Provide appropriate separation between a hazard and buildings, which, in combination with other measures, prevent direct flame contact and material ignition.	The width of the defensible space provided between the fixed assets and the bushfire prone vegetation (at least 50m) reduces the possibility of flame contact and high levels of radiant heat impact on the buildings.	No change. Adequate defensible space is still provided.	Yes
Ensure that safe operational access and egress for emergency service personnel and staff/visitors is available.	Safe egress from the MPE Stage 2 site is provided onto Moorebank Avenue.	No change. Access and egress to the Project will be onto Moorebank Avenue.	Yes
Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in Asset Protection Zones.	Management of the landscaped areas within the MPE Stage 2 site will be undertaken by the operators to maintain minimum dry fuels loads.	No change. Management of landscaping features is detailed within the Landscape Vegetation Management Sub-Plan, Operational Flora and Fauna Management Plan. Included as mitigation measure FF17, as well as within the Operational Emergency Response Plan Section 4.11.2.2. Both plans are currently in review with the Department of Planning and Environment).	Yes

Objective	Compliance with deemed-to-satisfy provisions of Planning for Bushfire Protection, 2006	Compliance with deemed-to-satisfy provisions of Planning for Bushfire Protection, 2006	Consistency with MPE Stage 2 objectives
	MPE Stage 2 EIS/RtS	MPE Stage 2 Modification 2 – Southern Boundary	
Ensure that utility services are adequate to meet the needs of fire-fighters and others assisting in bushfire fighting.	Utility services meet the needs of fire-fighting requirements.	There is no change to the utility services in relation to OSD2.	Yes

It is noted that planned bushfire hazard reduction activities, or controlled burns, will be undertaken by the NSW Rural Fire Service as has been discussed within the Biobanking Agreement (Ref: BA341) which has been executed⁴. Any controlled burn activity would be undertaken in conjunction with Qube and relevant NSW Rural Fire Service management measures. Management of the site during controlled burns would be through the implementation of the Emergency Response Plan and associated mitigation measures.

4. Mitigation Measures

Based on the previously prepared Bushfire impact assessment for the MPE Stage 2 Project, this review has determined that there remains adequate defensible space from the edge of the Boot Land to the nearest buildings, Warehouse 7 and 8. Therefore, it is not anticipated that any additional mitigation measures in addition to those provided with the Final Consolidated Mitigation Measures (FCMMs) are required.

However, upon approval of the modification, operational documentation, namely the Operational Flora and Fauna Management Plan and Emergency Response Plan will be updated as necessary.

5. Conclusion

Additional bushfire assessment and mitigation measures are not required as the MPE Stage 2 Project, as modified, remains compliant with Bushfire impact assessment (and therefore the *Planning for Bushfire Protection (2006)*).

⁴ By the Chief Executive of OEH on 16 January 2019.

Appendix E MPE Stage 2 Post-Development Catchments

Appendix F MPE Stage 2 Updated Stormwater Management Plan – WH1

MOOREBANK PRECINCT EAST – STAGE 2

Warehouse 1 Precinct

Stormwater Management Plan

07 JUNE 2019

MOOREBANK PRECINCT EAST – STAGE 2

Warehouse 1 Precinct

Stormwater Management Plan

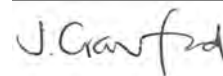
Current Revision

Author

Melanie Gostelow

**Checker**

Jamie Crawford

**Approver**

Melanie Gostelow

**Report No**

AA009017-MPE_Stg2_SMP_W1

Date

07/06/2019

Revision Text

5

Original Author Details

Author Details	Qualifications and Experience
Melanie Gostelow Level 16, 580 George Street Sydney NSW 2000	BEng Environmental Engineering (Honours) MEngSc Water Resources Melanie Gostelow has over 10 years' experience as a Water Resources Engineer.

This report has been prepared for SIMTA in accordance with the terms and conditions under the 'Environmental Planning and Engineering Design Services Agreement (1113295052) dated 22/06/2016. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
0	11/05/2018	DRAFT	MG/DC	MG
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	KP	MG
2	28/06/2018	Amended to address independent review and DP&E comments	GD/KP	MG
3	03/07/2018	Update of Section 6.2.2 to address DP&E comments in approval letter dated 02/07/18	GD/KP	MG
4	03/08/2018	Updated in line with RfMA 003	MB	KP
5	07/06/2019	Update to address modification to OSD9 footprint	MG	JC

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CONTENTS

KEY TERMS	I
ACRONYMS AND DEFINITIONS	III
1 INTRODUCTION	1
1.1 Project Overview	1
1.2 Summary of Project Delivery Phases	3
1.2.1 SMP Staging	4
1.2.2 Integration with Other Plans	6
1.3 Development Consent	6
1.3.1 Road Infrastructure Upgrades	6
1.3.2 Compliance Monitoring and Tracking	8
1.3.3 Compliance Matrix.....	8
1.4 Report Structure.....	23
1.5 Purpose of this Report.....	23
1.6 Review	23
2 SITE DESCRIPTION.....	24
2.1 Location	24
2.1.1 Regional Context.....	24
2.1.2 Local Context	24
2.2 Regional Environment	27
2.3 Existing Site Conditions	27
2.3.1 MPE Site - East of Moorebank Avenue	28
2.3.2 Moorebank Avenue	32
2.3.3 MPW Site - West of Moorebank Avenue	33
3 PREVIOUS FLOODING AND STORMWATER REPORTS	36
3.1 SIMTA Flood Study & Stormwater 12/08/2011	36
3.2 SIMTA Stage 1 Flood Study & Stormwater 10/04/2015.....	37
3.3 MPW Stage 2 Stormwater & Flooding 01/08/2016.....	38
3.4 MPE Stage 2 Stormwater and Flooding Environmental Assessment 23/11/2016	38
3.5 SIMTA MPE Response to Submissions Report 28/07/2017	39
4 STORMWATER MANAGEMENT OVERVIEW.....	41
4.1 Construction.....	41
4.2 Operation	42
5 STORMWATER QUANTITY MANAGEMENT	43
5.1 Existing Conditions Assessment.....	43
5.1.1 Assessment Methodology	43
5.1.2 Results	44
5.2 Post Development Conditions Assessment	44

5.2.1 Overview	44
5.2.2 Assessment Methodology	45
5.2.1 Results	45
5.2.2 Sensitivity Assessment.....	47
5.3 Detailed Design Considerations	48
5.3.1 On-Site Detention (OSD).....	48
5.3.2 Catchments and Development Flexibility	49
5.3.3 Drainage System Capacities and Grades	49
5.3.4 Warehouse Area Drainage.....	52
5.3.5 Pavement Grades	52
5.3.6 Minimum Floor Levels	52
5.3.7 Works Within Neighbouring Properties.....	52
5.3.8 OSD Outlets to Georges River	52
5.4 Construction Phase	53
6 STORMWATER QUALITY MANAGEMENT	54
6.1 Objectives and Performance Targets	54
6.2 Proposed Stormwater Quality Measures	54
6.2.1 Gross Pollutant Traps.....	54
6.2.2 Raingarden.....	55
6.3 Assessment Methodology	57
6.4 Results	58
6.4.1 Georges River Outlet.....	58
6.5 Detailed Design Requirements to Minimise the Risk of Failure	58
6.6 Monitoring.....	59
6.7 Construction Phase	60
6.7.1 Erosion Controls.....	60
6.7.2 Sediment Controls.....	61
7 SITE WATER BALANCE.....	62
7.1 Objectives	62
7.2 Methodology.....	62
7.3 Water Demand & Wastewater Generation.....	62
7.4 Rainfall Runoff Processes	62
7.5 Rainwater Harvesting and Water Reuse.....	63
7.5.1 Detailed Site Reuse Demand Calculation	64
7.5.2 Unsuitable Demands	65
7.5.3 Concept Options Analysis	65
7.5.4 Rainwater Tank Sizing	67
7.5.5 Rainwater Tank Placement	68

7.5.6 Comparison with Industrial	68
7.5.7 Comparison with Residential.....	68
7.5.8 Warehouse 1 Precinct.....	69
7.6 Comments.....	70
8 CONCLUSION	71

APPENDICES

Appendix A – Concept Design Drawings

Appendix B – Existing Conditions Hydraulic Modelling

Appendix C – Proposed Conditions Hydraulic Modelling

Appendix D – Flow Comparisons

Appendix E – MUSIC Model Information

Appendix F – Liverpool City Council Compliance Matrix

Appendix G – Raingarden Details

FIGURES

Figure 1-1: Project Footprint.....	2
Figure 1-2: Proposed Activities	5
Figure 2-1: Regional Context of the Project	25
Figure 2-2: Local Context of the Project	26
Figure 2-3: Existing Catchments of the MPE Site	29
Figure 2-4: Existing Drainage Network.....	30
Figure 2-5: MPE Site 100 year ARI Flood Levels (mAHD) and Flood Storage.....	31
Figure 2-6: Existing Site Conditions Catchment Plan.....	35
Figure 3-1: MPW Stage 2 Project Overview.....	40
Figure 5-1: Proposed Catchments of the MPE Site.....	46
Figure 5-2: Post Development Overland Flow Paths	51
Figure 6-1: Typical Raingarden Concept.....	55
Figure 6-2: Typical Raingarden Section - Saturated Zone	57
Figure 7-1: MPE Stage 2 Water Balance	63
Figure 7-2: Concept Rainwater Tank Sizing & Percentage Demand Relationship.....	66
Figure 7-3: Rainwater Tank Sizing & Percentage Demand Relationship	68
Figure 7-4: Rohlig Australia Warehouse.....	69

TABLES

Table 1-1 Project Delivery Phase Terminology	3
Table 1-2: Required Upgrades and Specified Timing Requirements (CoC B13).....	7
Table 1-3: Conditions of Consent (CoC)	8
Table 1-4: Final Compilation of Mitigation Measures (FCMM)	21
Table 5-1: Comparison of Peak Flows	47
Table 5-2: Detention Storage Performance Summary – 100yr ARI.....	47
Table 6-1: Water Quality Performance Targets.....	54
Table 6-2: MPE Stage 2 Land Use Areas and Imperviousness	57
Table 6-3: Georges River – Water Quality Treatment Performance.....	58
Table 7-1: Toilet Water Usage WELs Rating.....	64

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 300,000m ² 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 DSND 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
CSWMP	Construction Soil and Water Management Plan
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

Acronym	Meaning
PMF	Probable Maximum Flood
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
WELS	Water Efficiency Labelling and Standards
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.

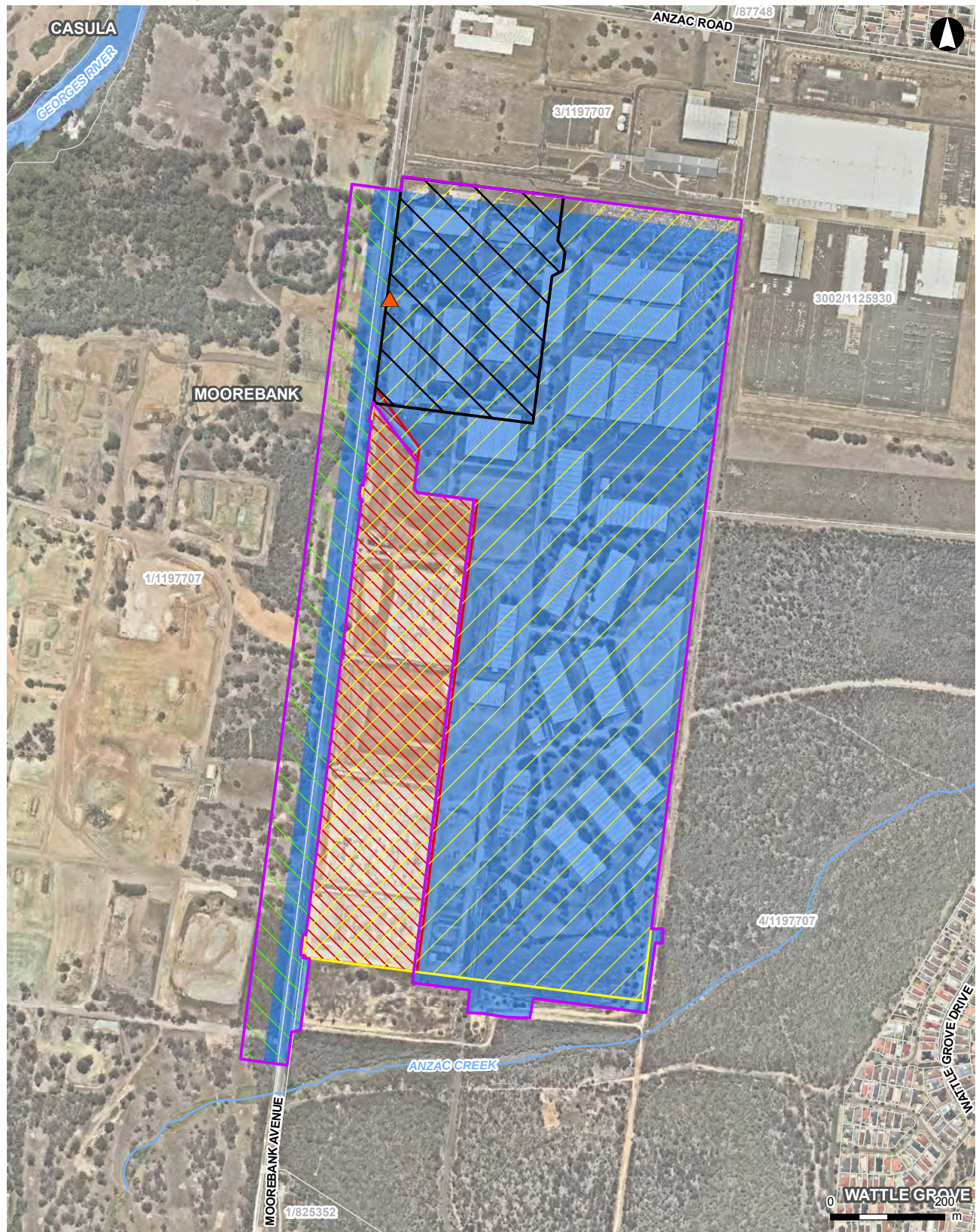
The MPE Project involves the development of an intermodal facility including warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank.

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 300,000m² GFA and additional ancillary offices.
- A freight village, comprising 8,000m² 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
 - Milling and demolition 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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 Aerial imagery supplied by nearmap (January, 2018)



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	Works Period A: Pre-construction
	Fill importation (to 60,000m ³)	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:

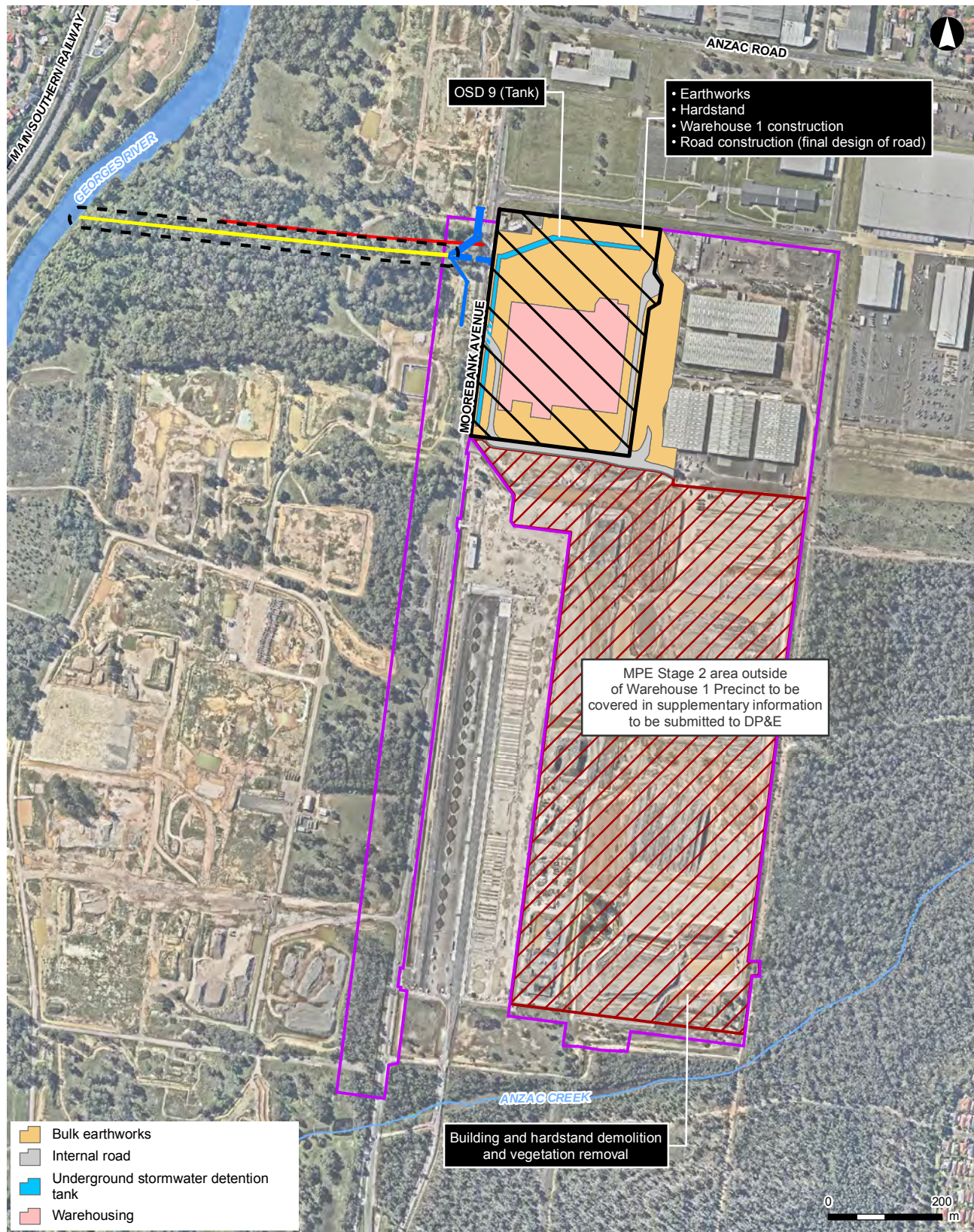
- Stormwater Management Plan – Warehouse 1 Precinct. To be approved by DP&E prior to commencement of Construction. Construction Phase A would then commence across the W1P, and Construction Phase A limited to Works Period B and E across the remainder of the site. Bulk earthworks would be limited to the 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 Precinct 1. 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 On-Site Detentions (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

- MPE Stage 2 construction area
- Warehouse 1 Precinct
- Maintenance access track
- East-west channel
- Construction footprint (30m buffer)
- Demolition and vegetation removal area (bulk earthworks exclusion zone)
- Moorebank Avenue Upgrade Drainage
- Apron Works
- Watercourse
- Existing railway

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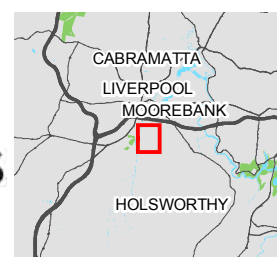


Figure 1-2: Proposed Activities

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 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 Melanie Gostelow. Melanie 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)	No OSDs in the Warehouse 1 Precinct are located within the southern ordinance burial pits.
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:		All outlets from the Project site discharge to constructed

CoC	Requirement	Report Reference	How Addressed
	(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	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.
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 of OSD 9. Numerous design features will be incorporated to ensure the raingardens are

CoC	Requirement	Report Reference	How Addressed
			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 1,000m ² in area, are to be divided into cells with no individual cell greater than 1,000m ² .	(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 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.	(vi) Section 6.2.2 – Raingardens (filter media)	Raingarden filter media will be specified in accordance with the CoC requirements.
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	To be provided.	This report will be independently reviewed and a copy of independent review

CoC	Requirement	Report Reference	How Addressed
	perceived conflicts of interest must be provided as part of the reporting of the findings and recommendations of the 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	
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.

CoC	Requirement	Report Reference	How Addressed
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 Section 6.7 – Construction Phase Section 7.5 – Rainwater Harvesting and Reuse	These sections identify the management measures considered, and where appropriate, integrated into design and implemented during construction and operation.
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	Section 2.8 of the CEMP details the response requirements to be

CoC	Requirement	Report Reference	How Addressed
		CEMP Section 2.8 SIOMP	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 performance of the development over time;	Section 1.3.2 – Compliance Monitoring and Tracking Section 6.6 - Monitoring	Section 1.3.2 describes how compliance tracking 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

CoC	Requirement	Report Reference	How Addressed
			requiring a review e.g. design changes.
C7	<i>Note; The Secretary may waive some of these requirements if they are unnecessary or unwarranted for a particular management plan.</i>	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 to meet the performance targets identified in Georges River Estuary CZMP.	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. 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.	Section 5.3.1 – On-site Detentions (OSDs) Section 6.5 – Detailed Design Requirements to Minimise the Risk of Failure	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 Section 6.5.

FCMM	Requirement	Report Reference	How Addressed
	• 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.	Appendix A – Concept Design Drawings	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

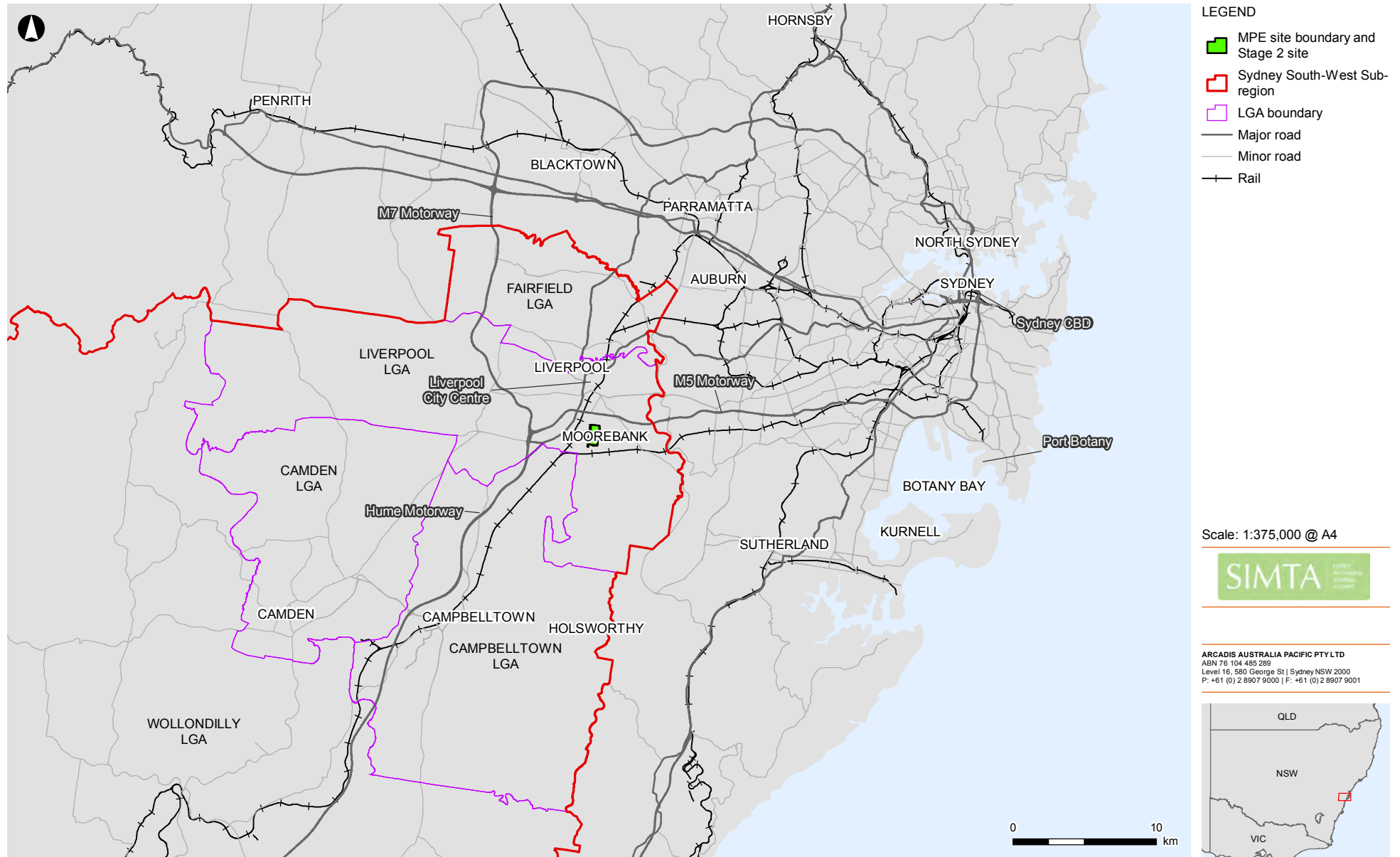
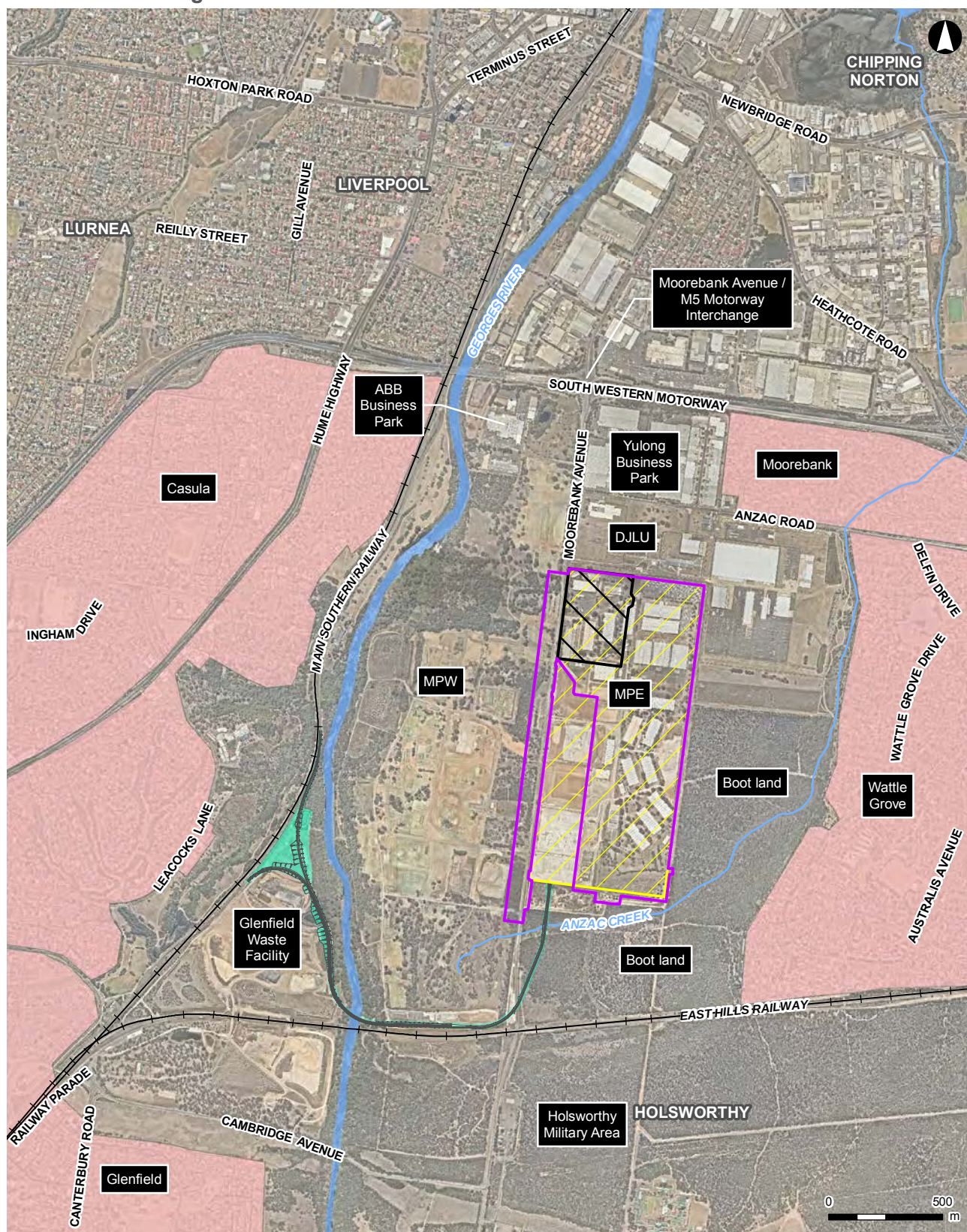


Figure 2-1: Regional Context of the Project

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

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

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



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

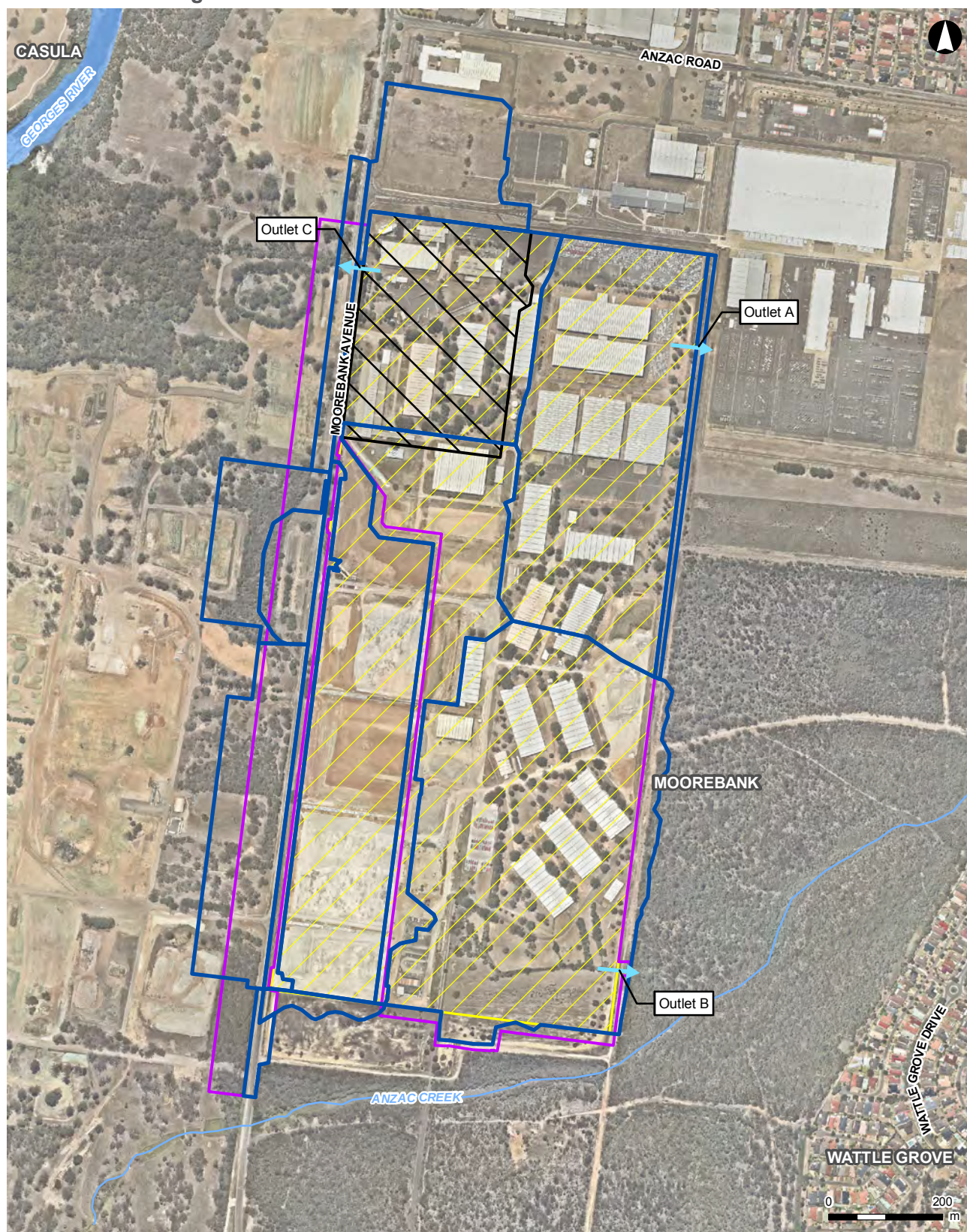
The north-east area is illustrated in **Figure 2-5** and has significant flood storage capacity.

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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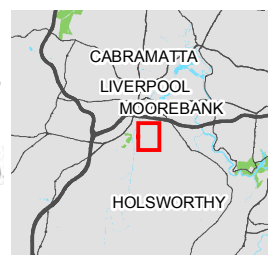
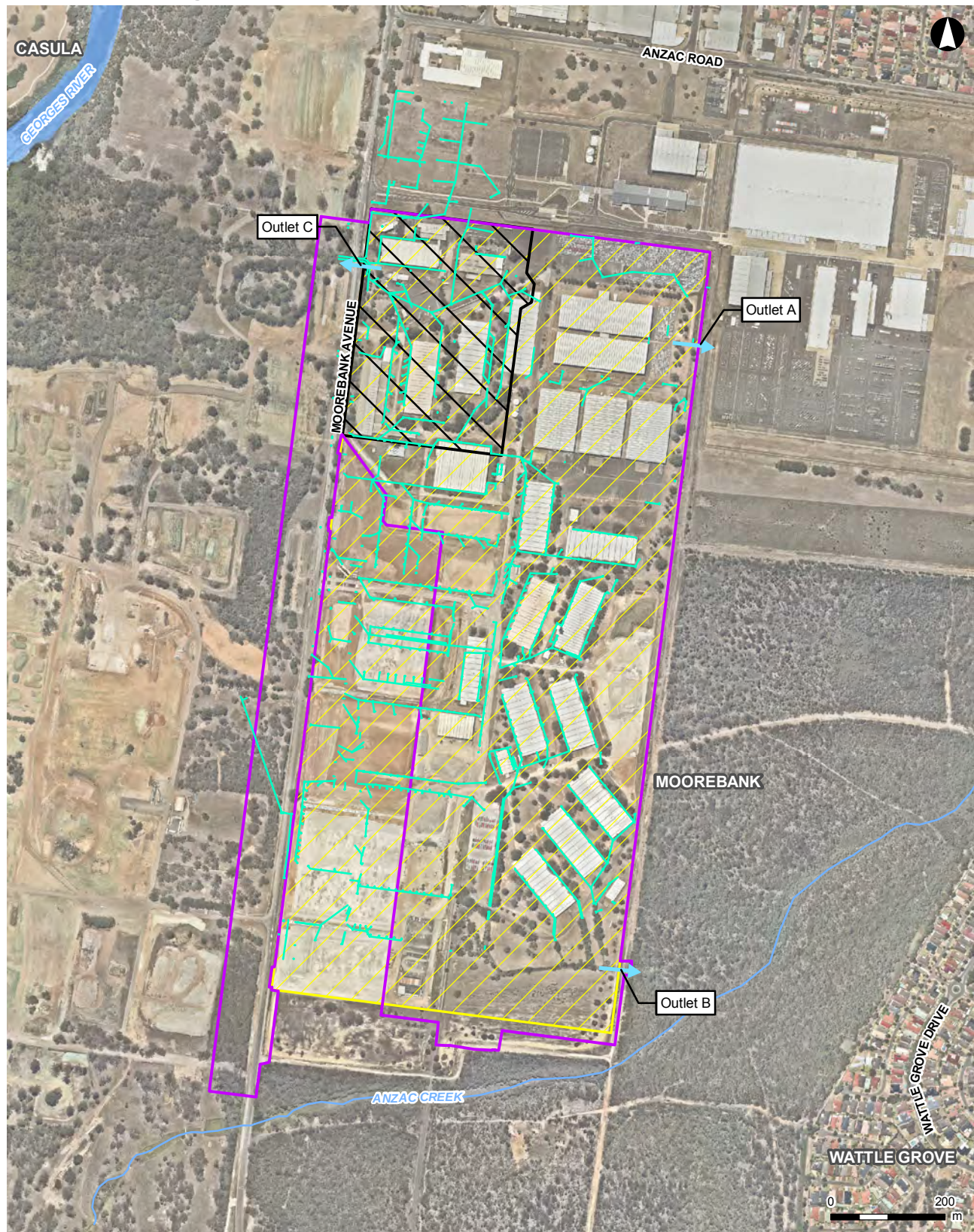


Figure 2-3: Existing Catchments of the MPE Site

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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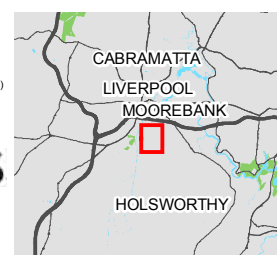
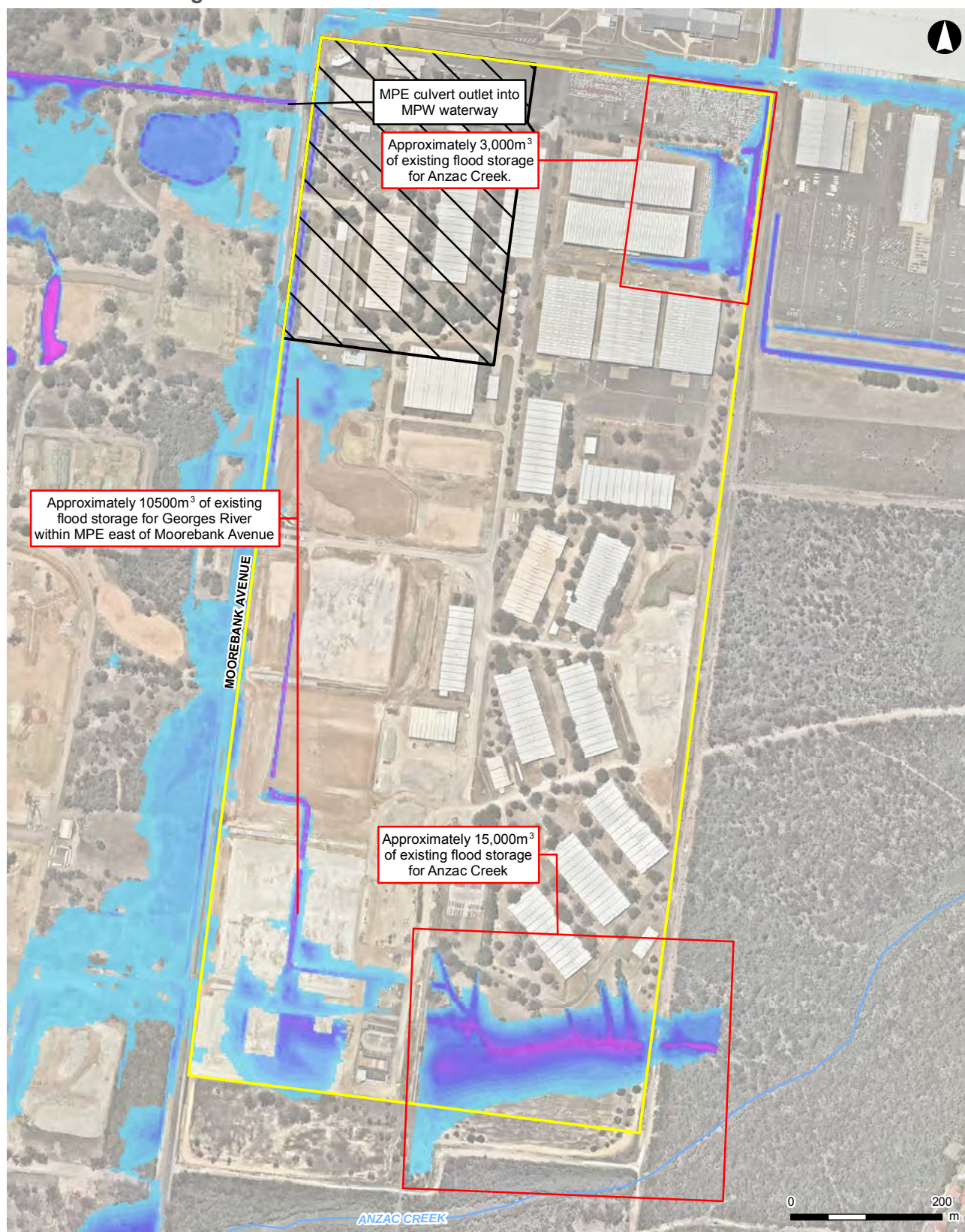


Figure 2-4: Existing Drainage Network

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

MPE site	Existing 100 year flood depth (m)	0.3 to 0.4	0.8 to 0.9
Warehouse 1 Precinct	0.0 to 0.1	0.4 to 0.5	0.9 to 1.0
Watercourse	0.1 to 0.2	0.5 to 0.6	1.0 to 1.2
	0.2 to 0.3	0.6 to 0.7	1.2 to 1.4
		0.7 to 0.8	> 1.4

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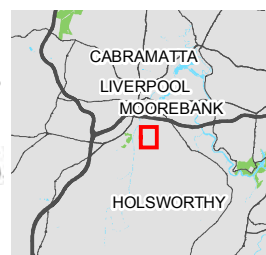
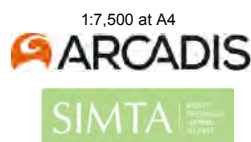


Figure 2-5: MPE site 100 year ARI flood levels (mAHD) and flood storage

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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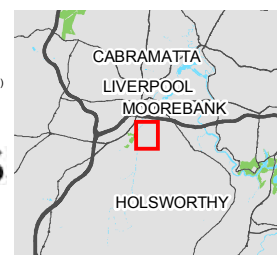


Figure 2-6: Existing Site Conditions Catchment Plan

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.

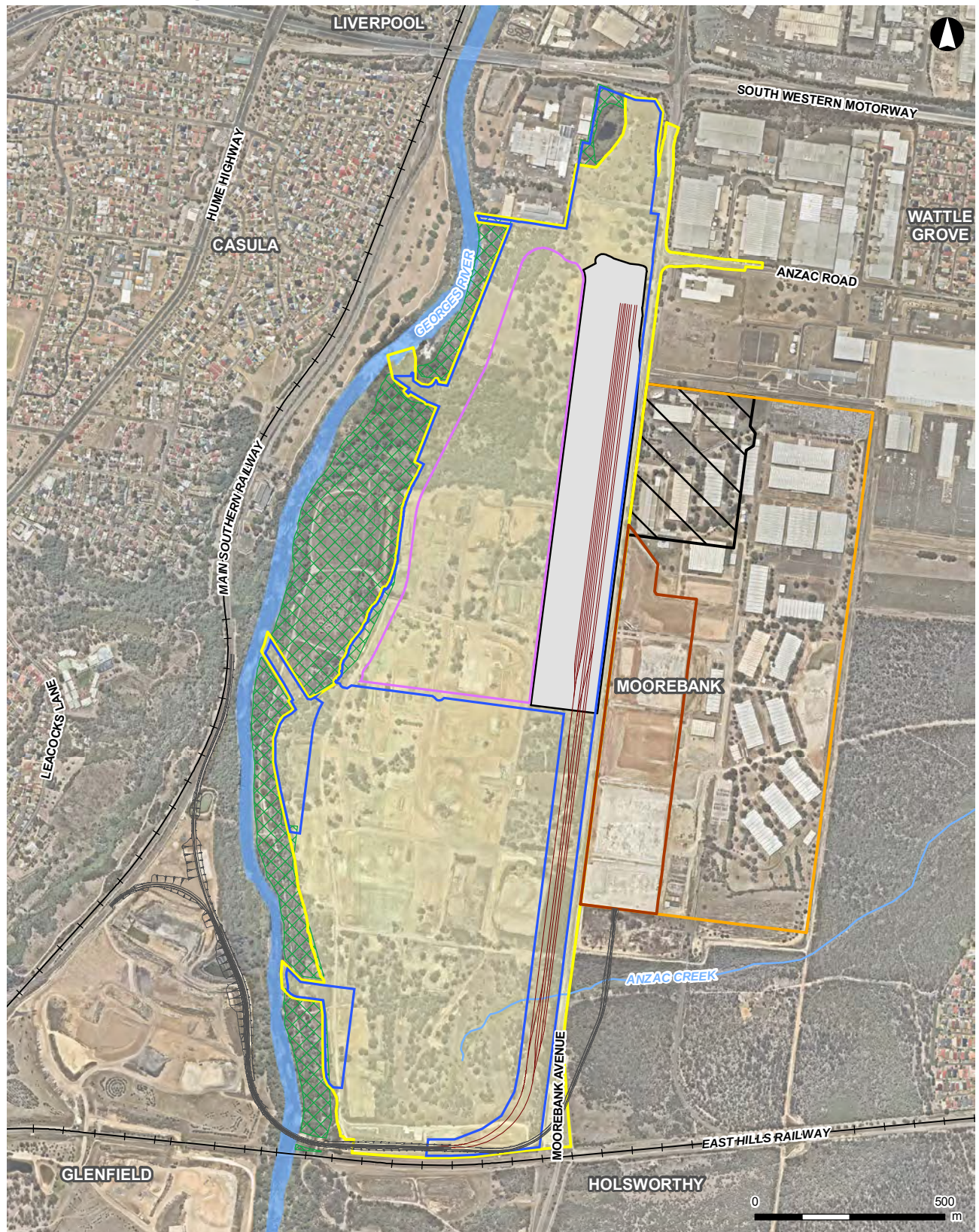
The amended Proposal included:

- 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.

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

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

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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 Construction Soil and Water Management Plan (CSWMP) 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 CSWMP 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 CSWMP 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 CSWMP):
 - 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 and B53.

4.2 Operation

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

- 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 and 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 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
 - 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 (separate to this document).

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**.

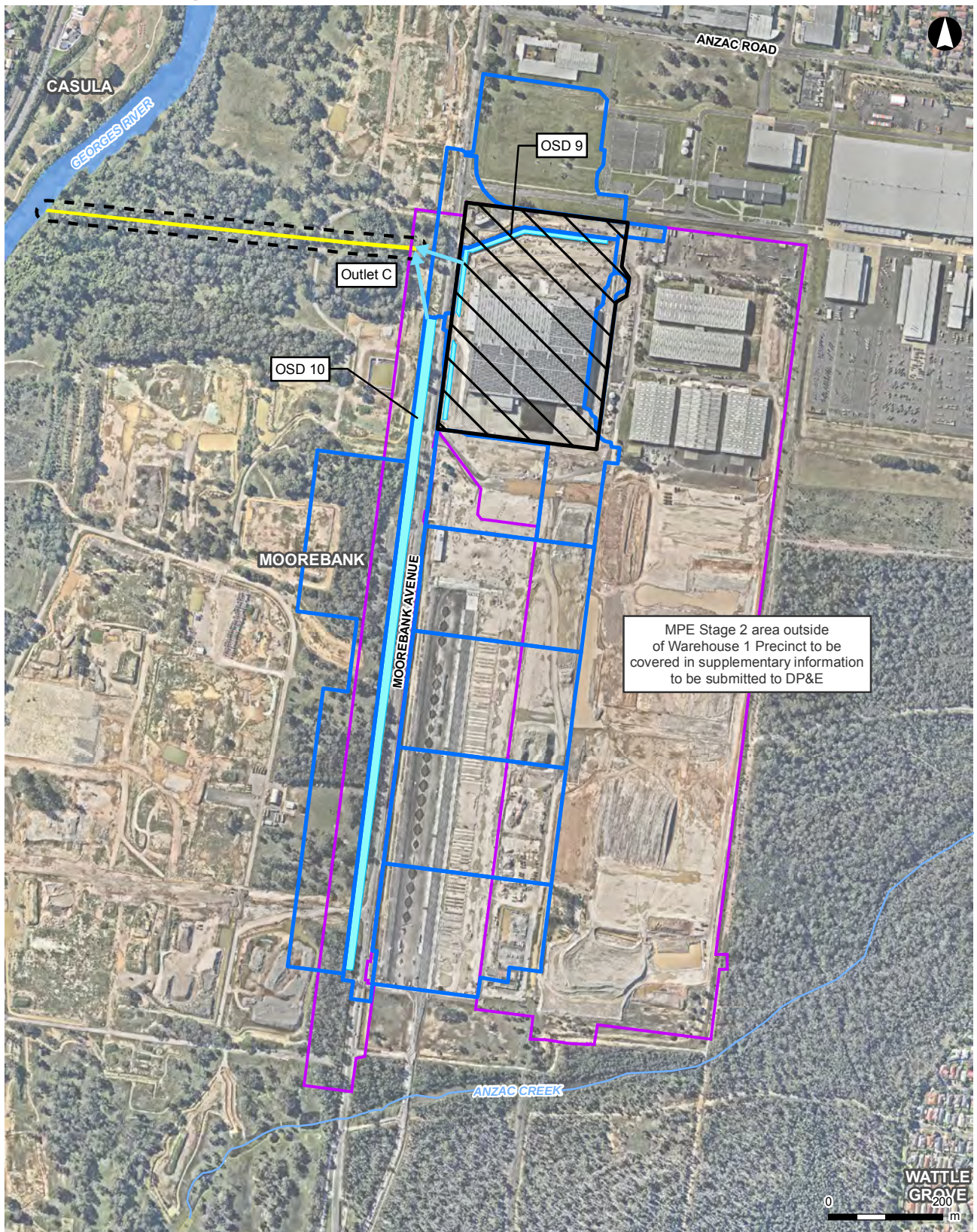
5.2.1 Results

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
- Warehouse 1 Precinct
- OSD
- Proposed catchment
- Construction footprint (30m buffer)
- East-west channel
- 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 (m ³ /s) [#]		
				1yr ARI	20yr ARI	100yr ARI
OSD C	Existing	59.50	EX Channel	3.19	9.80	12.9
	Proposed	62.69	Channel	2.40	5.73	6.67

[#] The tabulated peak flows do not indicate mitigation adequacy in themselves, rather refer to **Appendix C** for same storm duration comparisons

[Models: MPESStage2SMPEExisting-18-02-26.drn & MPESStage2SMPPProposed-19-06-03.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	12.34	6.69	0.91	15.6	7,182

Storage parameters & outlet configuration are included in **Appendix C**.

[Model: MPESStage2SMPPProposed-19-06-03.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 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 0.4m²/s within the Project site (excluding open waterways).

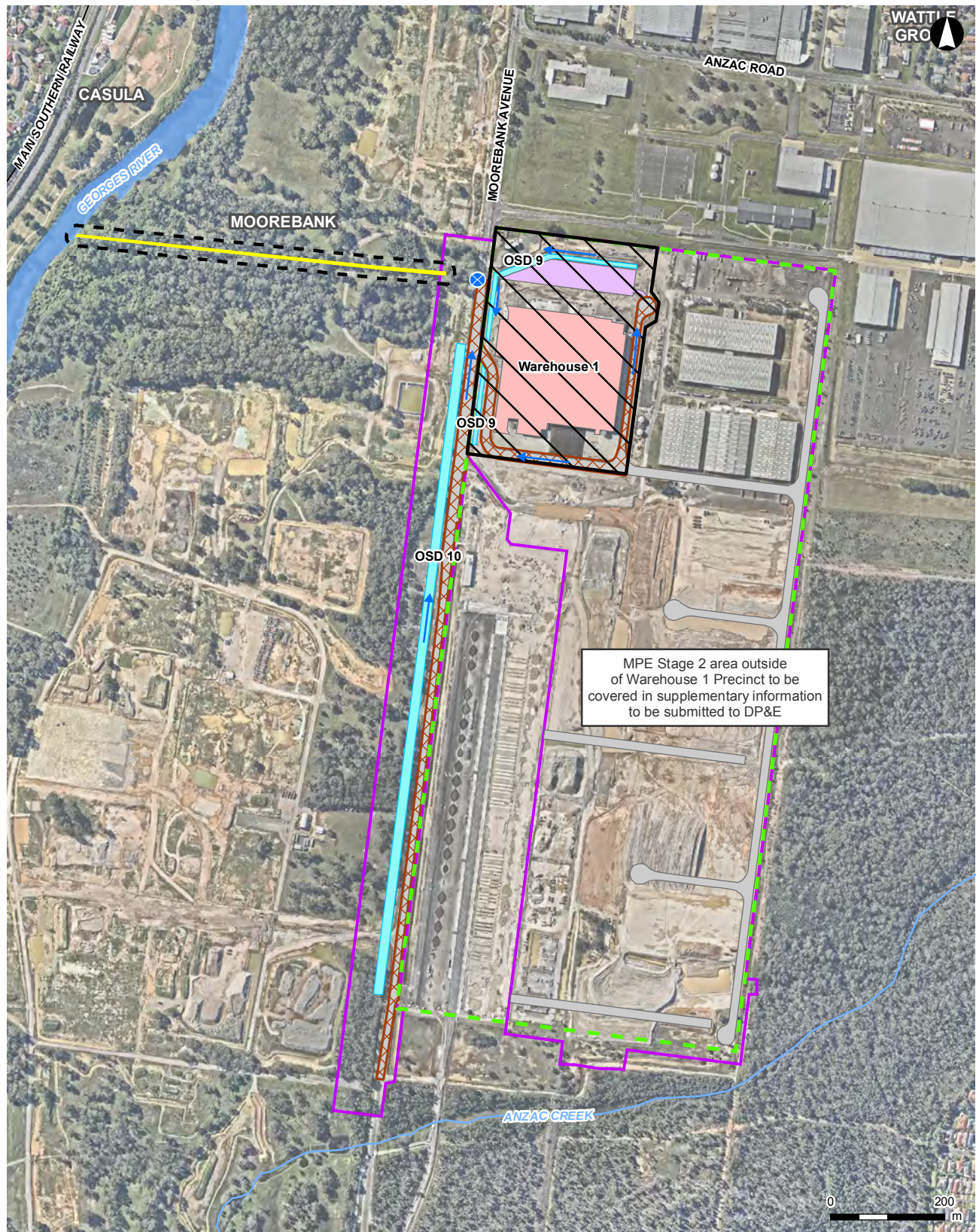
Drainage conduits are to typically have:

- 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 | Construction footprint (30m buffer) |
| MPE Stage 2 construction area | Freight Village |
| Warehouse 1 Precinct | OSD |
| Overland flow | Road |
| East-west channel | Warehouse |
| Discharge point | Overland flow direction |
| Watercourse | |

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 Aerial Imagery supplied by Nearmap (Mar, 2019)



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**.

5.3.8 OSD Outlets to Georges River

A proposed piped stormwater network will drain the outlets from OSD 9 and OSD 10 to the existing concrete channel located within MPW. A single junction pit will combine the flows from the upstream stormwater networks to discharge to the existing concrete channel. Flows will drain from the concrete channel to the Georges River.

The outlet from OSD 9 will discharge to proposed culverts running west beneath Moorebank Avenue. The culverts will replace the existing culverts currently in place at this location. Prior to the junction pit, a section of the drainage line will be a small length of open channel. This open section will act as an additional inlet for the drainage of overland flows in larger rainfall events. The ground level surrounding the area will be shaped to collect and convey overland flows to this location.

The outlet from OSD 10 will be piped to the north to the junction pit. An additional piped connection enters the junction pit from the north. This will provide for additional connections from future Moorebank Avenue Upgrade works.

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

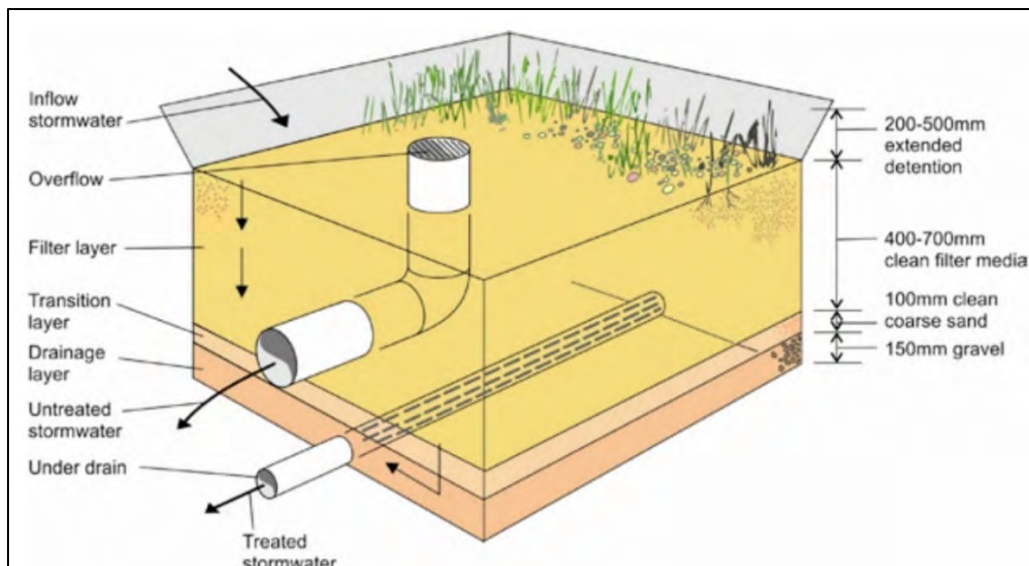
Gross pollutant traps (GPTs) are primary stormwater treatment measures, typically applied as the first measure in a stormwater treatment train. GPTs come in varying forms from simple trash racks through to more complex devices with continuous deflection screens and hydrodynamic separation.

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 1,000m².

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.

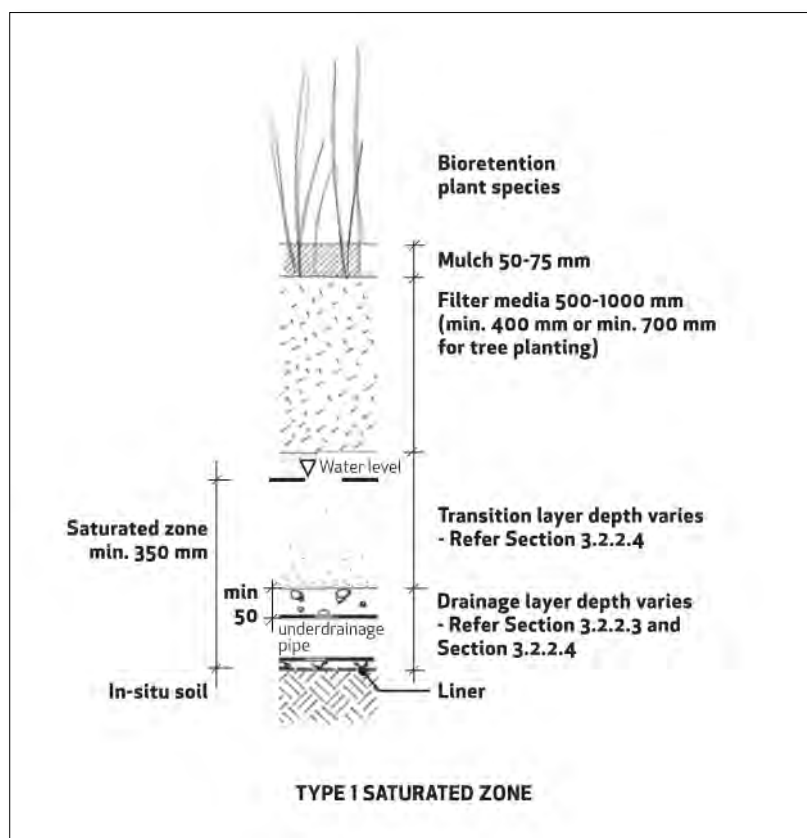
In addition to protection of adjacent structures and salinity hazards, the proposed raingardens have been designed to have a saturated zone due to the lack of grade on site. These systems integrate a water storage (wet sump) in the transition and drainage layer, which requires an impermeable liner to 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 health, 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.

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



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

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, MPEStage2SMPPProposed-18-03-06.sqz

As the proposed treatment train meets the required reduction targets, the five GPTs and the 2600m² 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 bioretention system downstream of the OSD tank it can 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 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 CSWMP and 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.

These 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**.

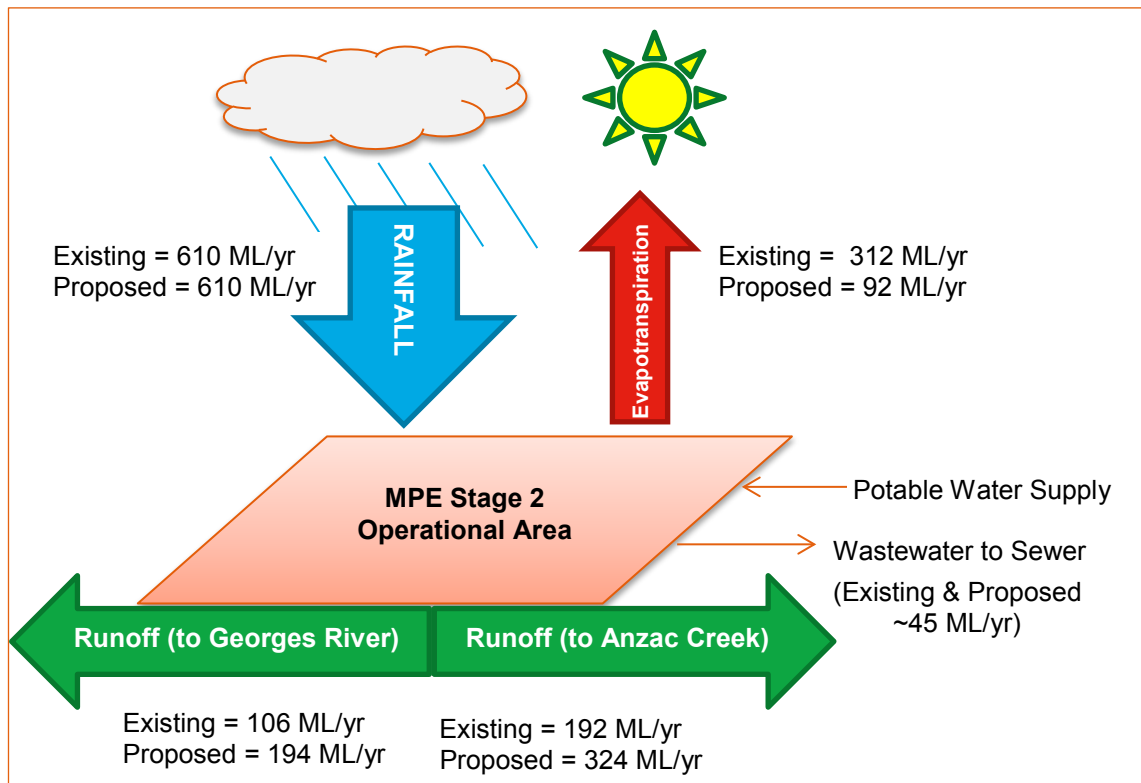


Figure 7-1: MPE Stage 2 Water Balance

7.5 Rainwater Harvesting and 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 Rating¹. To achieve this a minimum of a four star Water Efficiency Labelling and Standards (WELS) rating for toilets is required as described in AS6400².

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**

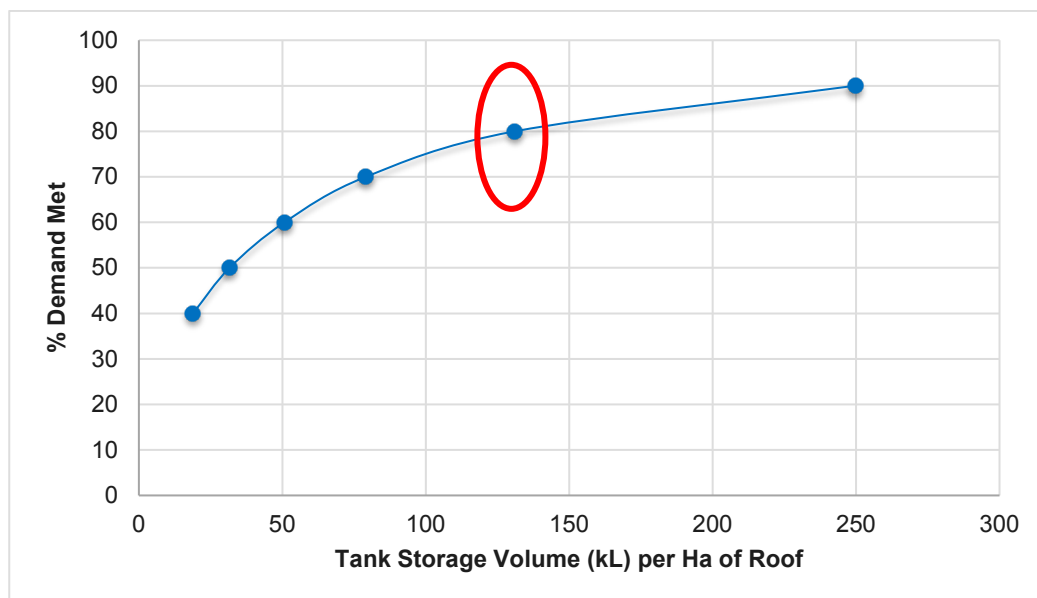


Figure 7-2: Concept Rainwater Tank Sizing & Percentage Demand Relationship

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.

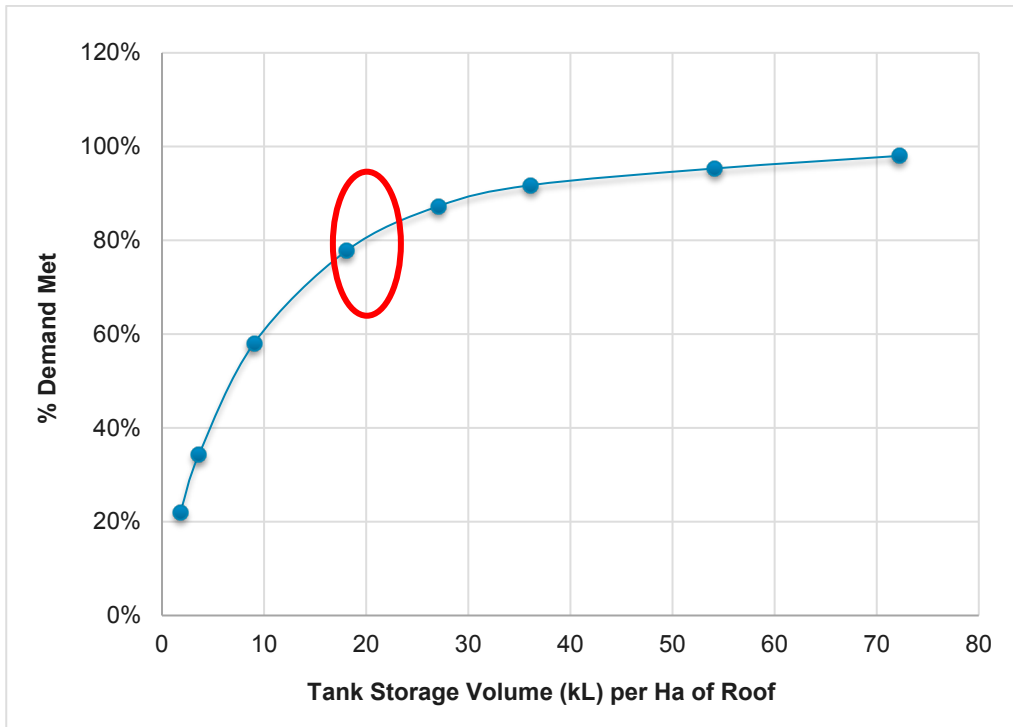


Figure 7-3: Rainwater Tank Sizing & Percentage Demand Relationship

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.

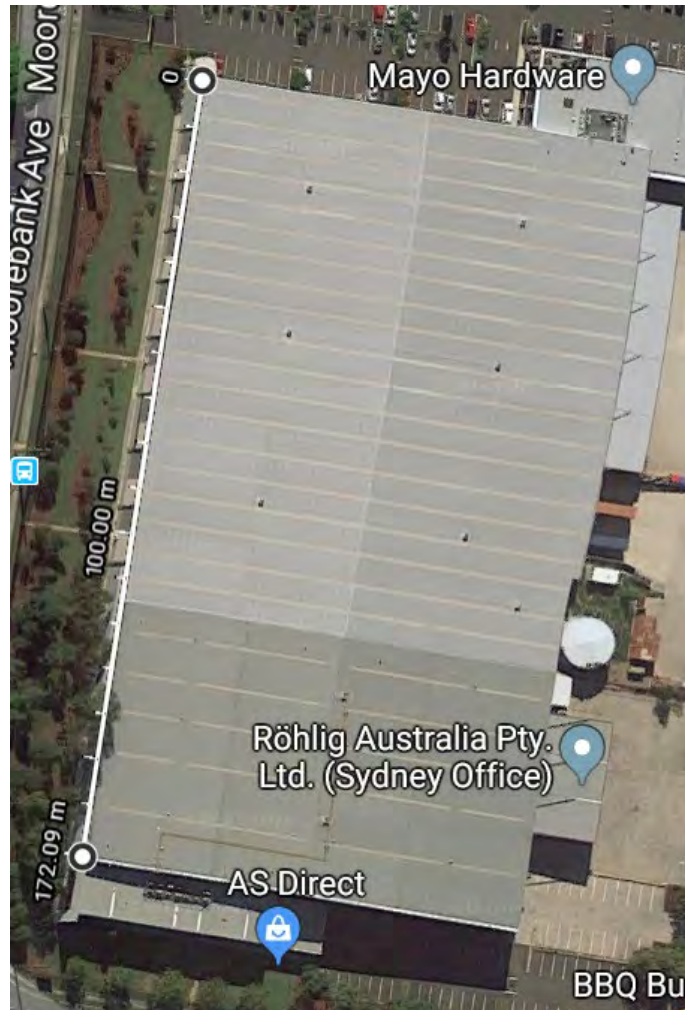


Figure 7-4: Rohlig Australia Warehouse

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 km² 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 for Warehouse 1 Precinct located within Stage 2 of the MPE Project (SSD 7628) has been prepared for approval by DP&E in accordance with CoC B40.

The following conclusions have been made within this report:

- A CSWMP and ESCP 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

These drawings represent the conceptual design for the Warehouse 1 Precinct and have been provided for information only. The design is subject to change during detailed design.

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

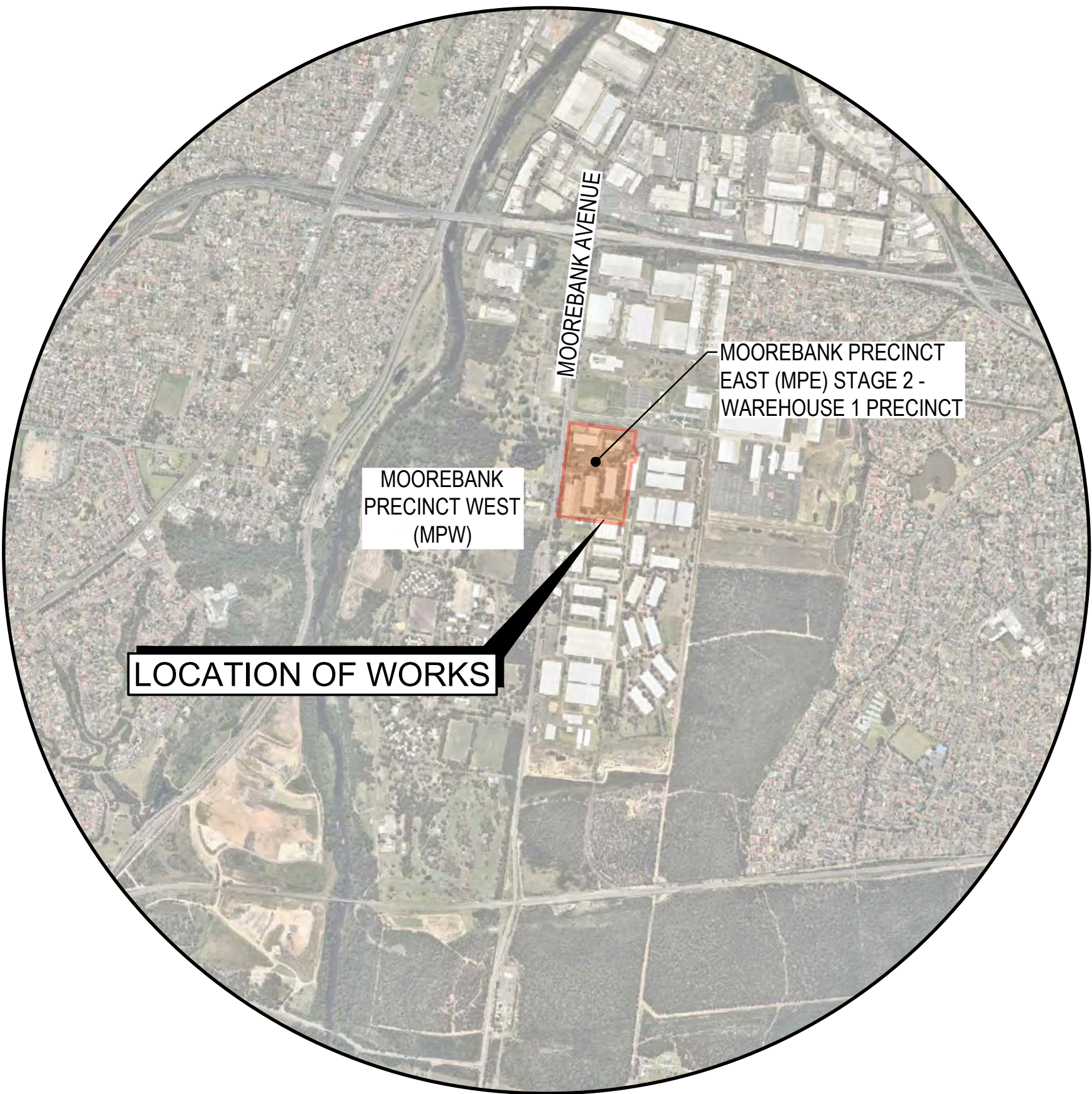
SSS2-ARC-CV-DWG-1101	EROSION AND SEDIMENT CONTROL PLAN
SSS2-ARC-CV-DWG-1102	EROSION AND SEDIMENT CONTROL DETAILS
SSS2-ARC-CV-DWG-1111	BULK EARTHWORKS PLAN

CIVIL WORKS

SSS2-ARC-CV-DWG-1201	CIVIL AND STORMWATER PLAN
SSS2-ARC-CV-DWG-1211	ROAD LONGITUDINAL SECTIONS

STORMWATER DRAINAGE

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

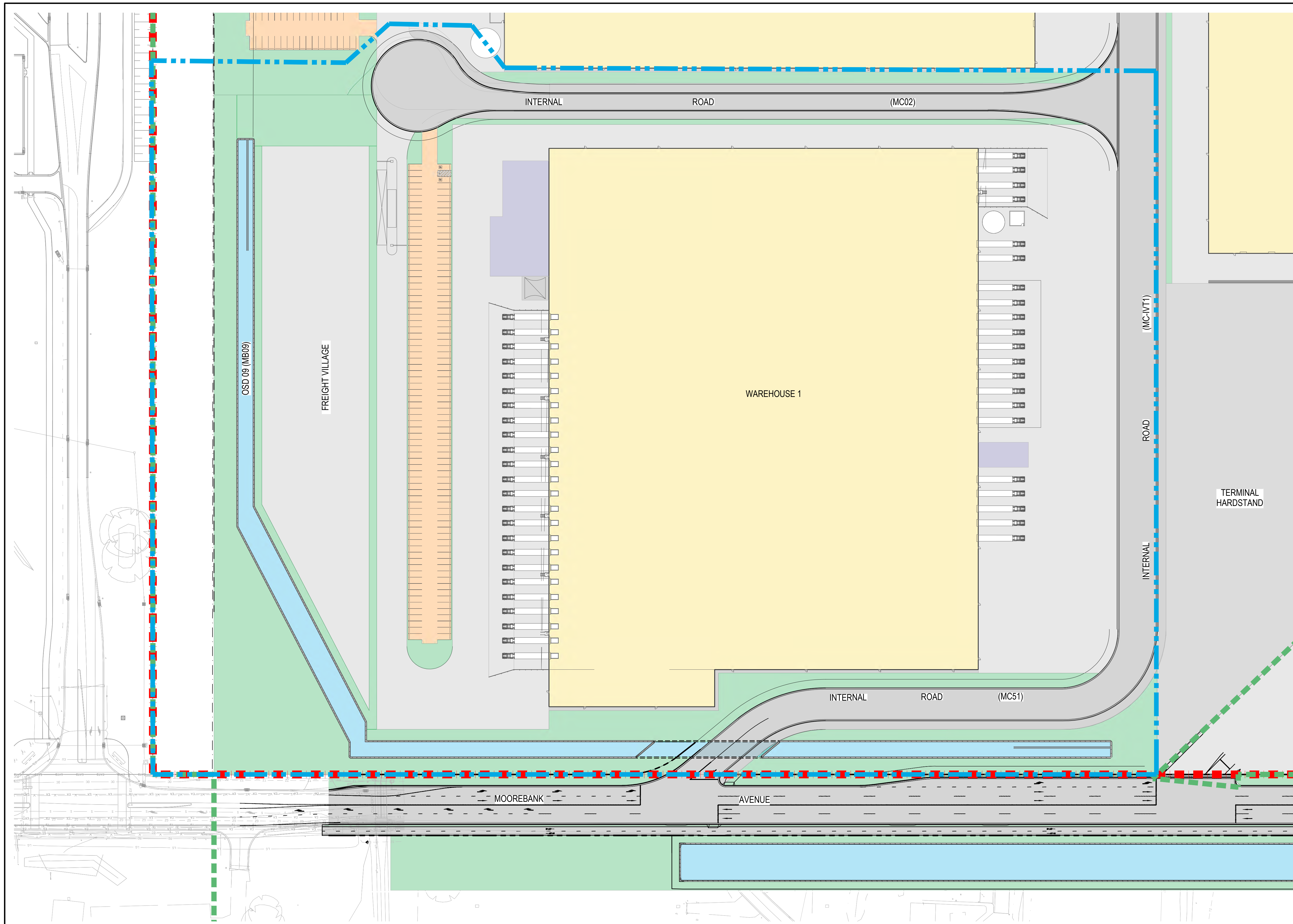


LOCALITY PLAN
1 : 20,000

IMAGERY EXTRACTED FROM nearmap.com

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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.

03	ISSUE FOR STORMWATER MANAGEMENT PLAN	07/06/2019
02	ISSUE FOR STORMWATER MANAGEMENT PLAN	05/06/2019
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018
Issue	Description	Date

01530456075m

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

Current Issue Signatures

Drawn
A.ZHAO

Designed
J.WOOD

Checked
G.DUNSTAN

Approved
M.KEFFORD

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

Project

MOOREBANK PRECINCT EAST
(MPE) STAGE 2
WAREHOUSE 1 PRECINCT

Title

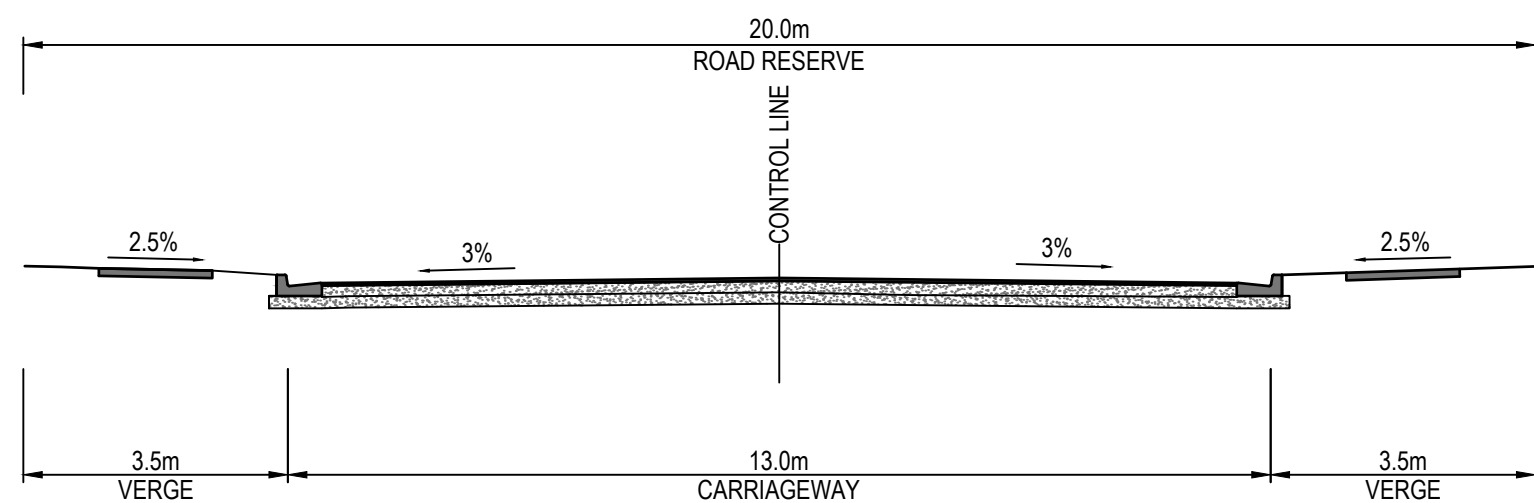
GENERAL ARRANGEMENT
PLAN

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

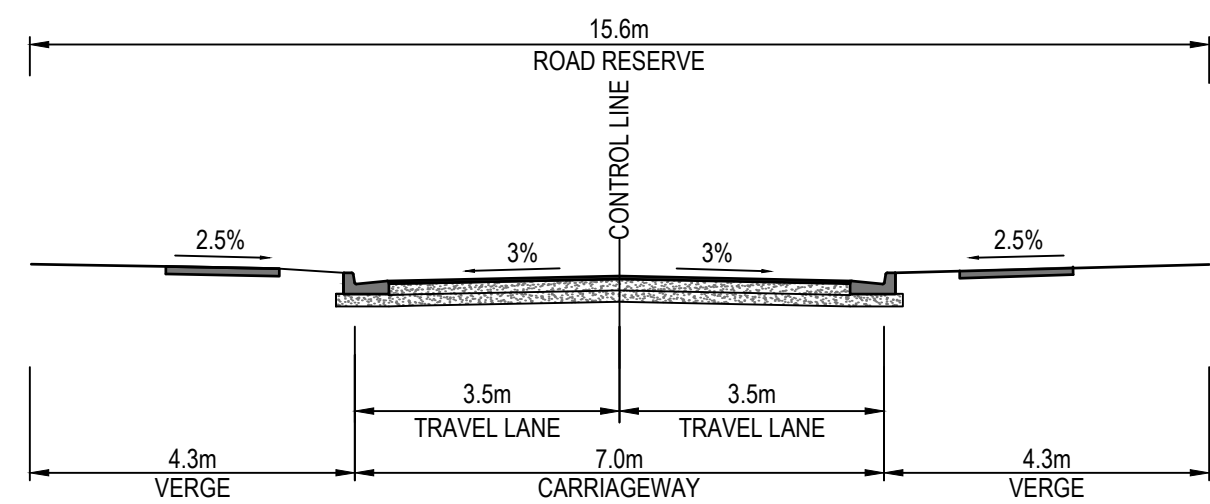
Project No.
AA009335

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

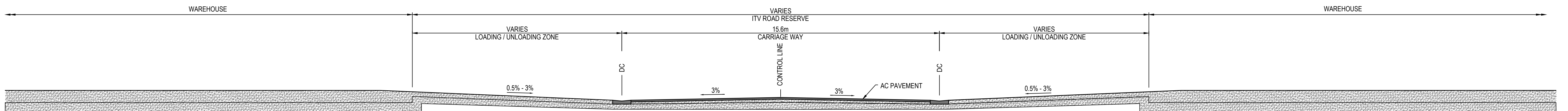
Issue
03



TYPICAL CROSS SECTION - INTERNAL ROAD (MC51)
SCALE 1 : 100

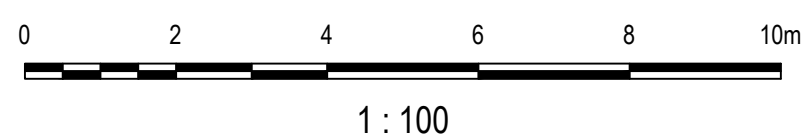


TYPICAL CROSS SECTION - INTERNAL ROAD (MC02)
SCALE 1 : 100



TYPICAL CROSS SECTION - INTERNAL ROAD (ITV ROAD)
SCALE 1 : 100

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



Status PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION			
Scales	1 : 100	Current Issue Signatures	
		Drawn A.ZHAO	
Original Size	A1	Designed J.WOOD	
Height Datum	AHD	Checked G.DUNSTAN	
Grid	MGA	Approved M.KEFFORD	
Filename: SSS2-ARC-CV-DWG-1003-TypicalRoadCrossSections.dwg			

Project MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT	
Title TYPICAL ROAD CROSS SECTIONS	

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arcadis.com

Project No.
AA009335

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

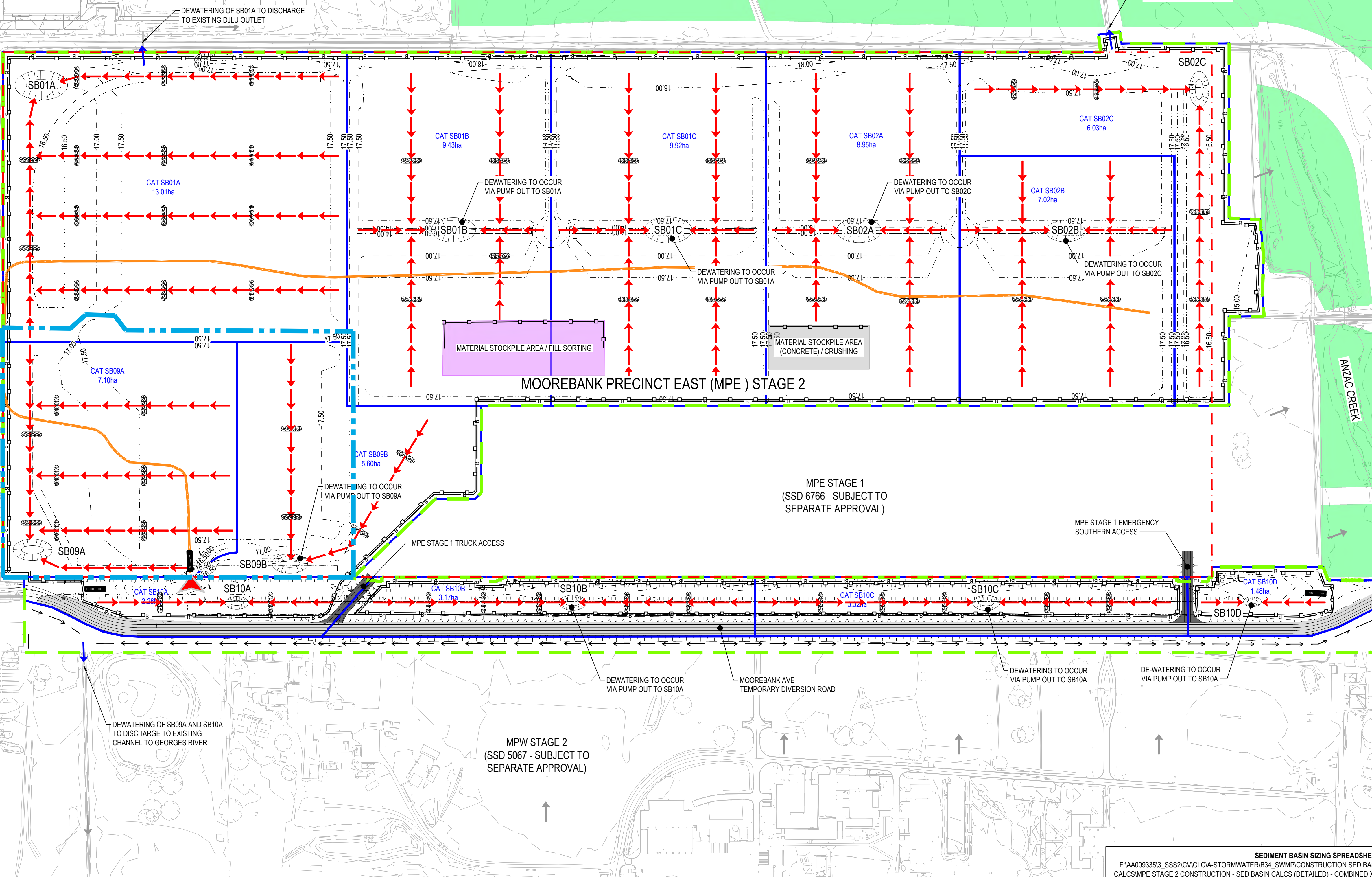
Issue
01

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.

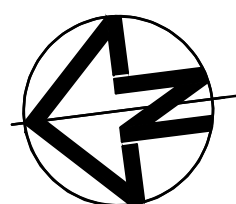
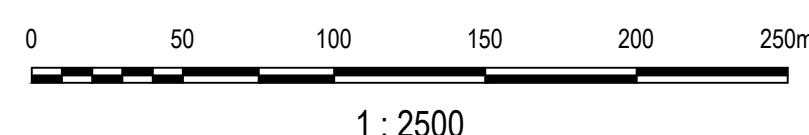
LEGEND

- 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
- 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	SITE											
	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 (fraction 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
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												
Site	Cv	Rx-day, y-kile	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						

Issue	Description	Date
02	ISSUE FOR STORMWATER MANAGEMENT PLAN	05/06/2019
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 : 2500

Original Size: A1

Height Datum: AHD

Grid: MGA

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

Current Issue Signatures

Drawn: M.OLAYA

Designed: J.KO

Checked: G.DUNSTAN

Approved: M.KEFFORD

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- 02

Issue

EROSION & SEDIMENT CONTROL NOTES

- GENERAL INSTRUCTIONS
- 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.
 - ALL WORK SHALL BE GENERALLY CARRIED OUT IN ACCORDANCE WITH
 - LOCAL AUTHORITY REQUIREMENTS
 - EPA REQUIREMENTS
 - LANDCOM "MANAGING URBAN STORMWATER, SOILS AND CONSTRUCTION", 4th EDITION, MARCH 2004 ('BLUE BOOK')
 - RELEVANT CONSTRUCTION AND ENVIRONMENT MANAGEMENT PLAN (CEMP)
 - RELEVANT SOIL AND WATER MANAGEMENT PLAN (SWMP)
 - RELEVANT EROSION AND SEDIMENT CONTROL PLAN (ESCP)
 - CONTRACTOR TO MAINTAIN THE EROSION CONTROL DEVICES TO THE SATISFACTION OF THE SUPERINTENDENT AND THE LOCAL AUTHORITY.
 - THE WATER IN THE SEDIMENT BASIN(S) SHALL BE LOWERED PERIODICALLY TO MAINTAIN THE MINIMUM STORAGE VOLUME REQUIRED FOR FINE SOILS.
 - AT ALL TIMES A WATER CART(S) SHALL BE MAINTAINED ON SITE TO:
 - WATER THE AREAS OF HYDROMULCH
 - CONTROL DUST
 - 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.
 - 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.
 - 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.
 - WHEN STORMWATER PITS ARE CONSTRUCTED, PREVENT SITE RUNOFF ENTERING UNLESS SEDIMENT FENCES ARE ERECTED AROUND PITS.
 - 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
- 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:
 - MAINTAIN EXISTING SECURITY / WIND FENCES INSTALLED AS PART OF THE ENABLING WORKS AND INSTALL NEW SECURITY / WIND FENCES AS SHOWN.
 - MAINTAIN EXISTING SEDIMENT FENCES INSTALLED AS PART OF THE ENABLING WORKS AND INSTALL NEW SEDIMENT FENCES AS SHOWN.
 - INSTALL SEDIMENT TRAPS AS SHOWN ON PLAN AND AS REQUIRED.
 - 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.
 - 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
 - SEED MIXTURES ARE TO BE APPROVED BY SUPERINTENDENT PRIOR TO SPRAYING. ALL GRASSSED AREAS SHALL BE REGULARLY WATERED AND MAINTAINED UNTIL EXPIRATION OF THE MAINTENANCE PERIOD.

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

- SEDIMENT CONTROL
- 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.

- 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.

- TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE REHABILITATED/STABILISED.

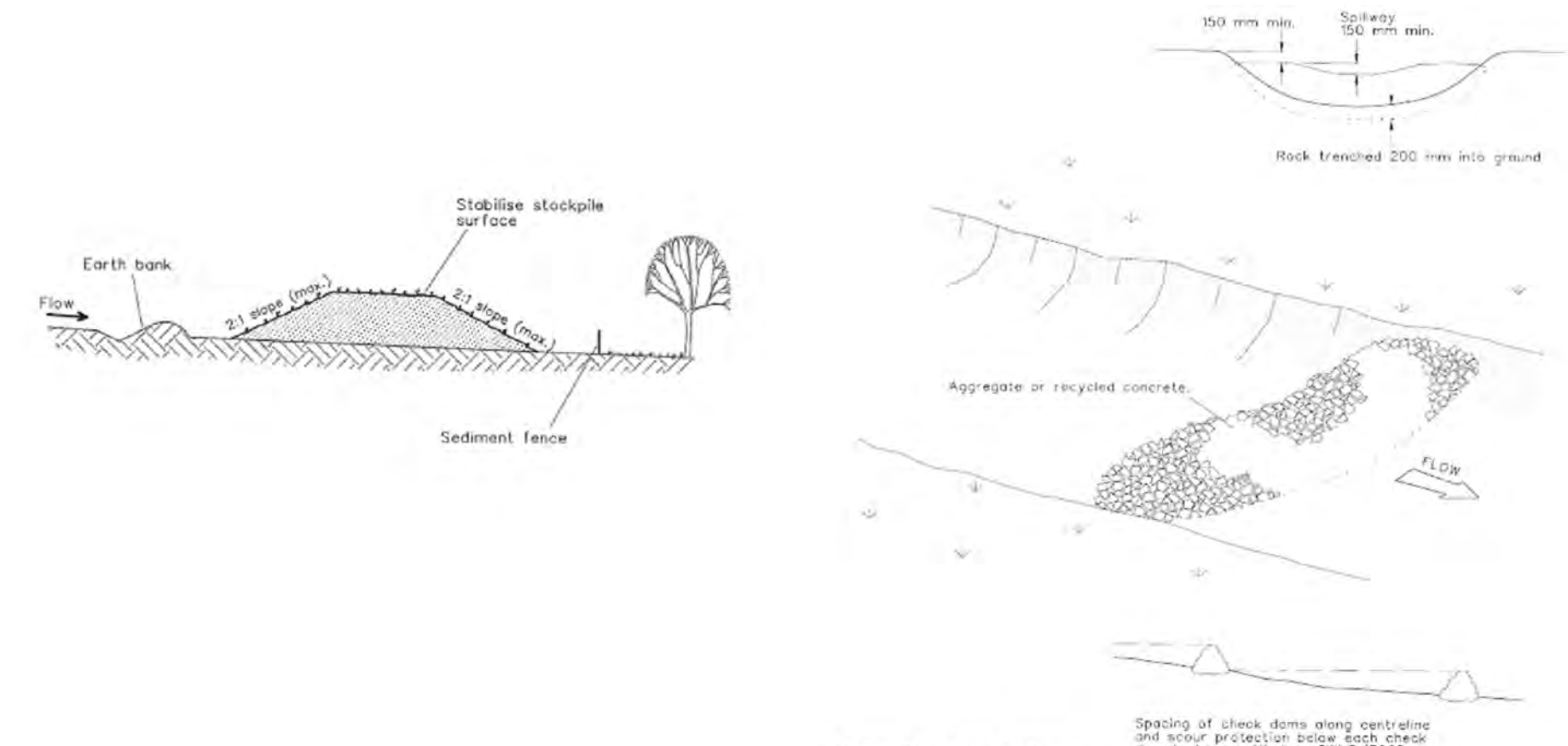
- ALL PROPOSED PITS TO HAVE GEOTEXTILE INLET FILTERS PRIOR TO PAVEMENT CONSTRUCTION. PROVIDE MESH AND GRAVEL INLET FILTER TO KERB INLET PITS ONCE PAVEMENT IS CONSTRUCTED.

- OTHER MATERIALS
- ACCEPTABLE RECEPTORS WILL BE PROVIDED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.

- ANY EXISTING TREES WHICH FORM PART OF THE FINAL LANDSCAPING PLAN WILL BE PROTECTED FROM CONSTRUCTION ACTIVITIES IN ACCORDANCE WITH LANDSCAPE ARCHITECTS DETAILS.

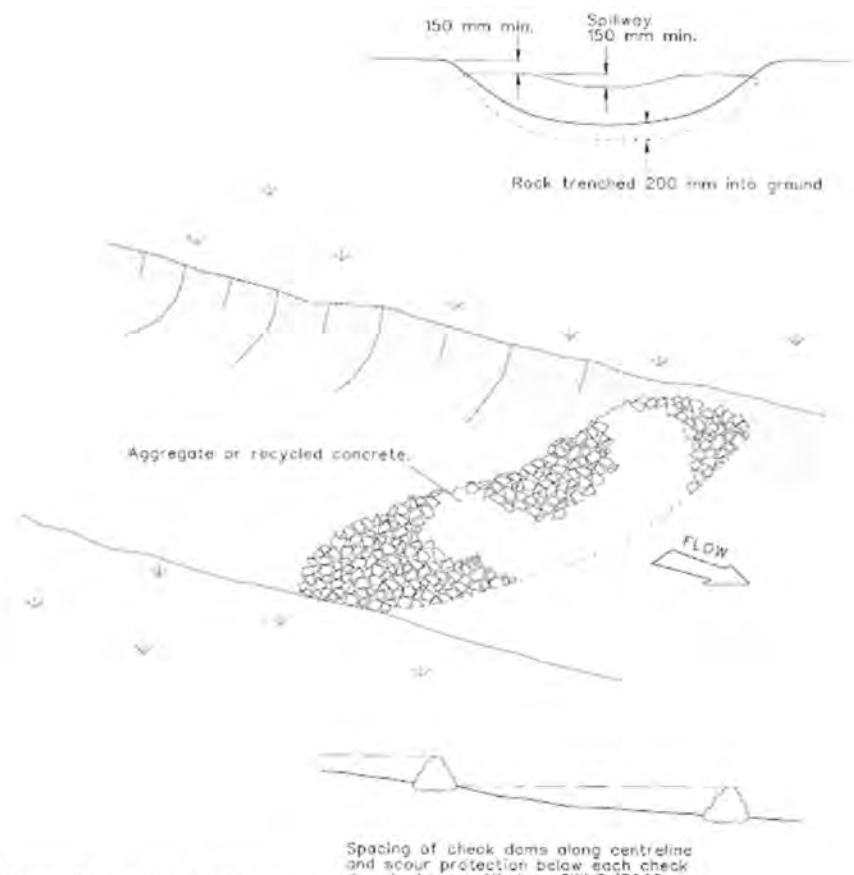
- ALL AREAS OF PUBLIC THOROUGHFARE MUST BE KEPT CLEAN AND FREE OF WATER RUNOFF, SEDIMENT AND CONSTRUCTION MATERIALS AT ALL TIMES. THIS INCLUDES AREAS OUTSIDE OF THE SITE BOUNDARY.

- 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.



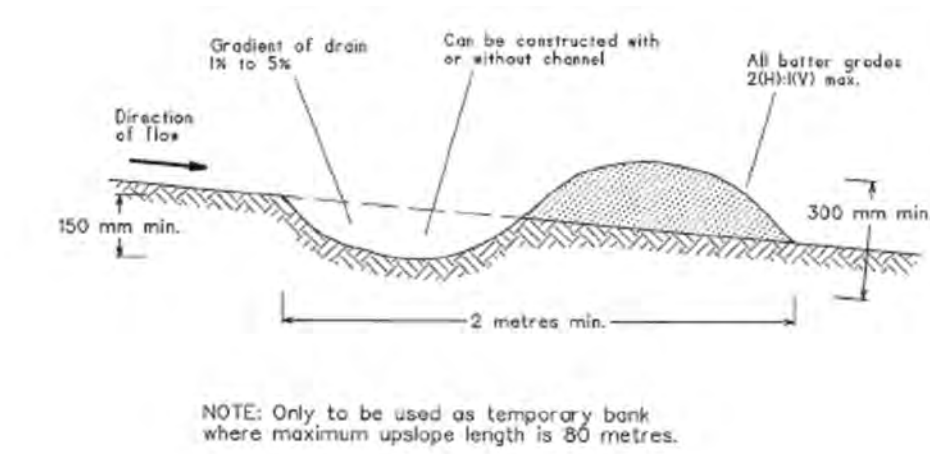
- Construction Notes
- Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
 - Construct on the contour as low, flat, elongated mounds.
 - Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
 - 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.
 - Construct earth banks (Standard Drawing 5-6) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-6) 1 to 2 metres downslope.

STOCKPILES (SD 4-1)



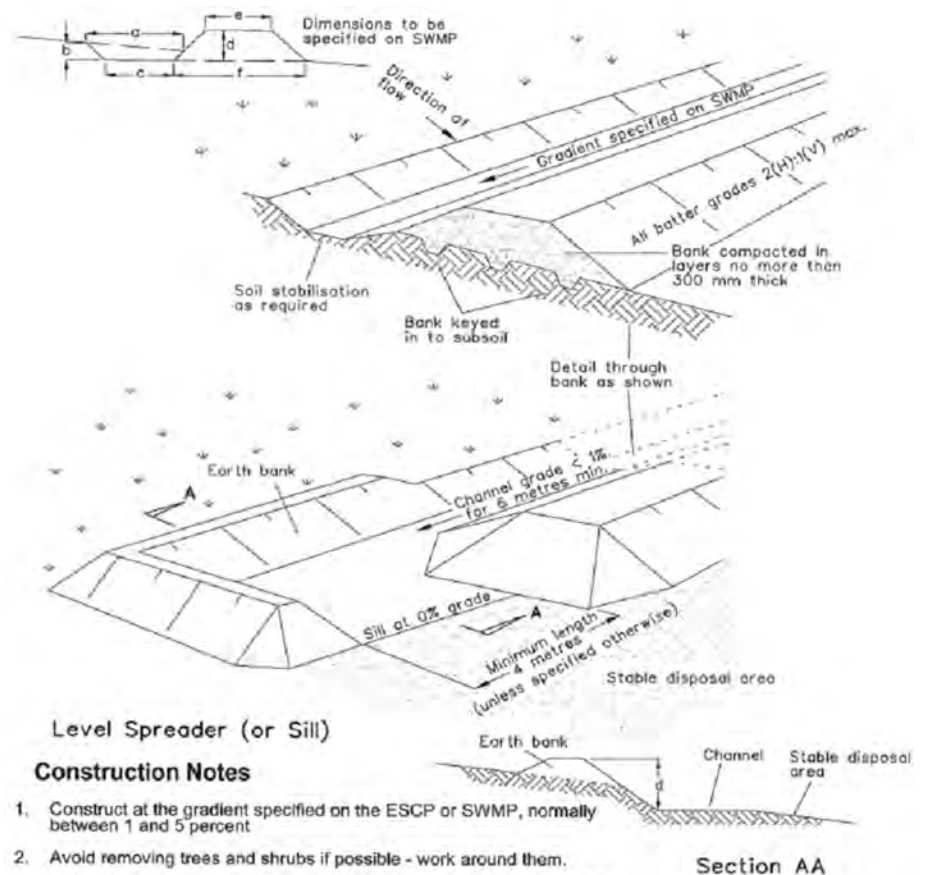
- Construction Notes
- Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.
 - 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.
 - 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.
 - 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)



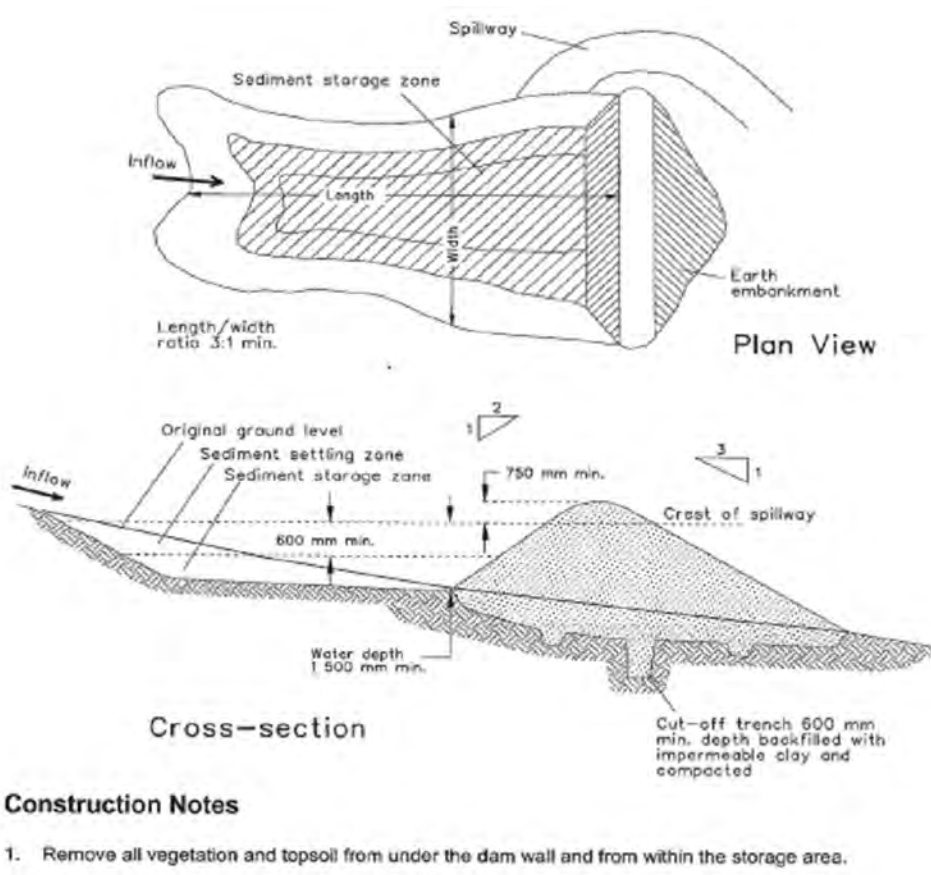
- Construction Notes
- Build with gradients between 1 percent and 5 percent.
 - Avoid removing trees and shrubs if possible - work around them.
 - Ensure the structures are free of projections or other irregularities that could impede water flow.
 - Build the drains with circular, parabolic or trapezoidal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

EARTH BANK LOW FLOW (SD 5-5)



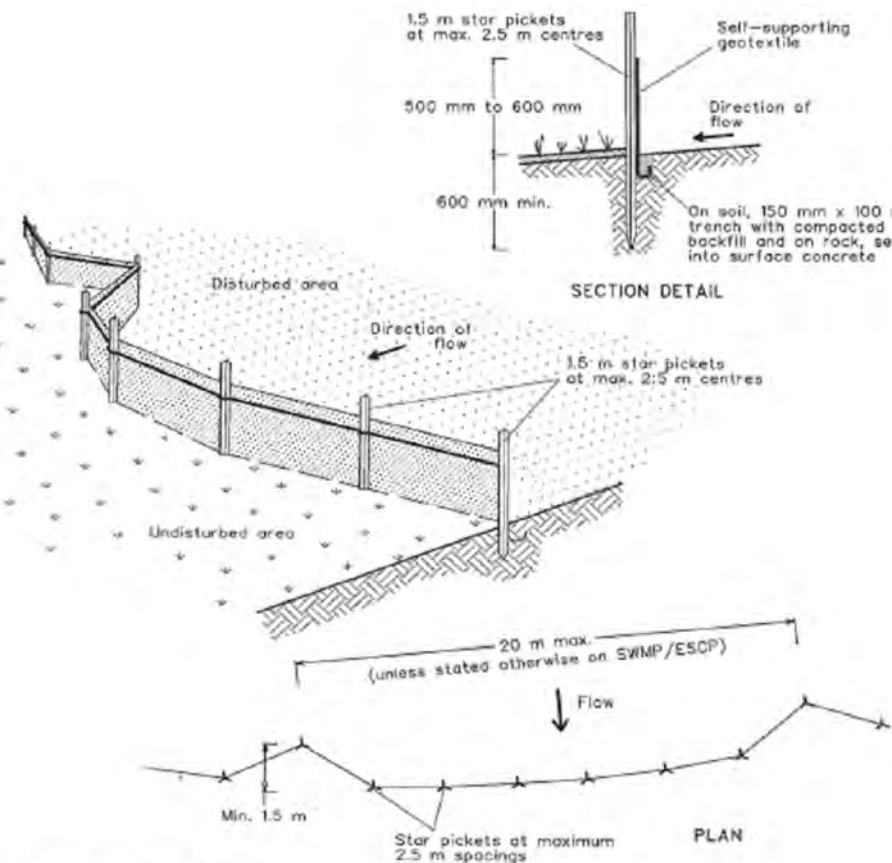
- Construction Notes
- Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent.
 - Avoid removing trees and shrubs if possible - work around them.
 - Ensure the structures are free of projections or other irregularities that could impede water flow.
 - Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
 - Ensure the banks are properly compacted to prevent failure.
 - Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
 - Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
 - Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
 - Where possible, ensure they discharge waters onto either stabilised or well-drained 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)



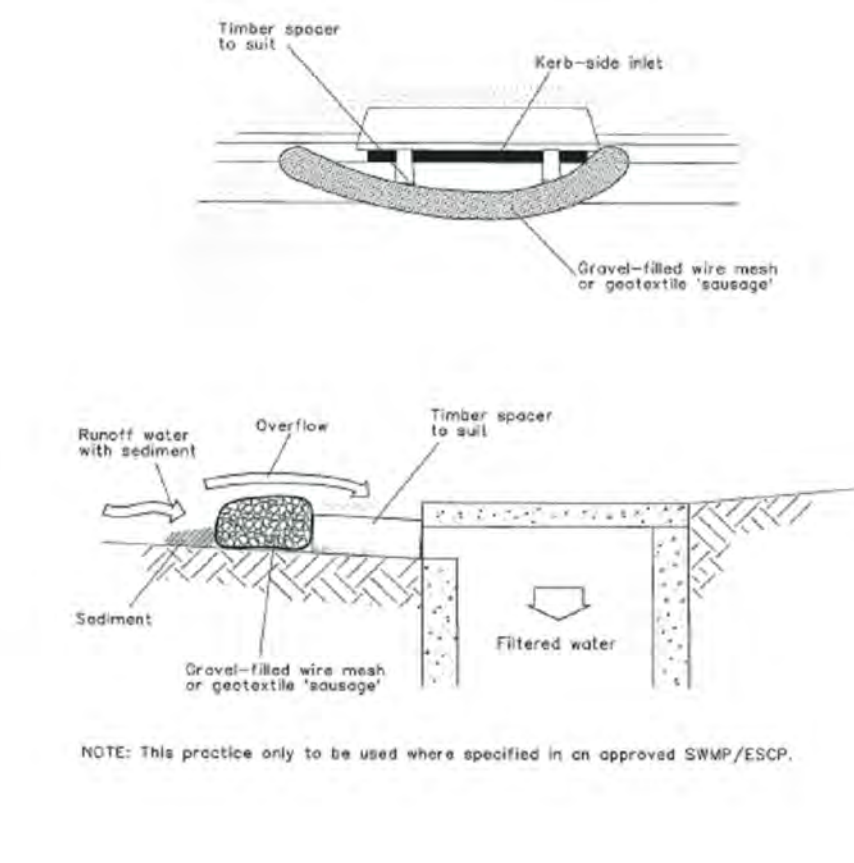
- Construction Notes
- Remove all vegetation and topsoil from under the dam wall and from within the storage area.
 - Construct a cut-off trench 500 mm deep and 1,200 mm wide along the controls of the embankment extending to a point on the gully wall level with the riser crest.
 - Maintain the trench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

SEDIMENT BASIN (SD 6-4)



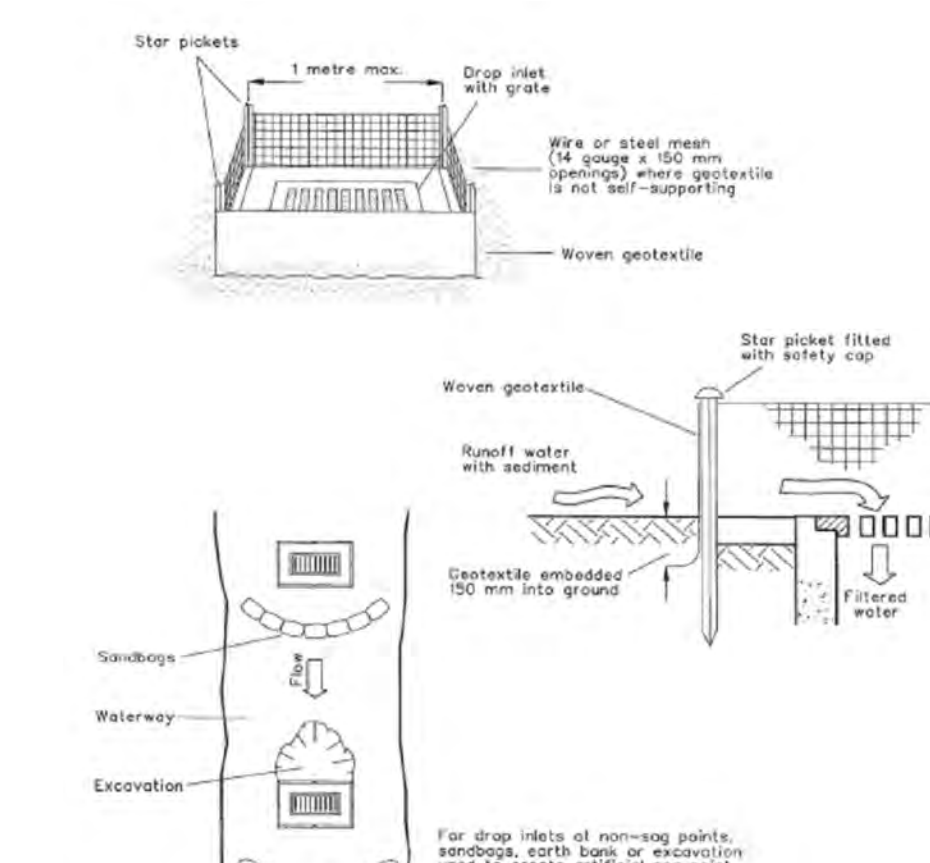
- Construction Notes
- Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
 - Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be embedded.
 - 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.
 - 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.
 - Join sections of fabric at a support post with a 150-mm overlap.
 - Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE (SD 6-8)



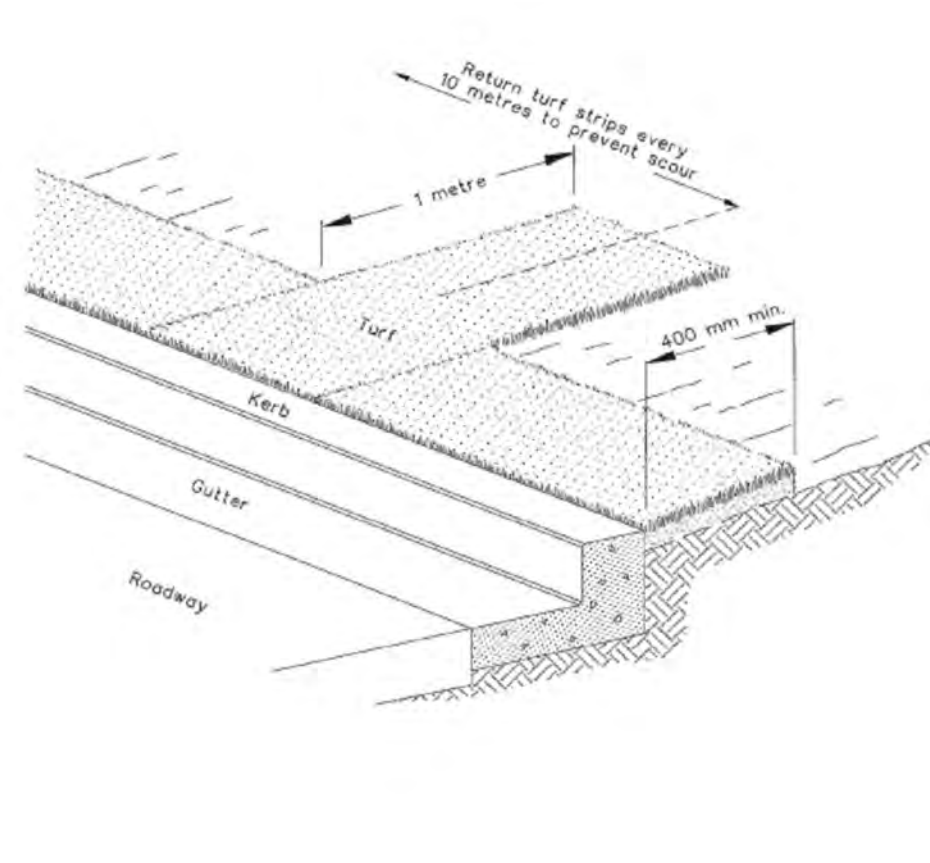
- Construction Notes
- Install filters to kerb inlets only at sag points.
 - Fabricate a sleeve made from geotextile or wire mesh longer than the length of the inlet pit and fill it with 25 mm to 50 mm gravel.
 - Form an elliptical cross-section about 150 mm high x 400 mm wide.
 - Place the filter at the opening leaving at least a 100-mm space between it and the kerb inlet. Maintain the opening with spacer blocks.
 - Form a seal with the kerb to prevent sediment bypassing the filter.
 - 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 water cannot pass between.

MESH AND GRAVEL INLET FILTER (SD 6-11)



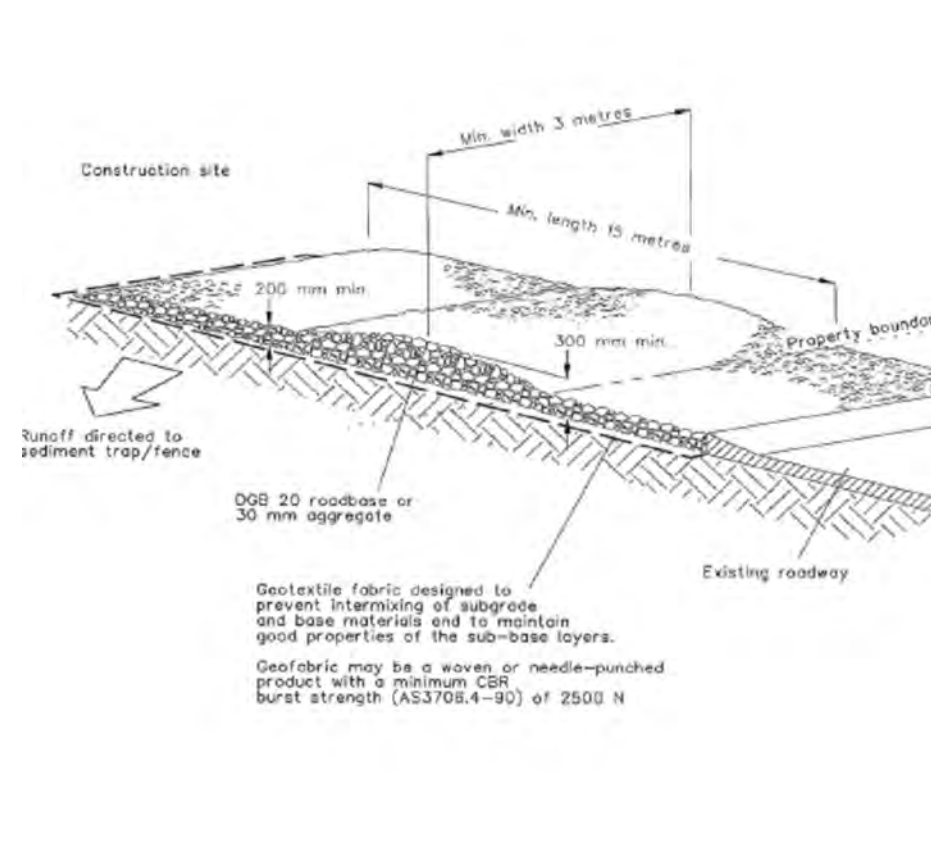
- Construction Notes
- Fabricate a sediment barrier made from geotextile or straw bales.
 - Follow Standard Drawing 6-7 and Standard Drawing 6-8 for installation procedures for the straw bales or geotextile. Reduce the picket spacing to 1 metre centres.
 - In waterways, artificial sag points can be created with sandbags or earth banks as shown in the drawing.
 - 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
- 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.
 - Lay 1.4 metre long turf strips normal to the kerb every 10 metres.
 - Rehabilitate disturbed soil behind the

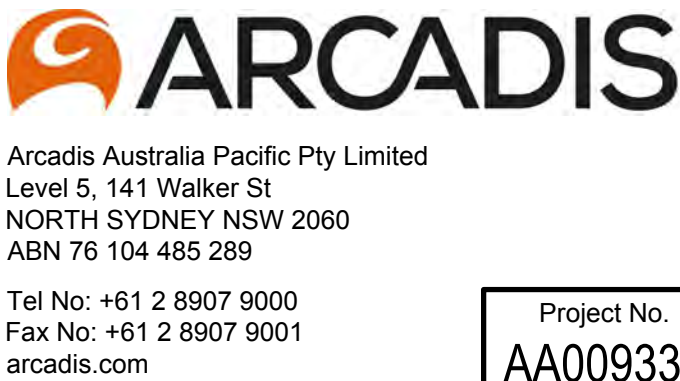
KERBSIDE TURF STRIP (SD 6-13)

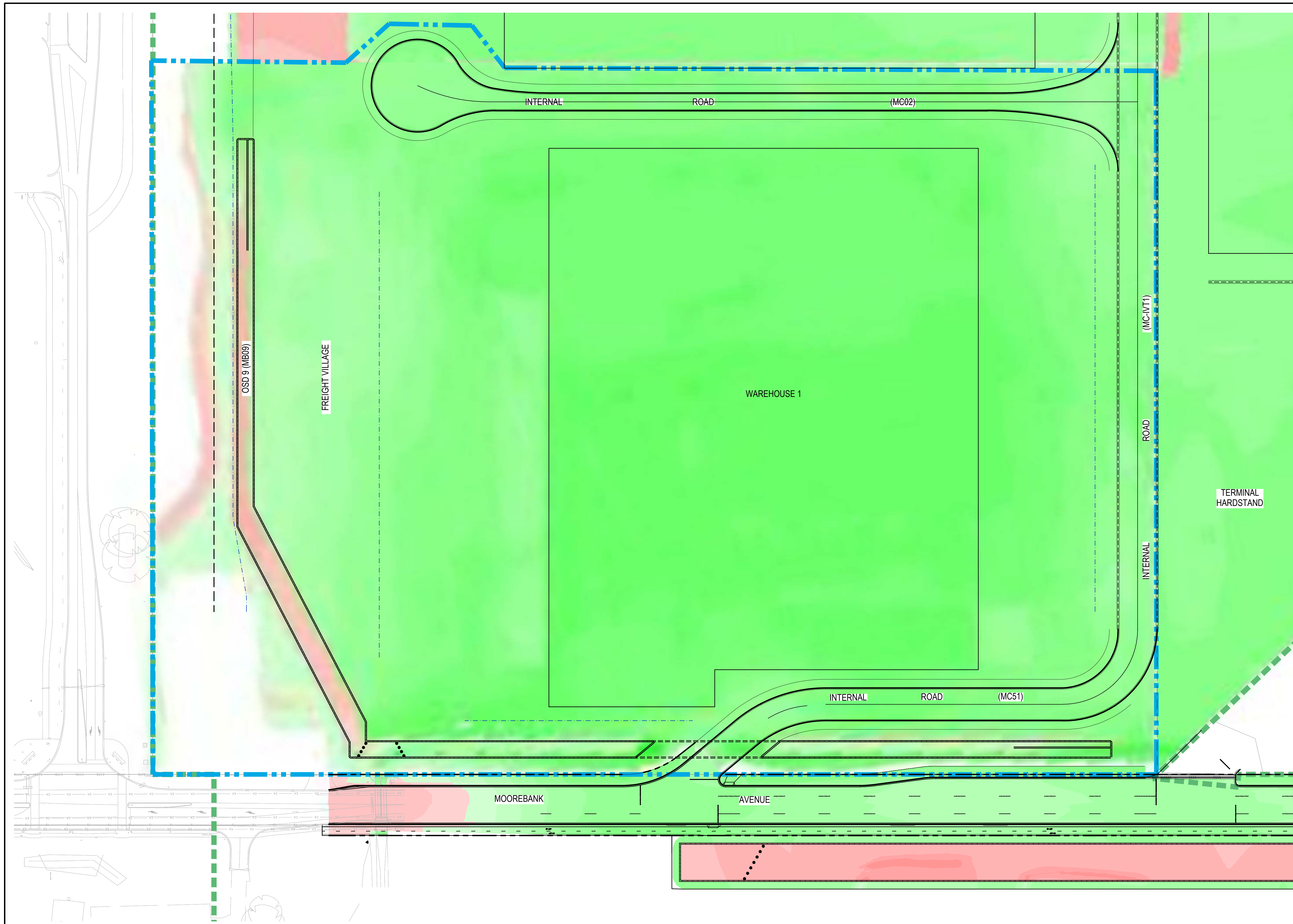


- Construction Notes
- Strip the topsoil, level the site and compact the subgrade.
 - Cover the area with needle-punched geotextile.
 - Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
 - Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
 - 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)

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

Client	Status	Project	
	PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION	MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT	
	Scales	Drawn	
	N.T.S.	M.O.LAYA	
	Original Size	Designed	
	A1	J.KO	
	Height Datum	Checked	
	AHD	G.DUNSTAN	
	Grid	Approved	
	MGA	M.KEFFORD	
	Filename:	SSS2-ARC-CV-DWG-1102-ErosionAndSedimentControlDetails.dwg	
			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

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

DEPTH RANGE LEGEND

999
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
999

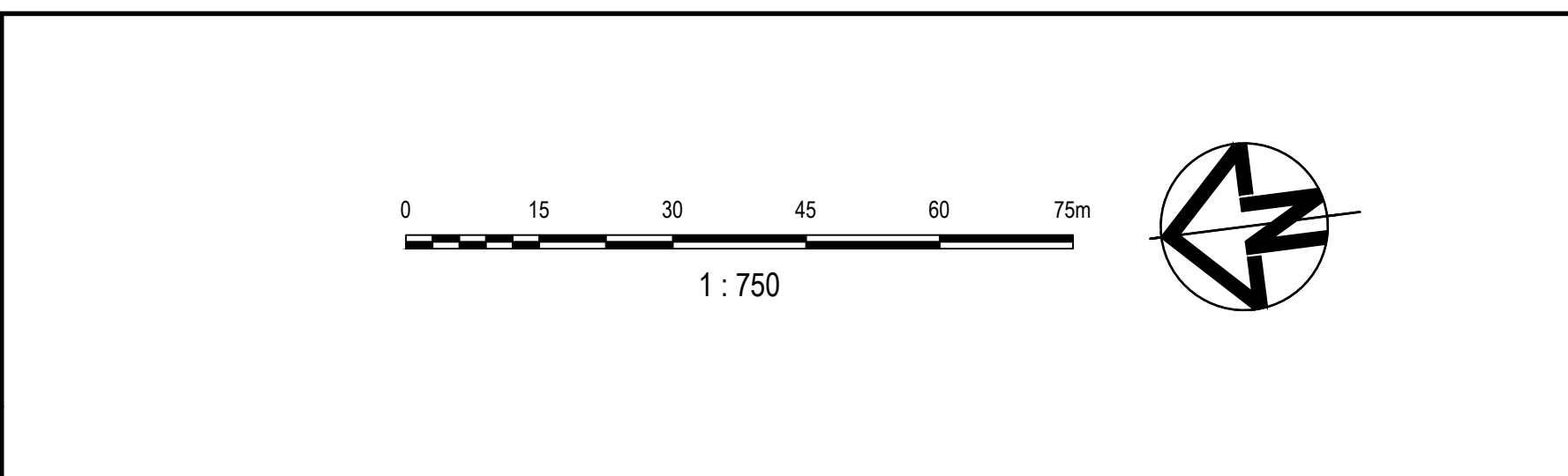
DEPTH OF FILL

DEPTH OF CUT

NOTES

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

02	ISSUE FOR STORMWATER MANAGEMENT PLAN	06/06/2019
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018
Issue	Description	Date



Client

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

TACTICAL GROUP

Status	PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION		
Scales	1 : 750	Current Issue Signatures	
Original Size	A1	Drawn	A.ZHAO
Height Datum	AHD	Designed	J.WOOD
Grid	MGA	Checked	G.DUNSTAN
Filename:	SSS2-ARC-CV-DWG-1111-BulkEarthworksPlan.dwg		
Approved	M.KEFFORD		

Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2
WAREHOUSE 1 PRECINCT

Title

BULK EARTHWORKS
PLAN

ARCADIS

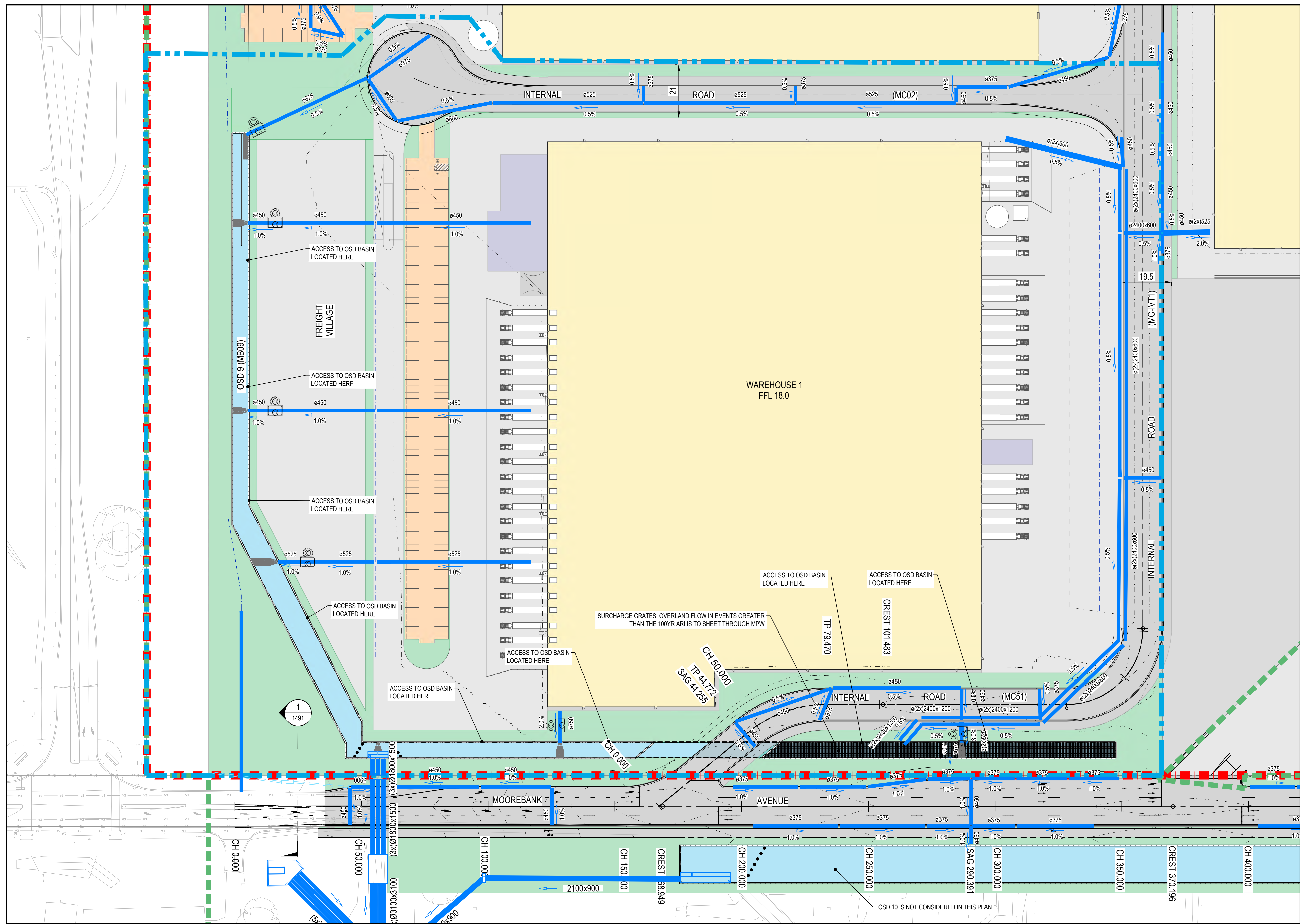
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arcadis.com

Project No.
AA009335

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

Issue
02



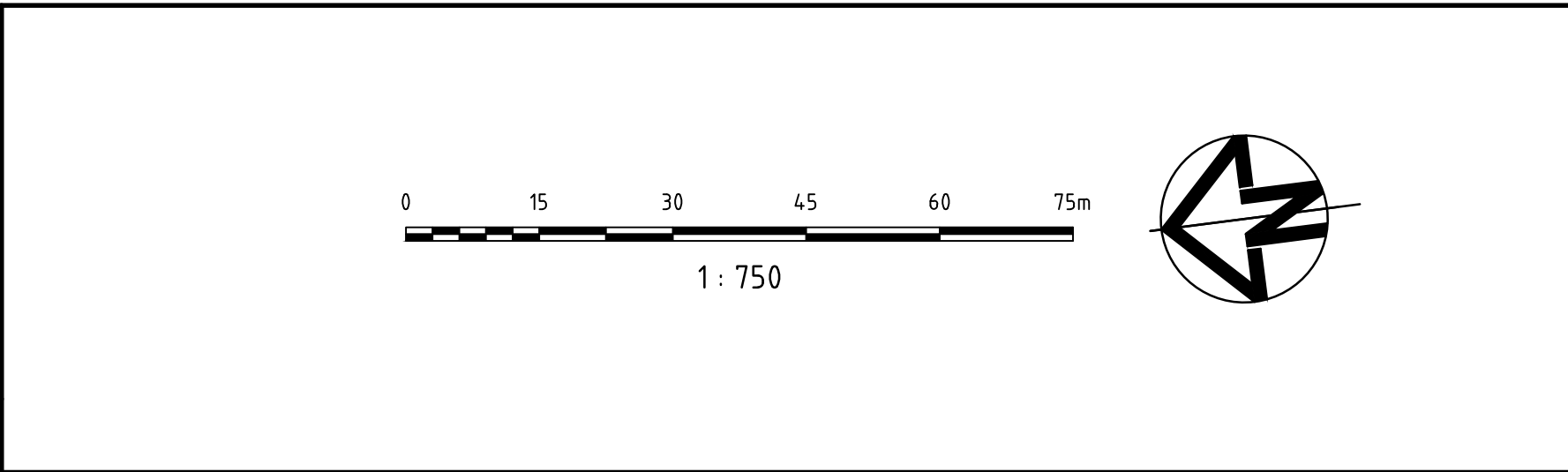
LEGEND

- 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

- REFER TO DRAWING SSS2-ARC-CV-DWG-1003 FOR TYPICAL ROAD CROSS SECTIONS.
- ONLY WORKS CONTAINED WITHIN THE WAREHOUSE 1 PRECINCT BOUNDARY ARE CONSIDERED WITHIN THE MOOREBANK PRECINCT EAST STAGE 2 - WAREHOUSE 1 PRECINCT STORMWATER MANAGEMENT PLAN.
- 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
04	ISSUE FOR STORMWATER MANAGEMENT PLAN	07/06/2019
03	ISSUE FOR STORMWATER MANAGEMENT PLAN	05/06/2019
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	
Scales	1 : 750	Current Issue Signatures
Original Size	A1	Drawn A.ZHAO
Height Datum	AHD	Designed J.WOOD
Grid	MGA	Checked G.DUNSTAN
Filename:	SSS2-ARC-CV-DWG-1201-CivilAndStormwaterPlan.dwg	
		Approved M.KEFFORD

Project

MOOREBANK PRECINCT EAST (MPE) STAGE 2
WAREHOUSE 1 PRECINCT

Title

CIVIL AND STORMWATER PLAN

ARCADIS

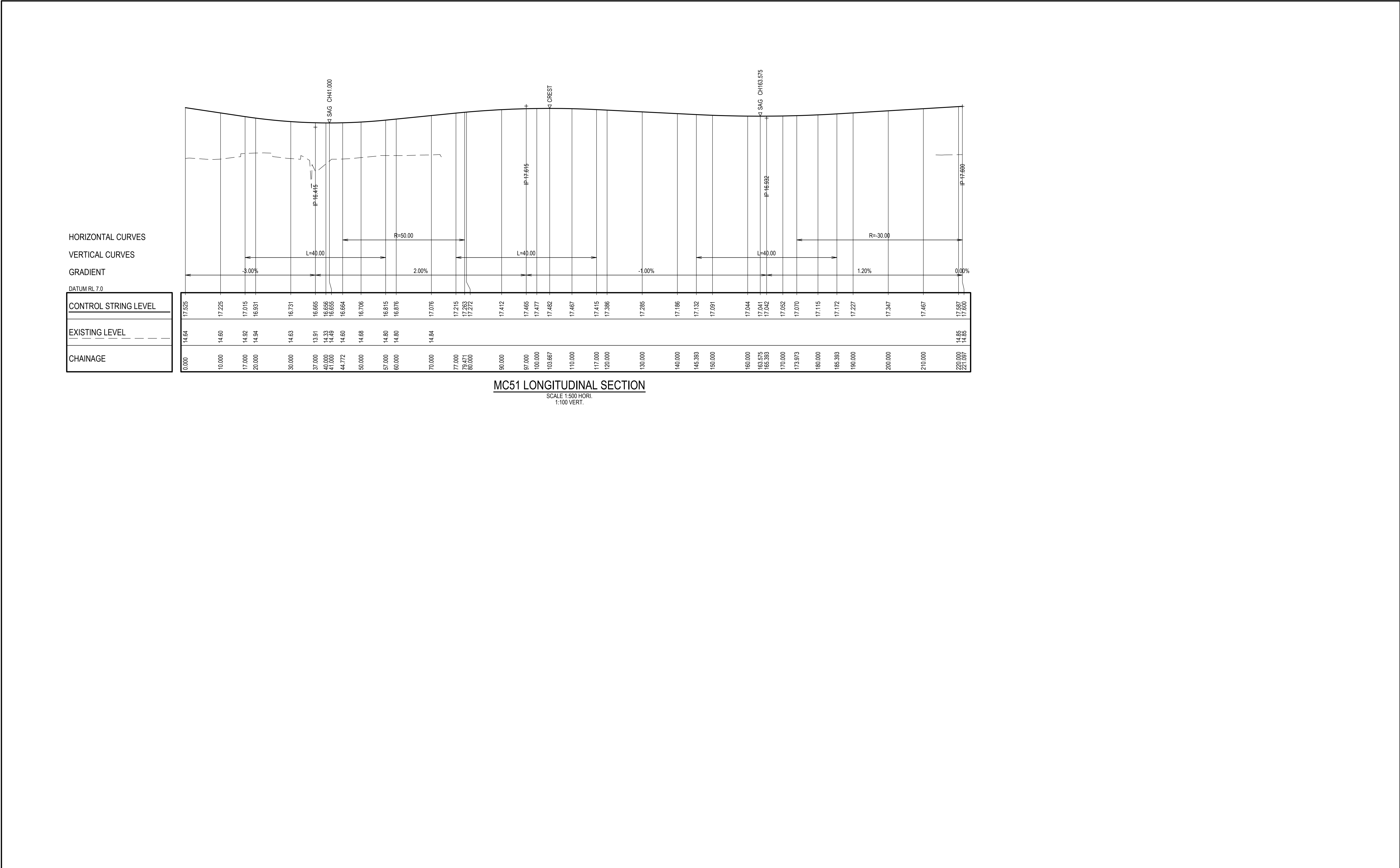
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Fax No: +61 2 8907 9001
arcadis.com

Project No.
AA009335

Drawing No.
SSS2-ARC-CV-DWG-1201- 04

Issue

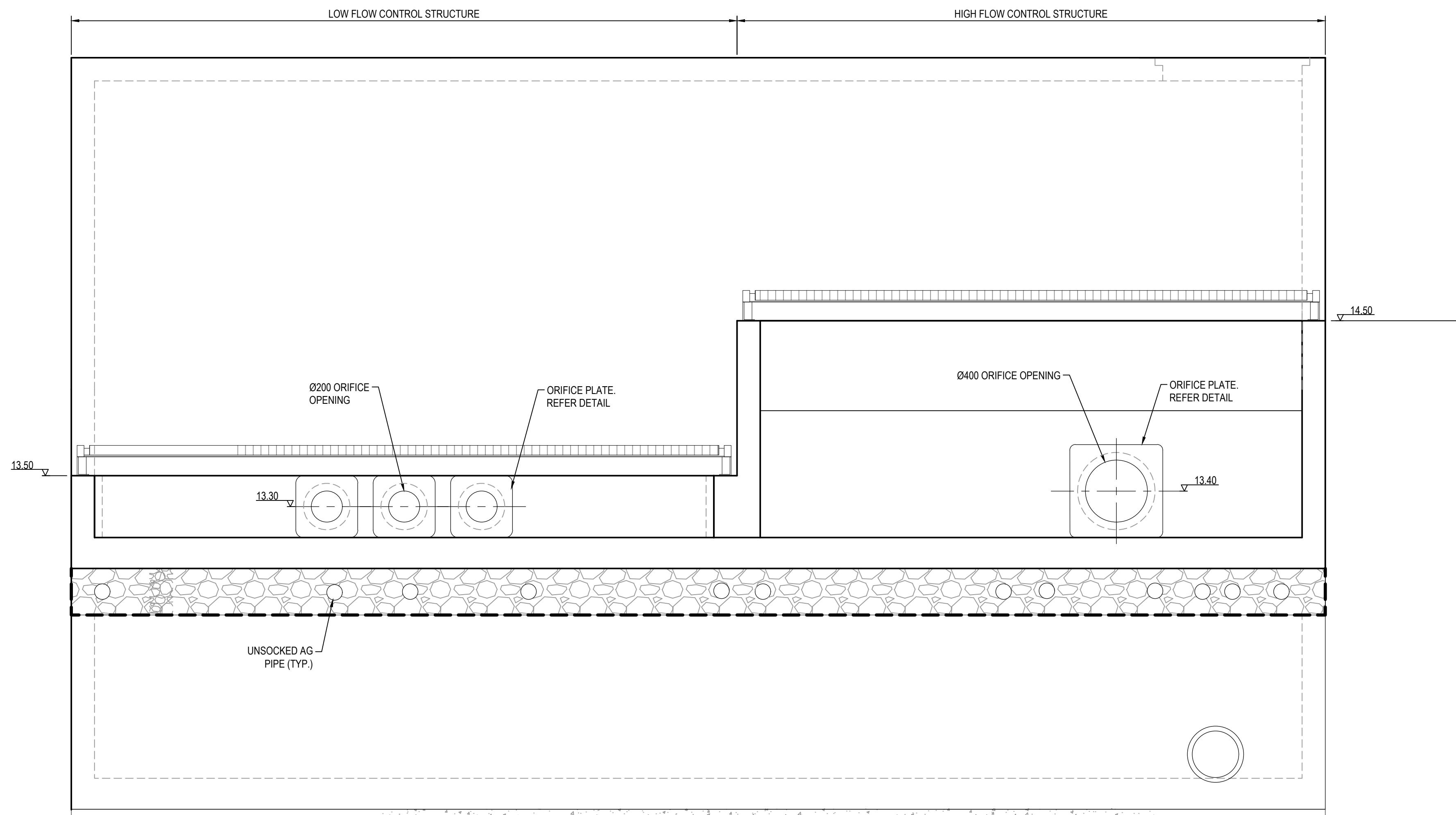


01 ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT 11/05/2018		0 10 20 30 40 50m 1 : 500 0 2 4 6 8 10m 1 : 100		Client SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE TACTICAL GROUP		Status PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION Scales AS SHOWN Original Size A1 Height Datum AHD Grid MGA Filename: SSS2-ARC-CV-DWG-1211-RoadLongitudinalSections.dwg Current Issue Signatures Drawn A.ZHAO Designed J.WOOD Checked G.DUNSTAN Approved M.KEFFORD		Project MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT Title ROAD LONGITUDINAL SECTIONS Drawing No. SSS2-ARC-CV-DWG-1211- Issue 01		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	
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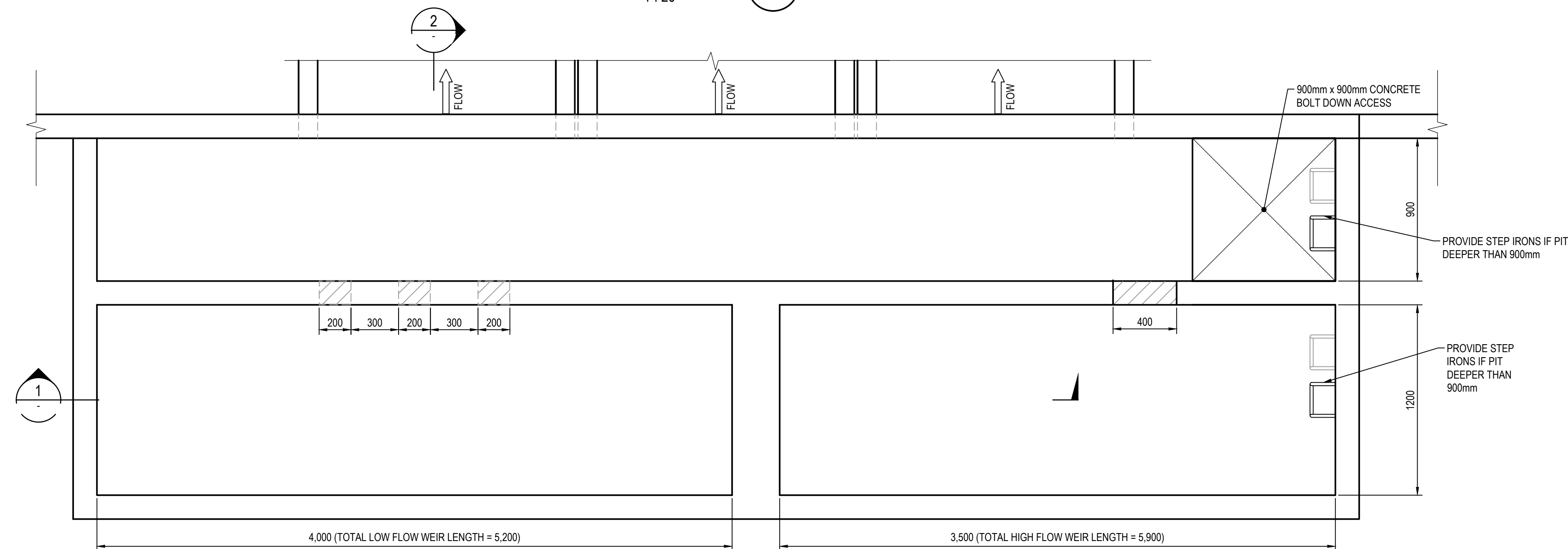
100mm on Original

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

V1

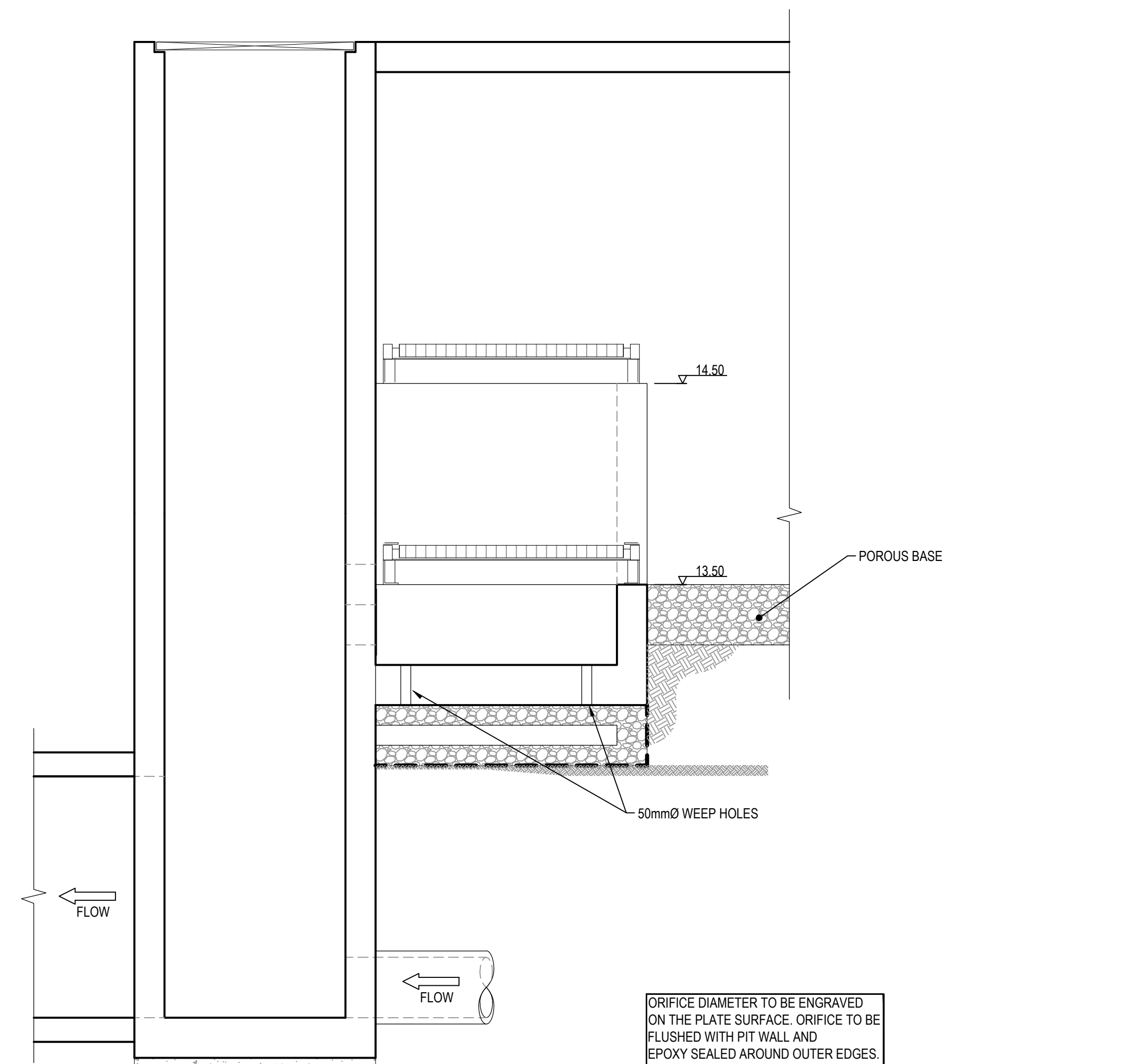


SECTION 1
1 : 20



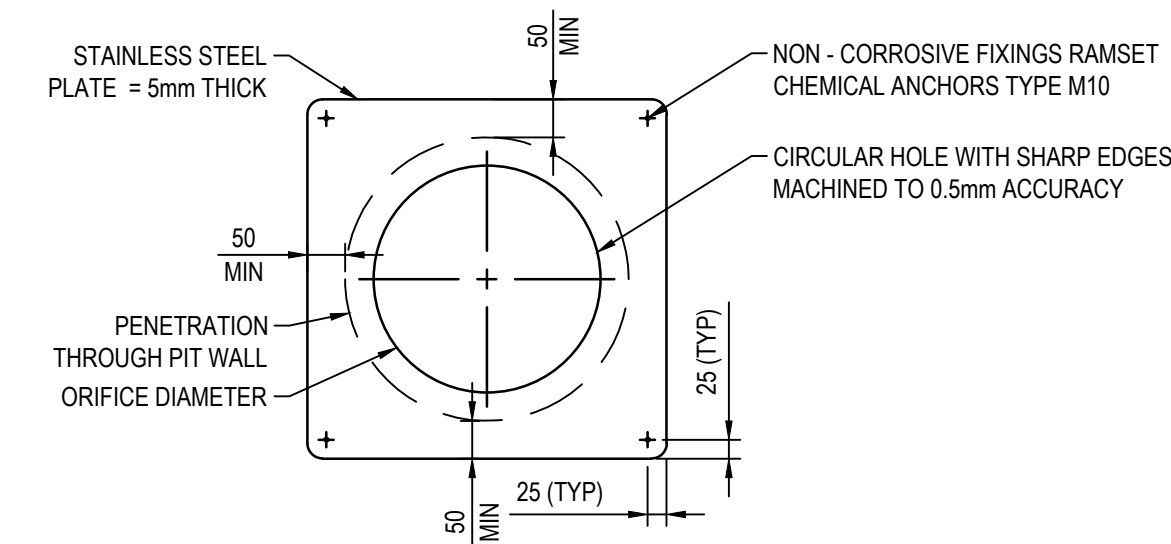
OSD BASIN OUTLET 9 PLAN - DETENTION CONTROL PIT

SCALE 1 : 20



SECTION 2
1 : 20

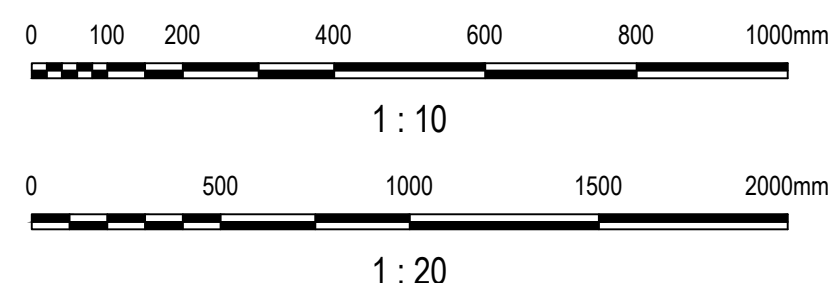
NOTES:
TRASH SCREENS TO BE PROVIDED.



TYPICAL CIRCULAR ORIFICE PLATE DETAIL

SCALE 1 : 10

02	ISSUE FOR STORMWATER MANAGEMENT PLAN	05/06/2019
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018
Issue	Description	Date



Status	PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION		
Scales	AS SHOWN	Current Issue Signatures	
Original Size	A1	Drawn	A.ZHAO
Height Datum	AHD	Designed	J.KO
Grid	MGA	Checked	G.DUNSTAN
Filename	SSS2-ARC-CV-DWG-1411-StormwaterDrainageOSDOutlet09.dwg		
Approved	M.KEFFORD		

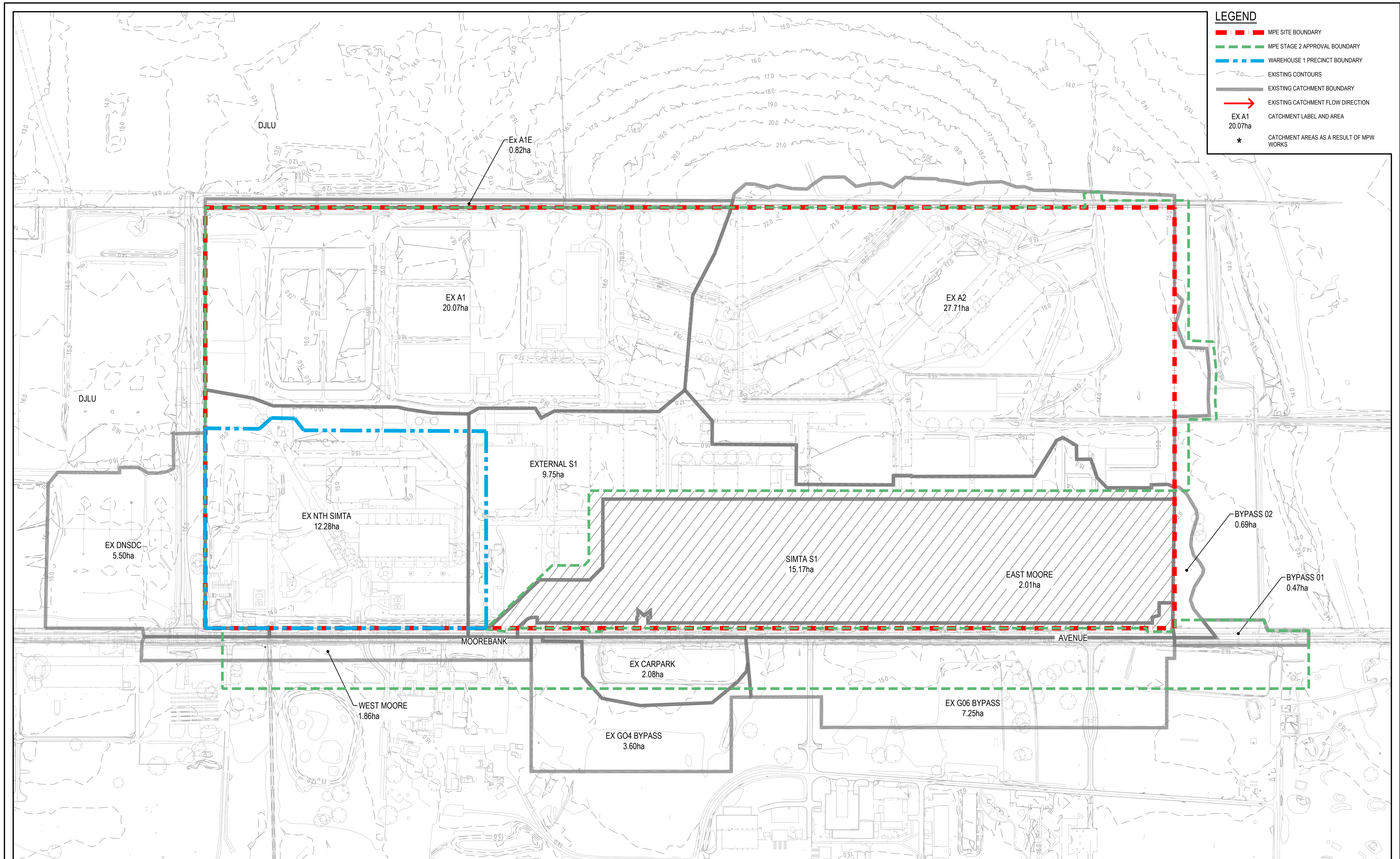
Project	MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT
Title	STORMWATER DRAINAGE OSD OUTLET 09

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

Project No.
AA009335

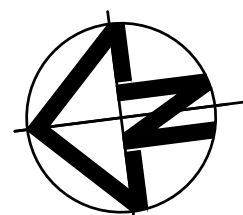
Drawing No.
SSS2-ARC-CV-DWG-1411-

Issue
02



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

0 50 100 150 200 250m
1 : 2500



Status PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION	
Scales	1 : 2500
Original Size	A1
Height Datum	AHD
Grid	MGA
Filename:	SSS2-ARC-CV-DWG-1431-ExistingCatchmentPlan.dwg

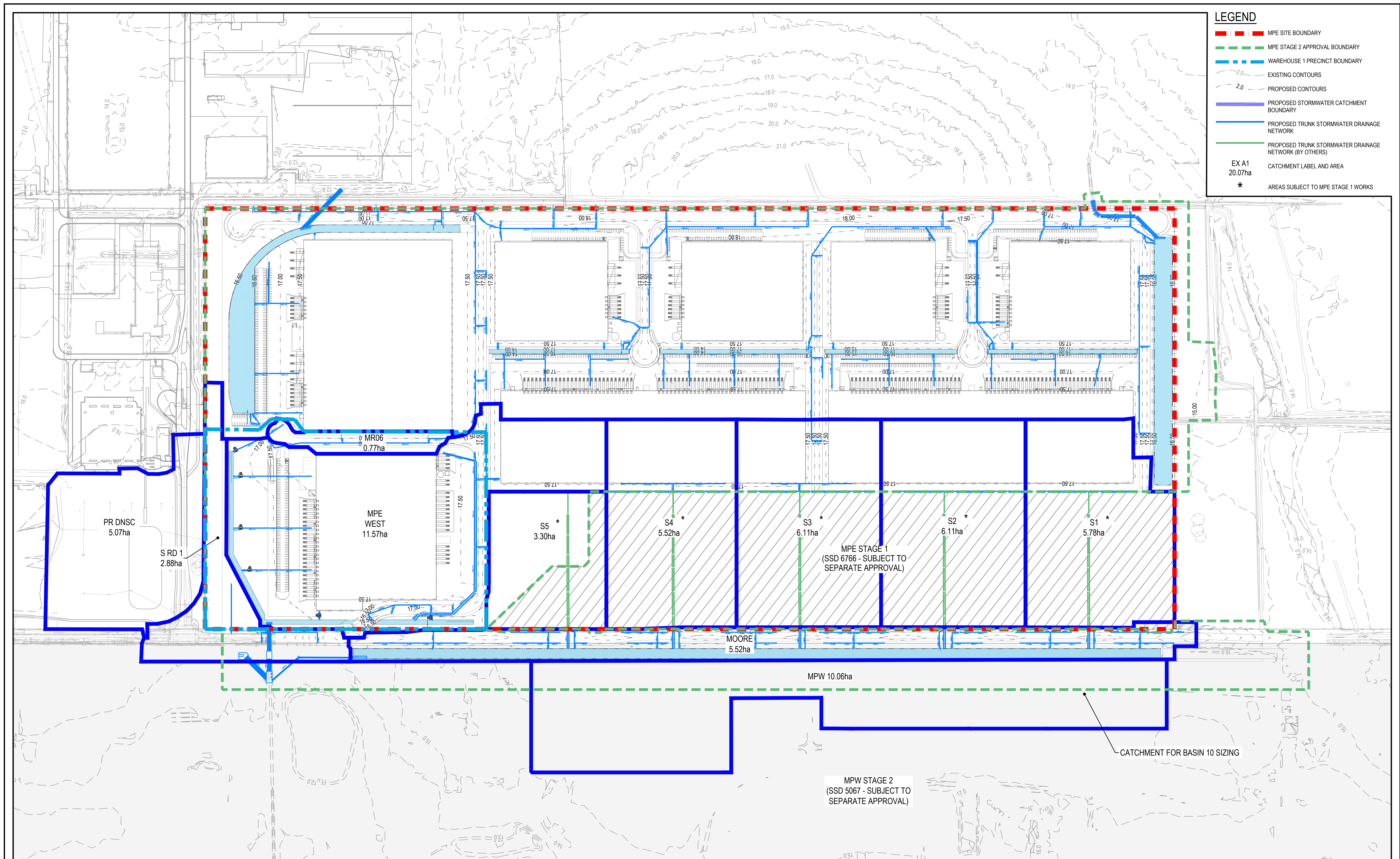
Project MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT	Title EXISTING CATCHMENT PLAN
--	----------------------------------

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- 01

Issue



02	ISSUE FOR STORMWATER MANAGEMENT PLAN	05/06/2019
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018
Issue	Description	Date

0 50 100 150 200 250m
1 : 2500



Status	PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION		
Scales	1 : 2500	Current Issue Signatures	
Original Size	A1	Drawn	A.ZHAO
Height Datum	AHD	Designed	J.KO
Grid	MGA	Checked	G.DUNSTAN
Filename:	SSS2-ARC-CV-DWG-1432-ProposedCatchmentPlan.dwg		
Approved	M.KEFFORD		

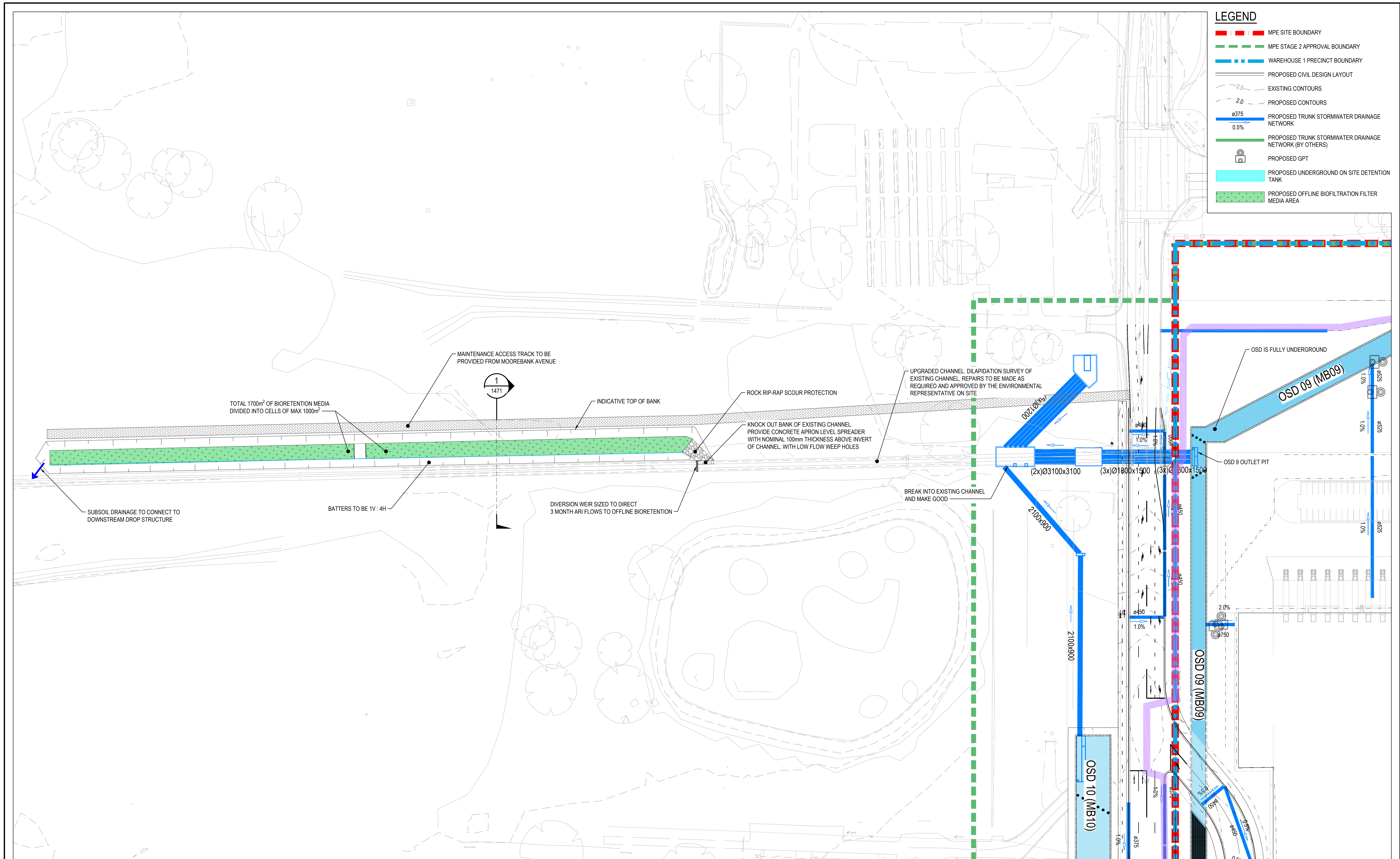
Project	MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT	
Title	PROPOSED CATCHMENT PLAN	

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

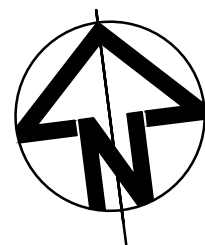
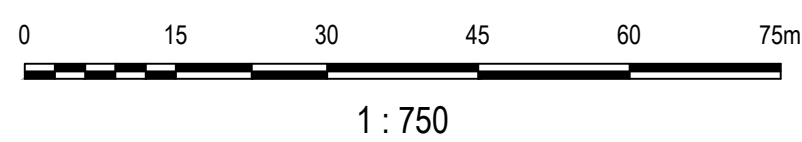
Project No.
AA009335

Drawing No.
SSS2-ARC-CV-DWG-1432- 02

Issue



02	ISSUE FOR STORMWATER MANAGEMENT PLAN	06/06/2019
01	ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT	11/05/2018
Issue	Description	Date



Client

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

TACTICAL GROUP

Status	PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION	
Scales	1 : 750	Current Issue Signatures
Original Size	A1	Drawn A.ZHAO
Height Datum	AHD	Designed J.KO
Grid	MGA	Checked G.DUNSTAN
Filer	SSS2-ARC-CV-DWG-1451-StormwaterDrainageWaterQualityPlanOSD09.dwg	Approved M.GOSTELOW

Project	MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT
Title	STORMWATER DRAINAGE WATER QUALITY PLAN OSD 09

ARCADIS

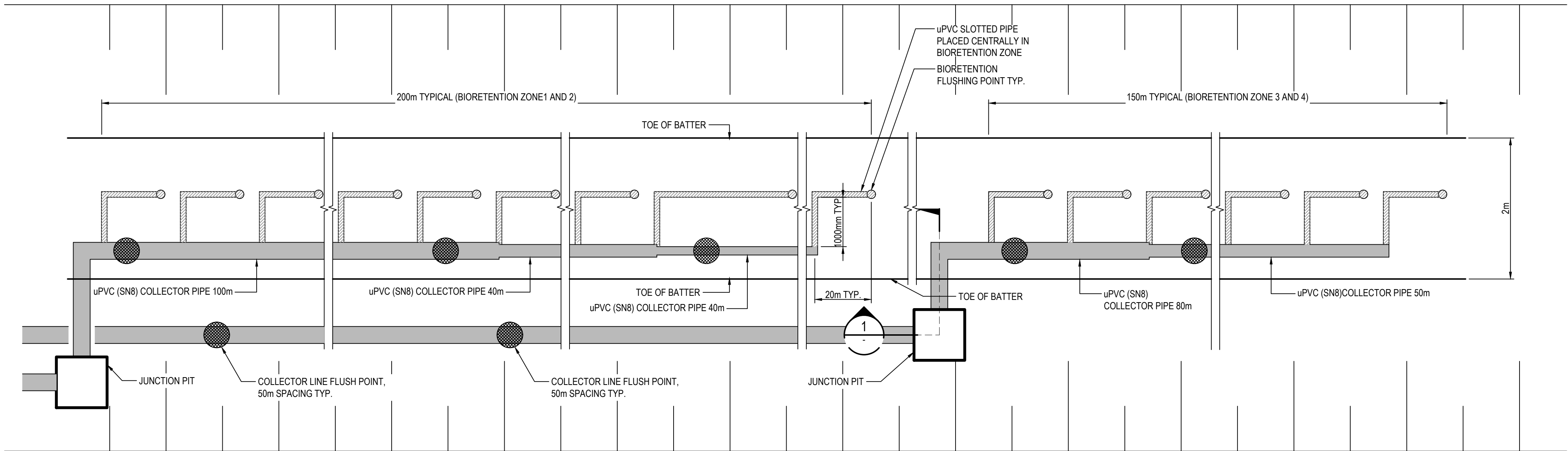
Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
ABN 76 104 485 289
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Project No.
AA009335

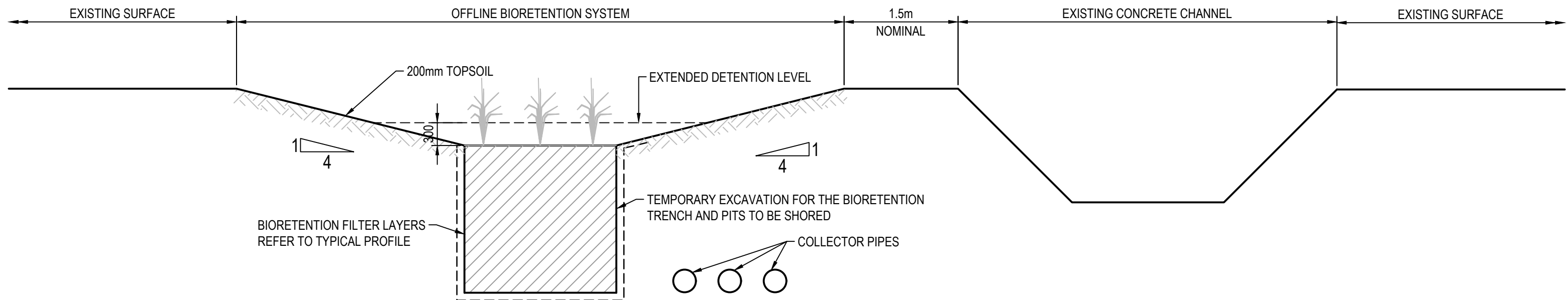
Drawing No.
SSS2-ARC-CV-DWG-1451-

Issue
02

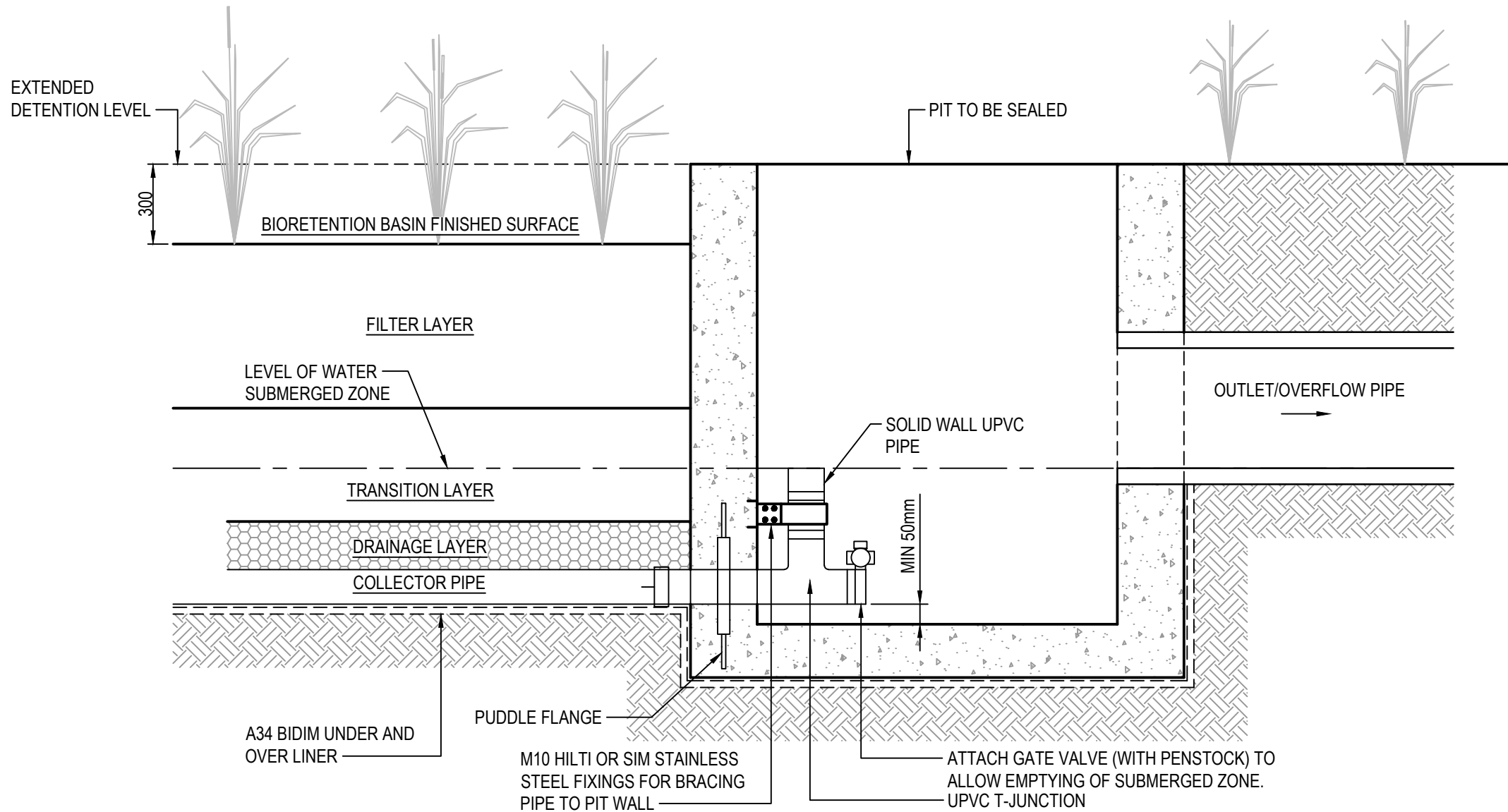
- NOTES**
- REFER TO THE MOOREBANK PRECINCT EAST STAGE 2 - WAREHOUSE 1 PRECINCT STORMWATER MANAGEMENT PLAN (CHAPTERS 5 AND 6) FOR FURTHER DETAILS OF THE DESIGN AND MODELLING OF WATER QUALITY TREATMENT MEASURES.
 - ALL FILTER MEDIA USED IN STORMWATER TREATMENT MEASURES MUST:
 - BE LOAMY SAND WITH AN APPROXIMATELY 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)



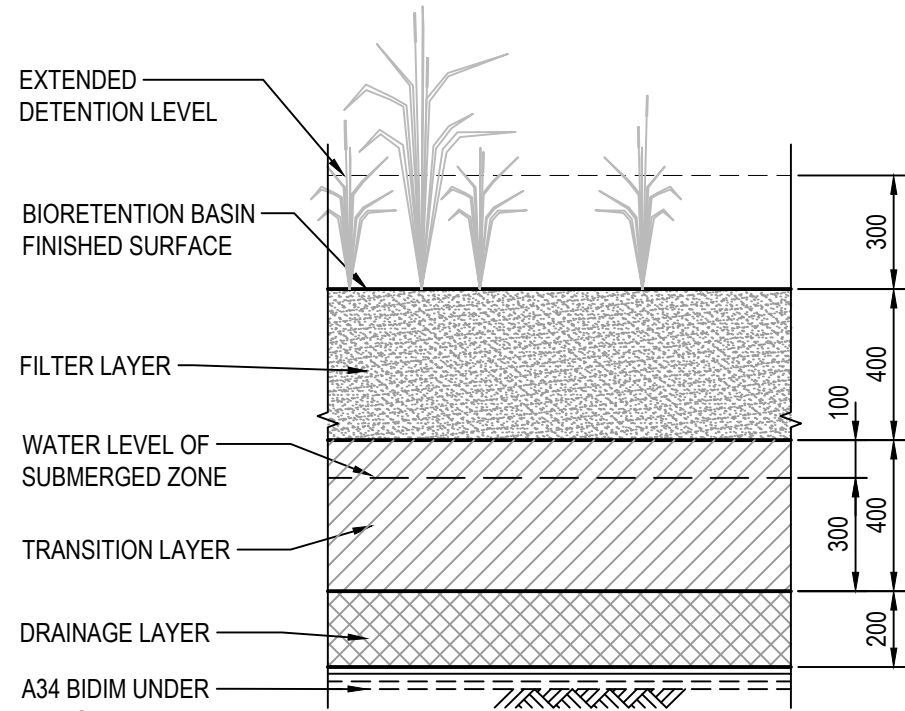
COLLECTOR PIPE CONFIGURATION PLAN
N.T.S.



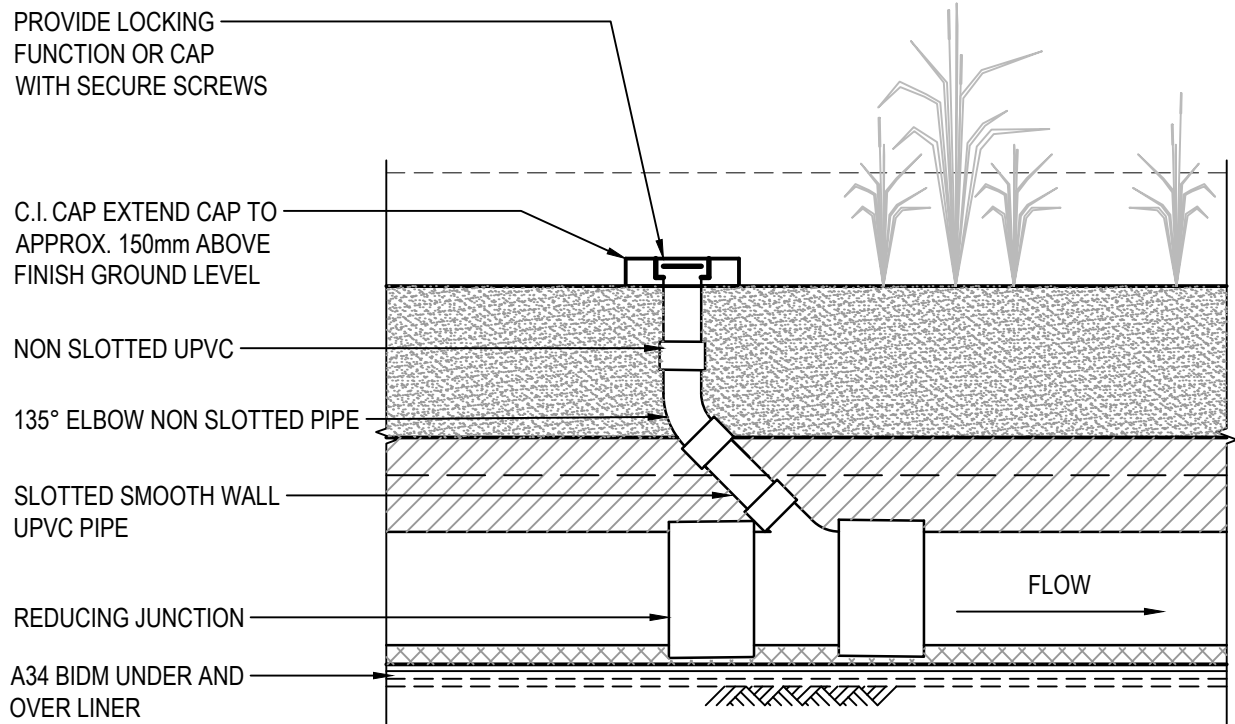
TYPICAL OFFLINE BIORETENTION SYSTEM
SECTION 1
N.T.S. 1451



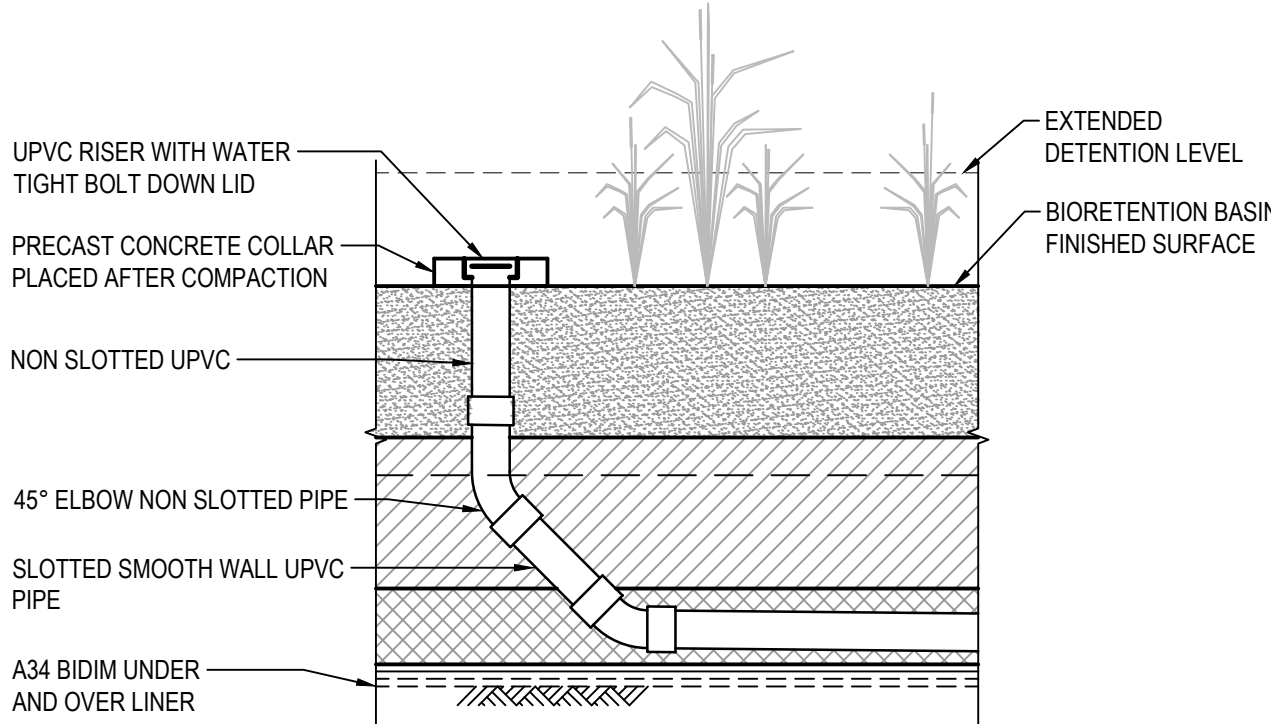
TYPICAL COLLECTOR LINE PIT
SECTION 1
N.T.S.



TYPICAL BIORETENTION FILTER PROFILE
N.T.S.



COLLECTOR LINE FLUSHING POINT
N.T.S.



BIORETENTION FLUSHING POINT
N.T.S.

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

100mm on Original



Status PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION			
Scales	N.T.S.	Current Issue Signatures	
Original Size	A1	Drawn	A.ZHAO
Height Datum	AHD	Designed	J.KO
Grid	MGA	Checked	G.DUNSTAN
		Approved	M.GOSTELOW
Filename: SSS2-ARC-CV-DWG-1471-StormwaterBioretentionTypicalDetails.dwg			

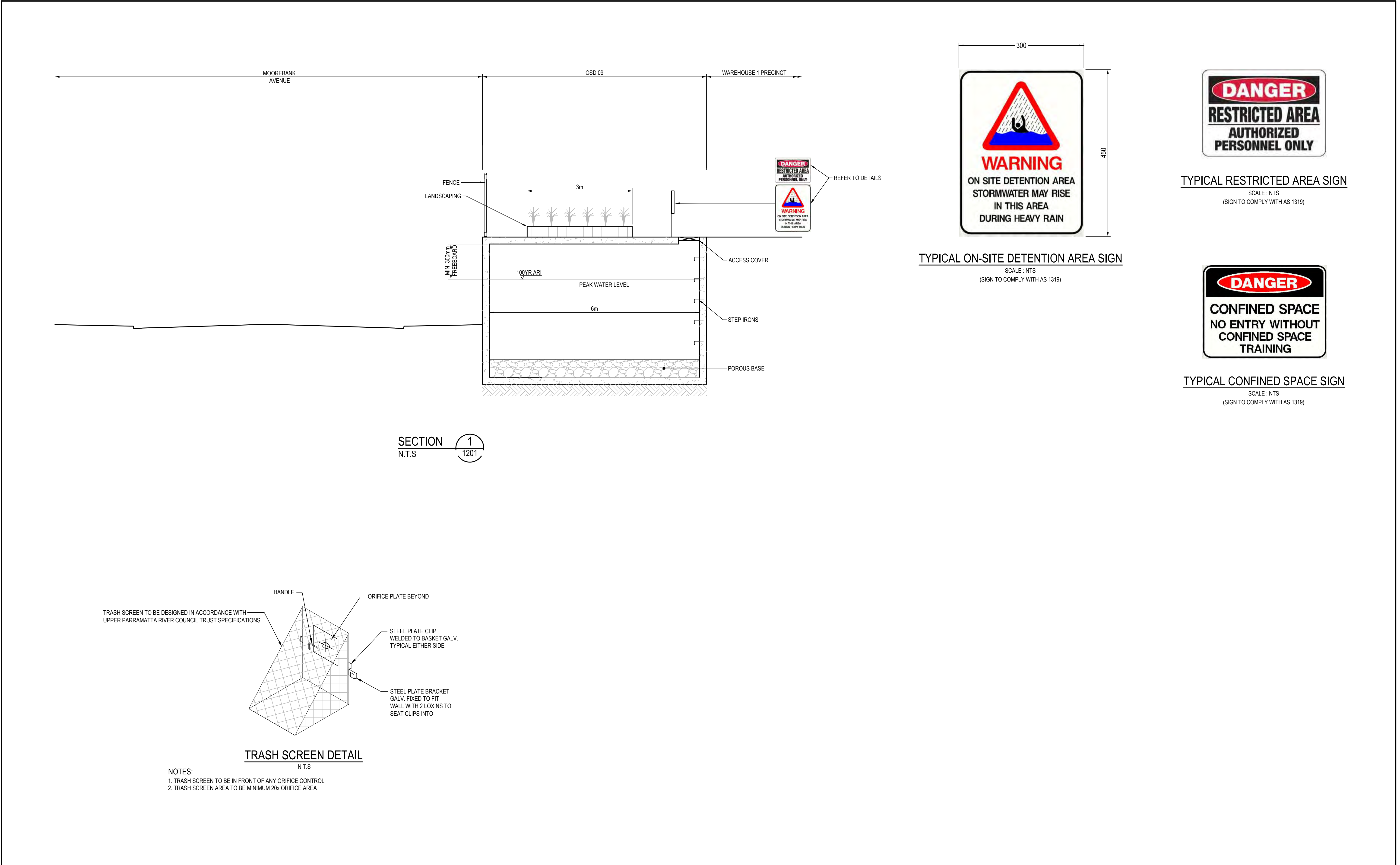
Project	MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT
Title	STORMWATER BIORETENTION TYPICAL DETAILS

Arcadis Australia Pacific Pty Limited
Level 5, 141 Walker St
NORTH SYDNEY NSW 2060
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Fax No: +61 2 8907 9001
arcadis.com

Project No.
AA009335

Drawing No.
SSS2-ARC-CV-DWG-1471-

Issue
02



			Client SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE TACTICAL GROUP		Status PRELIMINARY ONLY NOT TO BE USED FOR CONSTRUCTION		Project MOOREBANK PRECINCT EAST (MPE) STAGE 2 WAREHOUSE 1 PRECINCT		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		
02 RESPONSE TO VERIFIERS COMMENTS		18/06/2018			Current Issue Signatures Drawn A.ZHAO		Title OSD 09 TYPICAL SECTION AND DETAILS		Drawing No. SSS2 -ARC-CV-DWG- 1491- Issue 02		
01 ISSUE FOR STORMWATER MANAGEMENT PLAN - WAREHOUSE 1 PRECINCT		11/05/2018			Original Size A1 Designed J.KO						
Issue Description Date		Height Datum AHD Checked G.DUNSTAN									
		Grid MGA Approved M.GOSTELOW									
		Filename SSS2-ARC-CV-DWG-1491-OSD09TypicalSectionAndDetails.dwg									

APPENDIX B

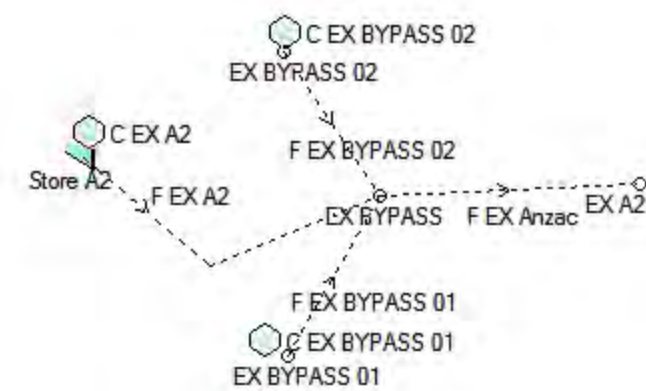
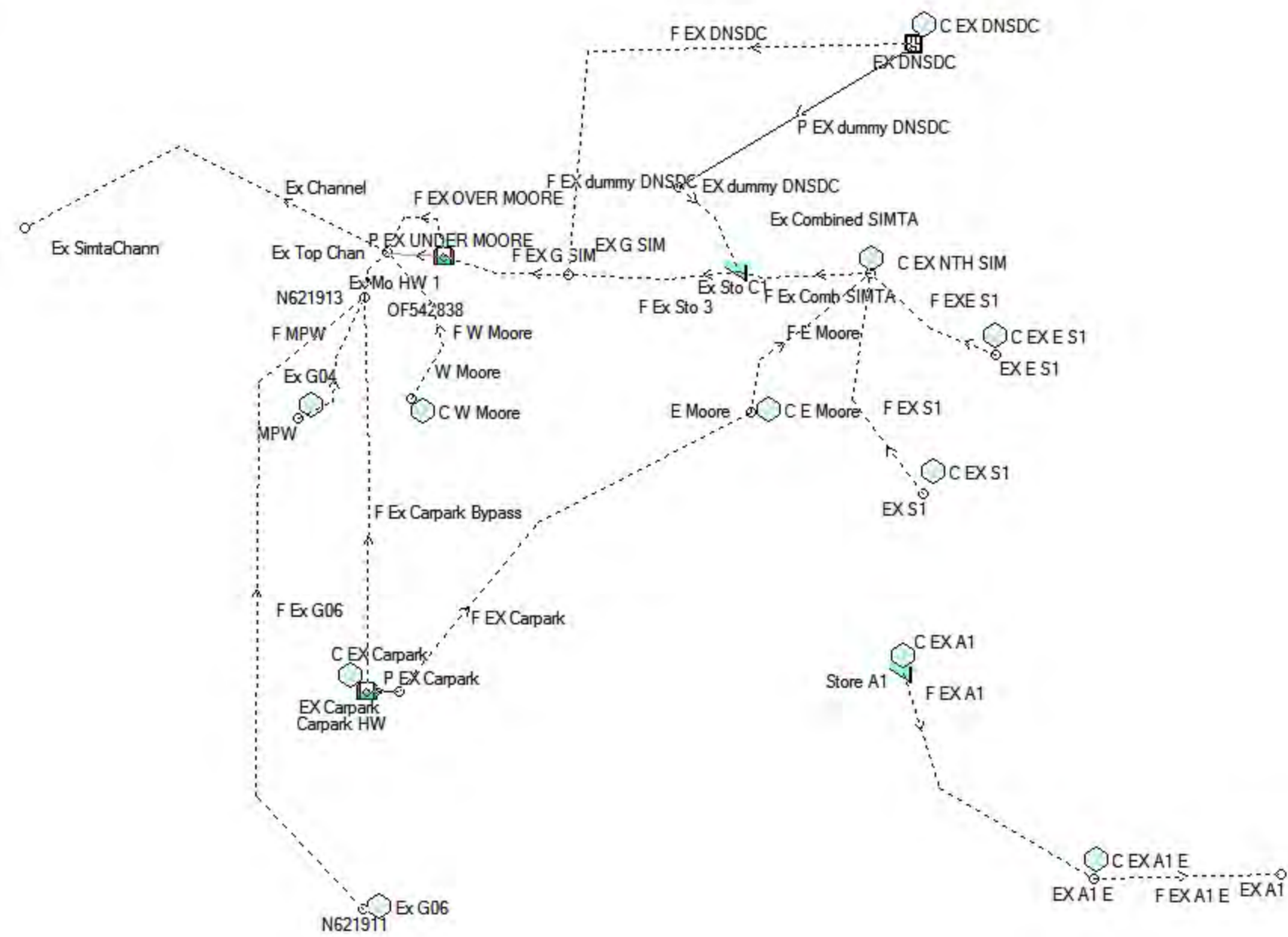
Existing Conditions Hydraulic Modelling

APPENDIX B

Existing Conditions Hydraulic Modelling

B.1 DRAINS Model Data

B.2 DRAINS Model Results



Job MPE Stage 2
Stormwater Management Plan

Design J.Ko
Date 27/02/2018
Checked G.Dunstan
Date 27/02/2018

Office Sydney
Job No AA009335

MPE Stage 2

Stormwater Management Plan

DRAINS Data and Results

Existing Model



DRAINS File Path:	F:\AA\009335\3_SSS2\CV\CLCA-Stormwater\840_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPE Stage 2\SMP Existing-16-02-26.drn
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64 bit) - 9 August 2017
Modeler's Name:	G.Dunstan
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	6241555.648		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		305993.511	6241576.725		121800214		
N621911	Node							0		305540.682	6241015.831		122115309		
N621913	Node					14.2		0		305942.149	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	52117.6													
	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	12.85	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	81.284													
	13.5	146.75													
	13.6	248.51													
	13.7	411.632													
	13.8	706.865													
	13.9	1261.34													
	14	2109.65													
	14.1	3230.35													
	14.2	4564.46													
	14.3	6071.14													
	14.4	7765.32													
	14.5	9587.54													
	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													
	12.85	7000													
	12.7	7300													
	13.07	10300													
	13.21	12000													
	14.315	16000													
SUB-CATCHMENT DETAILS															
Name	Pit or Node	Total Area	Paved Area	Grass Area	Supp Area	Paved Time	Grass Time	Supp Time	Paved Length	Grass Length	Supp Length	Paved Slope(%)	Grass Slope	Supp Slope	
	Node	Area (ha)	Area (%)	Area (%)	Area (%)	Time (min)	Time (min)	Time (min)	Length (m)	Length (m)	Length (m)	Slope (%)	Slope (%)	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	0.75		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						
DETAILS OF SERVICES CROSSING PIPES															
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	New/Fixed	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 (m)	SafeDepth (m)	Safe DvA (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	66866586	
F EX G SIM	Ex G SIM	Ex Mo HW 1		7			Dummy used to model flow across road low points	0.3	0.3	0.6	1	0	66866587	
F EX S1	Ex Combined SIMTA	Ex S1		7			Dummy used to model flow across road low points	0.3	0.3	0.6	1	0	66866571	
F MPW	MPW	N621913					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					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	66418933	
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	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			13.24		Really Long Weir	0.3	0.3	0.6	1	0	65770283	
F EX A1	Store A1	EX A1 E		0.1	12.85		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					Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	117904870	
F W Moore	EX Top Chan	EX Top Chan		15			Dummy used to model flow across road low points	0.3	0.3	0.6	1	0	121800271	
F EX G06	N621911	N621913		20			West Moorebank	0.15	0.2	0.6	0.2	0	122115311	
QF642638	N621913	Ex Top Chan		0.1			West Moorebank	0.15	0.2	0.6	0.2	0	122115331	
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	123442749	
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	123442753	
PIPE COVER DETAILS														
Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)										
P EX UNDER 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														

DRAINS File Path:	F:\AA009335\3_SSS2\CV\CLCA-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPExisting-18-02-26.drn
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64 bit) - 9 August 2017
Modeler's Name:	G.Dunstan
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	Max Surface	Version 8 Max Pond	Min	Overflow	Constraint				
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)					
			(cu.m/s)	(cu.m)	(m)						
EX DNSDC	10.72		1.148	0.164		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	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)					
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	Due to Storm									
	Flow										
	(cu.m/s)										
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	Total Runoff	Impervious Runoff	Pervious Runoff							
	cu.m	cu.m (Runoff %)	cu.m (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, average	55099.82	29672.24 (53.9%)	25513.38 (97.9%)	4158.86 (14.3%)							
AR&R 1 year, 9 hours storm, average	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	Max V	Max U/S	Max D/S	Due to Storm						
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)							
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	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			
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	21.67	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	Max Q	Max Q						
			Total	Low Level	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					
Note	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %	
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	752.97	752.97	0	0	
Store A2	7087.56	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 MPEStage2SMPEExisting 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					

DRAINS File Path:	F:\AA009335\3_SSS2\CV\CLCA-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2\SMPExisting-18-02-26.drn
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64 bit) - 9 August 2017
Modeler's Name:	G.Dunstan
Description:	MPE Stage 2 Stormwater Management Plan - Existing Model

DRAINS results prepared from Version 2017.10										10 YEAR ARI	
PIT / NODE DETAILS											
Name	Max HGL	Max Pond	Max Surface	Version 8 Max Pond	Min	Overflow	Constraint				
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)					
			(cu.m/s)	(cu.m)	(m)						
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	0.066	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 (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
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	7519.14	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 MPEStage2SMPEExisting 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 EX S1, F E Moore, Ex Channel				

DRAINS File Path:	F:\AA009335\3_SSS2\CV\CLCA-Stormwater\B40_SMP\Calcs\I-Issued Models\2018-02-27 MPE2 SMP DRAINS Models\MPEStage2SMPEXisting-18-02-26.drn
DRAINS Version:	DRAINS results prepared from Version 2017.10 (64 bit) - 9 August 2017
Modeler's Name:	G.Dunstan
Description:	MPE Stage 2 Stormwater Management Plan - Existing Model

DRAINS results prepared from Version 2017.10										100 YEAR ARI	
PIT / NODE DETAILS											
Name	Max HGL	Max Pond	Max Surface	Version 8 Max Pond	Min	Overflow	Constraint				
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)					
			(cu.m/s)	(cu.m)	(m)						
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	0.589	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 (66.8%)	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, aver	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				
Note	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
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		-0.5
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 MPEStage2SMPEExisting 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				

DRAINS results prepared from Version 2017.10										PMP		
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)							
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	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)						
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	Due to Storm										
	Flow											
	(cu.m/s)											
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	Total Runoff	Impervious Runoff	Pervious Runoff								
	cu.m	cu.m (Runoff %)	cu.m (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	338705.06	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 - 15 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%)	325789.91 (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	Max V	Max U/S	Max D/S	Due to Storm							
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)								
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	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				
F EX Comb SIMTA	60.596	60.596	-6.91168E+16	0.23	2.27	49.99	9.96	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	-4.6754E+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	Max Q	Max Q							
			Total	Low Level	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					
Note	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %	
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	66645.29	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 MPESStage2SMPExisting 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

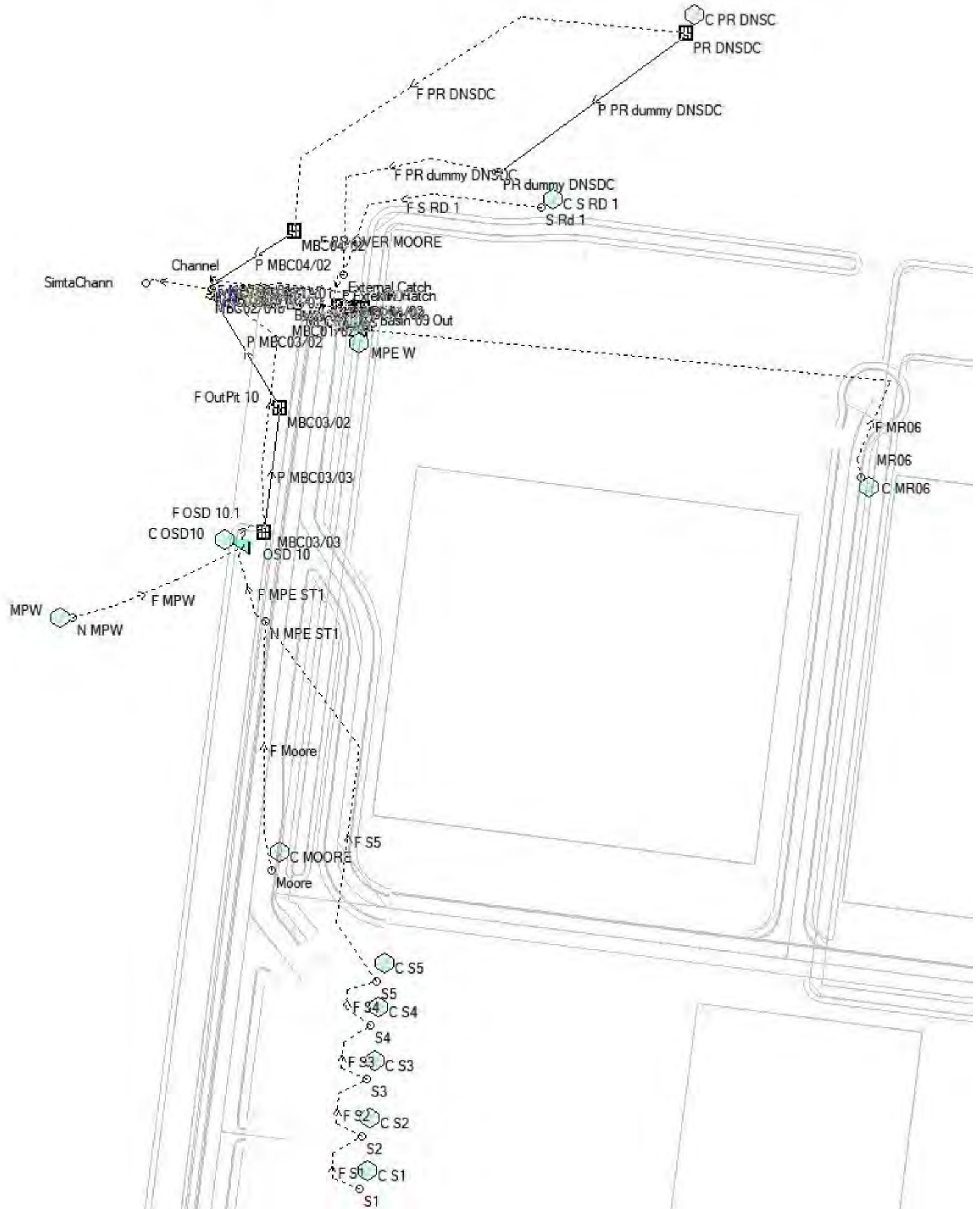
APPENDIX C

Developed Conditions Hydraulic Modelling

C.1 DRAINS Model Data

C.2 DRAINS Model Results

C.3 Orifice Calculations



Job MPE Stage 2
Stormwater Management Plan

Design MG
Date 3/06/2019
Checked MG
Date 3/06/2019

Office Sydney
Job No AA009335

MPE Stage 2

Stormwater Management Plan

DRAINS Data and Results

Proposed Model

[illegible]

SUB-CATCHMENT DETAILS														
Name	Pt1 or Node	Total Area	Paved Area	Grass Area	Supp Area	Paved Time	Grass Time	Supp Time	Paved Length	Grass Length	Supp Length	Paved Slope(%)	Grass Slope	Supp Slope
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%
MPE W	Basin 09	11.57	100	0	0	5	0	0	0	0	0			
C PR DNSDC	PR DNSDC	5.07	42	18	0	5	0	0	0	0	0			
C S	S	3.3	58	0	0	5	0	0	10	0	0			
C MOORE	Moore	3.16	100	0	0	5	0	0	10	0	0			
C S RD 1	S Rd 1	2.88	100	0	0	5	0	0	12	0	0			
C S4	S4	5.52	100	0	0	5	0	0	10	0	0			
C S3	S3	6.11	100	0	0	5	0	0	10	0	0			
C S2	S2	6.11	100	0	0	5	0	0	10	0	0			
C S1	S1	5.78	100	0	0	5	0	0	10	0	0			
MPW	N MPW	10.06	100	0	0	5	0	0	10	0	0			
C OSD10	OSD 10	2.36	100	0	0	5	0	0	8	0	0			
C MR06	MR06	0.77	100	0	0	5	0	0	8	0	0			
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 PR dummy DNSDC	PR DNSDC	PR dummy DNSDC	10	10	9.9	1	RCP Class 2		600	600	0.6	New	1	PR DNSDC
P S09/02	MB09	MBC01/02	6.5	11.702	11.669	0.51	Box Culverts	1.8W x 1.5H			0.6	New/Fixed	3	MB09
P MBC01/02	MBC01/02	MBC01/01A	5	11.669	11.651	0.36	Box Culverts	1.8W x 1.5H			0.6	New/Fixed	3	MBC01/02
P MBC01/01A	MBC01/01A	MBC01/01	24.634	11.631	11.417	0.87	Box Culverts	1.8W x 1.5H			0.6	New/Fixed	3	MBC01/01A
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
P MBC03/02	MBC03/02	MBC02/01a	50.037	10.752	10.5	0.5	Box Culverts	1.2W x 0.9H			0.6	New/Fixed	4	MBC03/02
P MBC03/03	MBC03/02	MBC03/02	64.281	12.05	11.29	1.18	Box Culverts	2.1W x 0.9H			0.6	New/Fixed	1	MBC03/03
P MBC03/02	MBC03/02	MBC02/01b	66.888	11.29	10.5	1.18	Box Culverts	2.1W x 0.9H			0.6	New/Fixed	1	MBC03/02
DETAILS OF SERVICES CROSSING PIPES														
Pipe	Chg	Bottom Elev (m)	Height of Service (m)	Chg Elev (m)	Bottom Elev (m)	Height of Service (m)	Chg Elev (m)	Bottom Elev (m)	Height of Service (m)	etc				
			(m)	(m)		(m)			(m)	etc				
CHANNEL DETAILS														
Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:7)	R.B. Slope (1:7)	Manning n	Depth (m)	Roofed	
				(m)	(m)	(m)	(%)	(m)	(1:7)	(1:7)		(m)		
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 DAV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing (%)	id	
Basin 09 Out	Basin 09	MB09	0.1	13.5			Dummy for OSD Weirs	1	1	1	5	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	103017786	
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	66866581	
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 for OSD Weirs	1	1	1	5	0	362918133	
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	397059810	
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	397059806	
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	SmtaChann	5				Concrete Channel	0.2	0.15	0.4	1	0	657445589	
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 OutPt1 10	MBC03/03	MBC02/01	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0	119491397	
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 MR06	MR06	Basin 09	0.1				Dummy used to model flow across road low points	0.2	0.15	0.4	1	0	396598490	
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	0.6	-1.57	Unsafe								
P MBC01/02	Box Culverts	0	0	0.6	-1.78	Unsafe								
P MBC01/01A	Box Culverts	0	0	0.6	-1.63	Unsafe								
MBC02/02	Box Culverts	0	0	0.6	2.33									
P MBC04/02	Box Culverts	0	0	0.6	1.3									
P MBC03/03	Box Culverts	0	0	0.6	1.3									
P MBC03/02	Box Culverts	0	0	0.6	1.26									
This model has no pipes with non-return valves														

DRAINS File Path:	F:\AA009335\3_SSS2\CV\CLCA-Stormwater\B40_SMP\Calcs\I-Issued Models\2019-06-03 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-19-06-03.drm
DRAINS Version:	DRAINS results prepared from Version 2018.09 (64 bit) - 27 November 2018
Modeler's Name:	M.Gostelow
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

DRAINS results prepared from Version 2018.09										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	10.73		1.058		3.27	0	None				
PR dummy DNSDC	10.48		0								
MB09	11.94		0.261		4.56	0	None				
MBC01/02	11.94		0		4.66	0	None				
MBC01/01A	11.93		1.722		4.67	0	None				
MBC01/01	10.85		0		5.75	0	None				
MBC02/01	10.55		1.779								
MBC04/02	10.75		0		2.25		None				
MBC02/01a	10.5		0								
MBC03/03	12.43		1.779		5.07	0	None				
MBC03/02	11.73		0		3.02		None				
MBC02/01b	10.75		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				
MPE W	2.687	2.687		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	0.669	0.669	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 MR06	0.179	0.179	0	5	8	0	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1				
Outflow Volumes for Total Catchment (61.8 impervious + 0.91 pervious = 62.7 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, average	8594.28	7865.59 (91.5%)	7851.41 (92.7%)	14.18 (11.3%)							
AR&R 1 year, 25 minutes storm, average	11199.05	10445.10 (93.3%)	10418.25 (94.4%)	26.85 (16.5%)							
AR&R 1 year, 45 minutes storm, average	14655.88	13861.19 (94.6%)	13824.75 (95.7%)	36.44 (17.1%)							
AR&R 1 year, 1 hour storm, average	16514.64	15701.87 (95.1%)	15656.50 (96.2%)	45.37 (18.9%)							
AR&R 1 year, 1.5 hours storm, average	19330.98	18480.14 (95.6%)	18431.82 (96.8%)	48.31 (17.2%)							
AR&R 1 year, 2 hours storm, average	21493.79	20617.86 (95.9%)	20563.05 (97.1%)	54.81 (17.5%)							
AR&R 1 year, 3 hours storm, average	24826.8	23899.16 (96.3%)	23847.68 (97.5%)	51.49 (14.2%)							
AR&R 1 year, 4.5 hours storm, average	28599.19	27619.66 (96.6%)	27565.12 (97.8%)	54.55 (13.1%)							
AR&R 1 year, 6 hours storm, average	31617.71	30597.55 (96.8%)	30539.98 (98.0%)	57.57 (12.5%)							
AR&R 1 year, 9 hours storm, average	36454.24	35395.39 (97.1%)	35305.68 (98.3%)	89.71 (16.9%)							
AR&R 1 year, 12 hours storm, average	40362.96	39267.88 (97.3%)	39157.97 (98.4%)	109.91 (18.7%)							
AR&R 1 year, 18 hours storm, average	46628.82	45400.18 (97.4%)	45331.20 (98.7%)	68.97 (10.2%)							
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 PR dummy DNSDC	1.061	3.77	10.725	10.49	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1						
P S09/02	0.262	0.21	11.937	11.936	AR&R 1 year, 3 hours storm, average 13.2 mm/h, Zone 1						
P MBC01/02	0.28	0.19	11.936	11.934	AR&R 1 year, 1.5 hours storm, average 20.6 mm/h, Zone 1						
P MBC01/01A	1.904	2.56	11.769	11.58	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1						
MBC02/02	1.884	2.27	10.807	10.546	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	1.779	3.42	12.298	11.728	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1						
P MBC03/02	1.779	3.42	11.538	10.749	AR&R 1 year, 2 hours storm, average 17.1 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 Dx/V	Max Width	Max V	Due to Storm	
Basin 09 Out	0.261	0.261	0	0.002	0	499.9	0.24	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	1.061	1.061	0	0.082	0.09	20.43	1.12	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	0.669	0.669	0	0.068	0.07	17.56	1	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	1.779	1.779	0	0.006	0	499.9	0.56	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	0	0	0	0	0		
F MBC01/01	0	0	0	0	0	0	0		
Channel	2.399	2.399	0	0.404	1.19	2.44	2.94	AR&R 1 year, 4.5 hours storm, average 10.1 mm/h, Zone 1	
F MBC02/01a	0	0	0	0	0	0	0		
F OutPt 10	0	0	0	0	0	0	0		
F MBC02/01b	1.779	1.779	0	0.102	0.13	24.39	1.28	AR&R 1 year, 2 hours storm, average 17.1 mm/h, Zone 1	
F MR06	0.179	0.179	0	0.04	0.03	11.99	0.69	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1	
F External Catch	1.722	1.722	0	0.101	0.13	24.21	1.26	AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1	
DETENTION BASIN DETAILS									
Name	Max WL	Max Vol	Max Q	Max Q	Max Q				
			Total	Low Level	High Level				
Basin 09	14.32	2741.6	0.261	0	0.261				
OSD 10	14.3	7189.8	1.779	0	1.779				
CONTINUITY CHECK FOR AR&R 1 year, 25 minutes storm, average 42.9 mm/h, Zone 1									
Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %					
Basin 09	2081.04	1260.31	821.25	0					
SimtaChann	6721.19	6721.19	0	0					
PR DNSDC	727.96	728.19	0	0					
PR dummy DNSDC	728.19	728.19	0	0					
S5	4522.98	4522.97	0	0					
Moore	532.91	532.91	0	0					
S Rd 1	485.69	485.69	0	0					
N MPE ST1	5055.87	5055.88	0	0					
S4	3966.45	3966.46	0	0					
S3	3035.65	3035.65	0	0					
S2	2005.15	2005.15	0	0					
S1	974.75	974.75	0	0					
N MPW	1696.54	1696.54	0	0					
OSD 10	7150.41	4293.29	2857.84	0					
MB09	1260.31	1257.06	0	0.3					
MBC01/02	1257.06	1254.77	0	0.2					
MBC01/01A	2468.64	2466.2	0	0.1					
MBC01/01	2466.2	2454.23	0	0.5					
MBC02/01	6725.14	6721.19	0	0.1					
MBC04/02	0	0	0	0					
MBC02/01a	0	0	0	0					
MBC03/03	4293.29	4285	0	0.2					
MBC03/02	4285	4272.38	0	0.3					
MBC02/01b	4272.38	4270.92	0	0					
MR06	129.85	129.85	0	0					
External Catch	1213.88	1213.87	0	0					
Run Log for MPEStage2SMPPProposed run at 21:23:51 on 3/6/2019									
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 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									

DRAINS File Path:	F:\AA009335\3_SSS2\CV\CLCA-Stormwater\B40_SMP\Calcs\I-Issued Models\2019-06-03 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-19-06-03.drm
DRAINS Version:	DRAINS results prepared from Version 2018.09 (64-bit) - 27 November 2018
Modeler's Name:	M.Gostelow
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

DRAINS results prepared from Version 2018.09								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			
PR DNSDC	11.37		2.055		2.63	0	None			
PR dummy DNSDC	10.48		0							
MB09	12.09		0.768		4.41	0	None			
MBC01/02	12.09		0		4.51	0	None			
MBC01/01A	12.09		3.248		4.51	0	None			
MBC01/01	10.92		0		5.68	0	None			
MBC02/01	10.6		2.387							
MBC04/02	10.75		0		2.25		None			
MBC02/01a	10.5		0							
MBC03/03	12.51		2.387		4.99	0	None			
MBC03/02	11.82		0		2.93		None			
MBC02/01b	10.8		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			
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	5	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C S5	1.377	1.377	0	5	10	10	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C MOORE	1.319	1.319	0	5	10	10	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C S RD 1	1.202	1.202	0	5	12	12	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C S4	2.304	2.304	0	5	10	10	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C S3	2.55	2.55	0	5	10	10	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C S2	2.55	2.55	0	5	10	10	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C S1	2.413	2.413	0	5	10	10	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
MPW	4.199	4.199	0	5	10	10	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C OSD10	0.985	0.985	0	5	8	8	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
C MR06	0.321	0.321	0	5	8	8	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1			
Outflow Volumes for Total Catchment (61.8 impervious + 0.91 pervious = 62.7 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	15466.67	14734.92 (95.3%)	14623.75 (95.9%)	111.17 (49.4%)						
AR&R 10 year, 25 minutes storm, a	20128.72	19368.76 (96.2%)	19217.92 (96.9%)	150.83 (51.5%)						
AR&R 10 year, 45 minutes storm, a	26417.05	25615.37 (97.0%)	25414.69 (97.6%)	200.67 (52.2%)						
AR&R 10 year, 1 hour storm, average	29851.94	29026.36 (97.2%)	28799.56 (97.9%)	226.80 (52.2%)						
AR&R 10 year, 1.5 hours storm, average	35118.94	34254.54 (97.5%)	33989.85 (98.2%)	264.69 (51.8%)						
AR&R 10 year, 2 hours storm, average	39198.5	38303.40 (97.7%)	38010.03 (98.4%)	293.37 (51.4%)						
AR&R 10 year, 3 hours storm, average	45556.83	44613.09 (97.9%)	44275.42 (98.6%)	337.67 (50.9%)						
AR&R 10 year, 4.5 hours storm, average	52827.29	51811.93 (98.1%)	51440.11 (98.8%)	371.82 (48.3%)						
AR&R 10 year, 6 hours storm, average	58715.46	57646.39 (98.2%)	57242.99 (98.9%)	403.40 (47.2%)						
AR&R 10 year, 9 hours storm, average	68347.77	67167.60 (98.3%)	66735.13 (99.1%)	432.47 (43.5%)						
AR&R 10 year, 12 hours storm, average	76340.76	75099.77 (98.4%)	74611.73 (99.2%)	488.03 (43.9%)						
AR&R 10 year, 18 hours storm, average	89496.26	88051.25 (98.4%)	87574.09 (99.3%)	477.16 (36.6%)						
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 PR dummy DNSDC	2.058	7.28	11.368	10.5	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1					
P S09/02	0.767	0.37	12.091	12.089	AR&R 10 year, 9 hours storm, average 12.1 mm/h, Zone 1					
P MBC01/02	0.771	0.34	12.089	12.089	AR&R 10 year, 1.5 hours storm, average 37.3 mm/h, Zone 1					
P MBC01/01A	3.49	3.08	11.841	11.658	AR&R 10 year, 25 minutes storm, average 77.1 mm/h, Zone 1					
MBC02/02	3.453	2.86	10.86	10.599	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	2.387	3.78	12.351	11.823	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1					
P MBC03/02	2.387	3.78	11.59	10.802	AR&R 10 year, 2 hours storm, average 31.3 mm/h, Zone 1					
CHANNEL DETAILS										
Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm					

OVERFLOW ROUTE DETAILS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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DRAINS File Path:	F:\AA009335\3_SSS2\CV\CLCA-Stormwater\B40_SMP\Calcs\I-Issued Models\2019-06-03 MPE2 SMP DRAINS Models\IPEStage2SMPProposed-19-06-03.drn
DRAINS Version:	DRAINS results prepared from Version 2018.09 (64-bit) - 27 November 2018
Modeler's Name:	M.Gostelow
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

DRAINS results prepared from Version 2018.09										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				
PR DNSDC	12.12		2.789		1.88	0	None				
PR dummy DNSDC	10.48		0								
MB09	12.21		0.907		4.29	0	None				
MBC01/02	12.21		0		4.39	0	None				
MBC01/01A	12.21		4.401		4.39	0	None				
MBC01/01	10.98		0		5.62	0	None				
MBC02/01	10.64		2.913								
MBC04/02	10.75		0		2.25		None				
MBC02/01a	10.5		0								
MBC03/03	12.57		2.913		4.93	0	None				
MBC03/02	11.9		0		2.85		None				
MBC02/01b	10.84		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				
MPE W	6.525	6.525		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	1.624	1.624	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 MR06	0.434	0.434	0	5	8	0	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1				
Outflow Volumes for Total Catchment (61.8 impervious + 0.91 pervious = 62.7 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,	22566.31	21833.18 (96.8%)	21620.04 (97.2%)	213.15 (64.9%)							
AR&R 100 year, 25 minutes storm,	29352.5	28590.11 (97.4%)	28307.39 (97.9%)	282.72 (66.2%)							
AR&R 100 year, 45 minutes storm,	38612.34	37806.94 (97.9%)	37432.51 (98.4%)	374.43 (66.6%)							
AR&R 100 year, 1 hour storm, average	43723.67	42894.25 (98.1%)	42469.39 (98.6%)	424.87 (66.8%)							
AR&R 100 year, 1.5 hours storm, average	51619.48	50752.05 (98.3%)	50250.04 (98.8%)	502.01 (66.8%)							
AR&R 100 year, 2 hours storm, average	57777.2	56879.33 (98.4%)	56318.24 (98.9%)	561.09 (66.7%)							
AR&R 100 year, 3 hours storm, average	67419.96	66467.53 (98.6%)	65820.88 (99.1%)	646.66 (65.9%)							
AR&R 100 year, 4.5 hours storm, average	78533.34	77508.24 (98.7%)	76773.66 (99.2%)	734.59 (64.3%)							
AR&R 100 year, 6 hours storm, average	87599.87	86500.29 (98.7%)	85706.22 (99.3%)	794.07 (62.3%)							
AR&R 100 year, 9 hours storm, average	102607.86	101362.95 (98.8%)	100496.89 (99.4%)	866.05 (58.0%)							
AR&R 100 year, 12 hours storm, average	115233.63	113899.03 (98.8%)	112937.91 (99.5%)	961.12 (57.3%)							
AR&R 100 year, 18 hours storm, average	136463.63	134889.98 (98.8%)	133860.75 (99.5%)	1029.24 (51.8%)							
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 PR dummy DNSDC	2.794	9.88	12.118	10.5	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1						
P S09/02	0.907	0.33	12.209	12.207	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1						
P MBC01/02	0.913	0.31	12.207	12.205	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1						
P MBC01/01A	4.849	3.29	11.904	11.719	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1						
MBC02/02	4.844	3.25	10.899	10.638	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	2.913	4.04	12.393	11.898	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1						
P MBC03/02	2.913	4.05	11.633	10.845	AR&R 100 year, 2 hours storm, average 46.1 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 Dx/V	Max Width	Max V	Due to Storm	
F PR DNSDC	0.907	0.907	0	0.005	0	499.9	0.4	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1	
F PR dummy DNSDC	2.794	2.794	0	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	0	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	0	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	1.624	1.624	0	0.098	0.12	23.67	1.25	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1	
F MPE ST1	9.299	9.299	0	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	0	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	0	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	0	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	0	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	0	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	2.913	2.913	0	0.009	0.01	499.9	0.66	AR&R 100 year, 2 hours storm, average 46.1 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	0	0	0	0	0		
F MBC01/01	0	0	0	0	0	0	0		
Channel	6.668	6.668	0	0.718	2.86	3.03	3.98	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1	
F MBC02/01a	0	0	0	0	0	0	0		
F OutPt 10	0	0	0	0	0	0	0		
F MBC02/01b	2.913	2.913	0	0.125	0.18	29.06	1.45	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1	
F MR06	0.434	0.434	0	0.057	0.05	15.41	0.88	AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1	
F External Catch	4.401	4.401	0	0.149	0.24	33.73	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	15.62	7182.1	0.907	0	0.907				
OSD 10	15.4	23233.4	2.913	0	2.913				
CONTINUITY CHECK FOR AR&R 100 year, 15 minutes storm, average 144 mm/h, Zone 1									
Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %					
Basin 09	4318.59	2082.82	2236.5	0					
SimtaChann	15372.97	15372.97	0	0					
PR DNSDC	1668.1	1669.14	0	-0.1					
PR dummy DNSDC	1669.14	1669.14	0	0					
S5	9386.11	9386.11	0	0					
Moore	1105.9	1105.9	0	0					
S Rd 1	1007.9	1007.9	0	0					
N MPE ST1	10492	10492	0	0					
S4	8231.21	8231.22	0	0					
S3	6299.4	6299.4	0	0					
S2	4161.1	4161.1	0	0					
S1	2022.81	2022.81	0	0					
N MPW	3520.66	3520.66	0	0					
OSD 10	14838.59	10708.33	4132.96	0					
MB09	2082.82	2078.5	0	0.2					
MBC01/02	2078.5	2075.65	0	0.1					
MBC01/01A	4752.69	4744.26	0	0.2					
MBC01/01	4744.26	4734.48	0	0.2					
MBC02/01	15385.61	15372.97	0	0.1					
MBC04/02	0	0	0	0					
MBC02/01a	0	0	0	0					
MBC03/03	10708.33	10686.2	0	0.2					
MBC03/02	10686.2	10656.69	0	0.3					
MBC02/01b	10656.69	10651.14	0	0.1					
MR06	269.47	269.47	0	0					
External Catch	2677.04	2677.04	0	0					
Run Log for MPEStage2SMPPProposed run at 21:27:23 on 3/6/2019									
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 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									

DRAINS File Path:	F:\AA009335\3_SSS2\CV\CLCA-Stormwater\B40_SMP\Calcs\I-Issued Models\2019-06-03 MPE2 SMP DRAINS Models\MPEStage2SMPProposed-19-06-03.drn
DRAINS Version:	DRAINS results prepared from Version 2018.09 (64-bit) - 27 November 2018
Modeler's Name:	M.Gostelow
Description:	MPE Stage 2 Stormwater Management Plan - Proposed Model

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS								100 YEAR ARI + 10% CC	
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	12.47		3.074		1.53	0	None		
PR dummy DNSDC	10.48		0						
MB09	12.25		0.946		4.25	0	None		
MBC01/02	12.24		0		4.36	0	None		
MBC01/01A	12.24		4.846		4.36	0	None		
MBC01/01	11		0		5.6	0	None		
MBC02/01	10.65		3.071						
MBC04/02	10.75		0		2.25		None		
MBC02/01a	10.5		0						
MBC03/03	12.59		3.071		4.91	0	None		
MBC03/02	11.92		0		2.83		None		
MBC02/01b	10.86		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		
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	1.786	1.786	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 MR06	0.478	0.478	0	5	8	0	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1		
Outflow Volumes for Total Catchment (61.8 impervious + 0.91 pervious = 62.7 total ha)									
Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)					
100 year +10% CC, 15 minutes stor	24816.88	24083.55 (97.0%)	23837.84 (97.5%)	245.72 (68.0%)					
100 year +10% CC, 25 minutes stor	32283.79	31521.20 (97.6%)	31196.00 (98.1%)	325.20 (69.2%)					
100 year +10% CC, 45 minutes stor	42471.44	41665.79 (98.1%)	41235.36 (98.5%)	430.43 (69.6%)					
100 year +10% CC, 1 hour storm, at	48095.25	47265.69 (98.3%)	46777.35 (98.7%)	488.33 (69.7%)					
100 year +10% CC, 1.5 hours storm	56788.28	55920.58 (98.5%)	55343.45 (98.9%)	577.13 (69.8%)					
100 year +10% CC, 2 hours storm,	63564	62665.03 (98.6%)	62020.23 (99.0%)	644.80 (69.7%)					
100 year +10% CC, 3 hours storm,	74177.95	73223.99 (98.7%)	72480.15 (99.2%)	743.84 (68.9%)					
100 year +10% CC, 4.5 hours storm	86408.78	85381.89 (98.8%)	84533.43 (99.3%)	848.46 (67.5%)					
100 year +10% CC, 6 hours storm,	96395.3	95290.38 (98.9%)	94372.00 (99.3%)	918.37 (65.4%)					
100 year +10% CC, 9 hours storm,	112923.5	111670.79 (98.9%)	110660.26 (99.4%)	1010.53 (61.5%)					
100 year +10% CC, 12 hours storm	126831.28	125486.35 (98.9%)	124369.29 (99.5%)	1117.06 (60.5%)					
100 year +10% CC, 18 hours storm	150211.52	148613.09 (98.9%)	147406.67 (99.6%)	1206.42 (55.2%)					
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 PR dummy DNSDC	3.079	10.89	12.469	10.5	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1				
P S09/02	0.952	0.33	12.244	12.243	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1				
P MBC01/02	0.959	0.31	12.243	12.241	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1				
P MBC01/01A	5.373	3.55	11.911	11.738	100 year +10% CC, 1.5 hours storm, average 60.4 mm/h, Zone 1				
MBC02/02	5.302	3.36	10.911	10.65	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	3.071	4.12	12.405	11.92	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1				
P MBC03/02	3.071	4.14	11.643	10.856	100 year +10% CC, 2 hours storm, average 50.7 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 Dx/V	Max Width	Max V	Due to Storm	
Basin 09 Out	0.946	0.946	0	0.005	0	499.9	0.41	100 year +10% CC, 9 hours storm, average 20.0 mm/h, Zone 1	
F PR DNSDC	0	0	0	0	0	0	0		
F PR dummy DNSDC	3.079	3.079	0	0.129	0.19	29.77	1.45	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1	
F S5	9.748	9.748	0	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	0	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	1.786	1.786	0	0.103	0.13	24.57	1.27	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1	
F MPE ST1	10.229	10.229	0	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	0	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	0	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	0	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	0	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	0	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	3.071	3.071	0	0.009	0.01	499.9	0.65	100 year +10% CC, 2 hours storm, average 50.7 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	0	0	0	0	0		
F MBC01/01	0	0	0	0	0	0	0		
Channel	7.197	7.197	0	0.75	3.04	3.09	4.06	100 year +10% CC, 1.5 hours storm, average 60.4 mm/h, Zone 1	
F MBC02/01a	0	0	0	0	0	0	0		
F OutPR 10	0	0	0	0	0	0	0		
F MBC02/01b	3.071	3.071	0	0.128	0.19	29.59	1.47	100 year +10% CC, 2 hours storm, average 50.7 mm/h, Zone 1	
F MR06	0.478	0.478	0	0.06	0.05	15.94	0.89	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1	
F External Catch	4.846	4.846	0	0.155	0.25	34.98	1.64	100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1	
DETENTION BASIN DETAILS									
Name	Max WL	Max Vol	Max Q	Max Q	Max Q				
			Total	Low Level	High Level				
Basin 09	15.81	7870.5	0.946	0	0.946				
OSD 10	15.6	26103.4	3.071	0	3.071				
CONTINUITY CHECK for 100 year +10% CC, 15 minutes storm, average 158 mm/h, Zone 1									
Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %					
Basin 09	4761.6	2391.7	2370.64	0					
SimtaChann	16786.26	16786.26	0	0					
PR DNSDC	1849.92	1851.41	0	-0.1					
PR dummy DNSDC	1851.41	1851.41	0	0					
S5	10348.95	10348.95	0	0					
Moore	1219.34	1219.34	0	0					
S Rd 1	1111.3	1111.3	0	0					
N MPE ST1	11588.28	11588.28	0	0					
S4	9075.59	9075.59	0	0					
S3	6945.6	6945.6	0	0					
S2	4587.95	4587.96	0	0					
S1	2230.31	2230.31	0	0					
N MPW	3881.82	3881.82	0	0					
OSD 10	16360.73	11556.06	4808.87	0					
MB09	2391.7	2387.31	0	0.2					
MBC01/02	2387.31	2384.36	0	0.1					
MBC01/01A	5347.06	5341.39	0	0.1					
MBC01/01	5341.39	5328.25	0	0.2					
MBC02/01	16805	16786.26	0	0.1					
MBC04/02	0	0	0	0					
MBC02/01a	0	0	0	0					
MBC03/03	11556.06	11524.97	0	0.3					
MBC03/02	11524.97	11485.31	0	0.3					
MBC02/01b	11485.31	11476.74	0	0.1					
MR06	297.12	297.12	0	0					
External Catch	2962.71	2962.71	0	0					
Run Log for MPEStage2SMPPProposed run at 21:18:22 on 3/6/2019									
No water upwelling from any pit. Freeboard was adequate at all pits.									
The maximum flow in these overflow routes is unsafe: F External Catch, F S4, F S3, F S2, F S5, F MPE ST1, F MPW, Channel									
These overflow routes carried water uphill (adding energy): 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									

 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 MG CHECKED MG DATE 3/06/2019 DATE 3/06/2019	
Stage-Discharge Outlet Relationships - OSD 09 (Unblocked)	
DRAINS Model:	F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2019-06-03 MPE2 SMP DRAINS Models\MPEStage2SMPPProposed-19-06-03.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)	0.05	This allows a more detailed calculation of flow for the height entered
Orifice increment (m)	0.05	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)	4.970	
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)	5.170	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of High Flow Pit (mAHD)	14.500	

Stage	Low Flow	High Flow	Weir	Discharge
H (m)	Qt (m3/s)	Qt (m3/s)	Qt (m3/s)	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	0.022	0.000	0.000	0.022
13.53	0.041	0.000	0.000	0.041
13.54	0.064	0.000	0.000	0.064
13.55	0.089	0.000	0.000	0.089
13.60	0.142	0.000	0.000	0.142
13.65	0.153	0.000	0.000	0.153
13.70	0.164	0.000	0.000	0.164
13.75	0.174	0.000	0.000	0.174
13.80	0.183	0.000	0.000	0.183
13.85	0.192	0.000	0.000	0.192
13.90	0.200	0.000	0.000	0.200
13.95	0.209	0.000	0.000	0.209
14.00	0.216	0.000	0.000	0.216
14.05	0.224	0.000	0.000	0.224
14.10	0.231	0.000	0.000	0.231
14.15	0.239	0.000	0.000	0.239
14.20	0.245	0.000	0.000	0.245
14.25	0.252	0.000	0.000	0.252
14.30	0.259	0.000	0.000	0.259
14.35	0.265	0.000	0.000	0.265
14.40	0.271	0.000	0.000	0.271
14.45	0.277	0.000	0.000	0.277
14.50	0.283	0.000	0.000	0.283
14.51	0.285	0.008	0.000	0.293
14.52	0.286	0.023	0.000	0.309
14.53	0.287	0.043	0.000	0.330
14.54	0.288	0.066	0.000	0.354
14.55	0.289	0.092	0.000	0.382
14.60	0.295	0.262	0.000	0.557
14.65	0.301	0.386	0.000	0.686
14.70	0.306	0.393	0.000	0.699
14.75	0.312	0.401	0.000	0.712
14.80	0.317	0.408	0.000	0.725
14.85	0.322	0.415	0.000	0.737
14.90	0.327	0.422	0.000	0.750
14.95	0.332	0.429	0.000	0.762
15.00	0.337	0.436	0.000	0.774
15.05	0.342	0.443	0.000	0.785
15.10	0.347	0.450	0.000	0.797
15.15	0.352	0.456	0.000	0.808
15.20	0.357	0.463	0.000	0.819
15.25	0.361	0.469	0.000	0.830
15.30	0.366	0.475	0.000	0.841
15.35	0.370	0.482	0.000	0.852
15.40	0.375	0.488	0.000	0.863
15.45	0.379	0.494	0.000	0.873
15.50	0.384	0.500	0.000	0.884
15.55	0.388	0.506	0.000	0.894
15.60	0.392	0.512	0.000	0.904
15.65	0.397	0.517	0.000	0.914
15.70	0.401	0.523	0.000	0.924
15.75	0.405	0.529	0.000	0.934
15.80	0.409	0.534	0.000	0.943
15.85	0.413	0.540	0.000	0.953
15.90	0.417	0.545	0.000	0.963
15.95	0.421	0.551	0.000	0.972
16.00	0.425	0.556	0.000	0.981
16.05	0.429	0.562	0.000	0.991
16.10	0.433	0.567	0.000	1.000
16.15	0.437	0.572	0.000	1.009
16.20	0.441	0.577	0.000	1.018
16.25	0.444	0.582	0.000	1.027
16.30	0.448	0.587	0.000	1.035
16.35	0.452	0.592	0.000	1.044
16.40	0.455	0.597	0.000	1.053
16.45	0.459	0.602	0.000	1.062
16.50	0.463	0.607	0.000	1.070

Stage-Discharge Outlet Relationships - OSD 10 (Unblocked)

DRAINS Model:

F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2019-06-03 MPE2 SMP DRAINS
Models\MPEStage2SMPProposed-19-06-03.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)	0.05	This allows a more detailed calculation of flow for the height entered
Orifice increment (m)	0.05	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	

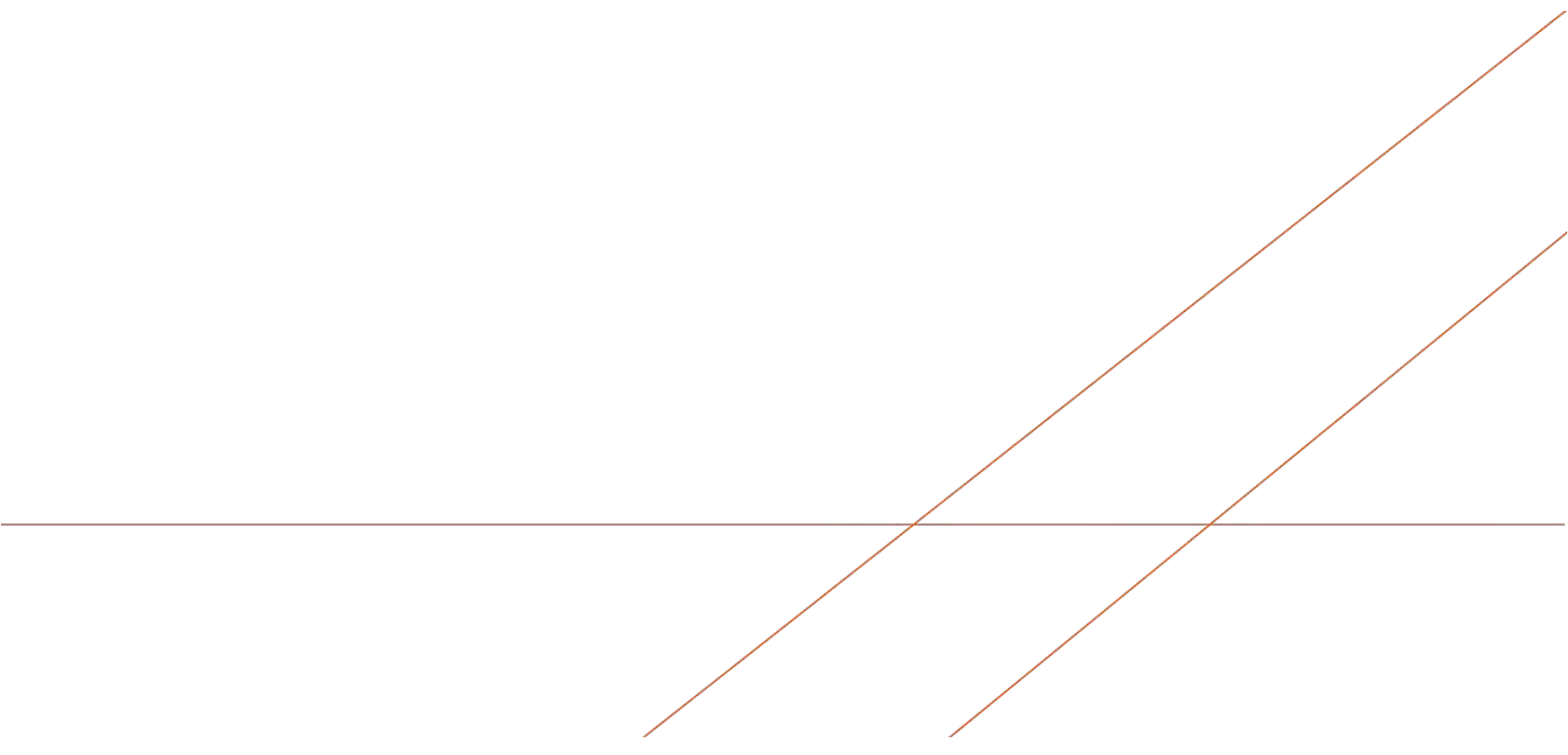
Low Flow Outlet Control		
Orifice Shape	R	C = Circular / R = Rectangular
Orifice Diameter Ø or Height (m)	0.200	
Number or Length of Orifice (m)	0.700	
Area (m2)	0.140	
Centreline of Orifice (mAHD)	13.600	This level sets the orifice flow calculation
IL of Low Flow Orifice (mAHD)	13.500	
OL of Low Flow 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)	6.000	
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)	15.100	
Blocked Perimeter Length (m)	0.000	
Weir Coefficient	1.6	
Crest Level of High Flow Pit (mAHD)	14.000	

Stage	Low Flow	High Flow	Discharge
H (m)	Qt (m3/s)	Qt (m3/s)	Qt (m3/s)
13.80	0.000	0.000	0.000
13.81	0.010	0.000	0.010
13.82	0.027	0.000	0.027
13.83	0.050	0.000	0.050
13.84	0.077	0.000	0.077
13.85	0.107	0.000	0.107
13.90	0.210	0.000	0.210
13.95	0.227	0.000	0.227
14.00	0.243	0.000	0.243
14.01	0.246	0.024	0.270
14.02	0.249	0.068	0.317
14.03	0.252	0.126	0.378
14.04	0.255	0.193	0.448
14.05	0.258	0.270	0.528
14.10	0.272	0.764	1.036
14.15	0.285	1.281	1.566
14.20	0.298	1.344	1.641
14.25	0.310	1.403	1.713
14.30	0.322	1.461	1.782
14.35	0.333	1.516	1.848
14.40	0.344	1.569	1.913
14.45	0.354	1.620	1.975
14.50	0.365	1.670	2.035
14.55	0.375	1.719	2.093
14.60	0.384	1.766	2.150
14.65	0.394	1.812	2.205
14.70	0.403	1.856	2.259
14.75	0.412	1.900	2.312
14.80	0.421	1.943	2.364
14.85	0.430	1.985	2.414
14.90	0.438	2.025	2.464
14.95	0.446	2.066	2.512
15.00	0.455	2.105	2.560
15.05	0.463	2.144	2.606
15.10	0.471	2.181	2.652
15.15	0.478	2.219	2.697
15.20	0.486	2.255	2.742
15.25	0.494	2.292	2.785
15.30	0.501	2.327	2.828
15.35	0.508	2.362	2.870
15.40	0.516	2.397	2.912
15.45	0.523	2.431	2.953
15.50	0.530	2.464	2.994
15.55	0.537	2.497	3.034
15.60	0.543	2.530	3.073
15.65	0.550	2.562	3.112
15.70	0.557	2.594	3.151
15.75	0.563	2.625	3.189
15.80	0.570	2.656	3.226

APPENDIX D

Flow Comparisons





PROJECT

MPE Stage 2 Stormwater Management Plan

TITLE

DRAINS Peak Flow Comparison - Existing vs. Proposed
Outlet C

JOB No

AA009335

PREPARED

MG

DATE

03/06/19

CHECKED

MG

DATE

03/06/19

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\MPESStage2SMPExisting-18-02-26.drn

F:\AA009335\3_SSS2\CV\CLC\A-Stormwater\B40_SMP\Calcs\I-Issued Models\2019-06-03 MPE2 SMP DRAINS Models\MPESStage2SMPProposed-19-06-03.drn

DRAINS Version:

Version 2017.10 (64.bit) - 9 August 2017

Existing Outlet Ref:

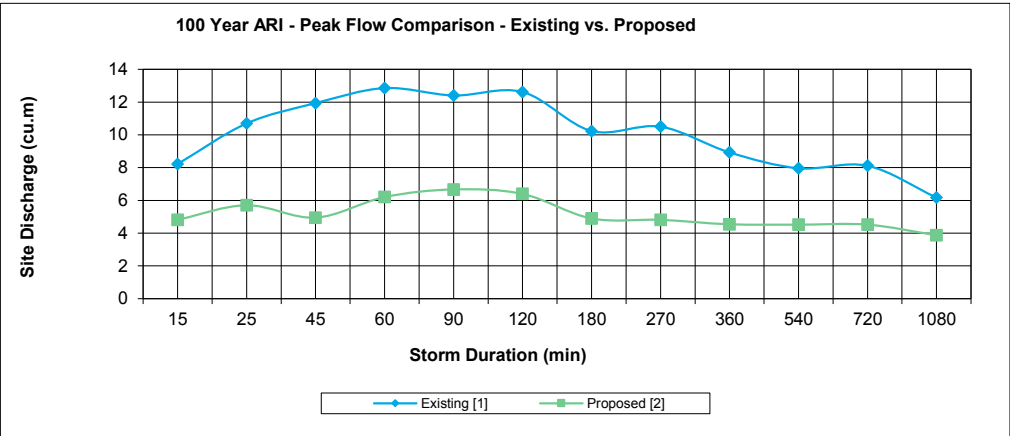
Ex Channel

Proposed Outlet Ref:

Channel

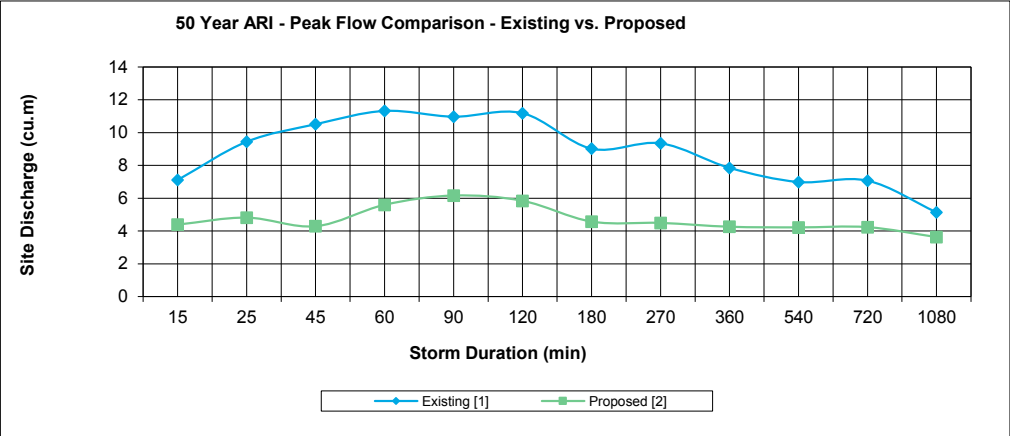
	100yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	8.222	4.816	-3.406
25	10.696	5.704	-4.992
45	11.935	4.946	-6.989
60	12.853	6.203	-6.650
90	12.403	6.668	-5.735
120	12.615	6.394	-6.221
180	10.234	4.896	-5.338
270	10.501	4.813	-5.688
360	8.926	4.543	-4.383
540	7.960	4.519	-3.441
720	8.112	4.521	-3.591
1080	6.171	3.873	-2.298
Max	12.853	6.668	

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



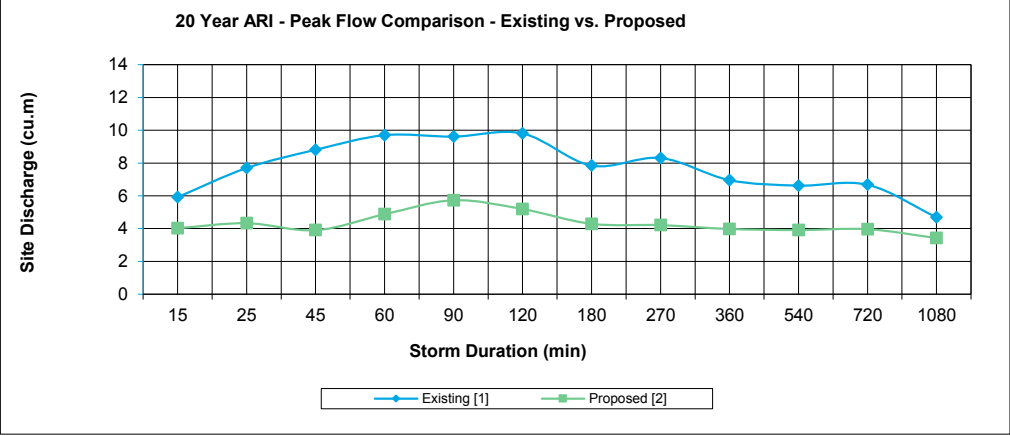
	50yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	7.109	4.387	-2.722
25	9.439	4.814	-4.625
45	10.509	4.287	-6.222
60	11.321	5.596	-5.725
90	10.969	6.161	-4.808
120	11.182	5.839	-5.343
180	9.017	4.571	-4.446
270	9.347	4.492	-4.855
360	7.848	4.258	-3.590
540	6.985	4.218	-2.767
720	7.067	4.233	-2.834
1080	5.137	3.629	-1.508
Max	11.321	6.161	

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



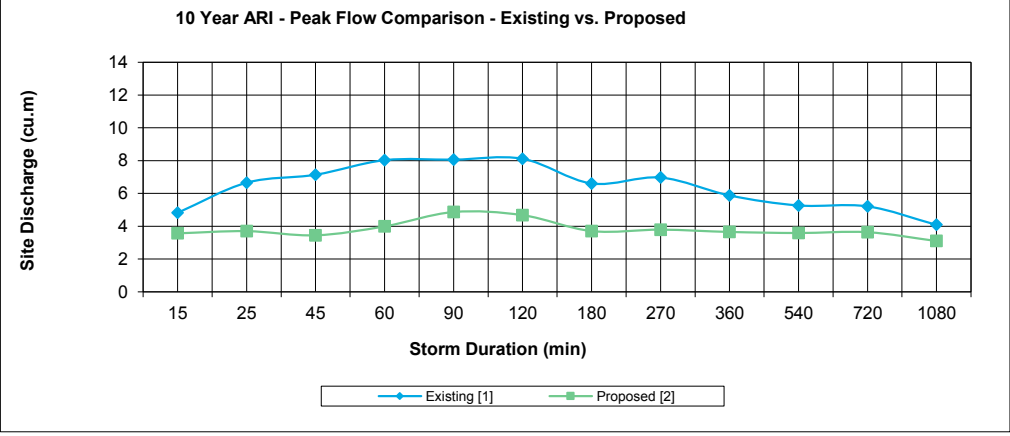
	20yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	5.919	4.023	-1.896
25	7.694	4.329	-3.365
45	8.806	3.902	-4.904
60	9.699	4.874	-4.825
90	9.610	5.728	-3.882
120	9.804	5.191	-4.613
180	7.841	4.290	-3.551
270	8.307	4.212	-4.095
360	6.955	3.977	-2.978
540	6.622	3.912	-2.710
720	6.673	3.964	-2.709
1080	4.689	3.425	-1.264
Max	9.804	5.728	

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



	10yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	4.820	3.568	-1.252
25	6.655	3.701	-2.954
45	7.142	3.448	-3.694
60	8.029	3.993	-4.036
90	8.061	4.867	-3.194
120	8.115	4.677	-3.438
180	6.608	3.706	-2.902
270	6.971	3.793	-3.178
360	5.878	3.653	-2.225
540	5.268	3.588	-1.680
720	5.213	3.636	-1.577
1080	4.086	3.099	-0.987
Max	8.115	4.867	

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





PROJECT

MPE Stage 2 Stormwater Management Plan

TITLE

DRAINS Peak Flow Comparison - Existing vs. Proposed
Outlet C

JOB No

AA009335

PREPARED

MG

DATE

03/06/19

CHECKED

MG

DATE

03/06/19

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\MPESStage2SMPExisting-18-02-26.drn](#)
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DRAINS Version:

Version 2017.10 (64.bit) - 9 August 2017

Existing Outlet Ref:

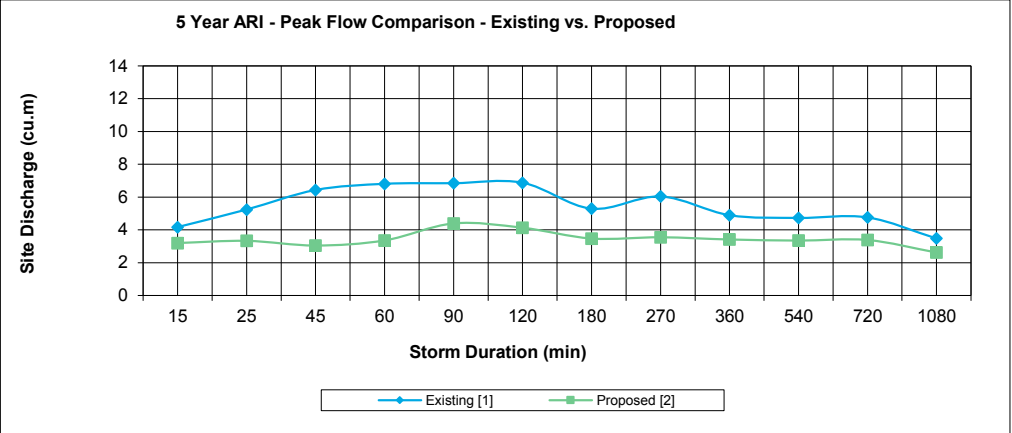
Ex Channel

Proposed Outlet Ref:

Channel

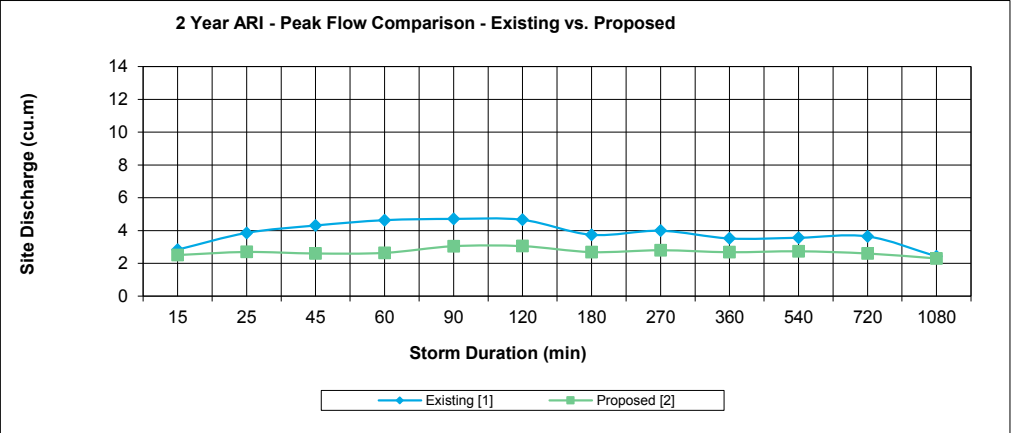
	5yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	4.171	3.199	-0.972
25	5.242	3.331	-1.911
45	6.434	3.046	-3.388
60	6.809	3.357	-3.452
90	6.847	4.394	-2.453
120	6.877	4.130	-2.747
180	5.292	3.474	-1.818
270	6.039	3.550	-2.489
360	4.896	3.414	-1.482
540	4.730	3.349	-1.381
720	4.761	3.382	-1.379
1080	3.477	2.620	-0.857
Max	6.877	4.394	

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



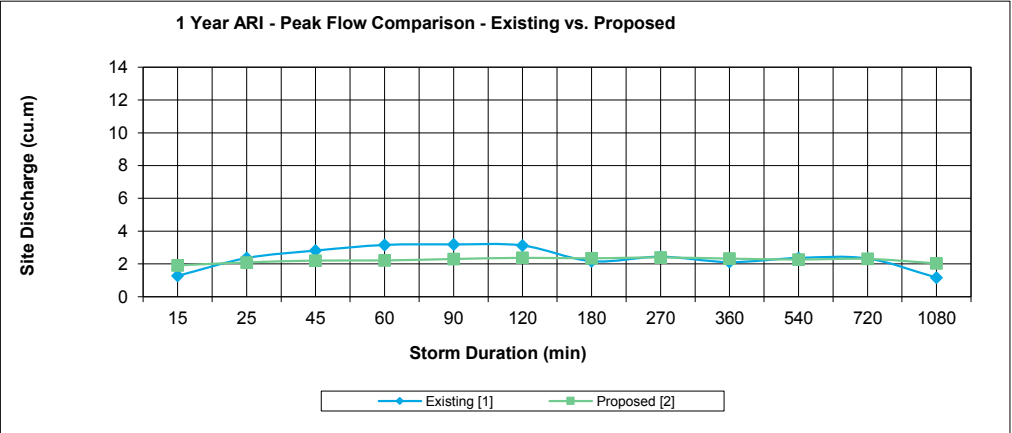
	2yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	2.834	2.505	-0.329
25	3.855	2.692	-1.163
45	4.307	2.599	-1.708
60	4.632	2.637	-1.995
90	4.708	3.044	-1.664
120	4.651	3.048	-1.603
180	3.740	2.685	-1.055
270	3.986	2.797	-1.189
360	3.516	2.677	-0.839
540	3.559	2.734	-0.825
720	3.639	2.599	-1.040
1080	2.424	2.296	-0.128
Max	4.708	3.048	

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



	1yr ARI		
	Total		
Storm Duration (min)	Existing [1]	Proposed [2]	[2] - [1]
15	1.274	1.913	0.639
25	2.359	2.095	-0.264
45	2.817	2.207	-0.610
60	3.159	2.214	-0.945
90	3.191	2.303	-0.888
120	3.126	2.374	-0.752
180	2.169	2.346	0.177
270	2.441	2.399	-0.042
360	2.113	2.326	0.213
540	2.368	2.271	-0.097
720	2.331	2.309	-0.022
1080	1.172	2.035	0.863
Max	3.191	2.399	

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



APPENDIX E

MUSIC Model Information

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

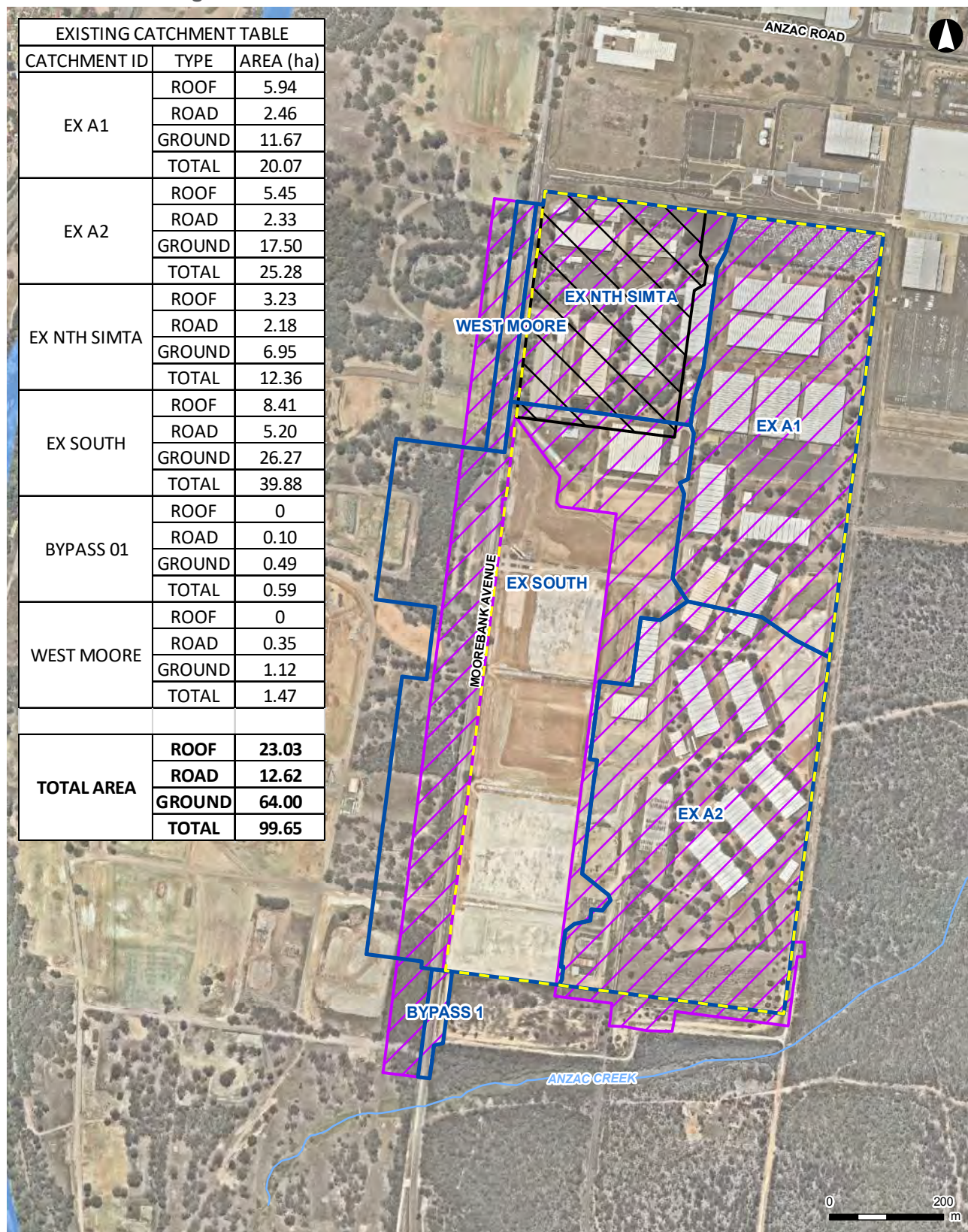
E.5 Bioretention Basin & GPT Modelling Parameters

E.6 Rainwater Reuse Parameters

E.7 MUSIC Model Treatment Train Effectiveness Results

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

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

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

ARCADIS AUSTRALIA PACIFIC PTY LTD
 ABN 76 104 485 289
 Level 16, 500 George St | Sydney NSW 2000
 P: +61 (0) 2 8907 9000 | F: +61 (0) 2 8907 9001
 Coordinate System: GDA 1994 MGA Zone 56
 Aerial imagery supplied by nearmap (January, 2018)

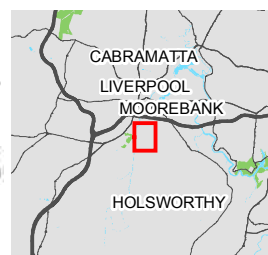
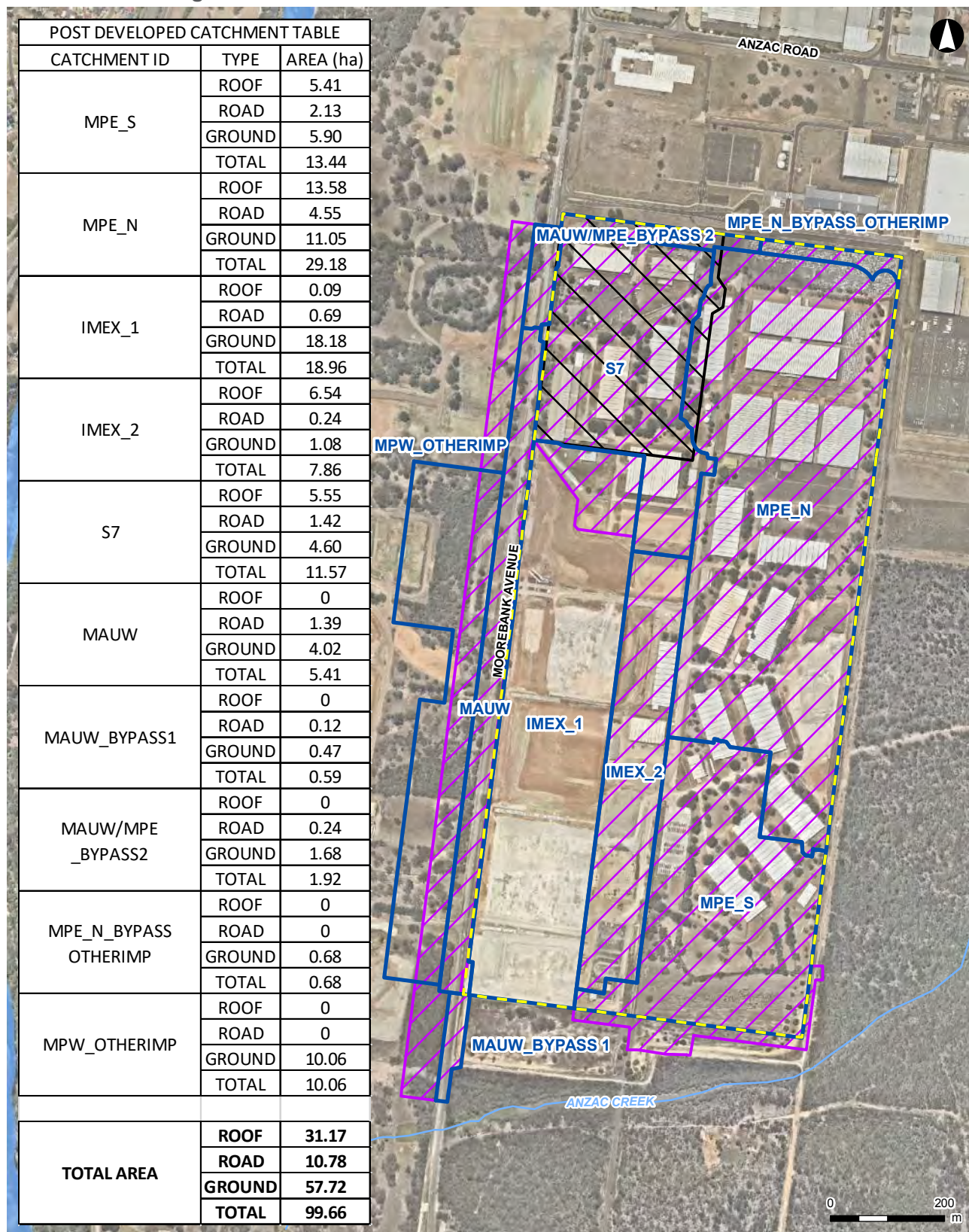


Figure E-3: MUSIC Model Existing Catchments

Stormwater Management Plan - Warehouse 1 Precinct



LEGEND

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

ARCADIS AUSTRALIA PACIFIC PTY LTD
 ABN 76 104 485 289
 Level 16, 580 George St | Sydney NSW 2000
 P: +61 (0) 2 8907 9000 | F: +61 (0) 2 8907 9001
 Coordinate System: GDA 1994 MGA Zone 56
 Aerial imagery supplied by nearmap (January, 2018)

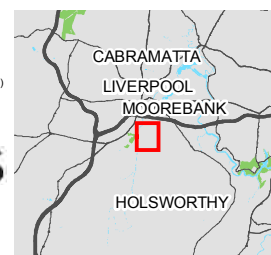


Figure E-4: MUSIC Post Development Catchments

E.2 Rainfall Data

Pluviograph data from Liverpool's Whittam 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

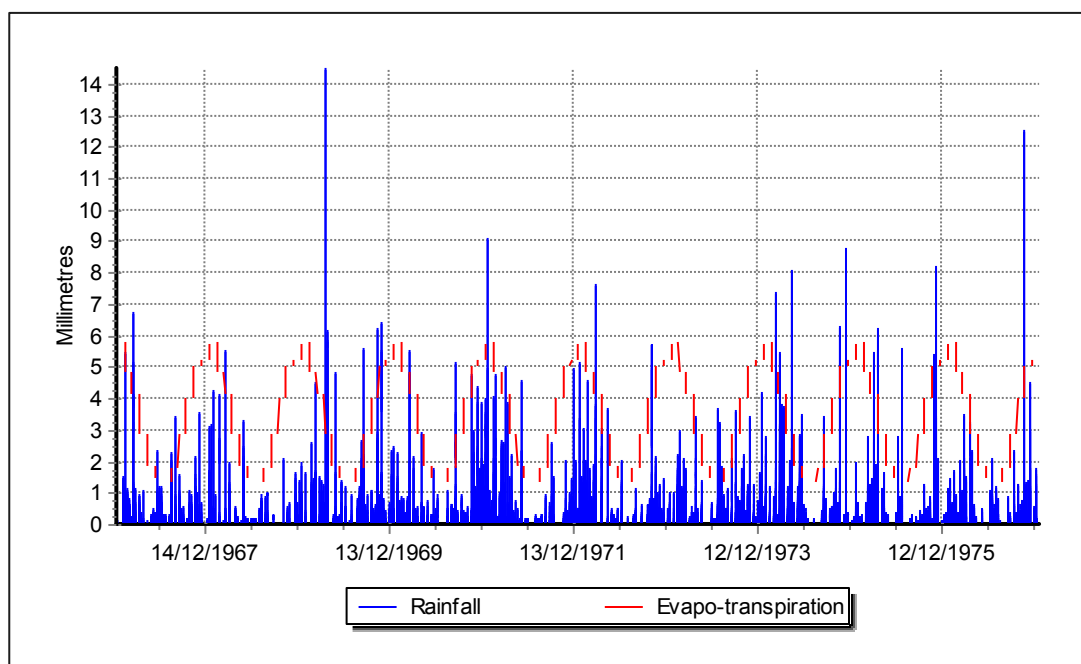


Figure E-5: Rainfall and potential evapotranspiration data used in MUSIC for the 1967-1976 period

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 (m ²)	1,300	4,300
[% Catchment Area]	[1.1%]	[1.0%]
Minimum Storage Surface Area (m ²)	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
<u>Toilet Demand:</u>			
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).
<u>Total Toilet Demand</u>	4.46	ML / year	
<u>Irrigation Demand:</u>			
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	
<u>Total Irrigation Demand</u>	13.86	ML / year	
<u>Wash-Down Area Demand</u>			
	0.5	ML / year	Estimated
<u>Total Site Demand</u>	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.

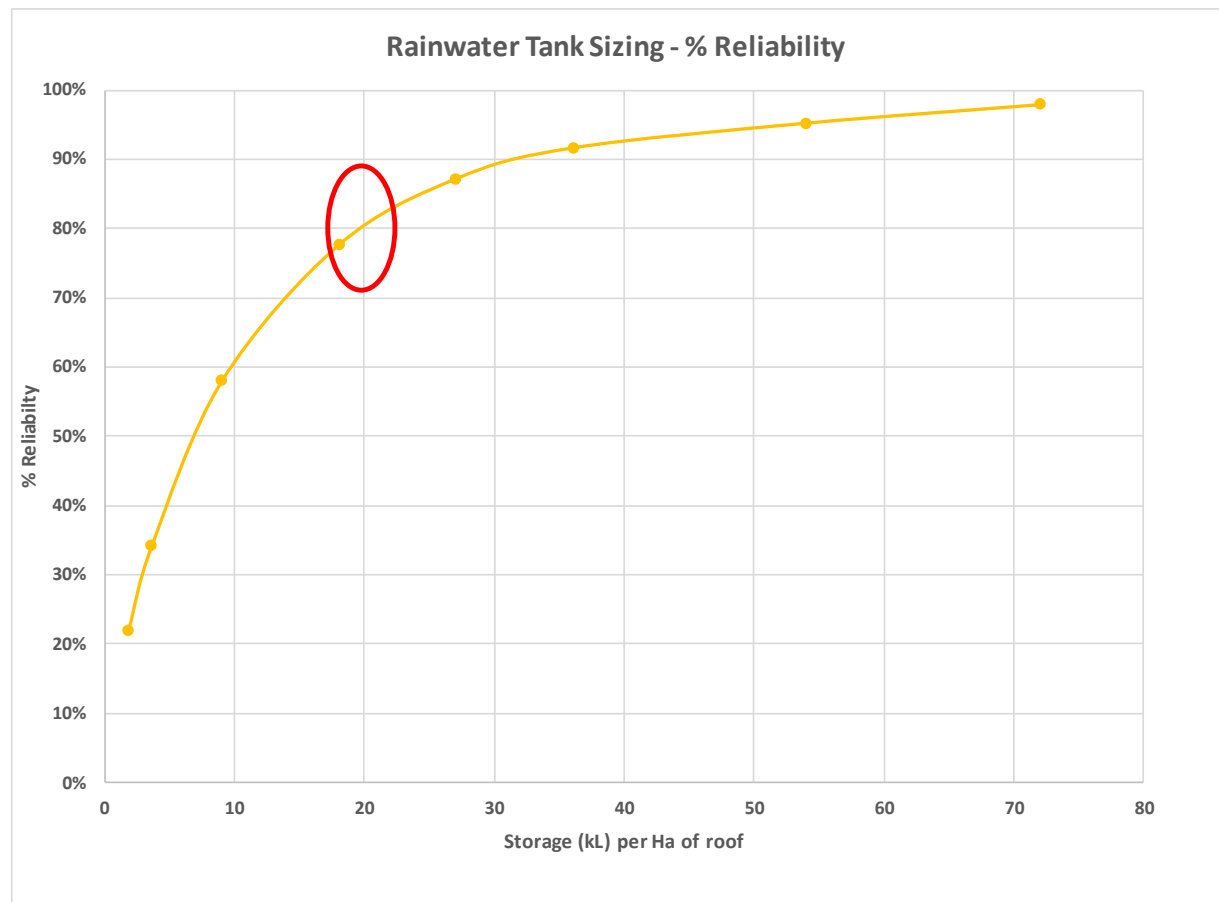


Figure E-6: Optimum Rainwater Tank Sizing per Hectare of Roof

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.



	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

APPENDIX F

**Liverpool City Council Compliance Matrix for the Warehouse 1
Precinct**

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 runoff.	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



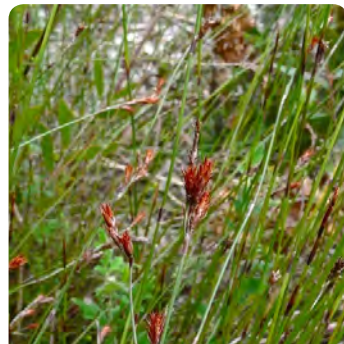
Hemarthria uncinata (Mat Grass)



Juncus prismatocarpus



Dampiera stricta (Blue Dampiera)



Leptocarpus tenax (Slender Twine Rush)



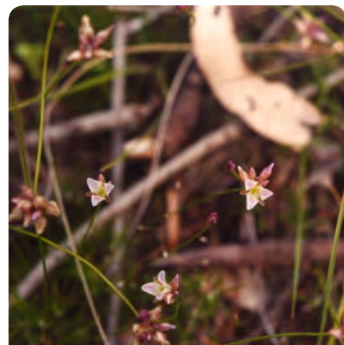
Philydrum lanuginosum (Wooly Waterlily)



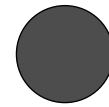
Goodenia hederacea (Ivy Goodenia)



Gahnia clarkii (Tall Saw-sedge)



Lazmannia gracilis (Slender Wire Lily)



FULL SHADE SEDGES AND GRASSES



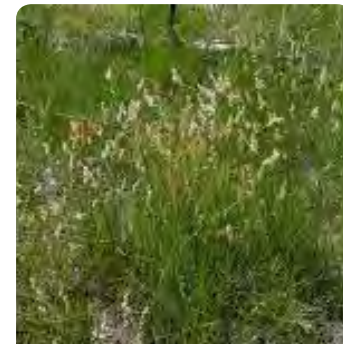
Dichondra repens (Kidney Weed)



Juncus continuus (Rush)



Isolepis inundata (Water Club-rush)



Lepyrodia scariosa (Scale rush)



Microlaena stipoides (Weeping Grass)